MAZAGON DOCK SHIPBUILDERS LIMITED
(Formerly known as Mazagon Dock Ltd.)
CIN : U35100MH1934GOI002079
(A Government of India Undertaking)
Shipbuilders to the Nation
Dockyard Road, Mazagon,
Mumbai 400 010.
INDIA

Replacement of Roof/ Cladding Sheets, Painting to the structural members including minor civil repair and electrical works of cable shed A, B, 7-C & PPT Plant at Anik Chembur, MDL, Mumbai

VOL-IV

GENERAL TECHNICAL SPECIFICATIONS

&

PREFERRED MAKES

I N D E X

TECHNICAL SPECIFICATIONS CIVIL WORKS

1. GENERAL

1.1. Materials

All materials required to complete the works shall be procured by the contractor including steel and cement unless specified. All materials shall be of Indian origin of the best quality of their respective kinds as specified and shall conform strictly to the stipulations laid down by the latest Indian Standards. Standards issued elsewhere may be used only if approved by the Engineer-In-Charge and for those materials only for which appropriate Indian Standard does not exist.

1.2. Sampling and Testing

The Contractor shall submit adequate number of samples of materials to the Engineer-In-Charge for approval giving all relevant information like source of supply, availability, etc. The approved samples shall be deposited with the Engineer-In-Charge whenever so instructed.

The Engineer-In-Charge shall order such tests and analysis of all materials before leaving the manufacturer's premises or the source of supply and/or when brought on site as considers necessary and the Contractor shall bear the cost of all sampling and testing which is in consonance with the Indian Standards.

If tests on materials lead to rejection of the particular consignment, notwithstanding the results of the tests at the manufacturer's works or elsewhere or of test certificates or of any approval given earlier, such materials shall be removed forthwith from the site by him at his own cost and replaced by other proper consignment. All charges in connection with of the new materials shall be borne by the Contractor.

Samples required for approval and testing must be supplied well in time 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 the completion of the Works.

1.3. Storage of Materials

Generally stacking and storage of construction materials at site shall be as per recommendations in IS: 4082. All materials required to be incorporated in the Works shall be stored in racks in bins, under cover etc. as appropriate and as amplified in the succeeding clauses to prevent deterioration or damage from any cause whatsoever to the satisfaction of the Engineer-In-Charge.

1.4. Records & Usage of Materials

The Contractor shall maintain detailed records of all materials received at Site or in his workshop and also about the consumption, balance in stock

etc. and shall make such records available to the Engineer-In-Charge at all times as the latter may reasonably require.

Depending on the types of materials the same should be used in the order in which they arrive at site and as directed by the Engineer-In-Charge.

1.5. Contractor's Responsibility

The Contractor shall be responsible for keeping the material in sound and acceptable condition from the time of consignment of any material is received at site and till its consumptions. Any material not approved for use shall be removed from the site at Contractor's cost.

1.6. Workmanship

In all cases the work shall be carried out in accordance with the latest Indian Standard Specifications and the best Engineering practice. In the absence of such specifications, work shall be executed in accordance with any other relevant standards issued elsewhere as approved by the Engineer-In-Charge or as per the instructions and directions of the Engineer-In-Charge.

1.7. Constructional Plant (s)

The Contractor shall be responsible for the supply, use and maintenance of all Constructional Plant and Equipment so as to ensure smooth and efficient working of the job at his own cost. The Engineer-In-Charge shall have access to the Plant at all times.

1.8. Workmen and Staff

The Contractor shall ensure that they employs only capable and experienced labour force, foremen, other tradesmen and supervisory staff on the job capable of handling the types of work assigned to them in a workmanlike and efficient manner to the satisfaction of the Engineer-In-Charge. They shall also ensure that his Sub-contractors or nominated Sub-contractors also employ all workmen and supervisory staff capable of delivering work of a high standard.

For all concrete work, a fully qualified and experienced Quality Control Engineer shall be employed by the Contractor and he shall be available on Site at all times when concreting operations are in progress. Operators for mixers, mechanical vibrators and personnel in-charge of placing of concrete shall be fully trained and experienced for their type of work.

1.9. Method of Measurement

Mode of measurement shall be in accordance with the relevant parts of IS: 1200 "Method of Measurement of Building and Civil Works" only, unless otherwise specified in various item wise specifications describes herein below.

1.10. Rates and Prices

Unless otherwise mentioned, the rates and prices set against items in the bill of quantities or which can be reasonably inferred there from complete as a

functioning entity shall include all costs and expenses which may be required in and for the construction of the work such as- material to be incorporated in the works (permanent/ temporary), labour required for all operations, temporary works, tools and equipments as required, all operations required for the completion and or maintenance of the relevant items as per specifications, all leads and lifts unless otherwise specifically mentioned in the items, including all general risks, liabilities and obligations set forth or implied in the documents on which the tender is based.

1.11. List of Bureau of Indian Standard Codes (BIS)

Following is the consolidated list of various Indian Standards relevant to the civil works appearing in this specification.

GENERAL

S. No	IS Code No	Particulars
1	IS : 4082-1977	a. Carriage of materials. Recommendation of stacking and storage of construction materials at sites. (1st revision) (Reaffirmed-1990)
2	IS:1200 (Part 22)-1988	Method of Measurement of Building & Civil Engineering Works-Part 22-Materials
3	IS : l7293-1974	Safety code for working with construction machinery
4	IS : 7969-1975	Safety code for handling & storage of building materials
5	IS : 8989-1978	Safety code for erection of concrete framed structures
6	IS : 4014 (part 2) 1967	Code of practice for steel tubular scaffolding – Part 2 – Safety regulations for scaffolding
7	IS:13416 (Part 1) 1992	Preventive measures against hazards at work places – Part 1 – Falling material hazard prevention.
8	IS : 13416 (Part 2)1982	Preventive measures against hazards at work places recommendations – Fall prevention.
9	IS: 13416 (part 3) 1994	Preventive measures against hazards at work places – Recommendations – Part 3 – Disposal of debris (MULBA)
10	IS : 13416 (Part 5) 1994	Preventive measures against hazards at work places – Recommendations – Part 5 – Fire protection

MARBLE/GRANITE / STONE WORK

S. No	IS Code No	Particulars
1	3316 – 1974	Granite slabs

STEEL WORK

S. No	IS Code No	Particulars
1	800-1984	Code of practice for use of structural steel in general in steel construction (2nd revision) (Amendments 2) (Reaffirmed 1991)
2	806-1968	Code of practice for use of steel tubes in general building construction (1st Revision) (Amendment 1) (Reaffirmed 1991)

3	812-1978	Glossary of terms relating to welding and cutting of metals (Reaffirmed 1991)
4	813-1986	Scheme of symbols for welding (revised) (Reaffirmed 1991)
5	816-1969	Code of practice for use of metal arc welding general construction in mild steel (1st revision) (Amendments 2) (Reaffirmed 1992)
6	818-1968	Code of practice for safety and healthy requirements in electric and gas welding and cutting operations (1st revision) (Reaffirmed 1991)
7	822-1970	Code of procedure for inspection of welds (Reaffirmed 1991)
8	1200-1993 (Part VIII)	Method of measurements of building and civil engineering works steel work and iron works (4th revision)

FINISHING

S. No	IS Code No	Particulars
1.	104-1979	Specification for ready mixed paint, brushing, zinc chrome, priming (Reaffirmed 1993) (2nd Revision)
2.	109-1968	Ready mixed paint, brushing, priming plaster to Indian Standard colour No.361.631 white and off white (Reaffirmed 1993) (1st Revision)
3.	419-1967	Putty for use on window frames (Reaffirmed 1992) (Revised)
4.	428-1969	Distemper, oil emulsion, colour as required (Reaffirmed 1993) (1st Revision)
5.	1200-1976 (Part XII)	Method of measurements of building and civil engineering works: Part XII – Plastering and pointing (Reaffirmed 1992) (3rd Revision)
6.	1200-1994(Part XIII)	Method of measurements of building and civil engineering works: Part XIII – white washing, colour washing, distempering and painting of building surfaces (5th Revision)
7.	1200-1987 (Part XV)	Methods of measurements of building and civil engineering works: Part XV – Painting, polishing, varnishing etc. (Reaffirmed 1992) (4th Revision)
8.	2932-1994	Enamel, synthetic, exterior (a) undercoating (b) Finishing (2nd Revision)
9.	5410-1992	Cement paint (1st Revision)
10.	1661	Application of plaster
11.	1542	Plaster for sand
12.	2645	Integral waterproofing compound
13.	2395 (Part I & II)	Painting workmanship

DISMANTLING AND DEMOLITION

S. No	IS Code No	Particulars
1	1200-1974	Method of measurements of building and civil engineering works: Part XVII: Demolition and dismantling (Reaffirmed 1992) (3rd Revision)

ALUMINIUM WORK

S. No	IS Code No	Particulars
1	1285-1975	Specification for wrought aluminium and aluminium alloy, extruded round tube and hollow sections (for general engineering purposes)

2	1868-1996	Anodic coatings on aluminium and its alloys – Specification
3	1948-1961	Specification for aluminium doors, windows and ventilators (Reaffirmed 2001)

2. EARTHWORK

2.1 Excavation

The work to be done under this section comprise performance of all work necessary for excavation with shoring, strutting, dewatering, pumping including disposing of all surplus excavated material from the site as directed by the Engineer.

Excavation shall be carried out in any type of soil, gravel, conglomerate, soft rock, boulders, old foundation, hard rock, concrete, asphalt or stone paved surfaces old masonry or concrete (plain or reinforced) encountered within width, length and depths indicated in the drawings. Where any temporary or permanent structure like sheet piling, diaphragm wall or piles have already been taken up, all excavation work shall be from the point carried out earlier and all precaution during further excavation and or any construction operation shall be exercised not to damage such existing temporary or permanent work. Where directed by the Engineer trees encountered within the work site shall be uprooted as per approved manner and serviceable wooden logs shall be stacked at site / disposed of as directed by the Engineer. Branches of trees etc. shall be disposed of or stacked at site as directed by the Engineer. No permanent work shall be commenced in the excavated area until the foundations pits have been inspected and approved by the Engineer. The Contractor may use any suitable excavated materials for incorporation in the permanent or temporary works as may be convenient subject to compliance with the specifications. Any obstacles encountered during excavation shall be reported immediately to the Engineer and shall be dealt with as directed by the Engineer.

2.2 Stacking / Removal of excavated material

Stacking, dumping, spreading at site or removal from site of excavated material shall be strictly as approved by the Engineer-In-Charge.

Excavated material when stacked shall be at a sufficient distance away from the edge of the excavated pits / trenches so as not to endanger the stability of sides. It should not also obstruct free movement of men, materials and vehicles or encroach upon the area required for construction purposes.

Excavated material suitable for filling shall be dumped in an orderly manner to required levels / grades as directed. All surplus material or material not suitable for filling shall be carried away from site to approved dumping ground.

2.3 Measurements

Excavation shall be measured as net dimensions in accordance with the instruction by Engineer-in-charge/ Drawings issued specifically for excavation work for foundation / trench excavation where PCC area shall be considered for measurements of excavation. No measurements shall be considered for extra excavation that may be required such as for working space, for keeping sides of excavation straight etc. or for extra excavation that may result due to removal by

blasting, mechanical equipments etc. Founding surface, if uneven, shall be made level with 1:3:6 nominal mix concrete at the Contractors expense.

The depth shall be reckoned from average G. L. of concerned pit / area.

2.4 Rates

Rate shall include all materials, labour involved in the above operations as described above including setting out works, profiles, preparing beds for foundations, site clearance, removal of slips/falls, watching and lighting wherever necessary. The rate of excavation is inclusive of dewatering to keep the bed dry irrespective of source of water (such as subsoil water, water table, tidal, rains, seepage, pipe line etc.) shoring if, and when required.

3. DRY RUBBLE SOLING

3.1 Materials

Supply of rubble stone of the specified type and size and shall be obtained from approved sources only and transporting to the site of work including all loads, lifts, handling, transportation etc.

The rubble of the specified type of stones shall be hard, tough, sound, durable, dense, clean of close texture and free from unsound material, cracks, decay and weathering. Their water absorption shall be as low as possible but not more than 5 percent.

The shape of the stones shall be as regular as can be obtained by quarrying without attempt at shaping or dressing. They shall be sufficiently flat bedded. The stone shall be broken with the smallest dimensions equal to the specified thickness of soling. The length and breadth should not generally exceed twice its thickness. Before starting collection, the contractor shall get a sample conforming to the required quality, shape and size approved by the Engineer-In-Charge who will keep it in his office for reference.

Stacking shall be done only after the quality; shape and size of rubble are approved.

The hard murum used as binding material shall be of disintegrated trap, granite, quartzite or gneiss rock freshly quarried. It shall be sufficiently hard and free from soft murum, earth, organic matter or order deleterious or soft material. The particle size of the hard murum shall generally fulfil the size (Square mesh) percentage passing through, 80mm - 95% and 25mm - 2%. Stacking lift and lead etc. shall be as specified in the BOQ, or as directed by the Engineer-In-Charge.

3.2 Laying Soling

The item provides for the labour for laying soling of specified type of stones in the specified thickness including preparing the sub-grade to proper sections by scrapping, dressing, compaction, etc. and hand packing the rubble chips to the required line, curve and grade and section.

The rubble supplied shall be laid with the largest face downwards and in contact with each other. The stones shall break joint as far as possible. The full thickness of the soling shall generally be made with one stone only. Unless otherwise provided in the plans or directed by the Engineer-In-Charge, the width of the soling shall be 30cm more than that of the metal above.

As the laying of rubble advances the soling shall be hand packed by wedging and packing with 80mm metal collected for the purpose in the joints of the soling and driving them by hammers in place so as to fill the voids as completely as possible. This operation of hand packing shall follow the rubble laying closely. The soling shall be laid and hand packed true to grade and section and these shall be often checked by boning rods, template boards and fish lines, etc. The grades sections etc. of the soling shall correspond to those of the surfacing coming on it.

The soling thus laid shall be finished by knocking out projecting stones and filling depressions by chips to come up to the grade and camber.

4. PLAIN AND REINFORCED CEMENT CONCRETE:

4.1 GENERAL

These specifications cover the general requirements of plain and reinforced concrete for use in various components of structures.

For all items of concrete in any portion of the structure or its associated works controlled concrete shall be used unless otherwise specified. Normal /ordinary concrete mix as indicated in the item specification may be used as directed by the Engineer-in-charge.

Controlled concrete shall be based on a mix design carried out in laboratory, approved by MDL, and shall conform to IS 456-2000.

4.1.1 OTHER CODES AND SPECIFICATIONS

Other IS codes pertaining to the items of cement concrete work in structural work not indicated above shall also be deemed to come under the purview of this clause. All Indian Roads Congress Standards, specifications and codes of practice also come under this purview.

4.2 GRADE OF CONCRETE

4.2.1 CONTROLLED CONCRETE

For controlled concrete, design of the mix shall be carried out for the respective target strength and in its production all necessary precautions shall be taken to ensure that the required works cube strength is attained and maintained.

The controlled concrete grades are designated as M 20, M 25, M 30, M 35, M 40, M 45 and M 50 and as per the latest IS codes.

4.2.2 ORDINARY CONCRETE (Concrete Grades M:15 & below)

In case of ordinary / nominal grade concrete, mix is required to be arrived at by preliminary tests, proportions of cement, fine aggregates and coarse aggregates are specified by mass as given in Table – 2

In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in N/mm^2.

4.3 STRENGTH REQUIREMENT OF CONCRETE

Where Ordinary Portland Cement conforming to IS:269 or Portland Blast Furnace Cement conforming to IS:455 is used, the compressive strength requirements for various grades of concrete controlled as well as nominal shall be as given in Table 1. Where rapid hardening portland cement is used, the 28 days compressive strength requirements shall be met at 7 days.

For controlled concrete, the mix shall be so designed for the so called Target strength as to attain in preliminary tests a strength at least 33 per cent higher than that required on work tests, for concrete strength upto and including M-25 and 25% higher for higher strengths.

Table 1

Grade of Concrete	Compressive Works Test Strength in N/Sq. mm on 150 mm Cubes after Testing Conducted in accordance with IS : 456	
	Min. at 7 days	**Min. at 28 days**
M 10	7	10
M 15	10	15
M 20	13.5	20
M 25	17	25
M 30	20	30
M 35	23.5	35

4.4 MATERIALS :

4.4.1 CEMENT:

Fresh quality cement shall be procured only from approved manufacturer / supplier and shall be subject to prior approval of the Engineer-in-Charge. Following types of cement shall be used :

i) All cement used for the work shall be ordinary portland cement or such other cement as may be permitted by the Engineer-in-charge. Portland cement shall comply with the requirements of the latest issue of IS 269. High alumina cement, rapid hardening cement and portland Slag cement etc., can be used only when permitted by the Engineer-in-charge. Such cements shall be in accordance with relevant IS Codes. Portland Pozzolana cement when permitted by the Engineer-m-charge shall conform to IS 1489 Part I but it shall not be used or RCC structural member.

ii) Cement which has remained in bulk storage at the mill for more than 6 months or which has remained in bags at the dealers storage for over 3 months, or which has been stored at project site for more than 3 months shall be re-tested before use. Cement shall also be rejected if it fails to conform to any of the requirements of these specifications.

iii) Different types of cement shall not be mixed.

4.4.2 FINE AGGREGATES

Fine aggregates shall consist of natural sand, manufactured sand or an approved combination thereof and shall conform to IS: 383. The grading zone of sand proposed for use shall be supplied by the contractor and got approved by the Engineer-in-Charge.

The sand shall be siliceous material, sharp, hard, strong and durable and shall be free from adherent coatings, clay, dust, alkali, organic material, deleterious matter, lumps, etc.

Either natural or manufactured sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter. Natural sand shall be washed, unless specific written authority is given by the Engineer-in-charge to use sand that meets specifications and standards of cleanliness without washing. The cost of screening and washing must be borne by the contractor. The fine aggregate shall be taken from a source approved by the Engineer-in-charge.

4.4.3 COARSE AGGREGATES

Coarse aggregates shall consist of hard, strong, durable particles of crushed stone and shall be free from thin elongated soft pieces, organic or other deleterious matter. It will be from a source approved by the Engineer in charge. Coarse aggregate shall conform to IS: 383.

Coarse aggregate shall be washed if necessary to remove all vegetable and other perishable substances and objectionable amounts of other foreign matter, the cost of washing and screening being borne by the contractor.

Size of Coarse Aggregates

Following shall be the maximum nominal size of coarse aggregate for the different items of work if not specified in the item of works or their respective specifications:

Sr. No.	Item of Construction	Max. Nominal Size of Coarse Aggregate
(i)	RCC well steining concrete, RCC well curb & RCC piles in plum concrete	40 mm
(ii)	Well cap or pile cap, solid type piers, abutments and wing walls, and, footing of open foundation and general items of work in bridge and building construction.	20 mm

(iii)	RCC works in girders, deck slab, wearing coat, kerbs, light posts, ballast walls, approach slab etc. and piers, returns, wing walls and retaining walls.	20 mm
(iv)	RCC bearings, shells and other thin walled members and in zones of congestion.	20 mm
(v)	For any other item of construction not covered by items (i) to (iv)	As specified in the drawings or as desired by the Engineer-in-Charge

For heavily reinforced concrete members as in the case of ribs of main beams, the nominal maximum size of aggregate shall usually be restricted to 5 mm less than the minimum lateral clear distance between the main bars, or 5 mm less than the minimum cover to the reinforcement, whichever is smaller.

4.4.4 REINFORCING STEEL

Reinforcing steel shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil, grease or other coatings which may impair or reduce bond.

a) Fe 240 - Mild steel shall conform to the latest edition of IS: 432 Part 1.
b) Fe 415 & Fe-500 high strength deformed bars shall conform to IS: 1786, **TMT bars conforming to IS: 1786 shall only be used.**
c) Structural steel sections and plates shall conform IS : 226 and IS : 2062.

Note: The reinforcement steel to be used for the construction shall be of Grade Fe – 500 only (for all RCC structures).

4.4.5 WATER

Water used mixing and curing shall be free from injurious amounts of deleterious material. pH value of water shall not be less than 6. Potable water is generally considered satisfactory for mixing and curing concrete. Water shall be got tested before use in concrete and curing. The cost for the same shall be borne by the contractor. Permissible limits for solid shall be as below:

PERMISSIBLE LIMIT FOR SOLIDS

	Tested as per	**Permissible limit max.**
Organic	IS : 3025 (Pt.18)	200 mg/lit.
Inorganic	IS : 3025 (Pt. 18)	3000 mg/lit.
Sulphates (as SO3)	IS : 3025 (Pt. 28)	400 mg./lit.
Chlorides (as C1)	IS : 3025 (Pt. 32)	2000 mg. lit. for concrete work not containing embedded steel and 500 mg./lit. for prestressed /reinforced concrete work.

Suspended matter	IS : 3025 (Pt. 7)	2000 mg./lit.

4.4.6 ADMIXTURES

No materials other than essential ingredients i.e., cement, aggregate and water, shall ordinarily by used in the manufacture of concrete or mortar. But the Engineer-in-Charge may permit the use of approved admixtures for improving the workability of the concrete, if so specified on satisfactory evidence that its use does not in any way adversely affect the properties of concrete particularly its strength, volume changes, durability and has no deleterious effect on the reinforcement. Admixture where allowed shall conform to relevant IS: 9103.

Chloride content in admixture shall be independently tested for each batch before acceptance.

4.5 MATERIALS FOR REPAIR WORK

The use of epoxy for bonding fresh concrete used for repairs will be permitted on written approval of the Engineer-in-Charge. Epoxies shall be applied in accordance with the instructions of the Manufacture. The cost of such repair when approved by the Engineer-in-Charge shall be borne by the contractor

4.6 STORAGE OF MATERIALS

i) Cement

The contractor shall make arrangements to the satisfaction of the Engineer-in- Charge for the storage of cement to prevent deterioration due to moisture and/or intrusion of foreign matter. Bulk cement shall be stored in approved water-proof bin or silo. Bagged cement shall be stored in a suitable weather tight warehouse in a manner to provide easy access for identification and inspection of each consignment. Stored cement shall meet the test requirements as per IS-269 at any time after storage, when a retest is ordered by the Engineer-in-Charge. Each consignment shall be stacked separately with the date of receipt flagged on it, not more than 12 bags being stacked in height, the bags being arranged with headers and stretchers. Normally consignments shall be used in the order of receipt at site unless otherwise directed. In the case of large concrete pours the Engineer-in- Charge will decide on the batch of cement to be used taking into consideration the quantity of cement with particular reference to the concerned concrete pours. Any additional work in handling and storage of cement contingent upon this requirement shall be to the contractors' account and no extra claim will be entertained. Cement shall be protected from closure to moisture in transit, in storage at the works and until it enters the concrete mixers. The contractor shall keep accurate records of the deliveries of the cement and of its use in the work.

ii) <u>Aggregates</u>

Coarse and fine aggregates shall be stacked separately in such manner as to prevent contamination by foreign materials. All aggregates shall be stored on concrete or masonry platforms, each size shall be kept separate with wooden, steel, concrete, or masonry bulk heads, or shall be stored in

separate stacks, taking care to prevent the materials at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart. The aggregates shall be stored in easily measurable stacks of suitable heights as may be directed by the Engineer- in-Charge.

iii) Reinforcing Steel

Reinforcing steel shall not be stored directly on the ground. These shall be stored under cover and shall be protected from rusting, oil, grease and distortions as directed by the Engineer-in-Charge.

4.7 PROPORTIONING CONCRETE

4.7.1 CONTROLLED CONCRETE

Concrete mix shall be designed for 33% higher strength than the grade of concrete specified. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available.

Except where it can be shown to the satisfaction of the Engineer-in-Charge that a supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be strictly controlled. The different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock-piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the design mix.

The quantity of both cement and aggregate shall be determined by weight. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be periodically checked.

It is most important to keep the specified water-cement ratio constant and at its correct value. To this end, the moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS: 2386 (Part III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content.
For the minimum cement and maximum water cement ratio and minimum grade of concrete refer Table : 5 of IS-456-2000.

For adjustments to Minimum Cement Contents for Aggregates other than 20 mm Nominal Maximum Size, refer Table:6 of IS-456-2000
For Limits of Chloride Content of Concrete refer Table : 7 of IS-456-2000

Condition of Exposure:

i) **Severe - Marine Environment :** Alternate wetting and drying due to sea spray, alternate wetting and drying combined with seezing, buried in soil (having corrosive effect); members in contact with water where the velocity of flow and the bed material are likely to cause corrosion of concrete.

ii) Moderate - Condition other than 'severe'

a) The minimum cement content is based on 20 mm size aggregates. For larger size aggregates, it may be reduced suitably by not more than 10%. Similarly for smaller size aggregates, it may be suitably increased, but not more than 10%.

b) The cement content shall not exceed 540 kg/cu.m. of concrete.

iii) Ordinary / Nominal Concrete:

The ordinary / nominal concrete mix shall also be specified by mass. Proportioning of sand shall be as per its dry volume and in case it is damp, allowance for 'bulking' shall be made as per IS : 2386 (Part III). Ingredients required for nominal mix concrete containing one 50 Kg. bag of cement for different proportions of mix shall be as given in Table-2.

PROPORTION OF NOMINAL MIX CONCRETE

TABLE – 2

Grade of Concrete	**Total quantity of dry aggregates by mass per 50 Kg. of cement, to be taken as the sum of the individual masses of fine & coarse aggregates, (Kg.), Max.**	**Proportion of fine aggregate to-coarse aggregate by mass.**	**Qty. of water per 50 Kg. of cement Max. (Ltrs.)**
M-7.5	625	Generally 1:2 for fine aggregate to coarse aggregate by volume but subject to a upper limit of 1:1 ½ and a lower limit 1.2 ½	45
M-10	480		34
M-15	330		32

Note No. 1: The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.

Note No.2 : The amount of water should be kept minimum required for proper workability. The quantity given in Col. 4 is not to be exceeded.

Example
For an average grading of fine aggregate (that is Zonethe proportions shall be 1:1 ½ , 1:2 and 1:3, for maximum size of aggregates 10 mm, 20 mm and 40 mm respectively.

Note No.3 : A mix leaner than M 10 may be used for non-structural parts if specified on the drawing or provided in the contract. In such case grading of aggregates shall be as specified in the contract or on the

drawings. Other requirements for mixing, placing and curing shall be the same as specified in this section.

iv) Quantity of Water

The quantity of water shall be just sufficient to produce a dense concrete of required workability and strength for the job. An accurate and strict control shall be kept on the quantity of mixing water.

In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips, all reinforcements. The degree of consistency, which shall depend upon the nature of work and the methods of vibration of concrete, shall be determined by regular slump tests. The slump shall be adopted for different types of works shall be as per IS 456, cl. No. 7, pg no. 17.

4.8 MIXING AND PLACING OF CONCRETE

INGREDIENTS AND MEASUREMENTS OF MATERIALS

The concrete shall be comprised of water, Portland cement, sand and coarse aggregate. If required by the Consultant the Contractor shall have to add approved brand of plasticizer in required quantities to facilitate easy flow of concrete. No extras shall be paid for providing and adding plasticizer.

All sand and coarse aggregate used on the works shall be carefully and accurately measured in suitable gauge boxes and in quantities to the entire satisfaction of the Consultant and the cement to be added to the aforesaid mix shall be either by one or two full scale bags, the water being added to the dry mix in a manner in which it can be properly controlled and measured. The cement shall be measured by weight or by bags. One bag of cement weighing 50 kg. shall be considered equal to 0.034 Cu.m. (1.20 cft) in volume. Volumetric measurement of cement will not generally be permitted. If loose cement is used it shall be weighed and 40.8 kg. shall be considered as 0.0283 Cu.m (1 cft). The contractor shall provide an accurate weighing apparatus on the work for this purpose. If he wants to use volumetric batching, he would have to prove the correct weights of cement bags.

The maximum quantity of mixing water per 50 kg. bag of cement shall be 25 litres which shall include free water carried by the Aggregate, corrections being made to this quantity of water according to the wetness of aggregate, as instructed by the Consultant. The consistency of the concrete shall be tested by the standard slump for concrete and shall be as per IS or as directed by consultant. Contractor shall have to use approved plasticizer in required quantity at his own cost to achieve necessary workability. Water Cement Ratio should be as per the design mix and it should be strictly adhered to.

The proportioning of concrete as per design mix shall be used for mixes of grade M-20 and above. For this the Contractor shall supply the different ingredients such as cement, sand, aggregate, admixtures etc. and the required slump approved by Engineer In charge. If any of the ingredients are altered in respect of the source of production, quality or any other

parameter the same will be got approved by the Engineer In charge and fresh design mix shall be done for the proportioning of the different ingredients to the satisfaction of the Engineer In charge and no parameters of the design mix for the concrete ingredients shall be altered from that submitted for the design of the concrete mix.

The concrete shall be mixed in an efficient power driven batch mixer. The capacity of the drum shall as far as possible be such that only whole bags of cement are used in each batch. Mixing shall continue for atleast 1.5 minutes after all the materials including water, are placed in the drum and before any part of the batch is discharged. The drum shall be revolved not less than 14 and not more than 18 revolutions per minute. The drum shall be completely emptied before receiving materials for each batch shall not exceed the mixer manufacture's rated capacity of the drum. The drum shall be thoroughly washed out when mixing operation cease for any period longer than one hour. Hand mixing of concrete, if permitted by the consultant shall be carried out in the following manner.

Ready mix concrete of specified grade and consistency namely water cement ratio, slump, cement content etc. shall be used to the extent possible particularly where the quantity of concrete required at one time is sufficiently large. The source of supplier and specifications of the concrete including the admixtures, retarders, setting time, transit time, method of placement of concrete on the job such as pumping etc., quality assurance from the supplier etc. should be got approved from the Engineer Incharge before ordering of the ready mix concrete for the job. The test cube strength specified in the drawings shall be closely monitored for ensuring the required strength of the concrete.

Mortar or concrete which has partially set before having been placed in-situ shall not be taken into use again either by itself or after mixing with additional materials or water.

All concrete shall be deposited in the forms within 15 minutes after leaving the mixer and shall be worked round the various reinforcement carefully by means of tamping and rodding as well as suitable vibrations.

As far as possible no joints shall be provided in any RCC work. However, if need arises the same shall be provided as per the instructions of Consultant, in which case the face of the construction joints shall be made rough by hacking and thoroughly cleaned and which before proceeding with further concrete work it shall be wetted and covered over with thick cement paste or "Hack-Aid-Plast" as directed by the Consultant.

Concrete after it has been placed in the forms should be allowed to set and should not be disturbed. The concrete shall be thoroughly cured by ponding or inundation or by means of hessian cloth covered, maintain in a wet condition. Where 53 grade cement is used curing of exposed surface of concrete shall commence within 4 hrs. of its placing. In no case shall the centering to any concrete work be removed without obtaining the permission of the Consultant. Great care shall be exercised while removing the centering to avoid jarring the structure or throwing away the forms on the floor.

The stripping time of form work shall be generally followed as per relevant I.S. Specification. However, the discretion of the Consultant shall be final. The form work of all RCC and PCC work shall be as to bring out the exposed surfaces to a smooth and clean finish. Immediately after the removal of the form work the exposed surface of all such RCC work shall be thoroughly roughened by making deep and closely spaced indentations with a pointed steel tool (Basuli) to the entire satisfaction of the Consultant. The exposed surface of RCC and concrete work wherever directed shall be finished with cement and sand plaster - smooth sand faced or rough cast as directed.

5. CENTERING AND SHUTTERING WORK

5.1 General:

All timbering for moulds and false work to be used in connection with reinforced work shall be strongly and firmly erected. The moulds must be planed smooth and free from knots, holes, open joints and other imperfections. They shall be quoted with mineral oil or other suitable materials to prevent the concrete adhering to the surface of the timber. The slabs centering shall be covered with double wazed water proofing paper or as directed if found necessary by the Engineer. Nothing extra will be paid for this.

The false work should be properly structed and braced in at least two directions and strong enough so as to be perfectly rigid and unyielding during the operation of filling and ramming the concrete. The timbers should be of sufficient thickness and scantlings of such a good quality as not to warp, deform or deflect the concrete.

The whole arrangement regarding the dimensions and construction of the false work shall be to the entire approval of the Engineer and shall be of proper size so as to bring out the completed work of the required dimensions.

Before filling the forms care shall be taken to see that the reinforcements are in their proper and ultimate positions and thoroughly secured from being disturbed during the filling and ramming of the concrete and that the moulds are absolutely free from dried up cement or concrete, any dust, pieces of wood, rags and projecting nails.

The arrangement of the forms and centering shall be such that the slab centering and sides of beams and column forms may be removed first allowing the bottoms of beams and girders to be supported for longer time.

5.2 REMOVAL OF CENTERING

In no case shall the centering of any concrete work be removed without obtaining the special permission of the engineer or his Assistant.

Proper care shall be exercised while removing the centering to avoid jarring the structure or throwing heavy form from the floor.

Generally nothing less than the following times should elapse between the filling in of the concrete and removal of the forms: -

Type of formwork	Minimum period before striking formwork
Vertical formwork to columns, beams and slabs	16-24 hrs.

Soffit formwork to slabs (Props to be re-fixed immediately after removal of formwork.)	3 days
Soffit formwork to beams (Props to be re-fixed immediately after removal of formwork.)	7 days
Props to slabs Spanning up to 4.5 m	 7 days
Type of formwork	**Minimum period before striking formwork**
Spanning over 4.5 m	14 days
Props to beams and arches Spanning up to 6.0 m Spanning over 6.0 m	 14 days 21 days

After removal of the centering any roughness or irregularity on the exposed surface of the work shall be made good by thin grouting of cement or a cement wash and the whole surface shall be so finished as to present an even and uniform appearance. No plastering will be permitted on the surface.

6. BRICKS & BRICK WORK IN GENERAL

6.1 GENERAL:

(a) Bricks shall conform to the latest Indian standard specifications (I.S.S.). All bricks shall be of first class of standard specifications made of good brick earth, whole sound, well burnt, free from cracks to ring when struck and not to crack or break when soaked in water regular in shape and uniform in size. They should be of the best of description obtainable in the market and of the best quality and colour, and in every respect to be approved by the Engineer-in-charge. No bricks to absorb water more than one fifth of their own weight when dry for use in load bearing wall. For bricks used in panel walls, the water absorption shall not exceed ¼ of their dry weight. Bricks to be thoroughly cleaned, well wetted or soaked in fresh water before being used on the work and no broken bricks to be used except as closures. Crushing strength of the dry bricks shall be not less than 35 kg./cm.2

(b) The mortar should be as described under the head of good quality carefully mixed and used stiff. For joints of face work only Cement and screened sand should be used in specified proportion.

(c) A good bond should be preserved throughout the work both laterally and transversely. All bed joints should be perpendicular to the pressure upon them, i.e. horizontal in vertical walls, radial in arches and at right angles to the slope in battering walls.

(d) In walling the courses shall be kept perfectly horizontal and rise in plumb. The vertical joints shall break joints with the courses immediately below and above, but they shall be directly over one another in alternate courses to prevent the necessity of bats. The joints shall not exceed 10 mm. thick shall be fully of mortar close, well flushed up and neatly struck or pointed as may be required.

(e) English bond to be used throughout in walling. In arching such bond shall be used as directed by Engineer.

(f) Facing of brick work to be specially selected brick of the same colour throughout. All external brick walls of thickness 25 mm. and above shall be constructed in plumb from the outside face with the help of scaffolding erected on the external side.

(g) In other respects, the work should comply with the general specification for brick work as per relevant IS code.

7. FINISHING WORKS

7.1 Cement Plastering

Cement plaster shall be of 6, 12, or 20 mm thick as specified in the respective item.

Materials

Cement mortar shall be as described under- Mortar specifications. However, cement used in the plaster shall be Portland Pozzolana Cement (PPC) Fly ash based conforming to IS: 1489 (Part-I.) unless other wise specified. Only river washed sand shall be used. Pan type mixer for mortar should preferably be used.

Application

Unless otherwise specified all plaster work shall be carried out in accordance with IS 1661.

The thickness and proportion of cement mortar shall be as specified or directed.

Unless permitted otherwise by the Engineer-In-Charge, only double scaffolding of adequate strength shall be provided by the Contractor. No holes shall be made in the masonry for supporting the scaffolding. Scaffolding members shall not be tied to windows, doors, other members provided in the walls.

No plastering work shall commence until the surface preparatory work is approved by the Engineer-In-Charge.

The sand shall be as approved by Engineer-In-Charge and in accordance with IS 1542 specification for plaster.

Preparation of Surface

Joints of all masonry work shall be carefully raked out for a depth of about 12 mm. without causing any damage to the masonry. Surfaces of concrete work shall be thoroughly roughened with chisel by pricks prior to application of plaster. For materials, which are not able to receive plaster directly, the necessary procedures shall be carried out as per the directions of the Engineer-In-Charge

All surfaces shall be thoroughly cleaned of all dirt, soot, oil, grease and any other material preventing proper bonding etc. and any efflorescence shall be removed by brushing and scraping. The surface shall then be soaked with water for at-

least 6 hours prior to application of plaster to ensure proper adhesion between the surface and plaster. If any surfaces become dry in spots, such area shall be moistened again to restore uniform suction.

Procedures / Precautions Applicable to Workmanship

Plaster work shall proceed from top to bottom in one operation on an entirely unobstructed surface or on areas upto break against openings.

Long straight edge shall be used to ensure perfectly even surface. All corners, angles and junctions shall be truly vertical and horizontal as the case may be and shall be carefully and neatly finished. All soffits, exposed angles with door and window frames shall be carefully finished. Internal angles shall be rounded if so directed and arises shall be rounded, splayed or beaded as directed. The mortar shall adhere to the surface intimately when set and there should be no hollow sound when struck.

All plaster work shall be kept cured for a minimum period of 10 days after the application of finishing coat to prevent excessive evaporation. Matting of gunny bags should be hung over the outside of the plaster in a hot dry weather.

1st Coat

The thickness shall be about 12 mm. thick in case of brick walls, RC walls and columns and 6 mm. thick for ceiling, soffit of beams etc. Before this coat hardens, the surface shall be cross scratched to provide a mechanical key for the 1st coat. The cross-scratch shall be horizontal as far as possible to aid curing which will be done for at least 2 days immediately following the application.

Finish Coat

At least a period of 3 days should elapse between the application of the first coat and the finish coat. Finish coat shall be applied as specified in the item description unless other wise, stated neeru finish shall apply as described under the neeru finish specifications given below.

Curing

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expenses by such means as the Engineer-In-Charge may approve. The Dates on which the plastering is done shall be legibly marked on the various sections so that for the specified period r can be watched.

Measurement

For plastering, the measurement shall be on area superficial for the unfinished surfaces as actually covered. Length and breadth shall be measured correct to a cm and its area shall be calculated in Sq.m. correct to two places of decimal. Dimensions before plastering shall be taken.

The areas shall include (all the actual pointed / plastered areas for jambs, sills, soffits of openings etc.

No deductions shall be made for ends of joints, beams etc.

No extra shall be allowed for beaded, chamfered or rounded arrises or curved angles.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above excluding chicken mesh, which shall be measured separately.

7.2 Plaster of Paris Finishing (POP) :

Material

The Plaster of Paris shall be of calcium-sulphate semi-hydrate variety. Its fineness shall be such that when sieved through a sieve of IS sieve designation 3.35 mm for 5 minutes after drying the residue left on it shall not be more than by 1% by weight. It shall not be too quick setting. Initial setting time shall not be less than 13 minutes. The average compressive strength of material determined by testing 5 cm cubes after removal from moulds, after 24 hours and drying in an oven at 40^0 C till weight of the cubes is constant & shall not be less than 84 kg per square metre.

Application

The 'POP' as prepared above shall be applied to the prepared surface with a steel trowel to a thickness not exceeding 6mm and rubbed and polished to a perfectly smooth and even finish working from top to bottom. While towelling is going on soap stone powder contained in thin muslin bags shall be dusted over the surface and worked in.

The surface of the under coat on which the punning is to be done shall be left rough. The punning shall be applied, when the under coat is still green. The mortar for punning shall be applied in a uniform layer slightly more than 6mm thick between gauged pads, with which to ensure an even and uniformly thick surface by frequent checking with a wooden straight edge. It shall be finished to an even and smooth surface with trowels.

All corners, arrises, angles and junctions shall be truly vertical and horizontal as the case may be and shall be carefully and neatly finished. Rounding or chamfering corners, arrises, junctions etc. where required, shall be punned without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the size required. No portion of the surface shall be left out initially to be patched up later on.

Thickness

The thickness of the finished punning shall not be less than 6mm thick, unless specified.

Scaffolding, Finishing, Precaution and Curing

Specifications for these shall be as described under- Plaster specifications.

7.3 Waterproof Cement Plaster :

Materials

Cement mortar shall be as described under – Sand faced plaster specifications.

Application

Application shall be as described under- Sand faced plaster specifications.

Finish coat

When the plaster has been brought to a true surface with wooden straight edge it shall be uniformly treated over its entire area with paste of neat cement and rubbed smooth, so that the whole for surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sq. m. Smooth finishing shall be completed with trowel immediately and in no, case later than half an hour of adding water to plaster mix.

The first coat shall be evenly dampened and 5 mm thick finish coat shall be well smooth after floating it with a coat of Portland Cement. The use of dry cement shall not be permitted.

Integral waterproofing compound conforming to IS: 2645 and of approved brand and manufactured, enlisted by the Engineer-In-Charge from time to time shall be used. Applications shall be as described under sand faced plaster specifications.

7.4 White / Colour Washing:

Materials

The materials for preparing lime wash shall be freshly burnt fat lime of good quality free from unburnt stone or other foreign matter. Lime shall be of "C" type as mentioned in IS 712.

Lime shall be slaked on the spot, mixed and stirred thoroughly with sufficient quantity of water (about 4.5 litres per Kg. of lime) to make a thin cream. This shall be allowed to stand for a period of 24 hours and then strained through a clean coarse cloth. Clean gum dissolved in hot water shall then be added in the proportion of 4 gm. of gum Arabic to one litre of lime cream to prevent lime wash coming off easily when rubbed.

Indigo (Neel) up to 3 gm per Kg of lime dissolved in water shall be added and stirred well. Water at 5 litres per Kg. of lime is then added to produce a milky solution.

Alternatively ready made whiting (ground white chalk) complying to IS 63 can be used. In this case whiting shall be dissolved in sufficient quality of warm water to form thin slurry, which shall then be screened through a clean coarse cloth. 2 gm. of gum and 0.4 gm. of copper sulphate dissolved separately in hot water shall be added for every litre of the slurry, which shall then be diluted with water to the consistency of milk for use. Rice size may be allowed instead of gum.

Colour wash shall be lime wash as above to which a solution of water and lime fast pigment, boiled if directed, shall be gradually added and stirred until the required tinge is available.

Preparation of surface

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fibre brush or other means to be

approved by the Engineer-In-Charge. All loose pieces and scales shall be stuffed with mortar and cured.

Application

Lime wash shall be applied with a brush. Each coat must be allowed to dry and shall be subject to an inspection before the next coat is applied. When dry, the surface shall not show any signs of cracking and shall present a smooth and uniform finish easily when rubbed with a finger. Patchy or streaky work will be rejected. No colour wash shall be done with a sample of the colour wash to the required tint or shade unless it is approved by the Engineer-In-Charge.

Precautions

Doors, Windows, floors etc., shall be protected form being splashed upon. Any splashing and droppings shall be removed and surfaces cleaned.

Scaffolding

Single or double scaffolding shall be provided by the Contractor as and when required.

Measurements

Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

The number of coats shall be 3 coats unless otherwise specified. The item to include removing nails making good holes, cracks, patches etc. not exceeding 50sq.m. each with material similar in composition to the surface to be prepared.

7.5 Painting

All the water base and oil base paints such as distemper, cement paint, enamel paint, flat oil paint etc. shall be of approved manufacturers and shall conform to the respective IS Codes and Standards.

Colour and Shade shall be as approved by the Engineer-In-Charge.

Supply

All paint materials shall be supplied to the Site in the manufacturer's sealed and branded containers. Any containers reaching site with broken seals are liable for instant rejection by the Engineer-In-Charge.

Storage

All paint materials shall be stored in cool dry conditions clear of other stores to the satisfaction of the Engineer-In-Charge.

Usage

The mixing of materials of different brands before or during application shall not be permitted.

Brushes, pails, kettles and other implements and tools used in painting or preparation of the work shall be clean and free from foreign matter.

The instructions of the manufacturer shall be followed regarding preparation of surface and application of priming and finishing coats. In any event the following engineering practices shall always be followed while carrying out work as specified in IS 2395 Part-I & Part-II.

a. No exterior or exposed painting shall be carried out under adverse weather conditions such as rains, extreme humidity, dust storms etc.,

b. The work shall preferably be carried out in shade to avoid blistering or wrinkling due to direct sunlight.

c. All surfaces to be painted shall be free of loose matter, efflorescence, dust etc. before application of each coat.

d. No paint shall be applied to works, which are internally or superficially damp.

Preparation of Surfaces

General

All surfaces requiring paint shall be thoroughly cleaned of all dirt, dust, grease or oil before spotting or priming. Oil or grease film shall be washed off with an acid that is non-injurious to the surface or shop primers and rinsed off completely with plain or soapy water. Surfaces shall be dry unless dampening is required for a particular finished material.

Before starting the work, the Contractor shall obtain the approval of the Engineer-In-Charge regarding the soundness and readiness of the surface to be painted on.

Masonry, Concrete and Plastered Surfaces

Surface shall be free from all efflorescence, mildew, loose paint or other foreign and loose materials. Surface with mildew or efflorescence shall be treated as follows:

- All mildewed surfaces shall be treated with an approved fungicide such as ammonical wash consisting of 7 gm. of copper carbonate dissolved in 80 ml. liquor ammonia and silica fluoride solution and allowed to dry thoroughly before paint is applied.

- All efflorescence shall be removed by scrubbing and affected surfaces shall be treated with a solution of muriatic acid in water (1:6 to 1:8) and washed fully with clean water and allowed to dry thoroughly.

Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surfaces uniformly textured. Where this type of re-surfacing may lead to the finishing paint being different in shade from the original surface, the surfaced area shall be treated with minimum one coat of cement primer, which shall be continued to the surrounding area from a distance of 100mm.

The plastered surface shall be carefully rubbed smooth and thoroughly cleaned with clean fresh water.

Metal

All metal surfaces shall be absolutely clean, dry and free from wax, grease or dried soap films. Grease shall be removed by proprietary brands of approved solvent cleaner or other solutions or detergents. In addition all steel and iron

surfaces shall be free from dust, rust and scales. This shall be done by wire brushing and scraping. All galvanised surface shall be pre-treated with a compatible primer according to the manufacturer's direction. Any abrasion in ship coats shall be touched with the same quality of paint as the original coat. The cleaning and operation of priming paint at site shall be carried out after the erection of steelwork.

As required single or double scaffolding or ladder shall be used without damaging or scratching the surfaces to be painted.

Cleaning up

Cleaning of paint droppings and spilling, splashed or splattered, films and smudges from finished surfaces and areas not to be painted shall be carried out concurrently with the work to the satisfaction of the Engineer-In-Charge. At completion, all equipments, excess materials and containers shall be removed and the premises shall be cleaned of all painting waste and debris.

Measurements

Length and breadth shall be measured correct to a cm and area shall be calculated in sq.m. correct to two places of decimals.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the percentage as described in above para to allow for girthed area.

Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

The number of coats shall be 3 coats unless otherwise specified. The item to include removing nails making good holes, cracks, patches etc. not exceeding 50 sq.m each material similar in composition to the surface to be prepared.

- Timber doors, windows etc. shall be measured flat (not girthed) overall including frames and all edges, cleats etc. shall be deemed to be included in the item.
- Steel doors, windows, etc. shall be measured flat (not girthed) including frames, edges, etc.
- All pipes shall be measured in running meters and shall allow for all specials, brackets, clamps, etc. which shall not be measured separately.

7.6 Oil bound Distemper

In regards to materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described above.

Application

Priming coat

The priming coat shall be with distemper conforming to IS: 428 in one coat. After the surface defects are treated with gypsum which is allowed to set hard and wiped clean, the priming coat is applied with distemper primer (when wall surface has not dried completely).

Newly plastered if required to be distempered before a period of six months shall be given a coat of alkali resistant priming paint conforming to IS: 109 and allowed to dry for at least 48 hours before distempering is commenced.

Distemper coat

After the primer coat has dried at least for 48 hours, the surface shall be lightly sand papered to make it smooth. Distemper is then applied in dry weather with a broad stiff brush in long paralleled strokes, each coat being allowed to dry before the next coat is applied. The subsequent coats shall be applied in the same way. Two coats of distemper shall be applied over primer coat to obtain an even shade. A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of preceding coat. For old work the distemper shall be applied over the prepared surface in the same manner as in new work. 15 cm double bristled distemper brushes shall be used. After each days work, brushes thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

7.7 Plastic Emulsion Paint :

Materials, surface preparation, Application, Equipment and protection, cleaning etc. shall be as described under- Painting specifications. The plastic emulsion paints is not suitable for application on external, wood, and iron surface, which are liable to heavy condensation. These paints are to be used on internal surfaces except wooden and steel. Plastic emulsion paints as per IS: 5411 of approved brand and manufacture and of the required shade shall be used.

Application

The paint is mixed thoroughly adding about 50% water and then strained through a cloth. The paint is then applied on wall and allowed to dry thoroughly. A putty is prepared by mixing whiting and paint and is filled wherever necessary in holes depressions etc.

For the second coat only about 15 to 20% water is added.

(The correct quantity of water to be added shall be as per manufacturer's instructions)

The number of coat shall be two unless otherwise specified in the item. The paint will be applied in the usual manner with brush, spray, or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance. Painting on old surface shall be as described for new work except that the surface before application of paint shall be flattened well to get the proper flat velvety finish after painting.

Oil Paint :

Materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described under-Painting specifications.

Application

Unless otherwise specified, paint shall be applied with brushes. The contents of the drum and tins shall be well stirred before using and occasionally during the use to prevent sedimentation at the bottom.

Priming coat

The priming coat shall be made up of materials depending on the surfaces to be plastered and specified or recommended by the manufacturer.

The primer shall be ready mixed primer of approved brand and manufacture and shall be compatible with finished painting scheme.

Where primer for wood work is specified it shall be prepared as per manufacturers specifications. The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness surface shall be rubbed down smooth with sand paper and shall be well dusted. Appropriate filler material conforming to IS: 345 with same shade as paint shall be applied .

Finishing coat

Unless otherwise specified, the finishing shall be done in at least two coats of paint. The last coat shall give a flat, semi glossy or glossy finish as directed by the Engineer-In-Charge.

Synthetic Enamel Paint :

In regards to materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described above. Synthetic enamel paint conforming to IS:2932 shall be of approved brand and manufacture and of required shade.

Application

Priming coat

Primary coat shall be of ordinary paint of shade to match with the top coat as recommended by the same manufacture. As top coat shall be used. Under coat shall be allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure smooth and even surface, free from brush marks and all loose particles brushed off.

Finishing coat

It shall be applied on properly primed surface. Subsequent coat shall not be applied till the previous coat is dry. The previous coat shall be lightly sand prepared for better adhesion of subsequent coats.

Top coats of synthetic enamel paint of desired shade shall be applied after the under coat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

Unless otherwise specified, the finishing shall be done in at least two coats of paint. The last coat shall give a flat, semi glossy or glossy finish as directed by the Engineer-In-Charge. If, however, the surface is not satisfactory additional coats as required shall be applied to get correct finish.

Waterproof Cement Paint :

In regards to materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described above. The cement paint shall be conforming to IS : 5410 of approved brand and manufacture and of required shade.

Application

Priming coat

Cement primer coat is used as a base coat on wall finish. The cement primer is composed of a medium and pigments which are resistant to alkalies present in the cement in wall finish and provides a barrier for the protection of subsequent coats. Primer coat material shall be as per recommendation of finish coat material. Primer coat shall be preferably applied by brushing and not by spraying on the clean dry and smooth surface. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before subsequent coat.

Finishing coat

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. Cement paint shall be mixed with water in two stages and strictly as per manufacturer's instructions.

The surfaces shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours), the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

Water proof cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, paints etc.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above including scaffolding, unless specified. Quoted rate shall be inclusive of Cement primer coat unless separate item is specifically provided for.

Material- Acid proof paint of approved brand and manufacturer and of required shade shall be used.

Standards- In regards to materials, surface preparation, application, equipment and protection, cleaning etc. shall be as described above.

8. SPECIFICATION FOR ALUMINIUM WORKS

8.1 General:

1. The partitions, windows etc. shall be made out of extracted aluminium sections only and of approved make conforming to IS: 733 and IS: 1285.

2. Unless otherwise specified in the BOQ, all sections shall be anodized in any colour as approved by MDL Representative and thickness of anodizing shall be as specified in item specification and in matt or smooth finish as specified by the Engineer In-charge.

3. The rate includes the cost for fabrication, erection on site, anodizing, beading, neoprene gaskets, fixtures, fastening, scaffolding etc. everything ready to use, The mode of measurements shall be as per IS.

4. Aluminium doors and windows etc. shall be used of approved fabricators only and fixing shall be carried out through the agency of fabricators as per the specifications

5. Aluminium doors and windows shall be completely water air tight. The aluminium doors and windows shall be confirm to I.S. specifications I.S. 1948 of latest revision and amended upto date in general.

6. As the sizes and weights of the aluminium extruded sections varies from manufactures to manufacturers + 5% tolerance is allowed in weight and sized for which no extra payment will be made.

8.2 SPECIFICATIONS FOR SLIDING WINDOW

1. The windows shall be made out of extruded aluminium sections as described in item specification. The aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.

2. Shutter shall be provided with two ball bearing rollers and 2 anti ratting pieces/guides one each at top and bottom and weather strip all around.

3. All joints shall be mechanically jointed wherever required including cleat angle.

4. Window shutters shall be provided with special locking arrangement.

5. Glazing shall be fixed in the shutter by means of EPDM rubber/ neoprene gasket.

6. The aluminium sections shall be anodized in natural matt. Finish of approved colour.

8.3 SPECIFICATIONS FOR ALUMINIUM CASEMENT WINDOWS AND VENTILATORS

1. The window shall be made out of extruded aluminium hollow sections or as described in BOQ.

2. The corner joints shall be mechanical and the joining cleats shall be made out of aluminum extrusions with minimum 3 mm. except for the doors, where the angle cleats should be strong enough to take the load.

3. The openable windows shall be made of double weather stripped. One weather strip shall be provided in the outer frame and the outer in the shutter frame. The weather strip shall be good quality natural rubber and of the size to make the window completely weather tight. The peg stays shall be made out of aluminium extruded sections only.

4. The hinges of openable shutter shall be strong and made out of aluminium extruded sections and pin of hinges shall be non Corrosive material preferably stainless steel. Alternatively the openable shutters shall be provided with 4 bar arm S.S. hinges.

5. The window shall be provided with handle for a single point locking. The handle shall be made out of 6 thick aluminium alloy flat.

6. The aluminium sections shall be as described in BOQ or as per prior approval obtained from MDL.

1. EPDM rubber/ neoprene gaskets shall be used in the glazing beads for shutter

2. For fixed glazing the glass shall be encased in PVC channel so as to avoid metal to glass contact.

9. SPECIFICATION FOR MARBLE/ GRANITE WORKS

9.1 GENERAL

Marble/Granite shall be hard, sound dense and homogenous in texture. It shall be free of stains, cracks decay and weathering. Before starting the Marble/ Granite work, the contractor shall get the sample of Marble/ Granite approved by the Engineer-in-charge The work shall conform to the sample. Entire Marble/ Granite work shall be from the same lot at least floor-wise to match the colour and quality of marble/ Granite. It should comply with I.S. 1130-1969.

9.2 FLOORING

Marble/ Granite slab or shall be of minimum 18 mm. thick as specified in

BOQ. Slab shall be truely horizontal, machine cut all sides shall be to right angle and sides shall be bewelled as required. The slabs/tiles shall be fixed on cement mortar 1:4 with filled in with matching white cement. The work shall be kept constantly moist for seven days and then the flooring shall be finished mirror like machine polish and cleaned with solution of adilic Acid and washed cleaned.

9.3 DADO

Marble/ Granite slabs shall be pre-polished and of required sized with 18mm. minimum thick, as directed and shall be truly vertical, machine cut all sides shall be true to right angle and shall be bewelled as required. The wall surface shall be first covered with 1:4 Cement sand mortar backing in plumb about 20mm. thick. The marble slabs then shall be arranged in true vertical plans with matching/grains after maxing suitable holes for electrical wiring, switches etc. The marble/ Granite slabs shall be fixed with brick wall by suitable copper brass or S.S. pin each. shall have 2 to 3 such pins fixed at the edges. Joints between slabs at any point shall not be more than 1.5 mm and shall be filed in with matching cement.

Cement slurry shall be poured in between the wall and back side of marble and shall be stirred properly to avoid cavaties. The surface shall be kept moist for seven days and shall be sand polished to remove any unevenness and shall be cleaned with the solution of exalic acid and washed where dado is specified if the height is upto ceiling height and pieces shall be so selected that there shall be minimum No. of vertical and horizontal joints and all slabs shall be of same size.

The rates are inclusive of scaffolding, staging, making be-velled of all edges, corners and junctions etc.

10. STEEL WORKS

Structural Work in built-up section (Welded/ bolted)

Although Broad Specifications for Structural Steel Works are as indicated below, the entire work shall be executed strictly in keeping with the working methodology, sequence of operations, safety and security etc. as approved by the Engineer-In-Charge, in best workmanship in conformity with relevant IS codes and the specifications of this tender document.

The Tenderer shall submit his own fabrication / erection methodology comprising sequence of operations to suit the works requirement such as –

- Material movement / storage of material
- Fabrication scheme considering space constraints
- Scheme for erection to be done at about 30 mtr. height for trusses
- Retractable Roof work
- Sliding Motorized Doors work
- Structural steel work of Blasting Chamber.
- Necessary Safety precautions as per prevailing rules.
- Security formalities to be maintained being a MDL area.

General

In addition to the requirements contained in this Specification, all materials shall conform to the latest edition of the relevant Indian Standard or its equivalent standard approved by the Engineer-In-Charge and shall, if required, be tested as prescribed therein.

In the event of conflict between this Specification and recognised standards, then the requirement of this Specification shall govern.

The work shall be carried out by competent personnel skilled in their various trades. All work shall be of the highest quality and the work shall be the subject of inspection and approval of the Engineer-In-Charge and the Employer.

All material shall be obtained from an approved supplier and manufacturer's appropriate test certificates shall be available upon request by the Engineer-In-Charge or the Employer.

All Steelwork shall be straightened or curved as necessary by pressure and not by hammering.

When bolt heads or nuts bear upon bevelled surfaces they shall be provided with square tapered washers to afford seating for the nut square with the axis of the bolt.

All nuts and bolts specified on the Drawings shall be to the required size with correct threaded length, and be supplied with matching nuts and washers also of the same material, except where electrolytic action is to be avoided.

Where small parts such as bolts and nuts etc. are to be sherardised, they shall be treated to receive a coating of finished thickness not less than 30 microns.

Where bolts, nuts and washers etc. are to be hot dip galvanised, they shall be treated to receive a finished thickness of zinc coating of not less than 80 microns thickness.

The Contractor shall give due notice to the Engineer-In-Charge in advance of the materials or workmanship getting ready for inspection.

The Engineer-In-Charge shall have free access at all reasonable times to those parts of the contractor’s work which are concerned with the fabrication of the steel work and those portions of the site where assembly or erection is being carried out. The contractor shall give all reasonable assistance required in connection with the inspection and testing of the work.

No part of the work shall be treated as approved unless so informed by the Engineer-In-Charge in writing. However, approval of any material fabricated at shop / field shall not invalidate final rejection at site by the Engineer-In-Charge if it fails to be in proper condition or has fabrication inaccuracies, which prevents proper assembly. Similarly any approval of the fabrication and / or erection by the Engineer-In-Charge shall not relieve the Contractor of his responsibility for furnishing material and / or workmanship conforming to the requirements of the specifications.

All sections shall be free from surface defects such as pitting, cracks, laminations, twists, bends etc. The use of defective sections shall not be permitted and all such rejected material shall be immediately removed away from the store / site at contractor’s cost.

All sections shall be marked for identifications and each lot shall be accompanied by manufacturers quality certificate, chemical analysis and mechanical characteristics as specified in relevant IS Codes.

Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality test certificate conforming to relevant IS codes.

Materials at the shops shall be kept clean and protected from weather.

All members likely to collect rain water shall have drain holes.

Not more than one shop shall be provided to make the full length of a member.

All bolts, nuts, washers, rivets, electrodes, screws, etc. shall be supplied 10% in excess of the requirement in each category and size.

Materials -

Unless specified other wise various materials shall conform to the following IS Codes and Standards –

- Structural steel (Standard quality) : IS:226
- Rolled steel sections : IS: 808
- Steel tubes for structural purpose : IS: 1161
- Structural steel (for walkways, ladder, hand rails) : IS: 1977
- Welded Electrodes : IS: 811
- Threaded fasteners : IS 1367

Supply

Supply of structural steel and all required material for the works shall be arranged by the Contractor.

Receipts and storing of materials

All steel shall be carefully off-loaded and stacked on timber or concrete supports suitably spaced on a firm level surface, and of sufficient height to keep steel clear of the ground and water. The steel shall be stored separately, by section size or thickness.

All sections shall be checked, sorted out and arranged by grade and quality in the store as per instructions of the Engineer-In-Charge.

All bolts including nuts and washers shall be thoroughly checked, sorted out and arranged diameter wise by grade and quality in the store.

All materials shall be kept protected from corrosion. Storing shall be generally in accordance with IS: 4082.

Welding electrodes and welding wires if used shall be stored separately in their original bundles or cartons, in a dry place adequately protected from weather

and other effects as per IS :9595 and as per instructions given by Engineer-In-Charge. Electrodes shall be kept dry.

Welding

Welding shall generally be done by electric arc process and shall conform to the respective IS Codes and Standards as listed above.

Sequencing of welding

a) The contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage and submit the same to the Engineer-In-Charge for comments and approval.
b) As far as practicable, all welds shall be made in sequence that will balance the applied heat of welding while the welding progresses.
c) The direction of the general progression in welding on a member shall be from points where the parts relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.
d) All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.
e) Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.
f) Welding shall be carried continuously to completion with correct number of runs.

Quality of Weld

The weld metal as deposited shall be free from blow holes, cracks, slag inclusions, excessive porosity, cavities and other faults. It shall be properly fused with the parent material without overlapping or serious under-cutting at the toes of the weld. The weld surfaces shall be cleaned of slag or flux and show a uniform and consistent contour and regular appearance.

Faulty Works

In the event of excessive convexity, weld size is to be reduced by removing the excess weld metal. In the event of faulty work the defective portions shall be cut out and re-welded. Where serious under-cutting occurs, additional weld metal shall be deposited to make good the reduction. In case of members getting distorted due to heat of welding, the members are to be straightened out by mechanical means or by careful applications of limited amount of heat when temperature of the areas affected more than 650 C.

Protection

Immediately after dislodging, inspection and approval, all site welds and the surrounding surfaces shall be painted to protect the metal.

Tolerances

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS: 1852 and/or ASTM A6.

No rolled or fabricated member shall deviate from straightness by more than 1/1000 of the axial length or 100 mm whichever is smaller.

The length of members with both ends finished for contact shall have a tolerance of ± 1 mm.

Members without ends finished for contact bearing shall have a tolerance of ± 1.5 mm for members upto 10 meters long and a tolerance of ± 3 mm for members over 10 meters in length.

Lateral deviation between centre line of web plate and centre line of flange plate at contact surface in the case of built up sections shall not exceed 3mm.

The combined warp age and tilt of flanges in welded built up sections shall not exceed 1/200th of the flange width or 3 mm whichever is smaller.

The deviation from flatness of welded plate girder web in the length between stiffeners or a length equal to the depth of the girder shall not exceed 1/150th of such length.

Deviations from the specified depth of welded girders measured at the centre line of the web shall not exceed ± 3 mm upto a depth of 1000 mm, ± 5 mm for depths above 1000mm, upto 2000mm and + 8mm and – 5mm for depths over 2000mm.

10.3 Painting

The whole of the steel work shall be thoroughly cleaned and all dirt, marks, grease overspills of primer paint and other foreign matter shall be removed by hand, cleaning tool (power tool cleaning) using compressed water jet etc. After this preliminary work of making good has been approved by the Engineer-In-Charge, all surfaces shall be thoroughly cleaned and when dry two finishing coats of approved paint shall be applied. Each coat shall be allowed to dry and harden thoroughly before the next coat is applied. The paint manufacturer's instructions shall be followed strictly. Also proper attention shall be paid to the following:

Proper storage to avoid exposure and extremes of temperature
Surface preparation prior to painting.
Mixing and thinning.
Application of paint and the recommended limit on time intervals between consecutive coats.

Primers and finish coat paints shall be from the same manufacture in order to ensure compatibility. Unless specified and approved, painting colour code shall be as directed by Engineer-In-Charge.

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

All preparation, priming and painting, in colours selected by the Employer, shall be deemed to be included in the Contract price.

Painting shall generally be in accordance with IS : 1477

All items of equipment shall be suitably protected and packed to resist corrosion and impact damage. Machined surfaces are to be treated with a proprietary sealing agent for transportation and storage.

Paint materials shall be in accordance with the appropriate Indian Standard and shall be obtained from approved manufacturers and applied in accordance with the manufacturers' instructions or as ordered by the Engineer-In-Charge. All materials shall be delivered to the Site in sealed and labelled containers.

The paint for each coat shall be from the same manufacturer, compatible with the underlying coat and shall be a different colour for ease of identification.

Particular regard shall be paid to the maintenance of the recommended temperature and humidity during application and curing. Painted steelwork shall not be over coated or handled until the recommended curing period has elapsed. No finished paint coating will be accepted until the specified dry film thickness has been achieved to the entire surface including edges.

All steel surfaces shall be completely dry and free from oil and grease and all welds ground smooth and weld spatter removed. All fins at saw cuts, burrs and sharp edges shall be removed, and the edges shall be rounded off.

For all painted items, the Contractor shall submit for approval a `Paint System Sheet' stating full details of each paint system proposed indicating the following information, with reference to IS : 1477 surface preparation system reference together with manufacturer's brand name and product reference dry film thickness colour time to repaint

Items to be painted

All existing & new structural steel member including columns, trusses, purlins, floor plates, floor gratings, stair treads, hand rails, brackets, steel inserts etc. but not limited to it shall be painted except if otherwise specified.

No black bolts, nuts, washers and welds shall be painted before assembly or erection and approved by Engineer-In-Charge. They shall be thoroughly cleaned and dipped into boiling linseed oil and after erection, painted as specified herein.

Standard

The operations, workmanship, schedules and equipment for painting shall be generally comply with the requirement to IS: 1477 (Parts I & II) “Code of Practice for Finishing of Iron and Steel in Building – Painting and Allied Finishes”.

All painting shall be carried out by brushing, spraying and roller application of paint shall not be allowed without the written permission of the Engineer-In-Charge.

No painting shall commence until the cleaned surfaces are approved by the Engineer-In-Charge.

No exterior or exposed painting shall be carried out under adverse weather conditions such as rain, extreme humidity, dust storms etc.

Rub down and primer application

The existing steel surfaces shall be rubbed down thoroughly with emery/abrasive paper to remove dust, rust, other foreign matters and degreased, if required, in accordance with IS: 1477, cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry. Primer coat of zinc chromate primer (conforming to IS: 2074) shall be applied by brushing/spraying in a manner so as to ensure a continuous and uniform film throughout. Special care shall be taken to cover all the crevices, corners, edges etc. The each primer coat shall be air dried and shall have a minimum film thickness of 25 microns (tolerance ± 10 %) after drying, unless specified.

Final paint application

After the primer is dry, the surfaces shall be dusted off and one coat of paint shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The second coat of paint shall be applied after the first coat is hard dry. The minimum thickness of each film shall be 20 microns (± 10 % tolerance) after drying, unless specified.

Mode of Measurement

The Paint item shall be measured as per plan area indicated in the tender drawing for the structure viz. PPT Plant, Cable store A, Cable Store B and shed 7C.

Rate

As specified in BOQ item for structural steel work.

10.4 M.S. Chequered Plate

Materials

Chequered plates shall be of mild steel (Grade I unless otherwise specified) and conforming to IS: 3502.

Shop Drawings

Shop drawings shall be prepared by the Contractor on the basis of "Approved for Construction" (AFC) design / drawing issued to the Contractor.

Fabrication

Chequered plates shall be fabricated as per the "Approved for Construction" Shop drawings (prepared by the Contractor based on design drawings and duly approved by Engineer-In-Charge). These shall be perfectly flat and without any dents / deformations and shall be cut to the required size and shape. Holes / notches / openings of the required size, if any shown in the drawings shall be made. If used for staircase treads, nosing shall be made by cold bending of chequered plates. All edges shall be made smooth and even. All chequered plate units shall be given distinct erection marks in accordance with the marking drawings.

Erection / Fixing

Chequered plates shall be fixed to the bearing members by welding / bolting / screwing as shown in the drawings.

Painting

Chequered plates shall be cleaned (both side) with wire brush and shall be given unless otherwise specified in the item description two coats of yellow zinc chromate primer on the plain surface after fabrication conforming to IS:2074 and specifications as described under –Steel work specifications.

Measurement

Measurement shall be made on the basis of admissible weight in metric tons of the chequered plates accepted by the Engineer-In-Charge. The weight shall be calculated on the basis of IS Hand Book. No allowance in weight shall be made for rolling tolerances.

Rate

The rate shall include supplying, fabricating, erecting M.S. chequered plate including transporting, handling, straightening, if required, cutting to required size and shape, making holes / notches / opening of required size and nosing, smoothening the edges, fixing by welding / bolting / screwing, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying two coat of yellow zinc chromate primer etc. all complete as specified.

M.S. Tubular Hand Railing

Material

M.S. tubes for hand railing shall be 25mm and 32 mm nominal diameter, unless specified of mild steel medium grade conforming to IS : 1239, vertical rolled steel angles etc. confirming to IS-808 .

Toe/Base plates shall be of mild steel conforming to IS: 226

Fabrication

Hand railing shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All tubes shall be straight and without any dents / deformations. Tubes shall be cut and ends shall be prepared to a neat and workman like finish. All elements shall be directly welded. Tubes shall be cold bent to shape and curvature in case of discontinuous ends of handrails. Lower ends of vertical posts shall be cut and splayed (for grouting in pockets provided in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower end of vertical posts.

Erection / Fixing

Hand railing shall be fixed to the bearing members by welding / bolting / grouting as indicated in the drawings or as directed by the Engineer-In-Charge.

Painting

MS tubes shall be cleaned (both the surfaces) with wire brush and given two coats of yellow zinc chromate primer on the plain surface after fabrication conforming to IS:2074 and 2 coats of approved synthetic enamel paint as per specifications described under-Steel work specifications.

Measurement

Actual length of structural steel tubes/ angles etc. fixed in place for railing as per design shall measured in running metres correct to a millimetre ,while M.S. Plates shall be measured in square meter nearest to two decimals and weights shall be calculated on the basis of Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue correct to the nearest kilogram.

Rate

The rate shall include preparation of fabrication drawings, supply of all materials handling, transporting, straightening if required, cutting to required size, bending, welding, bolting, grouting, surface cleaning, removal of rust, scale, grease and applying two coat of yellow zinc chromate primer after fabrication etc. all complete as specified.

11. ROOFING/CLADDING WORK

11.1 Galvalume Sheets of 0.70 mm Thickness.:

Material

High Tensile Alloy Steel 550 MPA yield stress (ASTM A 446 Grade-E) with hot dip metallic coating of Aluminium /Zinc alloy coating AZ 150 as 150 gm/sq.m, zinc / aluminium alloy coating of 55% and 45% respectively conforming to ASTM 792/AS 1397. Colour Coated Trapezoidal Sheets of **0.70mm TCT** (including metallic coating).

Storage on Site

Storage /stacking of the material shall generally in confirmation with IS 4082 unless otherwise specified by the manufacturer. Material shall be protected from damage while stored on site. When they are stacked for any length of time, it is recommended that cover be provided.

Packs of sheets shall be kept dry in transit and on site to prevent water and / or condensation being trapped between adjacent surfaces. Packs of sheets standing on site shall be stored clear off the ground. Sheets shall be handled using clean dry gloves.

Paint

20 microns exterior coat of silicon modified polyester (SMP) paint system over 5 micron epoxy primer and back coat of silicon modified polyester (SMP) paint of 5

micron approved shade. Colour/shade of the roofing and cladding sheet shall be as approved by the Engineer In-charge.

Laying and fixing

Overlaps: During installation, contractor has to ensure End over lap of 200 mm & Side Overlap of 150mm including necessary fittings like self taping screws, stitching screws, mastic tape, sealant, washer, bolts, fasteners, EPDM seals to make the roof leak proof, etc. complete (cost of Lapping shall not be paid separately)

Roofing sheets shall be factory cut and supplied in required lengths (upto 12m) to suit shop drawings. Sheets shall be crest fixed to purlins with 12 x 14 x 55 mm mechanically galvanized self drilling fasteners with EPDM seals (one fastener on each crest, unless specified) or as per manufacturer's recommendation. Colour caps same as that of roofing to be supplied along with fasteners. End laps of roofing to be minimum 200 mm.

Cladding sheets shall be supplied in required lengths (upto 12 m) to suit shop drawings. Sheets shall be valley fixed with 12 x 14 x 20 mm mechanically galvanized Self drilling fasteners with EPDM seals (one fasteners in each valley, unless specified) or as per manufacturer's recommendation. Colour caps same as that of cladding to be supplied along with fasteners. End laps of cladding to be minimum 100 mm.

Roofing and cladding shall generally comply with the following:

Slope of roofing shall be as shown on approved fabrication drawing.

Cut panels, sheets and flashings shall give clean true lines with no burrs.

Cut openings to minimum size necessary.

Lay panels and sheets with exposed joints of side laps away from prevailing wind unless shown otherwise on drawings.

Panel and sheet ends, laps and raking cut edges fully supported and with fixings at top of lap unless otherwise specified.

Drill holes, position at regular intervals in straight lines, centred on support bearings or as shown on the drawing.

Remove dust and other foreign matter before finally fixing panels and sheets.

After completion check fixings to ensure water tightness .

Cut edges paint to match face finish.

Foam fillers for roofing

Self adhesive PU form (polyurethane) fillers shall be supplied as per manufacturer's instructions matching to the shape of roof profile and to be fixed along the ridge and eaves end of roofing.

Finish

The roof when completed shall be true to lines and slopes and shall be leak proof. The ridge should be notched at the crest & turned down, at the ridge the valley of the roof to be turned up to prevent entry of water & dust.

Safety Precautions

No person other than workmen employed by the roofing contractor shall be permitted access to any area over which the sheeting is being laid. Cat ladders or roof boards should in variably be used by men working on the roofs. The observations of this rule which is advocated primarily on the grounds of safety, will also avoid damage to the roofing materials.

All personnel on roof top shall have safety belts tied to life-line attached from the ridge to the eaves and also any other safety as per requirement of the manufacturer's instructions.

Scaffolding for cladding

Only steel 'H' frames shall be used for scaffolding. The scaffolding shall be design to execute the work at 30 meters height and same shall be checked from the Engineer-In-Charge.

Material warranty

At least minimum 10 years warranty against corrosion of material shall be given.

Measurements

The length and breadth shall be measured correct to a cm. Area shall be worked in sq.m. correct to two places of decimal.

The superficial area of roof / cladding shall be measured net 'as laid' and paid for accordingly. Laps shall not be paid for separately. Measurement shall be taken on the flat and not girthed.

Roof with curved sheets shall be measured and paid for separately.

No deduction in measurement shall be made for opening up to 0.4 sq.m and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.4 sq.m in area, deduction in measurements for the full opening shall be made.

Cutting across corrugation shall be measured on the flat and not girthed. No additions shall be made for laps cut through.

The rate quoted should be inclusive of cost of packing, transportations, necessary required hard wares i.e. self tapping and drilling screws as per AS 3566 including stitching of vertical (side lap) joints with special aluminium roofing rivets and washers at approx 500mm distance including wastage, overlap and including the cost of all necessary scaffoldings, shop drawings etc. complete strictly as per manufacturers specification subject to approval of Engineer.

The steel manufacturers test certificate for the chemical and mechanical properties of steel must be submitted for approval to the client/ consultant prior to installation.

Also, contractor has do the joint sampling of sheets at site and submit the third party test reports of the samples from NABL accredited laboratories.

11.2 Galvalume Sheets of 0.50 mm Thickness.:

Material

High Tensile Alloy Steel 550 MPA yield stress (ASTM A 446 Grade-E) with hot dip metallic coating of Aluminium /Zinc alloy coating AZ 150 as 150 gm/sq.m, zinc / aluminium alloy coating of 55% and 45% respectively conforming to ASTM 792/AS 1397. Colour Coated Trapezoidal Sheets of **0.50mm TCT (**including metallic coating).

Storage on Site

Storage /stacking of the material shall generally in confirmation with IS 4082 unless otherwise specified by the manufacturer. Material shall be protected from damage while stored on site. When they are stacked for any length of time, it is recommended that cover be provided.

Packs of sheets shall be kept dry in transit and on site to prevent water and / or condensation being trapped between adjacent surfaces. Packs of sheets standing on site shall be stored clear off the ground. Sheets shall be handled using clean dry gloves.

Paint

20 microns exterior coat of silicon modified polyester (SMP) paint system over 5 micron epoxy primer and back coat of silicon modified polyester (SMP) paint of 5 micron approved shade. Colour/shade of the roofing and cladding sheet shall be as approved by the Engineer In-charge.

Laying and fixing

Overlaps: During installation, contractor has to ensure End over lap of 200 mm & Side Overlap of 150mm including necessary fittings like self taping screws, stitching screws, mastic tape, sealant, washer, bolts, fasteners, EPDM seals to make the roof leak proof, etc. complete (cost of Lapping shall not be paid separately)

Roofing sheets shall be factory cut and supplied in required lengths (upto 12m) to suit shop drawings. Sheets shall be crest fixed to purlins with 12 x 14 x 55 mm mechanically galvanized self drilling fasteners with EPDM seals (one fastener on each crest, unless specified) or as per manufacturer's recommendation. Colour caps same as that of roofing to be supplied along with fasteners. End laps of roofing to be minimum 200 mm.

Cladding sheets shall be supplied in required lengths (upto 12 m) to suit shop drawings. Sheets shall be valley fixed with 12 x 14 x 20 mm mechanically galvanized Self drilling fasteners with EPDM seals (one fasteners in each valley, unless specified) or as per manufacturer's recommendation. Colour caps same as that of cladding to be supplied along with fasteners. End laps of cladding to be minimum 100 mm.

Roofing and cladding shall generally comply with the following:

- Slope of roofing shall be as shown on approved fabrication drawing.
- Cut panels, sheets and flashings shall give clean true lines with no burrs.
- Cut openings to minimum size necessary.
- Lay panels and sheets with exposed joints of side laps away from prevailing wind unless shown otherwise on drawings.
- Panel and sheet ends, laps and raking cut edges fully supported and with fixings at top of lap unless otherwise specified.
- Drill holes, position at regular intervals in straight lines, centred on support bearings or as shown on the drawing.
- Remove dust and other foreign matter before finally fixing panels and sheets.
- After completion check fixings to ensure water tightness .
- Cut edges paint to match face finish.

Foam fillers for roofing

Self adhesive PU form (polyurethane) fillers shall be supplied as per manufacturer's instructions matching to the shape of roof profile and to be fixed along the ridge and eaves end of roofing.

Finish

The roof when completed shall be true to lines and slopes and shall be leak proof. The ridge should be notched at the crest & turned down, at the ridge the valley of the roof to be turned up to prevent entry of water & dust.

Safety Precautions

No person other than workmen employed by the roofing contractor shall be permitted access to any area over which the sheeting is being laid. Cat ladders or roof boards should in variably be used by men working on the roofs. The observations of this rule which is advocated primarily on the grounds of safety, will also avoid damage to the roofing materials.

All personnel on roof top shall have safety belts tied to life-line attached from the ridge to the eaves and also any other safety as per requirement of the manufacturer's instructions.

Scaffolding for cladding

Only steel 'H' frames shall be used for scaffolding. The scaffolding shall be design to execute the work at 30 meters height and same shall be checked from the Engineer-In-Charge.

Material warranty

At least minimum 10 years warranty against corrosion of material shall be given.

Measurements

The length and breadth shall be measured correct to a cm. Area shall be worked in sq.m. correct to two places of decimal.

The superficial area of roof / cladding shall be measured net 'as laid' and paid for accordingly. Laps shall not be paid for separately. Measurement shall be taken on the flat and not girthed.

Roof with curved sheets shall be measured and paid for separately.

No deduction in measurement shall be made for opening up to 0.4 sq.m and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.4 sq.m in area, deduction in measurements for the full opening shall be made.

Cutting across corrugation shall be measured on the flat and not girthed. No additions shall be made for laps cut through.

The rate quoted should be inclusive of cost of packing, transportations, necessary required hard wares i.e. self tapping and drilling screws as per AS 3566 including stitching of vertical (side lap) joints with special aluminium roofing rivets and washers at approx 500mm distance including wastage, overlap and including the cost of all necessary scaffoldings, shop drawings etc. complete strictly as per manufacturers specification subject to approval of Engineer.

The steel manufacturers test certificate for the chemical and mechanical properties of steel must be submitted for approval to the client/ consultant prior to installation.

Also, contractor should have done joint sampling of sheets at site and submit the third party test reports of the samples from NABL accredited laboratories.

11.3 Colour coated sheets for flashing, capping & trims, etc. :

Material

These shall be formed out of same substrates and corresponding thickness as that of the roofing / cladding sheets and shall be supplied in standard lengths of 2.5 m, unless specified in the required shapes and girths.

Fixing

These shall be supplied in required lengths (upto 2.5 m) to suit shop drawings and shall laid / fixed as per approved fabrication drawing. These shall be stitched to the roofing / cladding with 10x12x20 mm hex-head mechanically galvanised self drilling fasteners with EPDM seals at every 500 mm c/c, unless specified or as per manufacturer's recommendation. The end laps shall be stitched at minimum every 50 mm c/c unless otherwise specifically instructed by the manufacturer.

Finish

The edges of the flashing / capping and Trims shall be straight from end to end and their surfaces should be plane and parallel to the general plane of the roof. The ridges and hips shall fit in squarely on the sheets.

Storage, paint, safety precautions, warrantee etc. shall be as described under roofing and cladding specifications.

Measurement

The measurements shall be taken for net 'as laid' length along the centre line of flashing capping or Trims, correct to a cm. Laps provided in between shall not be measured.

12. POLYCARBONATE SEETING:

12.1 GENERAL PROPERTIES:

General Specification for Polycarbonate sheets shall be as tabulated below:

Material	Polycarbonate
Thickness	2.0 mm
Light Transmission(Max)	95%
UV Protection	99.90%
Chemical Resistance	Moderate
Diffused Light	No
Cracking Resistance	Poor
Appropriate Length	< 6m
Max. Span at 1 kPa	1.0 m

12.2 PHYSICAL PROPERTIES

Tensile Strength	65 MPa
Impact Strength	20 Joules
Shear Strength	41 MPa
Modulus of Elasticity	2400 MPa
Flexural Strength	87 MPa
Specific Gravity	1.2
Thermal Conductivity	0.21 watt / m °C
Water Absorption	0.36% in 24 hrs / 23 °C
Fire Spread	Self extinguishing
MATERIAL EXPANSION 0 °C TO 40 °C TEMPERATURE VARIATION, SHEET LENGTH 6 METERS	
Thermal Expansion	16.2 mm
Thermal Co-efficient	6.75 x 10-5 cm / cm /

Materials

Polycarbonate sheets shall be supplied in 2mm thick matching to the roof / wall cladding profile in required length to suit approved fabrication drawing and subject to prior approval of Engineer-In-Charge.

Storage of materials, safety precautions, warrantee etc. shall be as described under roofing/ cladding specifications.

Fixing

Polycarbonate sheets shall be fixed to purlins with 12 x 14 x 55 mm fasteners with EPDM seal and having cyclonic washers or as per manufacturer's recommendation. Butyl tape shall be applied on the side/ end lap of FRP sheets and near about roofing sheets.

Fix in profile, in accordance with manufacturer's day light system recommendations, technical manual. Fixing should not be over tightened. Overlap (side and end) as per approved drawing.

Measurement

The length & breadth shall be measured correct to a cm up to two places of decimal. The superficial area of roofing shall be measured net 'as laid'. Laps shall not be measured separately. Measurement shall be taken on the flat and not girthed.

Rates

The rate shall include the cost of all the materials and labour involved in all the operations described above including necessary fittings and accessories scaffolding for cladding, laps as per drawing, safety precautions, overlaps etc.

13. Aluminium Gutter

Material

These shall be formed of 2mm thick Aluminium sheets and shall be supplied in standard lengths of 2/2.5 m machine bent in required profile/ shape.

Profile

The required shape or profile of gutter should be trapezoidal shape having 25cm width with 80cm overall length and or as approved by Engineer In-charge. Providing and fixing 25cm wide, 80cm overall trapezoidal gutter as per existing gutter section, with GI brackets 40x5mm/50x5mm size at a distance ot 1m c/c , including bending, cutting, welding, hoisting, fixing in position with bolts, nuts and washers etc. all complete as directed.
The depth, width and height should be as per the rainfall catchments area and as approved.

Fixing

Gutters shall be fixed as per profile and drawings approved for construction.

The gutter shall be fixed on MS brackets of size 40x5mm/50x5mm size at a distance at 1m c/c , including bending, cutting, welding, hoisting, fixing in position with bolts, nuts and washers etc. all complete as directed by Engineer In-charge.

The end laps of gutter shall be bolted with galvanized (175 gauge minimum) nuts and bolts with metallic washers to suit design

Finish
The edges of the gutters shall be straight from end to end and their surface should be plain of the roof. Storage, paint, safety precautions, warrantee etc. shall be as described under roofing and cladding specifications.

Measurement

The measurements shall be taken for net 'as laid' length along the centre line of gutters correct to a cm. Laps provided in between shall not be measured.

Rate

The rate shall include the cost of all the materials and labour involved in all the operations described above including necessary fittings and accessories scaffolding, laps as per drawing, safety precautions, overlaps etc.

MS brackets shall be measured and paid for separately under relevant item.

14. TURBO VENTILATORS:

14.1 TECHNICAL DATA FOR 24" VARIABLE SLOPE ADJUSTABLE WIND VENTILATORS:

TECHNICAL DATA

Air Quantity	3750 CFM at 120 Feet HT
MOC of Vanes	Industrial Hi-Grade Aluminum
MOC of Top Plate	Stainless Steel
MOC Bottom of Ring for Variable Slope Adjustment	Stainless Steel
Angle Adjustment Range	0 to 17 Deg.
Weight of Ventilator	06 Kg.
Height of Ventilator	410mm ± 5 mm
Center Width of Ventilator	735mm ± 5 mm
Dia of Top Plate	500mm ± 5 mm
Dia of Bottom Ring	600mm ± 15 mm
Nos of Vanes	42 Nos Rolled Formed
Thickness of Vanes	0.45 mm
Nos of Bearing	02 Nos
Bearing Type	6001 ZZ Permanently Lubricated & Sealed
Rivets	Aluminum Alloy with Washer

14.2 TECHNICAL DATA FOR FRP BASE PLATE FOR 24" VARIABLE SLOPE ADJUSTABLE WIND VENTILATORS

TECHNICAL DATA

MOC of Base Plate	FRP in GP Resin
Type of Base Plate	Profiled Colour Pigmented Opaque
Length of Base Plate	1600 mm
Net width of Base Plate	1000 mm

Height of Base plate	125 mm
Thickness of Base Plate	2 mm+/- 0.3 mm
Top Dia of Base Plate	600 mm+/-10 mm
Weight of Base Plate	05 Kg +/-300gm

15. PVC RAIN WATER PIPES:

15.1. MATERIALS:

PVC Rain water pipes of 160 mm diameter conforming to I.S.13592-1992 including proper rain water receiving recess with PVC plug bend, necessary fittings such as offsets, shoes including fixing the pipe on wall using approved wooden cleats projecting 25mm to 40mm from face of wall and fixing with clips of approved quality and number, filling the joints using rubber gasket with solvent cement and properly resting the shoe of pipes on cement concrete or masonry blocks, including necessary scaffolding and maintenance for 3 years for any leakages or dislocation of pipes.

15.2. WORKMANSHIP:

A. The P.V.C. pipes of specified diameter shall be fixed as directed. Due to thermal expansion of rigid P.V.C Pipes, due allowance shall be made in pipe lines for any change in length of pipe line which may occur during installation or when pipe line is in service. P.V.C pipe should be undertaken after precautions are observed for their protection against dirt, sun rays and mechanical damage. P.V.C pipes shall be supported at an interval of 2000 mm.

B. Closer support spacing shall be provided, if recommended by the manufacturer.

C. The guide line indicated by the manufacturer regarding handling, transportation, storing, laying and jointing of pipes shall be kept in view during execution.

2.3. **Jointing the pipes:**

A. The jointing of PVC pipes shall be done using rubber gasket with solvent cement. The pipes end shall be accurately cut. The ends of the pipes and fitting should be absolutely free from dirt and dust. The outside surface of the pipes and the inside of the fittings shall then be roughened with emery paper, and then solvent cement shall be applied to the matching surface and pushed home and joined. Since solvent cement is aggressive to P.V.C care must be taken to avoid applying excessive cement to the inside of pipe sockets as any surplus cement cannot be wiped off after jointing. Empty solvent cement tins, brushes, rags of paper should be gathered, not left scattered about.

B. If any manufacturer recommends its own methods of jointing, the same shall be adopted after necessary approval from the Engineer –in-charge.
C. The pipes, fittings and joints shall be tested for leakage and any defects noticed shall be testified without extra cost to the MDL .

Measurement

The measurements shall be taken for net 'as laid' length along the centre line of pipe correct to a cm. Laps provided in between shall not be measured.

Rate

The rate shall include the cost of all the materials and labour involved in all the operations described above including necessary fittings and accessories scaffolding, laps as per drawing, safety precautions, overlaps etc.

16. DISMANTLING & DEMOLISHING

16.1 GENERAL:

The item wise detailed specifications are intended for the general description of quality, workmanship, etc. desired for the items covered in the Schedule of Items. The Specifications are not, however, intended to cover the minute details and the work shall be executed according to the relevant latest Indian Standard Codes. In absence of the later, the work shall be executed according to the prevailing local Public Works Department Practice or to the recommendations of American and British Standard Institution at the discretion of the Engineer-In-Charge.

16.2 Scaffolding

Single or double scaffolding shall be provided by the Contractor as and when required.

16.3 Objective

The desired technique to be adopted in carrying out the demolition and dismantling work of existing structure shall be such that the fragments falling out of such operation can be contained within the work area or taking suitable protection so as to prevent materials from going out. This would relieve the surrounding area from any uncertain or uncontrolled behaviour of dismantled materials.

The rubbish / materials after dismantling shall also be stored systematically and disposed off immediately outside the plant boundary in order to ensure no major formation of heaps inside / adjacent to the work site and not hamper in any way the normal business operation of the Employer.

The term demolition implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

The term 'Dismantling' implies carefully removing without damage (up or down). This shall consist of dismantling one or more part of the structures / facilities as specified or shown on the drawings.

16.4 Precautions

All materials obtained from dismantling or demolition shall be the property of the Contractor once the materials are taken out of the boundary of MDL after completion of the necessary gate pass and other formalities. But till such time the materials shall be kept in safe custody as per the directives of the Engineer-In-Charge.

The demolition shall always be planned beforehand and shall be done in reverse order of the one in which the structure was constructed. The scheme shall be got approved from the Engineer-In-Charge before starting the work.

Necessary propping, shoring and / or underpinning shall be provided for the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever required, as per the opinion of the Engineer-In-Charge, temporary enclosures or partitions shall be provided at the Contractor's cost.

Necessary precautions shall be taken to keep down the dust nuisance.

Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or demolishing roofs, masonry, etc. shall be carefully removed first. The dismantled articles shall be passed by hand, where necessary, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-In-Charge.

Where fixing is done by nails, screws, bolts, rivets, etc. dismantling shall be done by taking out the fixed items with proper tools and not by tearing or ripping of.

Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-In-Charge within work site for verification required for gate pass and other formalities for taking outside the boundary. All unserviceable materials, rubbish, etc. shall be disposed off immediately outside the Owner's premises as directed by the Engineer-In-Charge.

16.5 General

Necessary data such as building size, wall thickness, construction materials, etc. that may be required shall have to be collected by the Tenderer from MDL site at his own expenses.

Information to be supplied by the Tenderer along with Tender

The information to be provided for by the Tenderer, unless otherwise specified, shall include the following :

To submit his method of demolition duly supported by specifications and drawings and sequence of operation along with a list of equipment, plants and machineries to be employed during such operation, to meet the above mentioned objective.

16.6 Work to be provided by the Contractor

To arrange all the formalities as per requirement of statutory rules, if his method involves use of explosives. He has to obtain permission from appropriate authority of buying, storing, handling & making use of explosives.

To notify, the Employer for arranging to shut off all gas, water, electricity, steam and other service lines running over ground or underground. Any temporary service connections required for the demolition work shall be separately taken and arranged by the Contractor.

Any preliminary work, necessary for Contractor's method of demolition.

To furnish all materials, labour, tools and plant and all consumables required for this work and its related temporary work such as cordoning the area, staging etc.

To furnish the details of safety measures for human life / property / structures, the Contractor proposes to take during the blasting operation of explosives, if he proposes to use on this demolition work. This should be strictly as per rules and regulations laid down by the concerned authority for explosives to be used in this work.

16.7 Work by Others

No work under this specification will be provided for by any agency other than the Contractor, unless specifically mentioned otherwise elsewhere in the Contract or approved by the Engineer-In-Charge / Employer.

16.8 Codes & Standards

The demolition work shall be carried out as per Indian Standard Code of Practice No. IS 4130 - 1970 (Safety Code for demolition of buildings) or any other relevant Indian Standard Specifications and Codes of Practice. If demolition by blasting is adopted IS 4081 (Safety Code for blasting and related drilling operations) shall be followed. However, if any, particular aspect of the work is not specifically covered by any Indian Standard Specifications or any other standard practices, Engineer-In-Charge's instruction shall be followed.

16.9 Execution

The materials available after dismantling and demolition will be deemed to be the property of the Contractor once the material are disposed off from the plant boundary and the amount offered by the Contractor against each of the facilities / buildings / structures are received by the Employer.

It is presumed that the Contractor will adopt the most suitable method of demolition and dismantling to protect the materials and its surroundings. While doing so the Contractor shall ensure the following, which should be considered as binding towards the method and specification adopted by the Contractor:

Total safety of the people working in the area of the Employer, other agencies employed by the Employer as well as those employed by the Contractor.

Safety and no damage to the adjoining properties, facilities or services.

Disposal immediately after dismantling to keep the area clean after the days work and not more than one truckload being accumulated.

No noise or dust nuisance around the area of working.

No obstruction to vehicular / pedestrian traffic during dismantling and disposal inside the plant boundary as well as outside municipal areas.

No hindrance in the Employer's day to day production work or other operation.

No accidents or other hazards.

16.10 Rates

The rate shall include the cost of all labour involved and tools used in demolishing and dismantling including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable material properly and disposing off unserviceable material out side the premises into approved dumping grounds.

17. LIST OF PREFERRED BRANDS- CIVIL WORK

Sr. No.	DESCRIPTION	APPROVED MAKES
1	Cement	ULTRATECH/ AMBUJA/ BIRLA/L& T /ACC
2	White Cement/ POP	`A. C. C.', JK White, Birla.
3	Reinforcement Steel – Corrosion Resistance Steel (Fe 500 grade)	TISCON / JINDAL / TATA / SAIL / RINL VIZAG
4	Structural Steel	TATA / SAIL / JINDAL/ VIZAG
5	Bricks	Ordinary clay bricks of any brand conforming to I.S. 1077 minimum crushing strength 35 kg / sq. cm. water absorption allowed 25% for bricks used in panel walls. 20% for bricks used in load bearing walls.
6	Ready Mix Concrete Suppliers	ULTRATECH / ACC / GODREJ
7	Vitrified Tiles	EURO / KAJARIA / NITCO /RAK
8	Ceramic tiles	EURO / KAJARIA / NITCO/RAK
9	Glazed wall mounted & floor mounted European / Indian water closet / Urinal	HINDWARE / PARRYWARE / RAK / AMERICAN STANDARD
10	Flush valve	PLUMBER / AQUAL
11	Counter sunk wash basin	EURO / HINDWARE / PARRYWARE / RAK
12	Waste coupling	PLUMBER / AQUAL
13	Bottle trap	PLUMBER / AQUAL
14	Angle cock	PLUMBER/AQUAL
15	CP brass fittings (Bibcock, Stopcock, Shower rose)	Parryware/ Jaguar/ Plumber/ Crabtree
16	Telephone shower/ hand spray	PLUMBER/ JAQUAR
17	Stainless Steel Sink	Nirali/ Franke/ Kingston/ Neelkanth
18	Aluminium sections	JINDAL/ HINDALCO/ BHORUKA &

		GLASS WITH
19	Glass	SAINTGOBAIN/ MODI FLOAT
20	Oil bound Distemper	ASIAN / NEROLAC / BERGER
21	External Premium Acrylic Paint	Ultima of ASIAN / NEROLAC / BERGER / Snowcryl XT of SNOWCEM India Ltd.
22	Premium Plastic Emulsion Paint	Asian/ Nerolac/ Berger
23	Synthetic Enamel Paint	Asian/ Nerolac/ Berger
24	Polymers	Sunanda/ BSF/ Chemistic/ Krishna Conchem/ MC Bauchemie
25	Water Proofing compound	Structural Water Proofing Company/ Fosroc/ Sika/ Dichtament DM The water proofing shall be done after prior approval of the procedure and the same shall be followed at site. The sign and stamp of the agency will be required on the Waterproofing Bank Guarantee Bond (as per Annexure 'J')
27	Grouting Material	Sunanda/ Fosrok/ BSF/ Dr. Fixit
28	Door Closer/ Floor Spring	Dorma, Hettich, Hafele, Ingersol, Geze
29	G.I. 'C' class pipes	TATA/ JINDAL/ ZENITH / PREMIUM
30	CI Pipes	ALC/ NECO Conforming to I.S.1230 for rain water pipes & Fittings I.S.1729 & ISP 3889 for soil & wastewater pipes
31	PVC pipes	Prince / Supreme/ Finolex
32	CPVC pipes	Astral / Crilce / Supreme
33	UPVC pipes	Prince / Supreme /Finolex
34	PVC Water Stops	Deep-Jyoti/ Kanta Rubber Pvt. Ltd./ Santosh Rubber Pvt. Ltd./ Fixo-seal stoppers & profiles/ Maruti Techno rubber pvt. Ltd.
35	PVC Nahni Trap	Prince / Supreme
	PVC Door Shutter	Sintex/ Rajashree/ Radhika/ Wintech
36		
37	PVC Curtain	JMT Plasp Pvt. Ltd./ Kallerians/ Ganik Plastics
38	Plywood/ Particle board	Kit-ply/ Greenply/ Century/Novapan/ECO Board
39	RCC NP2 Hume pipes	Locally available (Vishwa/ Bharat/ India pipes, Arihant)
Note :	Brand deviation if any, needs to be tested for cement, reinforcement steel and structural steel prior to using it for construction only if above app makes are not available and after Prior confirmation/approval from Engine charge.	
	Brand deviation if any, for other finishing items can be changed only if above approved makes are not available and after Prior confirmation/approval from Engineer In-charge.	

ELECTRICAL WORK

TECHNICAL SPECIFICATION FOR ELECTRICAL WORK

1. SPECIAL INSTRUCTIONS

1.1. Actual work shall be carried out by persons holding valid PWD Wireman License. The electrification work shall be supervised by persons holding PWD Supervisors License / Diploma Holder.

1.2. The work of electrification shall be carried out after the layout is finalised and as per the instructions given from time to time by site engineer. The electrical installation shall be as per the Indian standard codes and in conformity with Indian Electricity rules 1956, as amended upto date, and also the relevant regulation of licensee.

1.3. The scope of electrification work will include providing labour, material, transport, insurance security, clearing of site, handing over and one year free maintenance of the work from the date of commissioning. The material used shall be new and of category makes specified or approved. Any work where specifications are not clear , relevant provision in I.S. or Indian Electricity rules shall be followed. Engineer' decision and direction in such cases shall be final.

1.4. Site Engineer's of MDL approval in writing shall be obtained prior to commencement of the work to the following:-

(a) Layout of wiring.

(b) Sizes of Cables.

(c) Layout of electrical lighting arrangement.

(d) Main Power DB, Lighting DB, Air Condition DB & Computer DB,

(e) Make of the materials, fittings / fixtures / Fan, etc. which shall be of the approved make.

2. QUALITY OF THE MATERIAL

2.1. All the materials shall be new from the fresh stock and shall conform to I.S. specifications. When standard does not exist, such material / sample shall be submitted for site Engineer's of MDL approval, with Test Certificate from Government approved laboratories.

2.2. Contractors shall produce, on demand, such details as called for by the site Engineer of MDL to prove the genuineness of the material.

2.3. Rejected materials must be replaced by the contractors within 7 (seven) days.

3. WORKMANSHIP

The work shall be carried out keeping in mind the aesthetic requirement of individual site and matching of final work with the surrounding by proper finishing as necessary to maintain uniformity. Good workmanship is an essential requirement of this contract. Poor workmanship will be liable for penalization.

4. MEASUREMENT & CANCELLATION OF THE PART CONTRACT

The bills of the quantities are based on the plans of the buildings/ individual office showing the approximate location of all outlets, switchgear, etc. and are approximate only. The contractor shall be paid at actual as measured jointly by the representatives of the Contractor and Site Engineer of MDL.

5. INSPECTION & TESTS

5.1. The Contractor shall offer each and every equipment for test at the works or otherwise test certificate shall be furnished in case inspection is waited.
5.2. All the materials shall be approved before starting the work.
5.3. PVC switchboards shall be ISI and approved make.
5.4. Wiring shall be approved before boards or blocks are fixed up.
5.5. Casing-N-Capping / Conduit pipes shall be inspected before erection.
5.6. Mounting arrangement of the ceiling fans / fluorescent fittings / spotlights shall be inspected and approved by the Site Engineer, MDL.
5.7. Connections to earth electrodes shall be inspected and got approved by the Site Engineer, MDL, prior to connection.

6. DRAWINGS & CERTIFICATION:

The contractor shall submit, following certificates, in duplicate, to the Site Engineer, MDL, for record purpose after the completion of the work.

6.1. Completion Drawings of in built lay out of cable (lighting DB, Power DB, Computer power DB, etc.)
6.2. Copies of Completion Certificate and Test Report submitted to Manufacturer.
6.3. Any other Certificate / Reports as called for by the Site Engineer, MDL.
6.4. Instruction & Operation Manuals, Catalogues, etc.
6.5. On completion of the work, 3 (Three) sets of wiring diagram with proper symbol shall be prepared and submitted to the Site Engineer, MDL.

All wiring diagrams shall indicate clearly the main Power Distribution Board, MCB Distribution Board, switchboards, the runs of various mains and sub-mains and position of all the points and their control. All circuits shall be clearly indicated and numbered in the wiring diagrams and all points shall be given the electrical connection.

7. WIRING:

7.1. All the wiring shall be done on the distribution system with the main and branch distribution boards at convenient physical and electrical load centre.
7.2. All runs of wiring shall be laid in such a manner that crossing is avoided.
7.3. All runs of wiring and exact position of all points and switchgear shall be first marked on the building or plan given MDL itself and approved by the Site Engineer, MDL.
7.4. Single / Multi-strand single / Double PVC/ FRLS cables shall be from fresh stock. Lights and fans shall be wired on a common circuit, including socket outlets.
7.5. As regards power circuits, in no case, there shall be more than 2 (Two) power points (16Amp) on each circuit.
7.6. When conductors pass through walls and floors, the conductors shall be wired through rigid pipe PVC sleeves of suitable size permitting easy passing of the wires. The ends of sleeves shall be neatly fixed with PVC bushings.
7.7. All the teakwood articles shall be given one coat of varnished shellac conforming to I.S. 347-1952 over an application on marketed articles. If no application has been made earlier, two coats of varnish shellac conforming to I.S. 347-1952 shall be given.

8. PVC Conduits Pipes

8.1. The contractor shall supply and install conduits as specified. All accessories, fittings required for making the installation complete including inspection tees and elbows, check nuts, male and female PVC reducers and gland, sealing fittings, junction boxes, box covers and saddles. All supporting accessories shall be supplied by the contractor. Conduit fittings shall be of the same material as the conduits i.e. all fittings shall be PVC as the case may be.

8.2. Conduits shall run along walls, floors, ceilings in accordance with relevant layout drawings or as directed by Engineer in Charge. Conduits shall be run as directly and as possible along with generally indicated route between two points with minimum length and width, minimum of crossing, bending and cutting but without creating interference with other installations.

9. LIGHTING SYSTEM & POWER RECEPTACLES:

9.1. The contractors shall supply all lighting switches, power receptacles, MCCB distribution boards and MCB distribution boards complete with MCCB & MCB with neutral terminal blocks and earthing terminal, glands, supporting and anchoring materials, to make the installation complete. The contractor shall also supply all lighting fixtures complete with fluorescent tubes / CFL lamps and cables. All materials, fittings and appliances used in the electrical installation shall conform to the I.S. specifications and technical specification mentioned in BOQ.

9.2. Wiring shall be colour coded so as to enable easy identification of phase, neutral and earth wire.

9.3. Main Power distribution boards shall conform to the stipulations of IS 732 or as approved by the Site Engineer, MDL at site. These shall be weatherproof and dust-proof and IP protection mentioned in item specification or technical specification.

9.4. Receptacle and lighting fixtures shall be fed from different circuits.

9.5. All receptacles and switches which are not flameproof to be installed outside near the main door of Shed and other which are Flameproof switch socket to be installed inside of the Shed.

9.6. All exposed metal parts of the plug, when the plug is in complete engagement with the socket outlet, shall be in effective electrical connection with the earthing pin.

9.7. Metal conduits and fixtures shall be grounded properly by tinned copper wires by means of approved type grounding clamps efficiently fastened to the conduit pipe with earthling clips. To achieve perfect electrical continuity, the conduits shall be bounded effectively on both end of couplings and other points. Conduits shall be grounded at the ends adjacent to switchboards at which they originate or otherwise at the commencement of the run by a grounding conductor connected to an earth clip, clamp or gland in active electrical contact with the conduit.

9.8. Installation tests stipulated in IS 732 and other codes or practices shall be carried out by the contractor in the presence of the Site Engineer, MDL, before putting the installation in service.

10. LIGHTING FIXTURES:

10.1. The lighting fixtures offered shall comply with the following requirement:

i. The fixtures shall be suitable for operation on a normal supply of 240 Volts, Single Phase, 50 Hz, A. C. with a voltage variation of ± 6%.

ii. All fixtures shall be designed for minimum glare. The finish of all parts of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.

iii. All fixtures shall be designed for continuous operation under atmospheric conditions specified without reduction in lamp life, deterioration of material and internal wiring.

iv. For multi-lamp fluorescent fittings, the circuit should be designed in such a manner as to reduce the stroboscopic effect to the minimum.

10.2. Lighting fixture ballast shall be designed, manufactured and supplied in accordance with the relevant standard and shall function satisfactorily under site conditions specified. The ballast shall have a long service life and low power loss.

i. Ballast shall be mounted using self-locking, anti-vibration fixture without removing the fixture. Ballast shall be of electronic type.

10.3. Lighting fixture starter shall be of the safety type i.e. if the lamp fails to ignite at the first start, no further starting must be possible without attending to the tube light. Starter shall have bimetal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool. Starter shall have brass contacts and radio interference capacitor.

10.4. Lamp holders for fluorescent tubes shall be spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation value, contact resistance or lamp holding quality. Rotors shall hold the lamp in position under normal condition of shock and vibration. Lamp holders for incandescent and manufactured in accordance with the relevant standard and designed to give long and satisfactory service.

10.5. Lighting fixture reflectors shall generally be manufactured from sheet steel or aluminium of not less than 22/24 SWG. Fixtures shall be readily removable from the housing for cleaning and maintenance without disturbing the lamp and without the use of tools. Fixtures shall be securely mounted to the housing by means of positive fastening devices of a captive type. The gauge of the C.R.C.A. sheet shall be as per manufacturer's design.

10.6. Each fixture shall be complete with a four way terminal block for the connection and looping of incoming and outgoing supply cables. Each terminal shall be able to accept two 6 sq. mm solid aluminium conductors.

10.7. Each lighting fixture shall be provided with a grounding terminal.

10.8. On completion of manufacture, all surfaces of the fixtures shall be thoroughly cleaned and degreased. The fixture shall be free from scale, dust, sharp edges and burrs.

i. The enamel finish shall be as per standard, non-porous and free from blemishes, blisters and fading.

ii. The surface shall be scratch resistant, and shall have no signs of cracking or flaking when bent through 90 degree on a 12mm diameter mandrel.

iii. All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall light specified.

iv. All reflectors and louvers shall be finished to the standard as the fixture housing.

10.9. The following routine tests shall be conducted as per the relevant Indian Standards:

i. Each fixture completes with its proper lamp / lamps shall operate satisfactorily at its normal voltage and frequency.

ii. Each fixture shall be examined visually to ensure that it is complete in all respects and satisfactorily finished.

iii. All luminaries provided with glass covers shall be subjected to thermal shockproof test. This test shall be conducted to ensure that the cover glass will withstand sudden variation in surface temperature due to rainfall or splashing water when the lighting fixture is fitted. The cover glass shall be heated in an oven to attain a steady temperature of 100°C and then plugged into cold water. No crack should develop.

11. CABLES:

11.1. Cables shall be capable of satisfactorily withstanding, without damage, during transportation to site, installation at site, and operation under normal and short circuit conditions of the various systems to which the respective cables are connected, when operating under the climatic conditions prevailing at the site as indicated in this specification.

11.2. Cables shall be capable of giving satisfactory performance when laid in trays, trenches conduit, and ducts and when directly buried in the ground.

11.3. Cables shall be capable of operating satisfactorily under a power supply system voltage variation of ± 6% and frequency variation of ± 2%.

11.4. Cables shall normally be laid under the following conditions

i. In air-ambient temperature of 40°C.
ii. In ground-ground temperature of 30°C.
iii. Depth of laying in ground – 750 mm or as per requirements.
iv. In conduits – space factor of not more than 60%.

11.5. PVC insulated cables shall be 1100 volt grade heat resistant type, whenever specifically mentioned.

11.6. FRLS cable for 11kv with ISI mark stranded aluminium/copper conductor, circular in shape conductor and insulator shielded, Screened, PVC inner sheathed, G.I. strip armoured PVC outer sheathed cable shall be 1100 volt grade heat resistant type, whenever specifically mentioned.

11.7. If shorter radius appears necessary, no bend shall be made until clearance and instructions have been received from the representative of MDL.

11.8. Wherever groups of H.V. and L.V. cables are to be laid along the same route, suitable barriers to segregate these cables physically shall be introduced.

11.9. Wherever cables crosses roads and water, oil, gas or sewage pipes or G.I. pipes, the cables shall be laid in reinforced spun concrete pipes. For road crossings the pipe for the cable shall be buried at not less than 1.5-meter depth (Pipe cost is not included in cable cost)

11.10. The armour of the cable shall be bonded to the earthing system of the station.

11.11. All new cables shall be megger tested before laying and after jointing is completed, all L.V. cables shall be megger tested and H.V./H.T cables (3.3 KV to 11 KV) pressure tested before commissioning. The voltage for pressure testing shall as per IS: 1255. 1100/650 Volts grade cables shall be tested by 1000 volts megger.

11.12. Cable cores shall be tested for:

i. Continuity
ii. Absence of cross phasing
iii. Insulation resistance to earth
iv. Insulation resistance between conductors

Contractor shall furnish all testing kit and instruments required for field-testing whenever asked by the MDL Site Engineer / Engineer's representative (without any extra cost for testing the cable).

11.13. **CABLE TRENCHES:**

Trenches shall be made for laying underground cable by excavation the earth breaking all type of layers, if any. Excavation shall be 750 mm. deep and 600 mm. wide and same shall be refilled with soft earth without any extra cost after the cable is laid in approved manner i.e., by using sand, bricks etc. Trenches shall be made good to the original surface.

11.14. **CABLE END TERMINATION:**

Providing cable end termination with suitable type cable gland and core termination by using tinned copper lugs/sockets. Lugs/sockets shall be fixed to the core by crimping process. If necessary hydraulic compression tool and die shall be used for higher size cables as per instructions of the Engineer. The end and core termination shall be suitable for the armoured PVC insulated PVC sheathed cable of 1.1 KV/ 11kV grade with aluminium/copper conductors. One set of termination includes gland, lugs for cable cores and accessories.

11.15. **G.I. CABLE TRAY PERFORATED TYPE:**

11.15.1. Scope of work includes providing & fixing of hot deep galvanised sheet steel factory fabricated cable tray with accessories, wherever required / specified, of required sizes (18 SWG up to 300 mm including 300 mm wide tray, 14 SWG for 400-1000 mm wide trays), including providing removable 14 SWG thick G.I cover, knock out holes (two holes per meter) on both sides & fixing accessories, earthing with 8 SWG copper wire as required, including supports, bends etc. as per site requirement & detailed specification as below.

11.15.2. The G.I cable tray shall be of perforated type. Cable tray shall have suitable G.I cover plate which shall be fixed over base tray by self threaded screws of G.I cable tray & cover plate with accessories like vertical outside/inside elbow, reducer, bends etc. shall be thoroughly hot dip galvanized. Galvanizing shall be as per IS: 2629/4759. G.I coupler plates with hardware shall also be provided. The cable tray assembly combined with cover plates shall be properly earthed. All the other material shall be conforming to relevant IS codes.

11.15.3. For wall mounting arrangement, Z sections of G.I. of size 50mmx25mmx50mm & 14/16 WG, shall be provided as a support for fixing cable tray. These sections shall be fixed to the wall by coach screws or anchor-fasteners firmly. Cable tray shall be fixed on these Z sections by G.I nut bolts of suitable size. These Z sections shall be provided at a distance of one meter of cable tray.

11.15.4. For ceiling suspended type arrangement, 25mmx25mmx3mm thick G.I. angle support or combination of Z section & 8mm threaded G.I. rods, shall be provided for cable tray up to 300 mm wide. These supports shall be fixed to the ceiling by anchor-fasteners firmly. And for cable trays, from 300 mm up to 600 mm width, 40mmx40mmx5mm thick G.I angle support shall be provided which shall be fixed to the ceiling by anchor-fasteners firmly. Tier type or layered arrangement shall be done wherever possible, for very effective use of cable tray & Z sections.

11.15.5. Items / accessories / parts / hardware which shall be not specified but required for neat & proper completion of work, is considered as part of specification. Re-instatement as original is also a part of scope of specification.

11.16. **G.I. Junction Box:**

Junction boxes made out of 16 / 18 SWG / 1.62 / 1.21mm G.I. sheet with full-hinged cover and complete with screw type locking arrangement. The boxes shall have suitable number of knockouts for incoming and outgoing cables. Incoming and outgoing cables shall be terminated with proper connection to this box with suitable glands and 10A heavy-duty connector for termination of wires/cables. Cost of connector is included in the cost of junction box. Glands are not included in the cost of junction box.

12. FITTINGS AND FIXTURES:

12.1. **Light Fitting suitable for HPMV lamps**

a)**Scope:**

Supplying & erecting Light fitting suitable for specified 400 watt of HPMV lamps ,with all accessories, erected with provided bracket at any place as directed by site engineer.

b)**Material:**

i)**Fitting:** The fitting comprises deep drawn one piece aluminium body. Lamp compartment has stove enamel white finish from inside and grey finish from outside.nickel chrome plated reflector /Aluminium reflector is mounted inside the lamp compartment houses a detachable gear tray & is wired with provided copper wound ballast, power factor improvement capacitor, electronic ignitor & with mains connector. The cable entry is through mounting type & terminated on mains connector inside the control gear housing with felt gasket which ensures weather proofness & also prevents entry of insects inside the housing. The fittings lamp compartment shall have IP 43 protection and IP 23 protection for control gear apartment. The fitting shall be ISI marked to IS:10322 part-5:1987 and comply with requirements IS:10322 : part-5/Sec-1/1985.Fitting shall be duly wired up internally with appropriate size of wire.

ii) Ballast:-Ballast shall confirm to IS: 6616/82 with following variations. The ballast shall be marked with watt loss and at rated voltage power delivered shall be between 92.5% and 107.5% of the power delivered by the reference ballast.

Ballast used in the fittings shall be energy efficient where watt loss will not exceed the following limits :-

Ballast for 400 watts lamp : 38 watt max

iii) Ignitor:-This shall be suitable for HPMV lamps. It shall not pulsate after the lamp has been fully ignited. Ignitor improper connection shall not cause any dexterous effects on the luminaries. The components shall be fitted inside the polypropylene ,insulating container. Necessary wires with standard colour coding(Red, Yellow & black) shall be drawn outside the container for facilitating the connections.

iv)Condenser:-Made of metalized Polypropylene housed in a Polypropylene container ,hermetically sealed design for tropical conditions of appropriate capacity conforming to IS:1869 of 1976 used for power factor improvement not less than 0.9 foe all types of luminaries.

v)Terminal connector-Connector shall be made of porcelain/Bakelite /PVC ,with necessary brass/copper contacts, screws for connections. The nominal cross sectional area of the connector shall be suitable for leads of 2.5 mm^2

c)**Method of construction**:-The complete fitting with all the above accessories shall be erected with provided bracket at any place as directed by site engineer, duly connected and giving necessary testing.

12.2. **LED Flood Light Fixtures :**

Supply and installation of LED Flood light fixture

A. Enclosure Protection.

The design of the offered LED Lighting Fixtures shall be Type Tested for IP65 ingress Protection by a Govt./ Govt. approved/ NABL Accredited/ Internationally Accredited Lab. Vendor shall submit TYPE TEST report for IP65 Ingress Protection at the time of offer itself to prove the design of the offered LED lighting fixtures.

B. General Conditions

Following codes and acts with its latest amendments shall be applicable for this work:

i) Indian Electricity Act, 2003 with amendments thereto if any
ii) Indian Electricity Rules, 1956
iii) CEA Regulations -2010
iv) Relevant standards of the Bureau of Indian Standards (IS Codes) /International standards
v) American Society of Testing of Materials (ASTM Codes).
vi) Other approved standards and / or Rules and Regulations related to the add subject matter of tender.

a) Design, materials, and workmanship shall satisfy all the applicable standards, specifications and codes as applicable for LED Lighting Fixtures.

b) Scope of work as described in tender document is not limiting in so far as the responsibilities of Vendor is concerned and shall include carrying out all works and providing all facilities that are required for commissioning of LED Lighting fixtures complying fully with all requirements as envisaged, complete in all respect and satisfying all Performance and guarantee requirements as stated or implied from contents of tender document.

C. Following protection shall be provided in LED Lighting Fixtures:

a) Over voltage both at Input and Output.
b) Over current both at Input and Output.
c) Short circuit
d) Surge protection

D. Tests / Inspection

Inspection will be done in 2 stages.
Stage-1: Inspection of LED Modules before assembly.
Stage-2: After Completion of Assembly & Manufacturing to ensure performance.

a) All standard tests on LED Lighting fixtures in accordance with the standards adopted & as per QAP shall be carried out at manufacturer's works so as to ensure efficient operation and satisfactory performance of all components / parts of LED lighting fixtures.
b) Work is subject to inspection at all times and at all places by MDL
c) Vendor shall carry out all instructions given during inspection and shall ensure that work is carried out according to relevant codes of practice & QAP
d) Decision of MDL in regard to quality of work and materials and performance to specifications shall be final & binding on vendor. If any item is found not conforming to standards during test/inspection, the same shall be replaced / rectified by Vendor without any cost to MDL and shall be re- offered for inspection within reasonable period at factory test.

E. Warranty

a) The offered LED Lighting Fixtures including the drivers shall be guaranteed for a minimum period of **60 Months**. During this period the lumen depreciation shall not exceed the permissible limit specified in the LM70 report of the lighting fixture. If it is found that the lumen depreciation is more than the permissible limit, the vendor shall replace the lighting fixture with no extra cost to MDL.

b) The vendor shall have final and total single point responsibility for the design and performance of the LED lighting fixture, driver, control gear and all components supplied under this specification.

c) The supplier shall,
   i) Warrant that the LED lighting fixture, driver and all materials to be free from defects in Design, material and workmanship.
   ii) Warrant that the LED lighting fixture will satisfy the requirements of the intended use and be suitable for the application.
   iii) Agree to repair or replace any component under this warranty at site with prevailing model of same make, which proves to be defective during **guarantee period of 60 months**. The fixture shall have suitable mounting arrangement on poles/walls with extended portion of control gear and 2 nos. of sturdy 'U' shaped clamps. The fixture shall have suitable mounting, arrangement on wall with swan neck type G.I pipe up to control gear using 2 nos. of sturdy 'U' shaped clamps, complete with G.I. 16 SWG/1.62 mm junction box 100mmx100mmx75mm with fuse unit connector and 3x2.5 Sq mm multi strand copper wires from fitting to junction box in PVC flexible pipe with gland.

The charges for above accessories are included in the cost of the fixture except Swan Neck type 'B' class G.I. pipe bracket.

12.2.1. **DISTRIBUTION BOARDS:** (incoming MCCB/MCB, outgoing MCB)

The DBs shall be suitable for operation on 3-phase/single phase 415/230 Volts, 50 cycles. The DBs shall comply with the addition of relevant Indian Standards and Indian Electricity Rules and Regulation.

Fabrication, supply, installation and commissioning of three-phase/single phase DB with neutral using C.R.C.A. sheet steel 18/20 SWG std. If 16/18 SWG/1.62/1.21mm is not available in market for approved makes by MDL. Distribution boards with front operated door, D.P & TPN switches with neutral link connectors for incoming and outgoing circuits. 'L' or suitable series miniature circuit breakers of appropriate rating mounted on DIN rail and enclosed in slotted lid type boards with PVC insulated wires of copper conductor for interconnection. The DB shall be mounted on angle iron frame with anchor fastener grouted in the wall as per specification. The cost is inclusive of interconnection with PVC insulated copper wires and sleeves / PVC flexible pipe, glands etc. in cost of DB. Charges for marine plywood and M.S angle iron frame are not included in the rate of DB. The SP, DP, TP MCB shall be as per Interconnection charges are included in cost of distribution board.

Vertical DB:

The vertical distribution board shall be three phase and neutral, sheet steel, powder coated double door type. One cover (door) shall be screwed for incoming and outgoing MCB's and as cover for protection of complete DB.DB shall be fitted with colour coated bus bar, neutral link, earth bar and DIN rail etc (Complete pre-wired DB). The TP & SP MCB's can be used for out going circuit as per the requirement of site.

12.3. **MINIATURE CIRCUIT BREAKERS (MCBs)**

General Specification for MCB's:

MCB's shall be of current limiting type, ISI marked confirms to IS 8828 - 1996. The power loss per pole shall be low and shall be in accordance with IS 8828 – 1996. All cable entries shall be either from bottom or top. Miniature circuit breakers shall have quick make and break non-welding self wiping silver alloy contacts for 10 kA short circuit both on the manual & automatic operation and shall conform to relevant Indian Standards. All the active, live parts of MCB's should be out of human reach, ensuring safety & conforms to IP: 55 degree of protection. The MCB's must house transparent label holder to ensure circuit identification. The MCB's must have fully insulated safety shutters. The MCB's shall have lockable switching lever. The minimum electrical endurance shall be 20,000 operations. The housing of the MCB shall be mounted self-extinguishing DMC (Dough Moulding Compound). The short circuit current shall be brought to zero within 4-5 milliseconds from the time they are established. All MCB's shall have a minimum short circuit capacity of 10 kA RMS.

Material:

Single pole / Single pole with neutral / Double Pole / Triple pole / Four Pole:

MCB, ISI marked as per IS 8828: 1996 (IEC 60898) with hammer trip and watch mechanism 15 arc plates, 10 kA capacity with nominal rating of 240/415V.

Lugs: Copper lugs of suitable size.

Method of Construction:

MCB's shall be erected in provided enclosure / distribution board and terminating the provided wires by copper lugs (crimping type) and connecting the same.

Mode of Measurement: Executed quantity shall be counted on number basis.

13. FUSE SWITCH UNIT:

The fuse switch unit shall be 3-pole double break type suitable for load duty quick make and break action. Separate neutral link shall be provided in the switch. All fuse switch units shall be provided with hinged doors duly interlocked with operating mechanism, so as to prevent opening of the door when the switch is 'ON' position and also to prevent closing of the switch when the door is not properly secured. All contacts shall be silver plated and all live parts shall be provided with switch fuse units and shall be accordance with IS:

9224 (Part II) – 1979 and having rupturing capacity of not less than 31 MVA at 415 volts. HRC fuse links shall be provided with visible indicators to show that they have operated.

14. SWITCHGEAR:

14.1. The metal clad, T.P / T.P.N switch fuse units, Bus bar, distribution boards, starters, etc. shall be mounted vertically on M.S frame of suitable sizes.

14.2. The M.S frame i.e. Angle Iron Frame shall be fabricated from M.S angles and M.S flat as specified.

14.3. The M.S frame shall be rigidly fixed to the wall by anchor fastener.

14.4. The switchgear shall be fixed on M.S. frame with suitable size nut and bolt etc. /M 10 (10 mm dia.) x 40 mm. Long G.I nuts, bolts and washers. The mounting height shall not be less than 1200 mm from the floor.

14.5. Before fixing, the M.S frame shall be painted with red oxide paint. After grouting, the surface shall be finished nicely and frame shall be painted with two coats of synthetic enamel paint of Grey shade.

14.6. After installation of switches, starters, busbar, D.B's, all nuts and bolts shall be thoroughly greased and tightened properly.

14.7. An earthing terminal shall be fixed to the M.S frame.

14.8. Inter connections shall be made with PVC insulated flexible copper wires in adequate size PVC flexible pipe with PVC glands. Inter connection charges are included in cost of switchgear.

14.9. Charges for marine plywood and M.S angle iron frame are not included in the rate of switchgear.

14.10. The switch fuse unit above 63A shall be provided with suitable size of cable end boxes wherever necessary. The cost is not included in the rate of switchgear.

15. REMOVAL OF ELECTRICAL ACCESSORIES:

The existing electrical accessories such as switch gears, point wiring, mains, sub mains, cables, fixtures, pumps, poles, panels etc. shall be removed without damaging the accessories, walls, ceilings etc. in neat manner with good workmanship. The holes/patches etc. shall be made good and painted to match surrounding surface. Dust and dirt sprayed due to work of removal/ re fixing shall be removed and the premises shall be cleaned properly. The removed material shall be handed over to the MDL as it is.

16. ONLY PVC CONDUIT LAYING:

16.1. Providing & Fixing of only rigid PVC conduit pipes conforming to IS: 9537 (Part III) marked 'medium' shall be used for surface mounting wiring & PVC conduits marked 'heavy' shall be used for surface concealed wiring. All PVC accessories shall be conforming to I.S.3419.

16.2. The PVC conduit pipes shall be ISI marked. All the dimensions and thickness shall be conforming to relevant IS. The wires shall be laid through these conduits, wherever required. Conduits shall have minimum joints. Instead of internal working sizes, al external dimensions shall be included in specifications.

16.3. PVC conduit of appropriate size on the locations as directed and as per the approved layout. The PVC conduit shall be of Precision, Asian or Diamond make. The PVC conduit shall run on wall in perfect manner with proper jointing at the corner. The necessary jointing pieces e.g. bend, tees, PVC flexible pipe, PVC glands / rubber bush (at the cable entry of junction box) & teakwood jumpers at (cable crossings) etc. shall be provided as per site condition.

16.4. The conduits shall be used as per the following: - (i) 20mm (ii) 25mm (iii) 12mm. The conduits shall be fixed with G.I. saddles & G.I spacers which

shall be properly screwed to the wall / ceiling, at a distance of 30 cms. To 45 cms., by self threaded metallic screws & PVC/wooden raw-plugs for firm support.

LIST OF PREFERRED MATERIAL

Unless otherwise mentioned specifically only the following preferred make / brands of various electrical accessoris will be used. In case, there are two types of product under one brand name, then product having I.S.I mark shall be used. In case, the approved brands are not available in the market then, equivalent product conforming to relavant standards, as approved by the Engineer Incharge shall be used. The contractors should distinctly understand that it would not be their prerogative to insist on using a particular make/brand amongst the approved ones.

Sr. No		**Item Description**	**Makes/Brand**
1		L.T.Switchgear	
	A)	Enclosed in sheet steel with H.R.C. fuses for 63A and above	L&T, Siemens,Schneider
	B)	Cast Iron with rewirable fuses	KEW, CPL, Kalki
	C)	Circuit Breakers (Moulded Case)	Legrand,Havell's, Schneider
	D)	Miniature Circuit Breakers	Legrand,Havell's,Schneider
	E)	Cubical Panel Switchgear Accessories	
	I)	TPN / DP Switches / Isolators	Legrand, Havell's,L&T
	II)	Rotary CAM type, Selector Switch	Siemens, AEI
	III)	Start / Stop push Button stations	L&T, Siemens, Havell's
	IV)	Contactors	Havell's, L&T, Siemens
	V)	Indicating Lamp	Siemens, Vaishno
	VI)	Earth Leakage Circuit Breakers	Legrand,Havells,Siemens
	VII)	HRC Fuse	Siemens, L&T, English Electric
2		Distrinution Boards with MCB's	Legrand,Havell's,,MDS
3		Cables	Polycab,Havell's,Finolex
4		Socket / Lugs	Dowells, Jainson
5		PVC wires	Polycab,Havell's,Finolex
6		Conduit	
	A)	M.S. Black and G.I. Conduit	Precision, Diamond, BEC

	B)	Rigid PVC Conduit and accessories	Precision, Asian, Diamond, BEC
7		PVC casing-n-capping and PVC casing-n-capping accessories	Precision, Modi's,Presto-plast
8		Screws	Precision Fastners
9		Piano switches flush mounting (5 to 15 A) / wall sockets & plugs (surface mounting), Modular switches (5 to 15 A) holder pendant / batten / angle, three plate ceiling rose (for 3 core twisted flexible wire), 30 A D.P. Ticcino type switch fuse with indicating lamp, bell push surface mounting, flush mounting	Legrand,Roma, Anchor, 'elle' of M/s Aerolite
10		Wall Socket and plug Metal clad (ray roll type)	Legrand, Crompton Greaves,Havell's
11		PVC Boards	Presto-Plast ISI marked
12		Special Accessories concealed / decorative (plate switches)	Roma, Precision,CPL, Anchor
13		Two / Three core flexible wires	Polycab, Havells, Finolex
14		Storage Heater with thermostatic control	Almonard,Crompton, Racold
15		Lamps	
	A)	Flourescent, HPMV, HP/LP-SV, Halogen / MLL	Crompton, Philips, Havells
	B)	Halogen / MLL& Metal Halide	Philips, Crompton,GEC
	C)	CFL 8 to 24 W upto 36W, Groove type, pin type	Philips,Crompton, Anchor, Wipro, GE
	D)	LED	Crompton, Philips, Havells,Bajaj,Halonix
16		Fittings for flourescent HPMV lamps and LP / HPSV lamps with copper wound chokes and condensers. Bulkhead fittings, Duoflux / dispersive reflectors, flood light fittings. Recessed mounted CFL 36W & low watt. Fittings which use energy saving light source like CFL, TL-5 and LED.	Crompton, Philips, Havells,Bajaj,Halonix
17		Bell	
		Call Bell / buzzer	Anchor, Rider, Cona
18		Exhaust Fans / Pedestal Fans air circulators	Crompton, Almonard, Bjaj
19	A)	Ceiling Fans with double ball bearings	Crompton, Almonard, Bjaj

	B)	Table Fans wall mounting Fans / cabin fans	Crompton, Usha
20		Terminal Block	Elmex, Everest, Jyoti
21		Meters: Ammeter & Voltmeter (Analog)	Automatic Electric, Meco
22		G.I. Pipes	Zenith, Diamond
23		Electronic Ballast	Philips, Asian
24		Fan's Electronic Regulator	Rider,Anchor, Cona
25		Flourescent Tube 28W T5 (4 ft or 3 ft or 2 ft)	Philips, GE, Osram
26		Cable Trays and its accessories	Legrand, Asian Anciliary Corporation