Detailed Scope Of Work: Civil & Interior Work.

Sub: - Modernization Of SB-MTC Dept. Ground Floor Service Block, NY

A. Dismantling of Existing:
   1. Partitions (wooden & MS), Doors, Windows, floor tiles, Brick Work for toilets, existing sanitary fittings, damaged plaster, damaged RCC structure, False ceiling, Existing paint, etc.
   2.

B. Providing & Fixing:
   1. PMM on damaged RCC Structure.
   2. Granite window –frame
   3. Two track Aluminum sliding window.
   4. Brick work
   5. Internal Plastering.
   6. Vitrified floor tiles.
   7. Waterproofing in toilets, wall tiles, Plumbing lines, Sanitary fixtures
   8. P & F Laminated partition + Partly Glazed partition+ 35mm Door Shutters with vision panel.
   9. Gypsum + Armstrong False Ceiling.
   10. Kitchen Pantry Platform, Kitchen sink with wall tiles.
   11. POP on wall
   12. Wall & Ceiling painting.
   13. Signage's +Vanishing blinds.
   14. Etc.

Detailed Scope of Work: Electrical Work

1. Carefully dismantling all electrical accessories after disconnection of mains power supply
2. Supply & Installation of underfloor raceways and junction boxes after completion of civil layout marking
3. Supply & Installation of Point wiring accessories
4. Supply of Installation of HMS PVC Conduits for wiring.
5. Supply & Laying of Main Supply Cables, Wires through conduit.
6. Supply & Laying of CAT-6 & Telephone Cables through Raceways.
7. Supply & Installation of LED Light Fixtures, Wall Fans, SFU, Power Distribution Boards.
8. Glanding & Termination of Mains Cable in SFU, Power Distribution Boards.
9. Supply & Installation of Modular Switch Sockets & Accessories and end connection of wires, data cables and telephone cable in Modular accessories.
10. Testing & Commissioning of PDB's, Switch Sockets, Light Fixtures, Network Switch, Telephone Junction Box, Data & Telephone Points, TV, Fridge, Oven.
11. Labeling PDB's, Modular Switch Boards, Data & Telephone Points etc. with Stick able Talley Plates.
12. Preparation of as Fitted Drawings (Four Copies) and submission of these sets after verification from Approving Authority.

1. Technical Specifications (Civil-Work):

Technical specification shall be as per Central Public Work Dept. Specification and relevant IS Code.
In case IS code for any activities are not available, the same shall be executed as per relevant others codes with approval of Engineer In charge.
Further, if any items not covered in IS Code, shall be done as per Manufacturer's specification.
The specifications as specialised in BOQ supersedes others.

LIST OF MATERIALS OF PREFERRED BRAND AND/OR MANUFACTURER

Sr.no	Description	Preferred make
1	Cement 53 Grade / 43 Grade only for Concrete works	Gujarat Ambuja, A.C.C., Ultra-tech, Birla
	Cement Portland Pozzolana (Fly ash based) for Plastering,masonry etc.	Gujarat Ambuja, A.C.C., Ultra-tech, Birla
2	White Cement	Birla / J.K. or equivalent
3	Mild & TOR Steel	Sail, Tisco, Rashtriya Ispat Nigam, Jindal or equivalent
4	Structural steel	SAIL/TATA/RINL/IISCO/JINDAL
5	AAC blocks	Ultratech/ Ascolite/ Siporex/Godrej & Boycee
6	Pest control	PCI/Godrej/Pecopp
7	White cement based putty	M/s Birla white, Plasto shine wall putty, M/s Walplast products pvt. Ltd.
8	Lustre oil paint	Nerolac / Akzo Nobel/ Asian Paint.
9	Emulsion paint	Nerolac/ Akzo Nobel / Asian Paints make.
10	Epoxy paint	Akzo Nobel /Berger/ Asian Paint
11	Vitrified tiles Matt or polished	KAJARIA/Somany/Johnson/RAK
12	Granite	As approved by Architect
13	Kotah Stone	As approved by Architect
14	Agglomerate Composite Marble	NITCO/Kalinga stone/CMC
15	Italian Marble	As approved by Architect

16	Timber	C.P seasoned teakwood of approved quality for lipping, beading, framing etc.
17	Laminated sheet	Greenlam /Merino / Euro
18	Plywood	Anchor / Green ply /Century
19	Veneer	Anchor / Green ply / Century / Euro / Timex (IS 710 : 200)
20	Melamine polish	Asian paint / MRF/ NEROLAC
21	Duco paint	MRF / Akzo Nobel / ASIAN
22	Adhesive	Fevicol
23	Self watering box	Greena/Gaia Pottery
24	Frosted film	3M
25	Hardware fittings	
i)	Hinges Butt	
	Stainless Steel (14g) powder coated hinges with screw Nettle fold screws/palladium size 5" x 11/4'' or as specified	Hettich / Palladium/Haffle/Kich / Dorma
ii)	Mortise lock - Brass or Stainless steel mortise lock of 6 lever 75mm width, all locks to be provided in one cabin shall be of common key and 5 such common keys shall be provided to the client.	Haffele / Dorma/ Hettich / Kich
iii)	Tower bolts - Stainless steel and brass	Haffle/Dorma / Hetich / Kich
iv)	Door closers	Haffle/Dorma / Hettich / Kich
v)	Floor spring	Haffle/Dorma / Hettich / Kich
vi)	Panic handle	DORMA/Haffle
vii)	Patch fittings	Dorma/kich/Haffle/Hettich
viii)	Door handle	Kich/Neki/Haffle/Hettich/Ozone
26	Flush doors	Century/Anchor or equivalent

27	Aluminum windows	Jindal, Hindalco,
28	Stainless Steel	Jindal/SAIL
29	Polycarbonate sheets	GE, Lexan, Danpalon, polygal
30	Gypsum	Saint Gobain Gyproc India/ USG Boral India
31	Water proofing chemicals	CICO/Sunanda/Sika/MC Bauchemie
32	Polymer modified mortar/Micro concrete	Sunanda/ROFF/Basf
33	Rust Preventive	Krishna Conchem/ Sunanda/ BASF
34	Bonding coat	Krishna Conchem/ Sunanda specialty coating/Fosroc
35	Glass	Saint Gobain/ Asahi India Glass Ltd / Gujarat Guardian - Modiguard
36	Galvalume roof	PHENIX Infra/ Kingspan/ LLOYD Insulations (I) Ltd
37	SWR PVC PIPE & FITTINGS 6 KG CM^2; FITTINGS : 6 KG CM^2 ECO. DRAIN PIPE & FITTINGS	FINOLEX / SUPREME/PRINCE SUPREME/ ASTRAL
38	GULLY TRAP	GIRCO / TIRUMALA / SONIA/ SUPREME/ ASTRAL
39	STONE WARE PIPES	GIRCO / TIRUMALA / SONIA
40	RCC HUME PIPES	INDIAN HUME PIPE / PRANALI
41	C.I. PIPE & FITTINGS	NICO OR EQ.
42	PPR PIPES & PPR FITTINGS	SUREME/PRINCE/
43	M.S/G.I. PIPES FOR WATER SUPPLY	TATA / JINDAL/ SWASTIK
44	ASTM/CPVC PIPE & FITTINGS FOR WATER SUPPLY	ASTRAL / SUPREME/ASHIRWAD /
45	COMPOSITE PLUMBING PIPE & COMPOSITE FITTINGS	KITEC OR EQ.
46	G.I. PIPES FITTINGS WATER SUPPLY	DRP-M / R-BRAND / ZOLOTO
47	GI TO GI JOINTS	CHAMPION / EQUIVALENT
48	SOLVENT CEMENT	SUPREME / KISSAN / FINOLEX

49	BALL VALVES	LEADER / ZOLOTO / AUDCO
50	WHEEL VALVES	LEADER / ZOLOTO/AUDCO

Detailed Scope of Work: Electrical Work

1. Carefully dismantling all electrical accessories after disconnection of mains power supply
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8. Glanding & Termination of Mains Cable in SFU, Power Distribution Boards.
9. Supply & Installation of Modular Switch Sockets & Accessories and end connection of wires, data cables and telephone cable in Modular accessories.
10. Testing & Commissioning of PDB's, Switch Sockets, Light Fixtures, Network Switch, Telephone Junction Box, Data & Telephone Points.
11. Labeling PDB's, Modular Switch Boards, Data & Telephone Points etc. with Stickable Talley Plates.
12. Preparation of as Fitted Drawings (Four Copies) and submission of those sets after verification from Approving Authority.

I. GENERAL INSTRUCTIONS

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 finalized 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 up to 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 Engineers 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 / light 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 layout 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.

II. TECHNICAL SPECIFICATION

1. WIRING (WG)

General:

All material shall be conforming to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available

in market, it shall either carry valid 'Quality Control' certificate issued by the Chief Engineer (Elect), P.W. Dept. Maharashtra State Govt. as included in approved list.
Work shall be carried out as per the Method of Construction specified by BIS. If there is no reference for particular Method of Construction in IS, such work shall be carried out as per the approved Method of Construction specified in chapter 16 of P.W. Dept. Handbook.
Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.
Material shall be tested in approved Testing Laboratory and shall qualify the relevant tests as and when directed by Engineer In-Charge.

Recommended Standards:

The following list is showing Indian Standards, which are acceptable as good practice, and accepted standards.

IS 732: 1989	Code of Practice for Electrical Wiring Installations?
IS 4648: 1968	Guide for Electrical Layout in residential buildings
IS 9537 (Part 1): 1980	Conduits for Electrical Installations: General requirements
IS 9537 (Part 2): 1981	Rigid Steel Conduits
IS 9537 (Part 3): 1983	Rigid Plain Conduits of insulating material
IS 3419: 1989	Specifications for fittings for rigid non metallic conduits
IS 694:	PVC insulated cables for working voltages up to and including 1100V
IS 1554 (Part 1): 1988	PVC insulated (heavy-duty) electric cables for working voltages up to and including 1100V
IS 3961 (Part 5): 1968	Recommended current ratings for cables: PVC insulated light duty cables.
IS 4288: 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and including 1100V
IS 14772: 2000	Specifications for Accessories for household and similar fixed Electrical Installations
IS 3043: 1987	Code of practice for Earthing
SP 30: 1984	National Electrical Code
SP 7 (Group 4): 2005	National Building Code
IS 14927(Part 1): 2001	Cable Trunking and Ducting systems for electrical installations.

1.1 Conduits / Trunking (Casing Capping) (Surface type)

1.1.1 PVC Conduits**Specification No :(WG-MA/CON)**
Scope:

PVC Conduits: Surface

Providing specified PVC Conduits and erecting as per approved Method of Construction; on surface of wall / ceiling, etc. including entries through walls / slabs / flooring as per requirement, and with all necessary hardware, accessories

such as Spacers, Saddles, Bends, Tees, Junction boxes, Check-nuts, etc.; making conduits erection work rigid and duly finishing, removing debris from site.

Material:

PVC Conduit:

PVC pipe minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No**.** 1/2) ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non-inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Hardware*:*

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Method of Construction:

Erection PVC Conduits for Surface type wiring:

General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm, round headed screws for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers. Distance between 2 spacers shall not be more than 600mm. Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/2 for PVC conduits). Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. or ant electrostatic partition/separate pipe should be used. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface and with colour coding conduit (For visual identification) as per Table No. 1/4. Flexible conduits shall be used at expansion joints.

Especially for PVC Conduits of surface type wiring:

In addition to general instructions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, it shall be done with bending spring. Size of conduit shall be as per Table No. **½** for number of wires to be drawn through the conduit.

1.1.2 PVC Trunking (Casing capping) **Specification No (WG-MA/CON)**

Scope:

PVC Trunking:

Providing specified PVC Trunking (Casing capping) and erecting as per approved Method of Construction, on surface of wall / ceiling, etc. including entries made with PVC conduit through walls / slabs / flooring as per requirement with all necessary hardware, accessories such as inner / outer Elbows, Tees, Junction boxes, etc. and duly finishing, removing debris from site.

Material:

PVC Trunking (casing capping):

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/3 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8mm thick push-fit joints/ accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Method of Construction:

Erection of PVC Trunking for surface type wiring:

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in single phase distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking or anti electrostatic partition to be provided. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and at required locations.

1.2 Bunch of wires: Specification No (WG-MA/BW)

Scope:

Bunch of wires:

Providing specified wires and drawing them through provided conduits / trunking and / or as directed; with coded ferrules, harnessing the bunch of wires with necessary material when used in panel boards, duly connecting / terminating with lugs, and testing for safety and beneficial use.

Material:

Wires: in conduits / Trunking / panel boards

Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5.

Wires: open

PVC insulated and PVC sheathed wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5.

Earth Continuity Wire:

PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green yellow colour, ISI marked, of specified size but not less than 2.5 Sq mm as per Table No 1/5.

Lugs: **Copper lugs of appropriate size & type**

Other material: Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:

Bunch of wires:

Drawing of wires: General

Specified wires shall be drawn with adequate care. Correct colour coding shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only, with appropriate type and size of lugs.

Drawing of wires: through PVC conduits

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to sharp edges. Number of wires shall not exceed with respect to size of pipe.

Drawing of wires: through Rigid Steel conduits

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs / sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/1.

Open Wire bunch: Open wires shall be erected with due care so as to avoid chances of any mechanical injury. Harnessing shall be done with required material in an approved manner in panel boards or where ever necessary. For covering lead wires flexible conduit shall be used with gland as per necessity.

Testing:

Insulation resistance test:

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured between termination points of Earth wire.

Polarity Test:

Test shall be carried out for ensuring the correct polarity in switch and plug.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter length of single wire or bunch as specified.

1.3 **Mains (surface type)**

1.3.1 Mains in PVC Trunking (casing capping) **Specification No (WG-MA/PC)**

Scope: **Surface type Mains in PVC Trunking (casing capping)**

Providing specified PVC Trunking, Wires and erecting the Trunking as per approved Method of Construction; on surface of wall / ceiling, etc. including entries made with PVC conduit through walls / slabs / flooring as per requirement with all necessary hardware, accessories such as inner / outer Elbows, Tees, Junction boxes, etc; including erection of specified wires in PVC trunking, with coded ferrules and duly connecting with lugs, and finishing, removing debris from site; testing for safety and beneficial use.

Material:

PVC Trunking*:*

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/2 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8mm thick push-fit joints/ accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

Hardware*:*

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires)

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire: PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green colour, ISI marked, of specified size but not less than 1.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of appropriate type and size.

Other material: Flexible PVC conduit, gland coded ferrules, etc.

Method of Construction:

Erection of PVC Trunking for surface type wiring

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of unleveled surface number and size of screws shall be changed to higher size as per requirement and in case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking or anti electrostatic partition is to be provided. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and required locations.

Erecting wires in Trunking:

Wires shall be erected within Trunking with adequate care. Correct colour coding as per Table No. 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be erected in single Trunking. Wires shall be terminated in the terminals of accessories only, with appropriate type and size of lugs. Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be erected through Trunking. Number of wires shall not exceed with respect to size of Trunking as per Table No. 1/3. After erection of wires double locking shall be checked while fixing capping. At the termination end flexible PVC conduit shall be used with gland as per required.

1.4 *Point wiring (Surface type)* **Specification No (WG-PW/SW)**

Scope:

Point wiring (Surface type):

Providing all required approved specified material including hardware and erecting wiring on surface of wall, ceiling from switch board to outlet for light / fan / bell / independent plug point, in rigid steel / PVC conduit or PVC trunking as specified; fixing one board with a 1 way switch for one way point or two boards with a 2 way switch on each board, in case of 2 way point; for controlling power supply and one board / block with accessory for outlet of light / fan / plug and terminating wires within as per approved Method of Construction; removing all debris and testing the installation for safety and beneficial use.

Material:

Point wiring (Surface)

PVC Trunking:

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/2 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8 mm thick push-fit joints / accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

Wires: Phase and Neutral

PVC insulated wires of specified size, 1.1 kV, & minimum FR grade insulation, electrolytic tough pitch (ETP) copper conductor, ISI marked, of required colour coding as per Table No 1/5

Earth Wire:

PVC insulated minimum FR grade copper wires of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, 2.5 Sqmm or bare copper wire of 14g

Accessories:

Switch: 1 or 2-way Piano type 6/10 A, 1 or 2-way Modular type switch 6/10A.
Outlet: 6A angle / batten lamp holder or 3 plate ceiling-rose or Bakelite / porcelain three way connector or if plug point, 6A, 3-pin plug socket.

Boards:

Switchboards shall be double walled (back and front) of suitable size, to accommodate independent slot for each switch, socket, fan regulator. Boards shall be made up of 4mm thick marine grade plywood for back and front fixed on wooden frame with 0.8mm thick laminate pasted on exposed portion of front ply, totally varnished and with either brass hinged door or screwed top.

Or

As above with 3mm thick Bakelite/Hylam top instead of laminated front ply.

Or

Board made from Filled polypropylene.
Round/Square double wooden block or PVC board for mounting light / fan outlet accessory.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, PVC/ rubber bushings etc.

Method of Construction:

Point wiring (Surface)

Erection of conduits:

General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be duly screwed and firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm round headed for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers and saddles. Distance between 2 spacers shall not be more than 600mm. Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface conduit with colour coding (For Visual identification) as per Table No 1/4. Flexible conduits shall be used at expansion joints. Bushing shall be provided at open ends.

Erection of conduits:

PVC pipes for surface type wiring:

In addition to General conditions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, same shall be done with bending spring. Size of conduit shall be correct depending on number of wires to be drawn as per Table No. 1/2.

Erection of PVC Trunking for surface type wiring:

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of unlevelled surface number and size of screws shall be changed to higher size as per requirement and in case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and required locations.

Drawing of wires: General

Wires shall be drawn with adequate care. Correct colour coding as per Table No 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped within circuit. For lighting load distribution wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only. Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be erected wherever necessary. In case of 2-way point wiring additional wires of phase conductor shall be provided between the 2-way switches.

Erecting wires in Trunking:

Wires shall be erected within Trunking with adequate care. Number of wires shall not exceed with respect to size of Trunking as per Table No. 1/3. After erection of wires double locking shall be checked while fixing capping.

Fixing Switchboards and accessories:

Control switchboards shall generally be erected at 1.35m height or as specified and fixed with minimum 2 Nos. (and more as per size of board) of screws of length not less than 50mm, termination of wires shall be done with lugs on switch and other accessories only by carefully inserting all strands in lugs, terminals and proper tightening. Switches shall be provided on phase wire only. Bare wire shall not be used for looping incoming supply to switches and for earthing inside switchboards. For plug socket phase wire shall be connected in right side terminal when seen from front. Proper termination of earth wire in Earth terminal shall be ensured.

Testing:

Insulation resistance test:

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured at all earth terminals of plug outlets and at earth terminals of metal enclosures.

Polarity test:

Polarity test shall be carried out for ensuing the correct polarity in switch and plug.

Mode of Measurement:

Measurement shall be carried out on the basis per number of points, **for the point length up to 6 metre between switch and outlet**. For the length exceeding 6 metre 10% of overall rate shall be added for every 1m.

1.5 TELEPHONE WIRING

1.5.1 General

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which PSI mark is not available in market, it shall be approved either by ITD ***I*** DOT of Govt. of India. Work shall be carried out as per the Method of Construction specified by BIS and as specified by DOT (Department of Telephone), Govt. of India. Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

1.5.2 Scope:

Specification No (WG-TW)

To provide wiring for telephone on surface of wall or ceiling concealed in slab, wall, under flooring, etc, through existing metallic conduits, rigid PVC conduits, PVC trunking, with all necessary hardware, material, etc. as specified. To provide, install, test & commission the instruments / equipments and accessories used in telephone system, such as; Main Distribution Frames (MDF), Krone Modules, Over Voltage Magazine, PBX / EPABX, CO-axial cable, Rosette box, Jumper wire, etc.

1.5.3 Material:

PVC Telephone cable: PVC insulated Tinned copper solid conductor with minimum 0.5 mm dia. (Single & Multi pair) properly paired and colour coded, shall be terminated on KRONE module with suitable tool.
Jelly filled Armoured Telephone cable: PVC insulated, PVC sheathed with steel armouring, Tinned copper solid conductor with minimum 0.5 mm dia multi pair, with Jelly, properly paired and colour coded.

Saddles: Saddles fabricated from G I sheet of required gauge (16/18 gauge) either galvanized finish or painted with superior quality enamel black paint, with necessary shearing for mechanical strength, semi circular shaped with extended piece having suitable holes for fixing on spacer.

Hardware: Sheet Metal (SM) screws of required sizes, plugs, wooden gutties, etc.

MDF: Manufactured by reputed manufacturer of specified capacity, facility for wall mounting, with door & lock, aluminium frame for fixing of KRONE, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour.

Junction box: Manufactured by reputed manufacturer of specified capacity, facility for + wall mounting, with door & lock, aluminium frame for fixing of Krone, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour. The depth of the box should consider the height of KRONE module plus protection magazine.

Rosette box: PVC I Bakelite box with LED indicator, RJ 11 jack, facility for fixing on wall.
Jumper wire: Twin twisted PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia.
KRONE Module: Disconnection type KRONE module having capacity to connect 10 pairs with silver-plated terminal contacts.
RG-11 Co-axial low voltage grade cable: PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia, with connector at both ends suitable for termination in RJ type socket.
PBX (Analogue type): Manufactured by reputed manufacturer and approved by Telephone Engineering Certificate (TEC) of specified extensions, having following features:

1.5.4 Method of Construction:

Drawing of telephone wire through Steel conduit/ PVC conduit/ PVC Trunking:

As specified in Chapter for Point Wiring.

Erection of MDF Junction box / Rosette box / PBX / EPABX, etc:

Specified equipment shall be fixed to wall with minimum 50x8 mm SM screws, with necessary plugs, wooden gutties, etc. or may be fixed on Table Top if required.

1.5.5 Mode of Measurement:

Work done for telephone in Steel I PVC conduit I PVC Trunking will be measured on running meter basis, (i.e. per running meter) for each single run. For the other accessories /equipments shall be done as per unit specified. (I.e. Job / each

1.6 NETWORKING (Computer Cabling)

A) UTP Networking Cable:

General:

All material shall conform to relevant standard as per ISO/IEC11801, CENELEC EN50173 & TIA/EIA 568-B2-1; CUL listed & ETL verified.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

Scope:
Specification No (WG-COC/NC)

To lay the cables for Computers on surface of wall or ceiling concealed in slab, wall, under flooring etc. through existing metallic conduits, rigid PVC conduits, PVC trunking, with all necessary hardware, material, etc. as specified. The cable shall

be used only for connections between Information Outlet & Patch/ Multimax Panel. (Exception: For making MDIX patch cord)

Material:

UTP cable:

4 pairs,100 ohms, unshielded twisted pair (UTP), each pair separated by a PE former (Star shaped) solid 23AWG tinned copper conductor rated for temperature of 75^0 C, PVC insulated grey colour with following types as in the table 1.12/1

Table 1.12/1

Sr. No.	Type	Class	Tested frequency
1	Cat 6	E	350MHz
2	Cat 6+	E	500MHz

1. The Category 6 cable and Category 6 channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6 channel cable, components, and applications for a period of 20 years.
2. The Delay Skew on the 100 meter channel shall not exceed 30 ns
3. The 20 year warranty shall be a transferable warranty and has component replacement policy in case of manufacturing defect
4. Category 6, 100mtr channel, **4-connection** model should guarantee 400% margin over standard NEXT specification across swept frequency
5. Category 6, 100mtr channel, **6-connection** model should guarantee +4dB margin over standard NEXT Specification across swept frequency (1~250MHZ)
6. The high performance Category 6 UTP cable 23AWG shall be of the traditional round design with Mylar bisector tape Non-Plenum rated.
7. The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem,Switched-56, T-1, ISDN,RS-232, RS422, RS-485, 10BASE – T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, IEEE 1394B S100 and S400, as well as all 77 channels (550 MHz) of analog broadband video.
8. The cable jacket shall comply with Article 800 NEC for use as a non-plenum cable. The 4 pair UTP cable shall be UL® and c (UL®) Listed Type CM.
9. Performance shall be characterized to 550 MHz to support high-bandwidth video applications

Non Plenum CAT6 UTP Cable

1 Weight=25.3 lb (1000 ft.)
2 Jacket Thickness=.022 in
3 Outside Diameter=0.232 in
4 Conductor Diameter=.022 in
5 Insulation Type=High density Polyethylene
6 Jacket Material=PVC
7 Maximum Pulling Tension=25 lbs
8 Nom. Velocity of Propagation=0.69
9 Max DC Resistance=9.83 Ohms/100m
10 Mutual Capacitance @ 1 kHz = 4.95 nF/100m
11 Operating Temperature= -20 to 60° C
12 The high performance Category 6 UTP cable shall be of the **traditional round design with Mylar bisector tape.**
13 The 4 pair UTP cable shall be UL Type CM (non-plenum)

14 Performance shall be characterized to 550 MHz to support high-bandwidth video applications

Method of Construction:
The cable shall be laid in provided separate casing n capping/ PVC conduit/ trunking 400mm away from electrical cables wherever required without sharp bends. The cable shall be spliced at both the ends for punching/ crimping at keystone jacks/ UTP connectors.

Mode of measurement: Executed quantity shall be measured on running metre basis.

B) UTP Patch cord

Scope:

Specification No (WG-COC/PC)

Structured cabling, to make connections from switch to patch panel or information outlet to computer

Material:
UTP Patch Cord:
Assembly (conforming to EIA/TIA 568B-2-1) of Cat 6 type 4 unshielded twisted pair 24-26AWG (0.51mm-0.40mm), each pair separated by a PE former (Star shaped) 100 ohms stranded wire PVC insulated cables with modular RJ-45 polycarbonate UL94V housing 15milliohms gold over nickel contacts (superior three piece connector) crimped on both ends with T568A & T568B wiring schemes with 8P8C connection. The cord shall be branded. The cords shall be used in structured cabling in accordance with following table 1.12/2.

Table 1.12/2

Sr. No.	Length	Use in
1	1m	from switch to patch panel
2	3m	from computer to information outlet

All patch cords shall exceed TIA/EIA and ISO/IEC Category 6/Classs E specifications.
All patch cords shall be backward compatible with Category 5 and Category 5E systems.
The patch cords shall incorporate an anti-snag feature that provides maximum protection from snagging during moves and re-arrangements.
Patch cords shall be UL listed, UL-C certified and AUSTEL approved.
Patch cords shall support network line speeds in excess of 1 gigabit per second.

Physical Specifications:
Contact Material: Phosphor Bronze

Contact Plating:	Gold 50 micro-inch (1.27 microns) Nickel 100 micro –inch (2.54 microns)
Insertion Life:	750 minimum
Plug Material:	Polycarbonate UL-rated 94 V-O
Operating Temperature:	14°F to 140°F (-10°C to 60°C)

Method of construction:
The patch cord shall be erected for making connections from switch to patch panel or from computer to information outlet.

Mode of measurement: Executed quantity shall be counted on number basis

1.17 Networking Accessories (NAS)

LAN Accessories

A) UTP connector (RJ-45) (UTPC)

General: All material shall conform to relevant standard as per TIA/EIA 568-B2-1.

Scope: **Specification No (WG-NAS/UTPC)**

To make MDIX (Cross) patch cord required for cascade connections of switches & routers.

Material:

UTP connector:

Assembly of Gold over nickel contacts with 1.5A current carrying capacity, 30V with 15milli ohms contact resistance, 8P8C connection easy to crimp with crimping tool in polycarbonate UL94V housing.

Method of construction:

The UTP cable shall be spliced, untwisted not more than 12mm, inserted into the connector with sequence as shown in the diagram ____ as per EIA/TIA 568 B.2-1 & crimped firmly with crimping tool.

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

B) Information Outlet (Ethernet) (IO)

General:

All material shall conform to relevant standard as per TIA/EIA 568-B2-1.

Scope: **Specification No:(WG-NAS/IO)**

For connecting computers to wired LAN or external wireless Ethernet interface in Wireless LAN.

Material:

Information Outlet Flush/ Surface type:

Spring shuttered front access, high impact plastic body FR grade with high performance unshielded RJ-45 keystone jack (conforming to EIA/TIA 568-B.2-1 Cat 6), 15 milliohms contact resistance, gold over nickel spring contact, 1.5A current carrying capacity, with T568A/T568B wiring option, insulation displacement connector for cable crimping to accept 22-26AWG solid wire for connections up to Gigabit Ethernet.

1. All Category 6 outlets shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in TIA/EIA 568-B.2-1 Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801:2002 Second Edition.
2. The Category 6 outlets shall be backward compatible with Category 5E, 5 and 3 cords and cables.
3. The Category 6 outlets shall be of a universal design supporting T568 A & B wiring.
4. The Category 6 outlets shall be capable of being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current 10BASE-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T and 1.2 Gbps ATM.
5. The Category 6 outlets shall be capable of being installed at either a 45° or a 90° angle in any M-series modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates.
6. The Category 6 outlets shall have improved pair splitters and wider channel for enhanced conductor placement. The outlet shall also have a low-profile wire cap, which protects against contamination and secures the connection. Multicolored identification labels shall be available to assure accurate installation.

Hardware:

Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, etc.

Method of construction:

The Information outlet shall be fixed on the wall with sheet metal (SM) screws, rawl plugs/wooden gitties and making due connections as per EIA/TIA 568 B.2-1 by splicing the UTP cable, untwisted up to 12mm & punching the 4 pairs in the keystone jack with the help of punching tool. Not a single wire shall be left without connections.

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

C) Keystone jack (RJ-45) (KJ)

Scope:

Specification No (WG-NAS/KJ)

Structured cabling, to provide connections to switch/ server from desktop computers/ Wireless devices in the patch panel.

Material:

Keystone jack:

High impact plastic body FR grade with high performance unshielded RJ-45 keystone jack (conforming to EIA/TIA 568-B.2-1 Cat 6) , 20milli ohms contact resistance, gold over nickel spring contact ,1.5A current carrying capacity, with T568A/T568B wiring option, insulation displacement connector for cable crimping to accept 22-26AWG solid wire for connections up to Gigabit Ethernet.

Method of construction:

The keystone jack shall be fixed with the help of its self-locking arrangement in provided patch panel before making due connection as per EIA/TIA 568 B.2-1 by splicing UTP cable, untwisted up to 12mm & punching the 4 pairs in the keystone jack with the help of punching tool. Not a single wire shall be left without connections.

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

D) Patch Panel (PP)

Scope:

Specification No (WG-NAS/PP)

Structured cabling for the installation of keystone jacks.

Material:

Patch Panel:

Three piece structure including front panel, cable management plate with pre-fitted B-clip to help in routing cables & metal case of 1.6mm thick Mild Steel powder coated panel of size 442.6mm X 44.5mm with the provision for 1 to 24 high density keystone jacks

1. 24 and 48 port patch panels with 110 IDC connector terminations on rear
2. The patch shall have electrical performance guaranteed to meet or exceed TIA/EIA 568-B.2-1 Category 6 and ISO/IEC Category 6/Class E specifications.
3. The panel shall have vertical and horizontal cord organizers available as to improve patch cord management.
4. The panel shall be available in 24-port and 48-port configurations with universal A/B labeling and 110 connector terminations on rear of panel allowing for quick and easy installation of 22 to 24 AWG cable.
5. The patch panel shall have a black powder finish over high-strength steel.
6. The panel shall be equipped with a removable rear mounted cable management bar and front and rear labels.
7. The panel shall be UL listed, UL-C certified and ACA approved.
8. The panel shall support network line speeds in excess of 1 gigabit per second

and be backward compatible with Category 5e, 5 and 3 cords and cables.

9. The Category 6 modular jack panels shall meet or exceed the Category 6/Class E standards requirements in ISO/IEC 11801, CENLEC EN 50173 and TIA/EIA and shall be UL Listed.
10. The panels shall be either wall or 19-inch rack mountable.
11. The panels shall meet the following specifications:

Performance Specifications:			
	Category 6 Patch Panel	High Performance Solution	Premium Performance Solution
		Category 6 Channel (4 Connectors)	
	Typical Worst	**Guaranteed**	**Guaranteed**
	Pair Margin*	**Margin****	**Margin****
Insertion Loss	64.3%	5.0%	7.5%
NEXT	6.6 dB	6.0 dB	7.0 dB
PSNEXT	7.3 dB	7.5 dB	8.5 dB
ELFEXT	6.4 dB	6.0 dB	8.0 dB
PSELFEXT	6.1 dB	8.0 dB	10.0 dB
Return Loss	6.6 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

Operational Specifications:

Operating Temperature Range:	14°F to 140°F (-10°C to 60°C)
Storage Temperature Range:	-40°F to 158°F (-40°C to 70°C)
Humidity:	95% (non-condensing)
Nominal Solid Conductor Diameter:	0.025 to 0.020 in (0.64 to 0.51 mm) (22 to 24 AWG)
Nominal Stranded Conductor Diameter:	0.025 to 0.020 in (0.64 to 0.51 mm (22 to 24 AWG)
Insulation Size:	0.042 in (1.08 mm) (22 to 24 AWG) Maximum DOD
Insulation Types:	All plastic insulates (including PVC, irradiated PVC, Polyethylene, Polypropylene,
	PTF Polyurethane, Nylon, and FEP)
Insertion Life:	750 minimum insertions of an FCC 8-Position Telecommunications Plug

Front Panel:	Black powder painted steel.
Plastic:	High-impact, flame retardant, UL-rated 94V-0 thermoplastic

Hardware:

Chromium plated brass nuts & bolts with special type of U shaped square washers of required sizes.

Method of construction

The Patch Panel shall be firmly secured in U Rack (Networking Cabinet) with 4 nos. of chromium plated brass nuts & bolts.

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

E) Lightguide Interconnect Unit (LIU)

General:

All material shall conform to relevant standard as per IEEE, EIA/TIA, and CENELEC

Scope:

Specification No (WG-NAS/LIU)

To terminate the fibre backbone cables & the equipment cables.

Material:

Lightguide Interconnect Unit:

Wall mount type Lightguide Interconnect Unit with dimensions shown in the table, an interfacing unit for fiber cables coming in from field & those originating from the equipments. consisting of fiber spools to provide minimum bending radius & splice trays as splice cover for pigtail splicing, two compartment design with adaptor panel in the centre, compartmentalizing the box, complete aluminium housing, fully powder coated, two doors enclosure with lock & key, rubber grommets at the cable entry points for tight sealing; Splice trays of 140 x125 x 10mm complete aluminium body fully powder coated with provision for fibre splices fully cushioned splice holder containing grooves for fixing splice protective sleeves; FR grade high impact resistance plastic two halves design stackable sufficient room for excess cable.

Sr. No.	**Ports**	**Dimensions**	**Fiber splices**
1	12	300 x 300 x 80mm	6
2	24	370 x 350 x 80mm	12

Hardware:

Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, etc.

Method of Construction:
Supplying & erecting Lightguide Interconnect Unit (LIU) on wall with cable termination complete with sheet metal screws of required size, plugs/ wooden gitties.

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

2. SWITCHGEAR

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 outgoing circuit as per the requirement of site.

2.2 IC/Metal clad TP/TPN switches (MTP)

Scope:

Specification No (SW-SWR/MTP)

Supplying and erecting IC/Metal clad TP/TPN /on load/off load changeover switches of specified rating on angle iron frame of suitable size.

Material*:*

TP/TPN Switches: Three phase Triple pole / Three phase Triple pole with neutral link weatherproof metal clad air break switch fuse unit of specified rating, confirming to IS: 13947 (part- 1 &3)/ 1993 with positive make and break arrangement with shrouded incoming contacts, facility suitable for Three phase 415 volts, 50 Hz AC supply, It shall be fitted with interlock-able cover and re-wire able type porcelain fuse and having cable entry holes, sealing arrangement and mounting arrangements.

Fabrication: Required size of angle iron / MS Flat.
Paint: Superior quality enamel paint of specified shade & colour, Red Oxide paint.
Hardware: SM screws, MS Nuts & bolts, rawl plug, wooden gutties etc.
Grouting Material: Cement, Sand, Putty, water, etc.

Method of Construction:

The switch shall be erected at designated place duly mounted on suitable size of angle iron frame as per Table No. 5.1/1 with the help of required nut bolt, washer, etc; on frame/wall. The angle frame to be erected on wall with the help of screws, or to be grouted in wall with the help of cement plaster, and finished as original. The Frame shall be painted prior to erection.

Mode of Measurement:

Executed quantity will be counted on number basis. (i.e. Each)

2.3 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.

2.4 SWITCHGEAR:

2.4.1 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.
2.4.2 The M.S frame i.e. Angle Iron Frame shall be fabricated from M.S angles and M.S flat as specified.
2.4.3 The M.S frame shall be rigidly fixed to the wall by anchor fastener.
2.4.4 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.
2.4.5 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.
2.4.6 After installation of switches, starters, busbar, D.B's, all nuts and bolts shall be thoroughly greased and tightened properly.
2.4.7 An earthing terminal shall be fixed to the M.S frame.
2.4.8 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.
2.4.9 Charges for marine plywood and M.S angle iron frame are not included in the rate of switchgear.
2.4.10 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.

3. TECHNICAL SPECIFICATIONS FOR SUPPLY OF LIGHT FIXTURE

SCOPE OF WORK

The scope of work shall cover the supply, installation and testing of various types of LED light fixtures & other fitting are used in the project.

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.

TECHNICAL REQUIREMENTS

3.1 LIGHTING SYSTEM & POWER RECEPTACLES:

3.1.1 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 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.

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

3.1.3 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.

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

3.1.5 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.

3.1.6 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.

3.1.7 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.

3.2 LIGHTING FIXTURES:

3.2.1 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.

3.2.2 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.

3.2.3 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.

3.2.4 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.

3.2.5 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.

3.2.6 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.

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

3.2.8 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.

3.2.9The 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.

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.

3.3LED Lamps:

LED lamp is a light-emitting diode (LED) product which is assembled into a lamp (or light bulb) for use in lighting fixtures. LED lamps have a lifespan and electrical efficiency which are several times longer than incandescent lamps, and significantly more efficient than most fluorescent lamps. LEDs come to full brightness without need for a warm-up time; the life of fluorescent lighting is also reduced by frequent switching on and off.
LEDs are "directional" light sources, which mean they emit light in a specific direction, unlike incandescent and compact fluorescent bulbs, which emit light and heat in all directions.
The chart below shows the amount of brightness in lumens you can expect from different wattage light bulbs. The LED bulbs require much less wattage than the CFL or Incandescent light bulbs.

LED PANEL LIGHT (IP43) TECH SPECS:-

- System power :- 36 WATT
- LED Type :- High Brightness Power Led
- Color Temperature :- 4000K-6500K
- Nominal Voltage 240V AC
- Frequency Range 50-60 Hz
- System Efficiency >10%
- Power Factor(PF) > 0.95
- THD < 10%
- Operating Temperature 10°C to +45°C
- Lamp Body Material PDC aluminum.
- IP Rating IP43
- Surge Protection up to 4 kV
- Working Life > 60,000 Hrs
- System efficacy shall not be less than 85 lumens/watt,
- CRI shall be more than 70.
- Total Harmonic Distortion Voltage and Current shall be less than 15%.
- Luminaries and Lamp shall be LM79, LM80 compliant respectively.

LED DOWNLIGHTER LIGHT (IP43) TECH SPECS:-

- System power: - 9- 12 WATT LED RECESSED DOWNLIGHTER
- LED Type :- High Brightness Power LED
- Color Temperature :- 2500 - 7500K
- CRI :- >90
- Lens :- 95 Deg.

LED Driver Specification: **-**

- Input Voltage 120V ~ 240V AC
- Frequency Range 50-60 Hz
- System Efficiency>90%
- Power Factor(PF)> 0.95
- THD < 10%

Other Parameters:-

- Working Humidity : 10 % ~ 90 % RH
- Lamp Body Material : PDC aluminium
- IP Rating : IP43
- Surge Protection : > 6.5KV
- Working Life : > 50,000 Hrs

LED DOWNLIGHTER LIGHT (IP43) TECH SPECS: -

- System power: - 19 WATT LED RECESSED DOWNLIGHTER
- LED Type :- High Brightness Power LED
- Color Temperature: - 2500 - 7500K
- CRI :- >90
- Lens :- 95 Deg.

LED Driver Specification: -

- Input Voltage 120V ~ 240V AC
- Frequency Range 50-60 Hz
- System Efficiency>90%
- Power Factor(PF)> 0.95
- THD < 10%

Other Parameters:-

- Working Humidity 10 % ~ 90 % RH
- Lamp Body Material PDC aluminium
- IP Rating IP43
- Surge Protection > 6.5KV
- Working Life > 50,000 Hrs

3.5 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

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.

3.6 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.

4. FANS

4.1 Wall Mounted Fans

Wall mounted fan with plastic body & blades, 300 mm sweep & air delivery of 52 Cu.mtr./min; three number blade made of plastic material, suitable for single phase,

AC 210 volts, 50 Hz supply and conforming to class I of IS :374/1979 with amendment no 1 to 6 except for performance parameters to the extent modified as details in general requirements. The power input required of 80Watt with the speed at 2100 RPM.

Method of Construction:
The Cabin fan complete with all above accessories and duly wired shall be erected at specified position, connected to the supply and tested.

Testing:
After erection fan shall be tested by connecting to supply. Also steadiness and Vibrations if any, of fan shall be checked at full speed, so that there is no wobbling. Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

4.2 EXHAUST FANS

The Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring. Mounting Plate shall be of steel construction, square with streamlined venturi inlet coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works. Motor shall be standard permanent split capacitor or shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia or larger and 1440 rpm for fans 45 cm dia and smaller. Motors for larger fans shall be suitable for 415±6% volts, 50 cycles 3 phase power supply, and for smaller fans shall be suitable for 220 ± 6% volts, 50 cycles single phase power supply. Motors shall be suitable for either horizontal or vertical service. Wire guard on inlet side and bird screen at the outlet, Fixed or gravity louvers built into a steel frame at the outlet., Regulator for controlling fan speed for single phase fan motor, Single phase preventors for 3 phase fans shall be included in fan cost.

5. CABLES:

5.1 General

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall be as included in approved list.

Work shall be carried out as per the method of construction specified by BIS. If there is no reference for particular method of construction in IS, such work shall be carried out as per the approved method of construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

5.2 Cables: (Armoured)

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

SP 30: 1984	:	National Electrical Code
SP 7 (Group 4): 2005	:	National Building Code
IS 1255: 1983		Code of practice of Installation & Maintenance of armoured cables up to 33 kV.
IS 3961: Part 2: 1967	:	Recommended current ratings of PVC cables.
IS 1554: Part 1; 1988 Part 1	:	PVC Insulated (Heavy duty) Electric Cables; for working voltages up to and including 1100 Volts.
IS 1554: Part 2; 1988 Part 1	:	PVC Insulated (Heavy duty) Electric Cables; for working voltages up to and including 3.3 kV to 11 kV.
IS 10810: Part 63; 1993:		Method for Test of cables, Part 63 Smoke density of electric cables under fire condition.
IS: 7098 (Part-I), 1988		Cross linked polyethylene insulated cables for working voltages upto 1100V.

5.3 Scope: (Armoured cables)
Specification No. (CB-LT/AL, CB-LT/CU, CB-HT)

Providing armoured cable of specified voltage level, size & specified conducting material (Aluminum / Copper) as per **Table no. 7/3** including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

5.4 Material:

Cables:

Cables shall be PVC for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, colour, shall carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every meter and having the total count of progressive length in meter at each mark.

Earth wire: Galvanized Iron (G I) wire of appropriate gauge

PVC/XLPE Cables (CB)

Armoured Cables (HT & LT)

General

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall be as included in approved list.

Work shall be carried out as per the method of construction specified by BIS. If there is no reference for particular method of construction in IS, such work shall be carried out as per the approved method of construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

Cables: (Armoured)

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical Code

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IS 1255: 1983 Code of practice of Installation & Maintenance of armoured cables up to 33 kV.

IS 3961: Part 2: 1967 : Recommended current ratings of PVC cables.

IS 1554: Part 1; 1988 Part 1 : PVC Insulated (Heavy duty) Electric Cables; for working voltages up to and including 1100 Volts.

IS 1554: Part 2; 1988 Part 1 : PVC Insulated (Heavy duty) Electric Cables; for working voltages up to and including 3.3 kV to 11 kV.

IS 10810: Part 63; 1993 density of : Method for Test of cables, Part 63 Smoke electric cables under fire condition.

Scope: (Armoured cables)

Specification No. (CB-LT/AL, CB-LT/CU, CB-HT)

Providing armoured cable of specified voltage level, size & specified conducting material (Aluminum / Copper) as per Table no. 7/3 including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

Material:

Cables:

Cables shall be XLPE for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, color, shall carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every meter and having the total count of progressive length in meter at each mark.

Earth wire: Galvanized Iron (G I) wire of appropriate gauge as per Table No 7/1.

Glands: As per specification (CB-GL)

Lugs: As per specification (CB-CL/AL, CB-CL/CU)

Saddles: Saddles fabricated from GI sheet of required gauge and size depending on dia of cable either galvanized or painted with superior quality enamel black paint with necessary shearing mechanical strength, semicircular shaped with extended piece having suitable holes for fixing.

G I Strip: 22 g x 25 mm width G I Strip.

Clamps: MS Clamps fabricated of required length and shape, having the size of 3/6 mm thick mild steel having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast grip for holding the cable.

Identification tags: For identifying root, connection position GI strip with identification mark / name embossed / painted with arrangement to tie should be fix on cable or arrangement of ferrules to be done.

Hardware: Sheet Metal (SM) screws of required sizes, plugs / wooden gutties, etc.

Method of Construction:

General:

Irrespective of method of construction the cable ends shall be terminated with appropriate size & type of glands with lugs duly crimped, as directed by Site engineer.

Wherever the cable has to be bent, the turning radius shall be as mentioned in Table No 7/2. Grouping of cables shall be done with adequate distance between cables as mentioned in IS so as to minimize de-rating. Cables shall be tagged/ferruled with identification name / mark at the point from where distribution starts and at ends. Bare earth wire of appropriate size as per Table no. 7/1 shall run along with the cable. Earth wire running with the cable shall be terminated at the earth terminal nearest to cable termination.

Erection of Cable on Surface:

Erection shall be done as per the routes and layout finalized, in perfect level and in plumb. Before fixing the cable shall be straightened as far as possible for good aesthetics look, continuous bare GI earth wire of required gauge as per Table No 7/1 shall be run. Cable with G I wire shall be fixed by saddles firmly clipped on cable and shall be fixed to

wall with minimum 50 x 8 mm SM screws with plugs/wooden gutties, etc. (Distance between two supports / saddles shall be maximum 450 mm). Wooden gutties shall be used wherever required (Especially for stone wall). The entries made in wall, floor slab, etc for laying the cable shall be made good by filling and finishing with plastering the same.

Erection of Cable on Trusses:

Cable along with bare GI earth wire, while erecting on trusses, shall be firmly clamped by wrapping GI strip of 22 g, 25 mm width of required length fixed to truss with nuts and bolts.

Erection of Cable on Pole:

Cable along with bare GI earth wire, while erecting on pole, shall be firmly clipped by suitable wooden / epoxy resin cast grips, clamped with 25 x 3 mm or50x6 mm MS strip of required length and fixed to pole with nuts and bolts.

Laying of Cable in provided Trench/Pole:

While laying Cable along with bare GI earth wire, utmost care shall be taken to prevent damage to the insulation of the cable and to the open end. Cable shall be brought out from trench vertically straight (minimum 1.0 metre above G L). Care shall be taken to inspect the trench so that depth of cable shall not be less than as shown in Table No 7/4. Suitable size of cable loops shall be provided near termination point at adequate depth.

Erecting cable in constructed Trench / duct:

Erection of cable/s in constructed trench / duct, shall be as per guide lines of IS 1255.

Erection of cable/s on trays:

Cable/s shall be tied with PVC tags on GI trays. At bending point care shall be taken so that sharp edges of sheet will not damage insulation of cable.

Mode of Measurement: Executed quantity shall be measured on the basis of running metre per run of cable.

Dismantling

Cable laid underground, or fixed on any surface shall be dismantled carefully without damaging complete with all its accessories, making coil and stored as directed. The surface of the dismantled cable shall be made clear by removing of unwanted material, cement mortar, etc. When cable is dismantled from trench refill back the trench and making the surface proper.

Mode of Measurement: Executed quantity shall be measured on the basis of running metre per run of cable.

Table No 7/1

Size of Bare GI Earth wire to be used with LT Cables upto 1.1 kV

S.No.	Size of cable	Size of bare GI Earth wire to be used with cable
1	2.5 Sqmm to 50 Sqmm of all cores.	12 SWG
2	70 Sqmm to 95 Sqmm of all cores.	10 SWG
3	120 Sqmm and above of all cores.	8 SWG

Table No 7/2

Minimum bending Radius for Cables

S.No.	Voltage level of cables	Single core	Multi core Unarmoured	Multi core Armoured
1	Up to 11 kV	20 D	15 D	12 D
2	Up to 22 kV	25 D	20 D	15 D
3	Up to 33 kV	30 D	25 D	20 D

Note: D diameter of cable.

Wherever possible, 25 percent larger radii than the specified above should be used.

Table No 7/3

Current Rating (In Ground) for PVC/ XLPE Insulated 1.1 kV Grade Cables

Nominal area of conductor	Aluminum Conductor				Copper Conductor			
	Single Core		Multi Core		Single Core		Multi Core	
Sqmm	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE
10	51	55	46	50	65	71	60	65
16	66	74	60	68	85	95	77	87

25	86	98	76	90	110	125	99	115
35	100	118	92	108	130	150	120	138
50	120	137	110	126	155	175	145	161
70	140	172	135	158	190	220	175	202
95	175	204	165	187	220	260	210	239
120	195	234	185	215	250	301	240	276
150	220	262	210	240	280	336	270	308
185	240	298	235	273	305	381	300	350
240	270	344	275	316	345	441	345	405
300	295	387	305	355	375	496	385	455
400	325	458	335	420	400	586	425	538
500	345	495	-	-	425	635	-	-
630	390	555	-		470	710	-	-
800	440	625	-	-	-	-	-	-
1000	490	685	-	-	-	-	-	-

Rating Factors for Variation in Ambient Air Temperature			
Air Temperature (oC)	40	45	50
Rating Factor (XLPE)	1.00	0.94	0.88
Rating Factor (PVC)	1.00	0.90	0.81

Table No 7/4

Minimum laying Depth of cables (IS: 1255)

S.No.	Voltage level of cables	Minimum depth from top of the cable
1	Up to 1.1 kV	750 mm
2	3.3 kV to 11 kV	900 mm

3	22 kV to 33 kV	1050 mm
4	At road crossing	1000 mm
5	At railway crossing (from Bottom of sleepers to Top of pipe)	1000 mm

Notes below Table No 7/4:

1.	PVC Insulated electrical cable for voltage grade up to 1.1 kV is based on 8 volts drop.
2.	The distances are given in meters and after rounding.
3.	The distances are given in meters and after rounding.

For Temperature Correction please see as detailed below:				
Ground temp.	20 degree C	25 degree C	30 degree C	35 degree C
Rating factors:	0.95	0.90	0.85	0.80

Table No 7/5

Distance up to which different sizes of UG Aluminum Conductor Cables 1.1 kV grade, can be used for different current ratings of 8 Volts drop. (PVC insulated, PVC Sheathed, 3 cores or 4 cores)

Maximum Conductor temperature – 70 degree C														
S. No	Current	Distance in meters for the following cable sizes in Sqmm												
	Amp	6	10	16	25	35	50	70	95	120	150	185	240	300
1	5	165	260	415	725	895	1300	1925	2360	3065	3555	4300	5770	6460
2	10	80	130	205	360	450	650	960	1180	1530	1775	2150	2885	3230
3	15	55	85	140	240	300	430	640	785	1020	1185	1430	1920	2155
4	20	40	65	100	180	225	325	480	590	765	890	1075	1440	1615

5	25	30	50	80	145	180	260	385	470	610	710	860	1150	1290
6	30	25	40	70	120	150	215	320	390	570	590	715	960	1075
7	40	20	30	50	90	110	160	240	295	380	445	535	720	805
8	50	-	25	40	70	90	130	190	235	305	355	430	575	645
9	60	-	-	35	60	75	110	160	195	255	295	355	480	535
10	70	-	-	30	50	65	90	135	165	215	255	305	410	460
11	80	-	-	-	45	55	80	120	145	190	220	265	360	405
12	90	-	-	-	40	50	70	105	130	170	195	235	320	360
13	100	-	-	-	35	45	65	95	115	150	175	215	290	320
14	110	-	-	-	-	40	60	85	105	140	160	195	260	290
15	120	-	-	-	-	35	55	80	95	125	145	180	240	270
16	130	-	-	-	-	-	50	75	90	115	135	165	220	250
17	140	-	-	-	-	-	45	70	80	110	125	150	205	230
18	150	-	-	-	-	-	-	65	75	100	115	140	190	215
19	160	-	-	-	-	-	-	60	70	95	110	130	180	200
20	170	-	-	-	-	-	-	55	70	90	105	125	170	190
21	180	-	-	-	-	-	-	50	65	85	100	120	160	180
22	190	-	-	-	-	-	-	-	60	80	90	110	150	170

23	200	-	-	-	-	-	-	-	60	75	90	105	145	160
24	225	-	-	-	-	-	-	-	-	65	80	95	125	145
25	250	-	-	-	-	-	-	-	-	-	70	85	115	130
26	275	-	-	-	-	-	-	-	-	-	-	80	105	115
27	300	-	-	-	-	-	-	-	-	-	-	70	95	105

Glands: As per specification (CB-GL)

Lugs: As per specification **(CB-CL/AL, CB-CL/CU)**

Saddles: Saddles fabricated from GI sheet of required gauge and size depending on dia of cable either galvanized or painted with superior quality enamel black paint with necessary shearing mechanical strength, semicircular shaped with extended piece having suitable holes for fixing.

G I Strip: 22 g x 25 mm width G I Strip.

Clamps: MS Clamps fabricated of required length and shape, having the size of 3/6 mm thick mild steel having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast grip for holding the cable.

Identification *tags:* For identifying root, connection position GI strip with identification mark / name embossed / painted with arrangement to tie should be fix on cable or arrangement of ferrules to be done.

Hardware: Sheet Metal (SM) screws of required sizes, plugs / wooden gutties, etc. the cable in the bent portion, shall be buried along the route of cable in the trench made for laying the cable. For clear visibility, the Cable indicator plate shall be buried in such a manner that the plate should be minimum 200 mm above the ground level and shall be provided at every 15-25 metre in straight run, at both ends of road crossing and immediate before and after turning point of cable.

5.5 Mode of Measurement:

Executed quantity will be measured on meter basis.

6. 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.

7. LABLING:

All installed electrical accessories to be labeled with stick able Talley plates according to as fitted drawings.

8. SUBMISSION OF AS FITTED ELECTRICAL DRAWINGS.

Upon completion with successful testing and commissioning all electrical, telephone, data work 04 Sets of as Fitted Electrical Drawings needs to be submitted.

LIST OF PREFERED MAKE OF MATERIALS

Unless otherwise mentioned specifically only the following approved make / brands of various electrical accessories 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 relevant standards, as approved by the Engineer in charge shall be used.

SR.NO.	ITEM	STANDARD MAKE
1	LT PANEL	APJ ELECTRICAL / ABAK ENGG / ZENITH ENGG.
2	DISTRIBUTION BOARDS	LEGRAND / HAGER / SCHNEIDER / C&S Electric
3	MEDIUM VOLTAGE CABLE	POLYCAB / FINOLEX / RRKABLE
4	CABLE TRAY	INDIANA / OBO BETTERMAN / LEGRAND/PROFAB
5	UPS / INVERTER	APC / DELTA / EATON
6	LT SWITCHGEAR (ALL RANGE)	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB
7	LT MCCB	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB / LEGRAND
8	LT MCB, ELCB, RCBO	SIEMENS / SCHNEIDER ELECTRIC / HAGER /LEGRAND
09	LT SFU	SIEMENS / SCHNEIDER ELECTRIC / L&T / ABB
10	LT CONTACTORS	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB
11	CHANGE OVER SWITCH	ASCO / SOCOMEC / ABB
12	METERS (DIGITAL)	ENERCON / L&T / TRINITY
13	LOAD MANAGER	ENERCON / L&T / TRINITY

SR.NO.	ITEM	STANDARD MAKE
14	RELAYS	SIEMENS / SCHNEIDER ELECTRIC / GE / L & T
15	INDICATING LAMPS	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB
16	ELECTRIC TIMER	SIEMENS / L&T / EAPL
17	SELECTOR SWITCH	KEYCEE / SALZER / AE
18	APFC RELAY	ELMEC / L & T / TRINITY
19	LT CAPACITORS	L & T / EPCOS / SEIMENS
20	LUGS	DOWELL'S / JAINSON / COMET
21	CABLE GLAND	JAINSON / COMET / DOWELL'S
22	PVC CONDUITS AND ACCESSORIES	PRECISION / DIAMOND / POLYCAB / ASTRAL
23	CASING CAPING	PRECISION / DIAMOND / LEGRAND
24	M.S. CONDUIT AND ACCESSORIES	AKG / BEC / STEELCRAFT
25	MODULAR SWITCHES, SOCKETS & OTHER ACCESSORIES	LEGRAND / MK - HONEYWELL / PANASONIC
26	METAL CLAD SOCKET WITH MCB	MDS-LEGRAND / SIEMENS / SCAME
27	PVC JUNCTION BOX	SINTEX / CLIPSAL / SPELSBERG
28	WIRES FOR INTERNAL WIRING	POLYCAB / FINOLEX / RRKABLE
29	FLEXIBLE WIRE	POLYCAB / FINOLEX / RRKABLE
30	TELEPHONE CABLE	DELTON / POLYCAB / FINOLEX
31	COAXIAL TV CABLE	DELTON / POLYCAB / FINOLEX
32	CAT 6	MOLEX/ D-LINK/Digisol
33	MULTICORE FLEXIBLE CABLE	POLYCAB / FINOLEX / RRKABLE
34	CONNECTORS (COLOURS AS PER PHASE & NEUTRAL)	SALZER / ELEMEX / CONNECTWELL

SR.NO.	ITEM	STANDARD MAKE
35	LIGHT FIXTURES	HAVELLS / WIPRO / Crompton
36	LIGHTING CONTROLLER	DYNALITTE /ANCHOR / LEGRAND
37	CEILING FAN / EXHAUST FAN/WALL MOUNTED FAN	CROMPTON / ORIENT / HAVELLS
38	FLOOR TRUNKING	LEGRAND / OBO / MK
39	NETWORK SWITCH	CISCO/ HP Aruba/Juniper
40	NETWORK RACK	PENDUIT / RITAL / PRESIDENT
41	NETWORK ACCESSORIES	PENDUIT / D-LINK / MOLEX
42	HDMI CABLE	POLYCAB / FINOLEX / D-LINK
43	Access Control System	MATRIX / SPECTRA / HONEYWELL

TECHNICAL SPECIFICATION FOR ELECTRICAL WORKS

III. GENERAL INSTRUCTIONS

7. SPECIAL INSTRUCTIONS

7.1. 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.

7.2. The work of electrification shall be carried out after the layout is finalized 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 up to date, and also the relevant regulation of licensee.

7.3. 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.

7.4. Site Engineers of MDL approval in writing shall be obtained prior to commencement of the work to the following: -

(f) Layout of wiring.

(g) Sizes of Cables.

(h) Layout of electrical lighting arrangement.

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

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

8. QUALITY OF THE MATERIAL

8.1. 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.

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

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

9. 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.

10. 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.

11. INSPECTION & TESTS

11.1. 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.

11.2. All the materials shall be approved before starting the work.

11.3. PVC switchboards shall be ISI and approved make.

11.4. Wiring shall be approved before boards or blocks are fixed up.
11.5. Casing-N-Capping / Conduit pipes shall be inspected before erection.
11.6. Mounting arrangement of the ceiling fans / light fittings / spotlights shall be inspected and approved by the Site Engineer, MDL.
11.7. Connections to earth electrodes shall be inspected and got approved by the Site Engineer, MDL, prior to connection.

12. DRAWINGS & CERTIFICATION:

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

12.1. Completion Drawings of in built layout of cable (lighting DB, Power DB, Computer power DB, etc.)
12.2. Copies of Completion Certificate and Test Report submitted to Manufacturer.
12.3. Any other Certificate / Reports as called for by the Site Engineer, MDL.
12.4. Instruction & Operation Manuals, Catalogues, etc.
12.5. 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.

IV. TECHNICAL SPECIFICATION

4. WIRING (WG)

General:

All material shall be conforming to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall either carry valid 'Quality Control' certificate issued by the Chief Engineer (Elect), P.W. Dept. Maharashtra State Govt. as included in approved list.

Work shall be carried out as per the Method of Construction specified by BIS. If there is no reference for particular Method of Construction in IS, such work shall be carried out as per the approved Method of Construction specified in chapter 16 of P.W. Dept. Handbook.
Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.
Material shall be tested in approved Testing Laboratory and shall qualify the relevant tests as and when directed by Engineer In-Charge.

Recommended Standards:

The following list is showing Indian Standards, which are acceptable as good practice, and accepted standards.

IS 732: 1989	Code of Practice for Electrical Wiring Installations?
IS 4648: 1968	Guide for Electrical Layout in residential buildings
IS 9537 (Part 1): 1980	Conduits for Electrical Installations: General requirements
IS 9537 (Part 2): 1981	Rigid Steel Conduits
IS 9537 (Part 3): 1983	Rigid Plain Conduits of insulating material
IS 3419: 1989	Specifications for fittings for rigid nonmetallic conduits
IS 694:	PVC insulated cables for working voltages up to and including 1100V
IS 1554 (Part 1): 1988	PVC insulated (heavy-duty) electric cables for working voltages up to and including 1100V
IS 3961 (Part 5): 1968	Recommended current ratings for cables: PVC insulated light duty cables.
IS 4288: 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and including 1100V
IS 14772: 2000	Specifications for Accessories for household and similar fixed Electrical Installations
IS 3043: 1987	Code of practice for Earthing
SP 30: 1984	National Electrical Code
SP 7 (Group 4): 2005	National Building Code
IS 14927(Part 1): 2001	Cable Trunking and Ducting systems for electrical installations.

1.1 Conduits / Trunking (Casing Capping) (Surface type)

1.1.1 PVC Conduits**Specification No :(WG-MA/CON)**
Scope:

PVC Conduits: Surface

Providing specified PVC Conduits and erecting as per approved Method of Construction; on surface of wall / ceiling, etc. including entries through walls / slabs / flooring as per requirement, and with all necessary hardware, accessories such as Spacers, Saddles, Bends, Tees, Junction boxes, Check-nuts, etc.; making conduits erection work rigid and duly finishing, removing debris from site.

Material:
PVC Conduit:

PVC pipe minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No**.** 1/2) ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non-inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Hardware*:*

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Method of Construction:

Erection PVC Conduits for Surface type wiring:

General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm, round headed screws for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers. Distance between 2 spacers shall not be more than 600mm. Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/2 for PVC conduits). Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. or ant electrostatic partition/separate pipe should be used. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface and with colour coding conduit (For visual identification) as per Table No. 1/4. Flexible conduits shall be used at expansion joints.

Especially for PVC Conduits of surface type wiring:

In addition to general instructions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, it shall be done with bending spring. Size of conduit shall be as per Table No. **½** for number of wires to be drawn through the conduit.

1.1.2 PVC Trunking (Casing capping) **Specification No (WG-MA/CON)**

Scope:

PVC Trunking:

Providing specified PVC Trunking (Casing capping) and erecting as per approved Method of Construction, on surface of wall / ceiling, etc. including entries made with PVC conduit through walls / slabs / flooring as per requirement with all necessary hardware, accessories such as inner / outer Elbows, Tees, Junction boxes, etc. and duly finishing, removing debris from site.

Material:

PVC Trunking (casing capping):

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/3 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8mm thick push-fit joints/ accessories for PVC trunking such as couplers,

elbows, internal / external angles, junction boxes of required ways of the same make.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Method of Construction:

Erection of PVC Trunking for surface type wiring:

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in single phase distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking or anti electrostatic partition to be provided. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and at required locations.

1.2 Bunch of wires: Specification No (WG-MA/BW)

Scope:

Bunch of wires:

Providing specified wires and drawing them through provided conduits / trunking and / or as directed; with coded ferrules, harnessing the bunch of wires with necessary material when used in panel boards, duly connecting / terminating with lugs, and testing for safety and beneficial use.

Material:

Wires: in conduits / Trunking / panel boards

Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5.

Wires: open

PVC insulated and PVC sheathed wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5.

Earth Continuity Wire:

PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green yellow colour, ISI marked, of specified size but not less than 2.5 Sq mm as per Table No 1/5.

Lugs: **Copper lugs of appropriate size & type**

Other material: Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:

Bunch of wires:

Drawing of wires: General

Specified wires shall be drawn with adequate care. Correct colour coding shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only, with appropriate type and size of lugs.

Drawing of wires: through PVC conduits
Bush shall be used at pipe opening to protect wire insulation from getting damaged due to sharp edges. Number of wires shall not exceed with respect to size of pipe.

Drawing of wires: through Rigid Steel conduits
Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs / sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/1.

Open Wire bunch: Open wires shall be erected with due care so as to avoid chances of any mechanical injury. Harnessing shall be done with required material in an approved manner in panel boards or where ever necessary. For covering lead wires flexible conduit shall be used with gland as per necessity.

Testing:
Insulation resistance test:
All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:
Earth continuity shall be ensured between termination points of Earth wire.
Polarity Test:
Test shall be carried out for ensuring the correct polarity in switch and plug.

Mode of Measurement:
Measurement shall be carried out on the basis per running meter length of single wire or bunch as specified.

1.4 **Mains (surface type)**

1.3.1 Mains in PVC Trunking (casing capping) **Specification No (WG-MA/PC)**

Scope: **Surface type Mains in PVC Trunking (casing capping)**

Providing specified PVC Trunking, Wires and erecting the Trunking as per approved Method of Construction; on surface of wall / ceiling, etc. including entries made with PVC conduit through walls / slabs / flooring as per requirement with all necessary hardware, accessories such as inner / outer Elbows, Tees, Junction boxes, etc; including erection of specified wires in PVC trunking, with coded ferrules and duly connecting with lugs, and finishing, removing debris from site; testing for safety and beneficial use.
Material:

PVC Trunking*:*

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/2 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8mm thick push-fit joints/ accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

Hardware*:*

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires)

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire: PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green colour, ISI marked, of specified size but not less than 1.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of appropriate type and size.

Other material: Flexible PVC conduit, gland coded ferrules, etc.

Method of Construction:

Erection of PVC Trunking for surface type wiring

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of unleveled surface number and size of screws shall be changed to higher size as per requirement and in case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking or anti electrostatic partition is to be provided. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and required locations.

Erecting wires in Trunking:

Wires shall be erected within Trunking with adequate care. Correct colour coding as per Table No. 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be erected in single Trunking. Wires shall be terminated in the terminals of accessories only, with appropriate type and size of lugs. Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be erected through Trunking.

Number of wires shall not exceed with respect to size of Trunking as per Table No. 1/3. After erection of wires double locking shall be checked while fixing capping. At the termination end flexible PVC conduit shall be used with gland as per required.

1.4 *Point wiring (Surface type)* **Specification No (WG-PW/SW)**

Scope:

Point wiring (Surface type):

Providing all required approved specified material including hardware and erecting wiring on surface of wall, ceiling from switch board to outlet for light / fan / bell / independent plug point, in rigid steel / PVC conduit or PVC trunking as specified; fixing one board with a 1 way switch for one way point or two boards with a 2 way switch on each board, in case of 2 way point; for controlling power supply and one board / block with accessory for outlet of light / fan / plug and terminating wires within as per approved Method of Construction; removing all debris and testing the installation for safety and beneficial use.

Material:

Point wiring (Surface)

PVC Trunking:

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/2 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8 mm thick push-fit joints / accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

Wires: Phase and Neutral

PVC insulated wires of specified size, 1.1 kV, & minimum FR grade insulation, electrolytic tough pitch (ETP) copper conductor, ISI marked, of required colour coding as per Table No 1/5

Earth Wire:

PVC insulated minimum FR grade copper wires of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, 2.5 Sqmm or bare copper wire of 14g

Accessories:

Switch: 1 or 2-way Piano type 6/10 A, 1 or 2-way Modular type switch 6/10A.
Outlet: 6A angle / batten lamp holder or 3 plate ceiling-rose or Bakelite / porcelain three way connector or if plug point, 6A, 3-pin plug socket.

Boards:

Switchboards shall be double walled (back and front) of suitable size, to accommodate independent slot for each switch, socket, fan regulator. Boards shall be made up of 4mm thick marine grade plywood for back and front fixed on wooden frame with 0.8mm thick laminate pasted on exposed portion of front ply, totally varnished and with either brass hinged door or screwed top.

Or

As above with 3mm thick Bakelite/Hylam top instead of laminated front ply.

Or

Board made from Filled polypropylene.
Round/Square double wooden block or PVC board for mounting light / fan outlet accessory.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, PVC/ rubber bushings etc.

Method of Construction:

Point wiring (Surface)

Erection of conduits:

General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be duly screwed and firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm round headed for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers and saddles. Distance between 2 spacers shall not be more than 600mm. Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface conduit with colour coding (For Visual identification) as per Table No 1/4. Flexible conduits shall be used at expansion joints. Bushing shall be provided at open ends.

Erection of conduits:

PVC pipes for surface type wiring:

In addition to General conditions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, same shall be done with bending spring. Size of conduit shall be correct depending on number of wires to be drawn as per Table No. 1/2.

Erection of PVC Trunking for surface type wiring:

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of unlevelled surface number and size of screws shall be changed to higher size as per requirement and in case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and required locations.

Drawing of wires: General

Wires shall be drawn with adequate care. Correct colour coding as per Table No 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped within circuit. For lighting load distribution wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only. Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be erected wherever necessary. In case of 2-way point wiring additional wires of phase conductor shall be provided between the 2-way switches.

Erecting wires in Trunking:

Wires shall be erected within Trunking with adequate care. Number of wires shall not exceed with respect to size of Trunking as per Table No. 1/3. After erection of wires double locking shall be checked while fixing capping.

Fixing Switchboards and accessories:

Control switchboards shall generally be erected at 1.35m height or as specified and fixed with minimum 2 Nos. (and more as per size of board) of screws of length not less than 50mm, termination of wires shall be done with lugs on switch and other accessories only by carefully inserting all strands in lugs, terminals and proper tightening. Switches shall be provided on phase wire only. Bare wire shall not be used for looping incoming supply to switches and for earthing inside switchboards. For plug socket phase wire shall be connected in right side terminal when seen from front. Proper termination of earth wire in Earth terminal shall be ensured.

Testing:

Insulation resistance test:

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured at all earth terminals of plug outlets and at earth terminals of metal enclosures.

Polarity test:

Polarity test shall be carried out for ensuing the correct polarity in switch and plug.

Mode of Measurement:

Measurement shall be carried out on the basis per number of points, **for the point length up to 6 metre between switch and outlet**. For the length exceeding 6 metre 10% of overall rate shall be added for every 1m.

1.5 TELEPHONE WIRING

1.5.1 General

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which PSI mark is not available in market, it shall be approved either by ITD ***I*** DOT of Govt. of India. Work shall be carried out as per the Method of Construction specified by BIS and as specified by DOT (Department of Telephone), Govt. of India. Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

1.5.2 Scope:

Specification No (WG-TW)

To provide wiring for telephone on surface of wall or ceiling concealed in slab, wall, under flooring, etc, through existing metallic conduits, rigid PVC conduits, PVC trunking, with all necessary hardware, material, etc. as specified.
To provide, install, test & commission the instruments / equipments and accessories used in telephone system, such as; Main Distribution Frames (MDF), Krone Modules, Over Voltage Magazine, PBX / EPABX, CO-axial cable, Rosette box, Jumper wire, etc.

1.5.3 Material:

PVC Telephone cable: PVC insulated Tinned copper solid conductor with minimum 0.5 mm dia. (Single & Multi pair) properly paired and colour coded, shall be terminated on KRONE module with suitable tool.
Jelly filled Armoured Telephone cable: PVC insulated, PVC sheathed with steel armouring, Tinned copper solid conductor with minimum 0.5 mm dia multi pair, with Jelly, properly paired and colour coded.

Saddles: Saddles fabricated from G I sheet of required gauge (16/18 gauge) either galvanized finish or painted with superior quality enamel black paint, with necessary shearing for mechanical strength, semi circular shaped with extended piece having suitable holes for fixing on spacer.

Hardware: Sheet Metal (SM) screws of required sizes, plugs, wooden gutties, etc.

MDF: Manufactured by reputed manufacturer of specified capacity, facility for wall mounting, with door & lock, aluminium frame for fixing of KRONE, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour.

Junction box: Manufactured by reputed manufacturer of specified capacity, facility for + wall mounting, with door & lock, aluminium frame for fixing of Krone, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour. The depth of the box should consider the height of KRONE module plus protection magazine.

Rosette box: PVC I Bakelite box with LED indicator, RJ 11 jack, facility for fixing on wall.
Jumper wire: Twin twisted PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia.
KRONE Module: Disconnection type KRONE module having capacity to connect 10 pairs with silver-plated terminal contacts.
RG-11 Co-axial low voltage grade cable: PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia, with connector at both ends suitable for termination in RJ type socket.
PBX (Analogue type): Manufactured by reputed manufacturer and approved by Telephone Engineering Certificate (TEC) of specified extensions, having following features:

1.5.4 Method of Construction:

Drawing of telephone wire through Steel conduit/ PVC conduit/ PVC Trunking:
As specified in Chapter for Point Wiring.

Erection of MDF Junction box / Rosette box / PBX / EPABX, etc:
Specified equipment shall be fixed to wall with minimum 50x8 mm SM screws, with necessary plugs, wooden gutties, etc. or may be fixed on Table Top if required.

1.5.5 Mode of Measurement:
Work done for telephone in Steel I PVC conduit I PVC Trunking will be measured on running meter basis, (i.e. per running meter) for each single run. For the other accessories /equipments shall be done as per unit specified. (I.e. Job / each

1.6 NETWORKING (Computer Cabling)

A) UTP Networking Cable:

General:

All material shall conform to relevant standard as per ISO/IEC11801, CENELEC EN50173 & TIA/EIA 568-B2-1; CUL listed & ETL verified.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

Scope:
Specification No (WG-COC/NC)

To lay the cables for Computers on surface of wall or ceiling concealed in slab, wall, under flooring etc. through existing metallic conduits, rigid PVC conduits, PVC trunking, with all necessary hardware, material, etc. as specified. The cable shall be used only for connections between Information Outlet & Patch/ Multimax Panel. (Exception: For making MDIX patch cord)

Material:

UTP cable*:*

4 pairs,100 ohms, unshielded twisted pair (UTP), each pair separated by a PE former (Star shaped) solid 23AWG tinned copper conductor rated for temperature of 75^0 C, PVC insulated grey colour with following types as in the table 1.12/1

Table 1.12/1

Sr. No.	Type	Class	Tested frequency
1	Cat 6	E	350MHz
2	Cat 6+	E	500MHz

10. The Category 6 cable and Category 6 channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6 channel cable, components, and applications for a period of 20 years.
11. The Delay Skew on the 100-meter channel shall not exceed 30 ns
12. The 20-year warranty shall be a transferable warranty and has component replacement policy in case of manufacturing defect

13. Category 6, 100mtr channel, **4-connection** model should guarantee 400% margin over standard NEXT specification across swept frequency
14. Category 6, 100mtr channel, **6-connection** model should guarantee +4dB margin over standard NEXT Specification across swept frequency (1~250MHZ)
15. The high performance Category 6 UTP cable 23AWG shall be of the traditional round design with Mylar bisector tape Non-Plenum rated.
16. The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS422, RS-485, 10BASE – T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, IEEE 1394B S100 and S400, as well as all 77 channels (550 MHz) of analog broadband video.
17. The cable jacket shall comply with Article 800 NEC for use as a non-plenum cable. The 4 pair UTP cable shall be UL® and c (UL®) Listed Type CM.
18. Performance shall be characterized to 550 MHz to support high-bandwidth video applications

Non Plenum CAT6 UTP Cable

1 Weight=25.3 lb (1000 ft.)
2 Jacket Thickness=.022 in
3 Outside Diameter=0.232 in
4 Conductor Diameter=.022 in
5 Insulation Type=High density Polyethylene
6 Jacket Material=PVC
7 Maximum Pulling Tension=25 lbs
8 Nom. Velocity of Propagation=0.69
9 Max DC Resistance=9.83 Ohms/100m
10 Mutual Capacitance @ 1 kHz = 4.95 nF/100m
11 Operating Temperature= -20 to 60° C
12 The high performance Category 6 UTP cable shall be of the **traditional round design with Mylar bisector tape.**
13 The 4 pair UTP cable shall be UL Type CM (non-plenum)
15 Performance shall be characterized to 550 MHz to support high-bandwidth video applications

Method of Construction:

The cable shall be laid in provided separate casing n capping/ PVC conduit/ trunking 400mm away from electrical cables wherever required without sharp bends. The cable shall be spliced at both the ends for punching/ crimping at keystone jacks/ UTP connectors.

Mode of measurement: Executed quantity shall be measured on running metre basis.

B) UTP Patch cord

Scope:

Specification No (WG-COC/PC)

Structured cabling, to make connections from switch to patch panel or information outlet to computer

Material:

UTP Patch Cord:

Assembly (conforming to EIA/TIA 568B-2-1) of Cat 6 type 4 unshielded twisted pair 24-26AWG (0.51mm-0.40mm), each pair separated by a PE former (Star shaped) 100 ohms stranded wire PVC insulated cables with modular RJ-45 polycarbonate UL94V housing 15milliohms gold over nickel contacts (superior three-piece connector) crimped on both ends with T568A & T568B wiring schemes with 8P8C connection. The cord shall be branded. The cords shall be used in structured cabling in accordance with following table 1.12/2.

Table 1.12/2

Sr. No.	Length	Use in
1	1m	from switch to patch panel
2	3m	from computer to information outlet

All patch cords shall exceed TIA/EIA and ISO/IEC Category 6/Classs E specifications.

All patch cords shall be backward compatible with Category 5 and Category 5E systems.

The patch cords shall incorporate an anti-snag feature that provides maximum protection from snagging during moves and re-arrangements.

Patch cords shall be UL listed, UL-C certified and AUSTEL approved.

Patch cords shall support network line speeds in excess of 1 gigabit per second.

Physical Specifications:

Contact Material:	Phosphor Bronze
Contact Plating:	Gold 50 micro-inch (1.27 microns) Nickel 100 micro –inch (2.54 microns)
Insertion Life:	750 minimum
Plug Material:	Polycarbonate UL-rated 94 V-O
Operating Temperature:	14°F to 140°F (-10°C to 60°C)

Method of construction:

The patch cord shall be erected for making connections from switch to patch panel or from computer to information outlet.

Mode of measurement: Executed quantity shall be counted on number basis

1.17 Networking Accessories (NAS)

LAN Accessories

A) UTP connector (RJ-45) (UTPC)

General: All material shall conform to relevant standard as per TIA/EIA 568-B2-1.

Scope: **Specification No (WG-NAS/UTPC)**

To make MDIX (Cross) patch cord required for cascade connections of switches & routers.

Material:

UTP connector:

Assembly of Gold over nickel contacts with 1.5A current carrying capacity, 30V with 15milli ohms contact resistance, 8P8C connection easy to crimp with crimping tool in polycarbonate UL94V housing.

Method of construction:

The UTP cable shall be spliced, untwisted not more than 12mm, inserted into the connector with sequence as shown in the diagram ____ as per EIA/TIA 568 B.2-1 & crimped firmly with crimping tool.

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

B) Information Outlet (Ethernet) (IO)

General:

All material shall conform to relevant standard as per TIA/EIA 568-B2-1.

Scope: **Specification No:(WG-NAS/IO)**

For connecting computers to wired LAN or external wireless Ethernet interface in Wireless LAN.

Material:

Information Outlet Flush/ Surface type:

Spring shuttered front access, high impact plastic body FR grade with high performance unshielded RJ-45 keystone jack (conforming to EIA/TIA 568-B.2-1 Cat 6), 15 milliohms contact resistance, gold over nickel spring contact, 1.5A current carrying capacity, with T568A/T568B wiring option, insulation displacement connector for cable crimping to accept 22-26AWG solid wire for connections up to Gigabit Ethernet.

7. All Category 6 outlets shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in TIA/EIA 568-B.2-1 Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801:2002 Second Edition.
8. The Category 6 outlets shall be backward compatible with Category 5E, 5 and 3 cords and cables.
9. The Category 6 outlets shall be of a universal design supporting T568 A & B wiring.
10. The Category 6 outlets shall be capable of being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current 10BASE-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T and 1.2 Gbps ATM.
11. The Category 6 outlets shall be capable of being installed at either a 45° or a 90° angle in any M-series modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates.

12. The Category 6 outlets shall have improved pair splitters and wider channel for enhanced conductor placement. The outlet shall also have a low-profile wire cap, which protects against contamination and secures the connection. Multicolored identification labels shall be available to assure accurate installation.

Hardware:

Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, etc.

Method of construction:

The Information outlet shall be fixed on the wall with sheet metal (SM) screws, rawl plugs/wooden gitties and making due connections as per EIA/TIA 568 B.2-1 by splicing the UTP cable, untwisted up to 12mm & punching the 4 pairs in the keystone jack with the help of punching tool. Not a single wire shall be left without connections.

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

C) Keystone jack (RJ-45) (KJ)

Scope:

Specification No (WG-NAS/KJ)

Structured cabling, to provide connections to switch/ server from desktop computers/ Wireless devices in the patch panel.

Material:

Keystone jack:

High impact plastic body FR grade with high performance unshielded RJ-45 keystone jack (conforming to EIA/TIA 568-B.2-1 Cat 6) , 20milli ohms contact resistance, gold over nickel spring contact ,1.5A current carrying capacity, with T568A/T568B wiring option, insulation displacement connector for cable crimping to accept 22-26AWG solid wire for connections up to Gigabit Ethernet.

Method of construction:

The keystone jack shall be fixed with the help of its self-locking arrangement in provided patch panel before making due connection as per EIA/TIA 568 B.2-1 by splicing UTP cable, untwisted up to 12mm & punching the 4 pairs in the keystone jack with the help of punching tool. Not a single wire shall be left without connections.

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

D) Patch Panel (PP)

Scope:

Specification No (WG-NAS/PP)

Structured cabling for the installation of keystone jacks.

Material:

Patch Panel:
Three piece structure including front panel, cable management plate with pre-fitted B-clip to help in routing cables & metal case of 1.6mm thick Mild Steel powder coated panel of size 442.6mm X 44.5mm with the provision for 1 to 24 high density keystone jacks

12. 24 and 48 port patch panels with 110 IDC connector terminations on rear
13. The patch shall have electrical performance guaranteed to meet or exceed TIA/EIA 568-B.2-1 Category 6 and ISO/IEC Category 6/Class E specifications.
14. The panel shall have vertical and horizontal cord organizers available as to improve patch cord management.
15. The panel shall be available in 24-port and 48-port configurations with universal A/B labeling and 110 connector terminations on rear of panel allowing for quick and easy installation of 22 to 24 AWG cable.
16. The patch panel shall have a black powder finish over high-strength steel.
17. The panel shall be equipped with a removable rear mounted cable management bar and front and rear labels.
18. The panel shall be UL listed, UL-C certified and ACA approved.
19. The panel shall support network line speeds in excess of 1 gigabit per second and be backward compatible with Category 5e, 5 and 3 cords and cables.
20. The Category 6 modular jack panels shall meet or exceed the Category 6/Class E standards requirements in ISO/IEC 11801, CENLEC EN 50173 and TIA/EIA and shall be UL Listed.
21. The panels shall be either wall or 19-inch rack mountable.
22. The panels shall meet the following specifications:

Performance Specifications:			
	Category 6 Patch Panel	High Performance Solution	Premium Performance Solution
		Category 6 Channel (4 Connectors)	
	Typical Worst	**Guaranteed**	**Guaranteed**
	Pair Margin*	**Margin****	**Margin****
Insertion Loss	64.3%	5.0%	7.5%
NEXT	6.6 dB	6.0 dB	7.0 dB
PSNEXT	7.3 dB	7.5 dB	8.5 dB
ELFEXT	6.4 dB	6.0 dB	8.0 dB
PSELFEXT	6.1 dB	8.0 dB	10.0 dB
Return Loss	6.6 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

Operational Specifications:

Operating Temperature Range:	14°F to 140°F (-10°C to 60°C)
Storage Temperature Range:	-40°F to 158°F (-40°C to 70°C)
Humidity:	95% (non-condensing)
Nominal Solid Conductor Diameter:	0.025 to 0.020 in (0.64 to 0.51 mm) (22 to 24 AWG)
Nominal Stranded Conductor Diameter:	0.025 to 0.020 in (0.64 to 0.51 mm (22 to 24 AWG)
Insulation Size:	0.042 in (1.08 mm) (22 to 24 AWG) Maximum DOD
Insulation Types:	All plastic insulates (including PVC, irradiated PVC, Polyethylene, Polypropylene,
	PTF Polyurethane, Nylon, and FEP)
Insertion Life:	750 minimum insertions of an FCC 8-Position Telecommunications Plug
Front Panel:	Black powder painted steel.
Plastic:	High-impact, flame retardant, UL-rated 94V-0 thermoplastic

Hardware:

Chromium plated brass nuts & bolts with special type of U shaped square washers of required sizes.

Method of construction

The Patch Panel shall be firmly secured in U Rack (Networking Cabinet) with 4 nos. of chromium plated brass nuts & bolts.

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

E) Lightguide Interconnect Unit (LIU)

General:

All material shall conform to relevant standard as per IEEE, EIA/TIA, and CENELEC

Scope:

Specification No (WG-NAS/LIU)

To terminate the fibre backbone cables & the equipment cables.

Material:

Lightguide Interconnect Unit:

Wall mount type Lightguide Interconnect Unit with dimensions shown in the table, an interfacing unit for fiber cables coming in from field & those originating from the equipments. consisting of fiber spools to provide minimum bending radius & splice trays as splice cover for pigtail splicing, two compartment design

with adaptor panel in the centre, compartmentalizing the box, complete aluminium housing, fully powder coated, two doors enclosure with lock & key, rubber grommets at the cable entry points for tight sealing; Splice trays of 140 x125 x 10mm complete aluminium body fully powder coated with provision for fibre splices fully cushioned splice holder containing grooves for fixing splice protective sleeves; FR grade high impact resistance plastic two halves design stackable sufficient room for excess cable.

Sr. No.	**Ports**	**Dimensions**	**Fiber splices**
1	12	300 x 300 x 80mm	6
2	24	370 x 350 x 80mm	12

Hardware:
Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, etc.

Method of Construction:
Supplying & erecting Lightguide Interconnect Unit (LIU) on wall with cable termination complete with sheet metal screws of required size, plugs/ wooden gitties.

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

5. SWITCHGEAR

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 outgoing circuit as per the requirement of site.

2.2 IC/Metal clad TP/TPN switches (MTP)

Scope:

Specification No (SW-SWR/MTP)

Supplying and erecting IC/Metal clad TP/TPN /on load/off load changeover switches of specified rating on angle iron frame of suitable size.

Material*:*

TP/TPN Switches: Three phase Triple pole / Three phase Triple pole with neutral link weatherproof metal clad air break switch fuse unit of specified rating, confirming to IS: 13947 (part- 1 &3)/ 1993 with positive make and break arrangement with shrouded incoming contacts, facility suitable for Three phase 415 volts, 50 Hz AC supply, It shall be fitted with interlock-able cover and re-wire able type porcelain fuse and having cable entry holes, sealing arrangement and mounting arrangements.

Fabrication: Required size of angle iron / MS Flat.
Paint: Superior quality enamel paint of specified shade & colour, Red Oxide paint.
Hardware: SM screws, MS Nuts & bolts, rawl plug, wooden gutties etc.
Grouting Material: Cement, Sand, Putty, water, etc.

Method of Construction:

The switch shall be erected at designated place duly mounted on suitable size of angle iron frame as per Table No. 5.1/1 with the help of required nut bolt, washer, etc; on frame/wall. The angle frame to be erected on wall with the help of screws, or to be grouted in wall with the help of cement plaster, and finished as original. The Frame shall be painted prior to erection.

Mode of Measurement:

Executed quantity will be counted on number basis. (i.e. Each)

2.3 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.

2.4 SWITCHGEAR:

5.4.1 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.
5.4.2 The M.S frame i.e. Angle Iron Frame shall be fabricated from M.S angles and M.S flat as specified.
5.4.3 The M.S frame shall be rigidly fixed to the wall by anchor fastener.
5.4.4 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.
5.4.5 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.
5.4.6 After installation of switches, starters, busbar, D.B's, all nuts and bolts shall be thoroughly greased and tightened properly.
5.4.7 An earthing terminal shall be fixed to the M.S frame.
5.4.8 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.
5.4.9 Charges for marine plywood and M.S angle iron frame are not included in the rate of switchgear.
5.4.10 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.

6. TECHNICAL SPECIFICATIONS FOR SUPPLY OF LIGHT FIXTURE

SCOPE OF WORK

The scope of work shall cover the supply, installation and testing of various types of LED light fixtures & other fitting are used in the project.

General Conditions

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

vii. Indian Electricity Act, 2003 with amendments thereto if any
viii. Indian Electricity Rules, 1956
ix. CEA Regulations -2010
x. Relevant standards of the Bureau of Indian Standards (IS Codes) International standards
xi. American Society of Testing of Materials (ASTM Codes).
xii. Other approved standards and / or Rules and Regulations related to the add subject matter of tender.

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

TECHNICAL REQUIREMENTS

3.4 LIGHTING SYSTEM & POWER RECEPTACLES:

3.4.1 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 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.

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

3.4.3 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.

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

3.4.5 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.

3.4.6 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.

3.4.7 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.

3.5 LIGHTING FIXTURES:

3.5.1 The lighting fixtures offered shall comply with the following requirement:

v. 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%.

vi. 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.

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

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

3.5.2 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.

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

3.5.3 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.

3.5.4 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.

3.5.5 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.

3.5.6 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.

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

3.5.8 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.

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

vi. 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.
vii. All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall light specified.
viii. All reflectors and louvers shall be finished to the standard as the fixture housing.

3.2.9The following routine tests shall be conducted as per the relevant Indian Standards:

iii. Each fixture completes with its proper lamp / lamps shall operate satisfactorily at its normal voltage and frequency.
iv. Each fixture shall be examined visually to ensure that it is complete in all respects and satisfactorily finished.

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.

3.6LED Lamps:

LED lamp is a light-emitting diode (LED) product which is assembled into a lamp (or light bulb) for use in lighting fixtures. LED lamps have a lifespan and electrical efficiency which are several times longer than incandescent lamps, and significantly more efficient than most fluorescent lamps. LEDs come to full brightness without need for a warm-up time; the life of fluorescent lighting is also reduced by frequent switching on and off.
LEDs are "directional" light sources, which mean they emit light in a specific direction, unlike incandescent and compact fluorescent bulbs, which emit light and heat in all directions.
The chart below shows the amount of brightness in lumens you can expect from different wattage light bulbs. The LED bulbs require much less wattage than the CFL or Incandescent light bulbs.

LED PANEL LIGHT (IP43) TECH SPECS:-

- System power :- 36 WATT
- LED Type :- High Brightness Power Led
- Color Temperature :- 4000K-6500K
- Nominal Voltage 240V AC
- Frequency Range 50-60 Hz
- System Efficiency >10%
- Power Factor(PF) > 0.95
- THD < 10%
- Operating Temperature 10°C to +45°C
- Lamp Body Material PDC aluminum.
- IP Rating IP43
- Surge Protection up to 4 kV
- Working Life > 60,000 Hrs
- System efficacy shall not be less than 85 lumens/watt,
- CRI shall be more than 70.
- Total Harmonic Distortion Voltage and Current shall be less than 15%.

- Luminaries and Lamp shall be LM79, LM80 compliant respectively.

LED DOWNLIGHTER LIGHT (IP43) TECH SPECS:-

- System power: - 9- 12 WATT LED RECESSED DOWNLIGHTER
- LED Type :- High Brightness Power LED
- Color Temperature :- 2500 - 7500K
- CRI :- >90
- Lens :- 95 Deg.

LED Driver Specification: **-**

- Input Voltage 120V ~ 240V AC
- Frequency Range 50-60 Hz
- System Efficiency>90%
- Power Factor(PF)> 0.95
- THD < 10%

Other Parameters:-

- Working Humidity : 10 % ~ 90 % RH
- Lamp Body Material : PDC aluminium
- IP Rating : IP43
- Surge Protection : > 6.5KV
- Working Life : > 50,000 Hrs

LED DOWNLIGHTER LIGHT (IP43) TECH SPECS: -

- System power: - 19 WATT LED RECESSED DOWNLIGHTER
- LED Type :- High Brightness Power LED
- Color Temperature: - 2500 - 7500K
- CRI :- >90
- Lens :- 95 Deg.

LED Driver Specification: -

- Input Voltage 120V ~ 240V AC
- Frequency Range 50-60 Hz
- System Efficiency>90%
- Power Factor(PF)> 0.95
- THD < 10%

Other Parameters:-

- Working Humidity 10 % ~ 90 % RH
- Lamp Body Material PDC aluminium
- IP Rating IP43
- Surge Protection > 6.5KV
- Working Life > 50,000 Hrs

3.5 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.

d) 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.

e) Work is subject to inspection at all times and at all places by MDL

f) Vendor shall carry out all instructions given during inspection and shall ensure that work is carried out according to relevant codes of practice & QAP

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.

3.6 Warranty

d) 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.

e) 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.

f) 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.

4. FANS

4.1 Wall Mounted Fans

Wall mounted fan with plastic body & blades, 300 mm sweep & air delivery of 52 Cu.mtr./min; three number blade made of plastic material, suitable for single phase, AC 210 volts, 50 Hz supply and conforming to class I of IS :374/1979 with amendment no 1 to 6 except for performance parameters to the extent modified as

details in general requirements. The power input required of 80Watt with the speed at 2100 RPM.

Method of Construction:
The Cabin fan complete with all above accessories and duly wired shall be erected at specified position, connected to the supply and tested.

Testing:
After erection fan shall be tested by connecting to supply. Also steadiness and Vibrations if any, of fan shall be checked at full speed, so that there is no wobbling. Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

4.2 EXHAUST FANS

The Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring. Mounting Plate shall be of steel construction, square with streamlined venturi inlet coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works. Motor shall be standard permanent split capacitor or shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia or larger and 1440 rpm for fans 45 cm dia and smaller. Motors for larger fans shall be suitable for 415±6% volts, 50 cycles 3 phase power supply, and for smaller fans shall be suitable for 220 ± 6% volts, 50 cycles single phase power supply. Motors shall be suitable for either horizontal or vertical service. Wire guard on inlet side and bird screen at the outlet, Fixed or gravity louvers built into a steel frame at the outlet., Regulator for controlling fan speed for single phase fan motor, Single phase preventors for 3 phase fans shall be included in fan cost.

6. CABLES:

5.1 General

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall be as included in approved list.

Work shall be carried out as per the method of construction specified by BIS. If there is no reference for particular method of construction in IS, such work shall be carried out as per the approved method of construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

5.2 Cables: (Armoured)

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical Code

SP 7 (Group 4): 2005 : National Building Code

IS 1255: 1983 Code of practice of Installation & Maintenance of armoured cables up to 33 kV.

IS 3961: Part 2: 1967 : Recommended current ratings of PVC cables.

IS 1554: Part 1; 1988 : PVC Insulated (Heavy duty) Electric Cables; Part 1 for working voltages up to and including 1100 Volts.

IS 1554: Part 2; 1988 : PVC Insulated (Heavy duty) Electric Cables; Part 1 for working voltages up to and including 3.3 kV to 11 kV.

IS 10810: Part 63; 1993: Method for Test of cables, Part 63 Smoke density of electric cables under fire condition.

IS: 7098 (Part-I), 1988 Cross linked polyethylene insulated cables for working voltages upto 1100V.

5.3 Scope: (Armoured cables)
Specification No. (CB-LT/AL, CB-LT/CU, CB-HT)

Providing armoured cable of specified voltage level, size & specified conducting material (Aluminum / Copper) as per **Table no. 7/3** including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

5.4 Material:

Cables:

Cables shall be PVC for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, colour, shall carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every meter and having the total count of progressive length in meter at each mark.

Earth wire: Galvanized Iron (G I) wire of appropriate gauge

PVC/XLPE Cables (CB)

Armoured Cables (HT & LT)

General

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall be as included in approved list.

Work shall be carried out as per the method of construction specified by BIS. If there is no reference for particular method of construction in IS, such work shall be carried out as per the approved method of construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

Cables: (Armoured)

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

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IS 1554: Part 2; 1988 Part 1 : PVC Insulated (Heavy duty) Electric Cables; for working voltages up to and including 3.3 kV to 11 kV.

IS 10810: Part 63; 1993 density of : Method for Test of cables, Part 63 Smoke electric cables under fire condition.

Scope: (Armoured cables)

Specification No. (CB-LT/AL, CB-LT/CU, CB-HT)

Providing armoured cable of specified voltage level, size & specified conducting material (Aluminum / Copper) as per Table no. 7/3 including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

Material:

Cables:

Cables shall be XLPE for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, color, shall carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every meter and having the total count of progressive length in meter at each mark.

Earth wire: Galvanized Iron (G I) wire of appropriate gauge as per Table No 7/1.

Glands: As per specification (CB-GL)

Lugs: As per specification (CB-CL/AL, CB-CL/CU)

Saddles: Saddles fabricated from GI sheet of required gauge and size depending on dia of cable either galvanized or painted with superior quality enamel black paint with necessary shearing mechanical strength, semicircular shaped with extended piece having suitable holes for fixing.

G I Strip: 22 g x 25 mm width G I Strip.

Clamps: MS Clamps fabricated of required length and shape, having the size of 3/6 mm thick mild steel having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast grip for holding the cable.

Identification tags: For identifying root, connection position GI strip with identification mark / name embossed / painted with arrangement to tie should be fix on cable or arrangement of ferrules to be done.

Hardware: Sheet Metal (SM) screws of required sizes, plugs / wooden gutties, etc.

Method of Construction:

General:

Irrespective of method of construction the cable ends shall be terminated with appropriate size & type of glands with lugs duly crimped, as directed by Site engineer.

Wherever the cable has to be bent, the turning radius shall be as mentioned in Table No 7/2. Grouping of cables shall be done with adequate distance between cables as mentioned in IS so as to minimize de-rating. Cables shall be tagged/ferruled with identification name / mark at the point from where distribution starts and at ends. Bare earth wire of appropriate size as per Table no. 7/1 shall run along with the cable. Earth wire running with the cable shall be terminated at the earth terminal nearest to cable termination.

Erection of Cable on Surface:

Erection shall be done as per the routes and layout finalized, in perfect level and in plumb. Before fixing the cable shall be straightened as far as possible for good aesthetics look, continuous bare GI earth wire of required gauge as per Table No 7/1 shall be run. Cable with G I wire shall be fixed by saddles firmly clipped on cable and shall be fixed to wall with minimum 50 x 8 mm SM screws with plugs/wooden gutties, etc. (Distance between two supports / saddles shall be maximum 450 mm). Wooden gutties shall be used wherever required (Especially for stone wall). The entries made in wall, floor slab, etc for laying the cable shall be made good by filling and finishing with plastering the same.

Erection of Cable on Trusses:

Cable along with bare GI earth wire, while erecting on trusses, shall be firmly clamped by wrapping GI strip of 22 g, 25 mm width of required length fixed to truss with nuts and bolts.

Erection of Cable on Pole:

Cable along with bare GI earth wire, while erecting on pole, shall be firmly clipped by suitable wooden / epoxy resin cast grips, clamped with 25 x 3 mm or50x6 mm MS strip of required length and fixed to pole with nuts and bolts.

Laying of Cable in provided Trench/Pole:

While laying Cable along with bare GI earth wire, utmost care shall be taken to prevent damage to the insulation of the cable and to the open end. Cable shall be brought out

from trench vertically straight (minimum 1.0 metre above G L). Care shall be taken to inspect the trench so that depth of cable shall not be less than as shown in Table No 7/4. Suitable size of cable loops shall be provided near termination point at adequate depth.

Erecting cable in constructed Trench / duct:

Erection of cable/s in constructed trench / duct, shall be as per guide lines of IS 1255.

Erection of cable/s on trays:

Cable/s shall be tied with PVC tags on GI trays. At bending point care shall be taken so that sharp edges of sheet will not damage insulation of cable.

Mode of Measurement: Executed quantity shall be measured on the basis of running metre per run of cable.

Dismantling

Cable laid underground, or fixed on any surface shall be dismantled carefully without damaging complete with all its accessories, making coil and stored as directed. The surface of the dismantled cable shall be made clear by removing of unwanted material, cement mortar, etc. When cable is dismantled from trench refill back the trench and making the surface proper.

Mode of Measurement: Executed quantity shall be measured on the basis of running metre per run of cable.

Table No 7/1

Size of Bare GI Earth wire to be used with LT Cables upto 1.1 kV

S.No.	Size of cable	Size of bare GI Earth wire to be used with cable
1	2.5 Sqmm to 50 Sqmm of all cores.	12 SWG
2	70 Sqmm to 95 Sqmm of all cores.	10 SWG
3	120 Sqmm and above of all cores.	8 SWG

Table No 7/2

Minimum bending Radius for Cables

S.No.	Voltage level of cables	Single core	Multi core Unarmoured	Multi core Armoured
1	Up to 11 kV	20 D	15 D	12 D
2	Up to 22 kV	25 D	20 D	15 D
3	Up to 33 kV	30 D	25 D	20 D

Note: D diameter of cable.

Wherever possible, 25 percent larger radii than the specified above should be used.

Table No 7/3

Current Rating (In Ground) for PVC/ XLPE Insulated 1.1 kV Grade Cables

Nominal area of conductor	Aluminum Conductor				Copper Conductor			
	Single Core		Multi Core		Single Core		Multi Core	
Sqmm	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE
10	51	55	46	50	65	71	60	65
16	66	74	60	68	85	95	77	87
25	86	98	76	90	110	125	99	115
35	100	118	92	108	130	150	120	138
50	120	137	110	126	155	175	145	161
70	140	172	135	158	190	220	175	202
95	175	204	165	187	220	260	210	239
120	195	234	185	215	250	301	240	276
150	220	262	210	240	280	336	270	308
185	240	298	235	273	305	381	300	350
240	270	344	275	316	345	441	345	405
300	295	387	305	355	375	496	385	455
400	325	458	335	420	400	586	425	538
500	345	495	-	-	425	635	-	-

630	390	555	-		470	710	-	-
800	440	625	-	-	-	-	-	-
1000	490	685	-	-	-	-	-	-

Rating Factors for Variation in Ambient Air Temperature			
Air Temperature (oC)	40	45	50
Rating Factor (XLPE)	1.00	0.94	0.88
Rating Factor (PVC)	1.00	0.90	0.81

Table No 7/4

Minimum laying Depth of cables (IS: 1255)

S.No.	Voltage level of cables	Minimum depth from top of the cable
1	Up to 1.1 kV	750 mm
2	3.3 kV to 11 kV	900 mm
3	22 kV to 33 kV	1050 mm
4	At road crossing	1000 mm
5	At railway crossing (from Bottom of sleepers to Top of pipe)	1000 mm

Notes below Table No 7/4:

1.	PVC Insulated electrical cable for voltage grade up to 1.1 kV is based on 8 volts drop.
2.	The distances are given in meters and after rounding.
3.	The distances are given in meters and after rounding.

For Temperature Correction please see as detailed below:				
Ground temp.	20 degree C	25 degree C	30 degree C	35 degree C
Rating factors:	0.95	0.90	0.85	0.80

Table No 7/5

Distance up to which different sizes of UG Aluminum Conductor Cables 1.1 kV grade, can be used for different current ratings of 8 Volts drop. (PVC insulated, PVC Sheathed, 3 cores or 4 cores)

Maximum Conductor temperature – 70 degree C														
S. No	Current	Distance in meters for the following cable sizes in Sqmm												
	Amp	6	10	16	25	35	50	70	95	120	150	185	240	300
1	5	165	260	415	725	895	1300	1925	2360	3065	3555	4300	5770	6460
2	10	80	130	205	360	450	650	960	1180	1530	1775	2150	2885	3230
3	15	55	85	140	240	300	430	640	785	1020	1185	1430	1920	2155
4	20	40	65	100	180	225	325	480	590	765	890	1075	1440	1615
5	25	30	50	80	145	180	260	385	470	610	710	860	1150	1290
6	30	25	40	70	120	150	215	320	390	570	590	715	960	1075
7	40	20	30	50	90	110	160	240	295	380	445	535	720	805
8	50	-	25	40	70	90	130	190	235	305	355	430	575	645
9	60	-	-	35	60	75	110	160	195	255	295	355	480	535
10	70	-	-	30	50	65	90	135	165	215	255	305	410	460
11	80	-	-	-	45	55	80	120	145	190	220	265	360	405
12	90	-	-	-	40	50	70	105	130	170	195	235	320	360
13	100	-	-	-	35	45	65	95	115	150	175	215	290	320

14	110	-	-	-	-	40	60	85	105	140	160	195	260	290
15	120	-	-	-	-	35	55	80	95	125	145	180	240	270
16	130	-	-	-	-	-	50	75	90	115	135	165	220	250
17	140	-	-	-	-	-	45	70	80	110	125	150	205	230
18	150	-	-	-	-	-	-	65	75	100	115	140	190	215
19	160	-	-	-	-	-	-	60	70	95	110	130	180	200
20	170	-	-	-	-	-	-	55	70	90	105	125	170	190
21	180	-	-	-	-	-	-	50	65	85	100	120	160	180
22	190	-	-	-	-	-	-	-	60	80	90	110	150	170
23	200	-	-	-	-	-	-	-	60	75	90	105	145	160
24	225	-	-	-	-	-	-	-	-	65	80	95	125	145
25	250	-	-	-	-	-	-	-	-	-	70	85	115	130
26	275	-	-	-	-	-	-	-	-	-	-	80	105	115
27	300	-	-	-	-	-	-	-	-	-	-	70	95	105

Glands: As per specification (CB-GL)

Lugs: As per specification **(CB-CL/AL, CB-CL/CU)**

Saddles: Saddles fabricated from GI sheet of required gauge and size depending on dia of cable either galvanized or painted with superior quality enamel black paint with necessary shearing mechanical strength, semicircular shaped with extended piece having suitable holes for fixing.

G I Strip: 22 g x 25 mm width G I Strip.

Clamps: MS Clamps fabricated of required length and shape, having the size of 3/6 mm thick mild steel having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast grip for holding the cable.

Identification *tags:* For identifying root, connection position GI strip with identification mark / name embossed / painted with arrangement to tie should be fix on cable or arrangement of ferrules to be done.

Hardware: Sheet Metal (SM) screws of required sizes, plugs / wooden gutties, etc. the cable in the bent portion, shall be buried along the route of cable in the trench made for laying the cable. For clear visibility, the Cable indicator plate shall be buried in such a manner that the plate should be minimum 200 mm above the ground level and shall be provided at every 15-25 metre in straight run, at both ends of road crossing and immediate before and after turning point of cable.

5.5 Mode of Measurement:

Executed quantity will be measured on meter basis.

9. 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.

10. LABLING:

All installed electrical accessories to be labeled with stick able Talley plates according to as fitted drawings.

11. SUBMISSION OF AS FITTED ELECTRICAL DRAWINGS.

Upon completion with successful testing and commissioning all electrical, telephone, data work 04 Sets of as Fitted Electrical Drawings needs to be submitted.

LIST OF PREFERED MAKE OF MATERIALS

Unless otherwise mentioned specifically only the following approved make / brands of various electrical accessories 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 relevant standards, as approved by the Engineer in charge shall be used.

SR.NO.	ITEM	STANDARD MAKE
1	LT PANEL	APJ ELECTRICAL / ABAK ENGG / ZENITH ENGG.
2	DISTRIBUTION BOARDS	LEGRAND / HAGER / SCHNEIDER / C&S Electric
3	MEDIUM VOLTAGE CABLE	POLYCAB / FINOLEX / RRKABLE
4	CABLE TRAY	INDIANA / OBO BETTERMAN / LEGRAND/PROFAB
5	UPS / INVERTER	APC / DELTA / EATON
6	LT SWITCHGEAR (ALL RANGE)	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB
7	LT MCCB	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB / LEGRAND
8	LT MCB, ELCB, RCBO	SIEMENS / SCHNEIDER ELECTRIC / HAGER /LEGRAND
09	LT SFU	SIEMENS / SCHNEIDER ELECTRIC / L&T / ABB
10	LT CONTACTORS	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB
11	CHANGE OVER SWITCH	ASCO / SOCOMEC / ABB
12	METERS (DIGITAL)	ENERCON / L&T / TRINITY
13	LOAD MANAGER	ENERCON / L&T / TRINITY

SR.NO.	ITEM	STANDARD MAKE
14	RELAYS	SIEMENS / SCHNEIDER ELECTRIC / GE / L & T
15	INDICATING LAMPS	SIEMENS / SCHNEIDER ELECTRIC / L & T / ABB
16	ELECTRIC TIMER	SIEMENS / L&T / EAPL
17	SELECTOR SWITCH	KEYCEE / SALZER / AE
18	APFC RELAY	ELMEC / L & T / TRINITY
19	LT CAPACITORS	L & T / EPCOS / SEIMENS
20	LUGS	DOWELL'S / JAINSON / COMET
21	CABLE GLAND	JAINSON / COMET / DOWELL'S
22	PVC CONDUITS AND ACCESSORIES	PRECISION / DIAMOND / POLYCAB / ASTRAL
23	CASING CAPING	PRECISION / DIAMOND / LEGRAND
24	M.S. CONDUIT AND ACCESSORIES	AKG / BEC / STEELCRAFT
25	MODULAR SWITCHES, SOCKETS & OTHER ACCESSORIES	LEGRAND / MK - HONEYWELL / PANASONIC
26	METAL CLAD SOCKET WITH MCB	MDS-LEGRAND / SIEMENS / SCAME
27	PVC JUNCTION BOX	SINTEX / CLIPSAL / SPELSBERG
28	WIRES FOR INTERNAL WIRING	POLYCAB / FINOLEX / RRKABLE
29	FLEXIBLE WIRE	POLYCAB / FINOLEX / RRKABLE
30	TELEPHONE CABLE	DELTON / POLYCAB / FINOLEX
31	COAXIAL TV CABLE	DELTON / POLYCAB / FINOLEX
32	CAT 6	MOLEX/ D-LINK/Digisol
33	MULTICORE FLEXIBLE CABLE	POLYCAB / FINOLEX / RRKABLE
34	CONNECTORS (COLOURS AS PER PHASE & NEUTRAL)	SALZER / ELEMEX / CONNECTWELL
35	LIGHT FIXTURES	HAVELLS / WIPRO / Crompton
36	LIGHTING CONTROLLER	DYNALITTE /ANCHOR / LEGRAND
37	CEILING FAN / EXHAUST FAN/WALL MOUNTED FAN	CROMPTON / ORIENT / HAVELLS

SR.NO.	ITEM	STANDARD MAKE
38	FLOOR TRUNKING	LEGRAND / OBO / MK
39	NETWORK SWITCH	CISCO/ HP Aruba/Juniper
40	NETWORK RACK	PENDUIT / RITAL / PRESIDENT
41	NETWORK ACCESSORIES	PENDUIT / D-LINK / MOLEX
42	HDMI CABLE	POLYCAB / FINOLEX / D-LINK
43	Access Control System	MATRIX / SPECTRA / HONEYWELL

Scope of work and Technical specifications for HVAC System

AC INSTALLATION WORKS AT SOUTH YARD 5TH FLOOR LIBRARY, MOGUL HOUSE, MDL, MUMBAI.

SCOPE OF WORK

A) Works under this shall comprise of Supply, installation, testing and commissioning of following at 5th floor Library Mogul House South Yard.

i) Inverter Cassette/Inverter Split Air conditioning units consisting of indoor units, outdoor units, cordless remote controllers with batteries, remote control holder, adequate length of power supply cables along with connecting pin & accessories.
ii) Make: Daikin/Mitsubishi/Hitachi
iii) M.S stands, grill work, structural work as per site requirements for installation of A.C outdoor units.
iv) Copper refrigerant piping with insulation/nitrile rubber sleeves including clamping/supporting arrangement including making precise holes in the walls with core cutting m/c, providing sleeves and proper finishing for connectivity from indoor to outdoor units.
v) Suitable L-shaped brackets duly painted with bush and fasteners for mounting outdoor units wherever necessary as directed by MDL engineer.
vi) ISI mark UPVC plumbing grade condensate drain pipe & fittings with supports & clamps etc all complete for taking out condensate drain water from AC units up to the Ground Level.
vii) 2.5 Sq mm 3 core/4 core Electrical cable for Inverter split AC (from indoor units to outdoor units) all complete.
viii) Purging with suitable **eco-friendly** gas for flushing before leak test, leak testing of copper piping & first charge of pre-filled **eco- friendly** refrigerant gas considering lengths of copper piping & A.C unit's capacity etc all complete.
ix) Scaffolding work required if any for the above work **(Under Contractor scope)**
x) The contractor shall arrange free of cost servicing to be carried out by Air Conditioner Manufacturers service engineer for the completed works including indoor unit, outdoor unit, copper tubing etc all complete at the interval of **every three months during Defect liability period.**

B) DRAWINGS AND DOCUMENTATION

i) The locations of the AC indoor units and outdoor units as shown in the tender drawings **are indicative and approximate**.
ii) After award of contract, Contractor is required to submit the **print of**

installation/working drawings of A3 size in 04 sets for the above scope of work and get it approved from MDL before starting up the work. Drawings (plan and elevation) should indicate the exact locations of AC indoor units, outdoor units, capacities of the ACs, copper tubing layout from indoor to outdoor units and its size, condensate drain UPVC piping layout along with size and its looping/routing from A.C indoor units to the nearest drain point. **Drawing shall contain tabulation of all measurable items of Equipment/Materials/works.**

iii) Installation/Woking drawings shall be submitted for approval sufficiently in advance of installation of any material to allow MDL Engineer ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce installation/working drawings at the right time, in accordance with the approved program.

iv) When MDL Engineer makes any amendment in the above drawings, the contractor shall supply 02 fresh sets of drawings with the amendments duly incorporated, for approval. The contractor shall submit further 02 sets of installation/working drawings to the Engineer for the exclusive use by the MDL Engineer.

v) **4 sets of prints of approved drawings in A3 size to be submitted by the Contractor to MDL**.

vi) Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the Contractor of the responsibility or requirement to furnish material and perform work as required by the Contract.

vii) After completion of work, **Contractor shall submit 04 sets of A3 size prints of "as built" drawings and 02 sets on CD-R disc in a PC compatible AutoCAD & PDF format**.

C) MATERIALS, DESIGNS, INSTALLATIONS, TESTING & COMMISSIONING

i) Inverter split A.C units shall be factory assembled, wired and tested. It shall comprise of Indoor and Outdoor Units along with all the accessories. Copper Refrigerant Piping interconnecting evaporator and Condensing Unit shall be charged with **eco-friendly** gas and be provided with suitable length of Copper Refrigerant Piping with insulation and cabling to be provided per Evaporator Unit. Condensing Unit shall be suitable for outdoor installation with weather proof enclosure and shall be field serviceable.

ii) Contractor to select the model from the preferred list of manufacturers of the Inverter Cassette/split A.C considering the climatic conditions prevailing through the year at MDL Mumbai site.

iii) Copper refrigerant piping of suitable diameter compatible with the refrigerant gas & air conditioner model with insulation/nitrile rubber sleeves (19 mm thk), end connections to be installed true to line and level, jointing by brazing & adequately supported intermittently at uniform distance with appropriate clamps / support arrangement including making precise holes in walls with core cutting m/c, providing sleeves & proper finishing for connectivity from indoor to outdoor unit etc all complete as directed by MDL engineer. The alignment of copper piping in horizontal and vertical direction to be maintained.

iv) Reputed make of ISI mark UPVC plumbing grade condensate drain pipe & fittings to be used for taking out condensate drain water from AC Units up to the Ground Level including looping/routing. The joints shall be properly sealed so that there is no water leakage. Proper grouping of condensate drain pipes & gradient to be maintained for the easy flow of condensate drain water from the A.C units to the ground level. UPVC pipelines to be adequately supported intermittently at uniform distance with clamps, pipe supports with proper alignment in horizontal and vertical direction.

v) Unless otherwise specified and approved, all materials and designs shall comply with the current issue of the relevant Indian or International Standard Specifications and their installation shall comply with the relevant current Indian/International Standard Codes of Practices.
vi) Materials, designs and installations shall comply with the building regulations, local authority regulations and by-laws, Gas Safety Regulations, National Electric Codes for the Electrical Equipment of buildings, insurance company requirements and other statutory rules. All equipment and materials shall be products, which shall meet with the acceptance of authorities having jurisdiction over the work.
vii) Each item of Equipment/Material shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in the list of preferred makes.
viii) All equipment and materials required for installations shall be new and without blemish.
ix) The contractor shall raise inspection call to MDL for the works undertaken at below mentioned stages –
    a) After delivery of material at site before starting of installation works
    b) After testing & commissioning of the completed works.
x) All the works under or in course of execution or executed in pursuance of the contract shall at all times be open to inspection & supervision of the MDL engineer / executives & the contractor at all times during the usual working hours offer assistance for the inspection of work.
xi) The contractor shall submit supporting documents such as delivery challan(s), Test reports / certificates, packing lists, Invoice, Performance guarantee certificates & other technical documentation in requisite sets as relevant along with the invoice for the purpose of certification by MDL engineer.

D) PROTECTION OF MATERIALS AND WORK

i) Copper tubes stored on site shall be supported clear of the ground and kept separate from all other stored ferrous materials & shall be suitably protected against the weather.
ii) All equipments and materials, fixed or unfixed shall be protected against ingress of dirt or moisture into working parts by means of Polythene covers or other equivalent measures.
iii) Precautions against mechanical damage by other trades shall be provided.
iv) Precautions shall be taken and all necessary protection provided to safeguard the work during bad weather.
v) The inlet and discharges of all fan coils, and other terminal units shall be kept covered until all local Plastering, Purging, etc. is completed and the units are ready to run.

Equipment and material damaged shall be replaced by contractor at the discretion of the MDL engineer. Equipment and materials are subject to rejection and replacement, if in the opinion of the MDL Engineer, or in the opinion of the

vi) manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use is questionable, or that its normal life expectancy has been curtailed.

vii) The contractor shall be solely responsible to protect all the delivered materials from the time of delivery at site till satisfactory completion & handing over of the completed works from any mode/type of damage/loss that may occur during this period.

E) INSTALLATION LIAISON

i) The Contractor is responsible for the co-ordination of all installation work on site. The Contractor shall plan his installation before the work is commenced and to ensure correct installation to the design intent during the course of construction. Any work, which has to be re-done due to negligence in this respect, will not constitute an extra & also shall not amount to Extension of Time to the Contract.
ii) Contractor has to depute experienced and knowledgeable engineer/supervisors in the field of HVAC who can co-ordinate, execute the work and take site decisions without any delay.
iii) Particular care shall be taken to obtain uniform and tidy arrangements of wall mounted indoor and outdoor units.
iv) Where the work of the Contractor has to be installed in co-ordination with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment.

F) OPERATION & MAINTENANCE MANUAL

Upon practical completion of the works, 04 copies of operation & maintenance manual shall be provided.

The manual shall contain full operating and maintenance instructions presented in a form to deal systematically with AC units. The manual may contain manufacturer's standard operating and maintenance instructions and leaflets where these are applicable.

The contractor shall furnish Guarantee / warrantee certificate of each air conditioner unit duly signed & stamped by the manufacturer, effective from the date of satisfactory completion & acceptance of the completed works by MDL.

G) REFERENCE STANDARDS

Reference standards to be followed shall be of latest versions.

- ASHRAE Standards
- ASHRAE/ISHRAE Hand Books
- Safety Code for Mechanical Refrigeration, ASHRAE
- HVAC Commission Guideline (ASHRAE)
- IS 1239 for Piping

PREAMBLE TO THE BILL OF QUANTITIES

1. GENERAL INSTRUCTIONS

1.1 The Bill of Quantities must be read with the scope of work, Conditions of Contract, Drawings and the Specifications and the Contractor shall be deemed to have examined the Scope of Work, Drawings, Specifications, Conditions of Contract and to have visited the Site and acquainted himself with the Works to be done and the way in which they are to be carried out and all factors affecting the execution of the Works and the Costs thereof including temporary works if required to complete the works.

1.2 All work shall be measured net as it is finished and/or fixed in the Works and no allowance shall be made for wastage notwithstanding any general or local custom. Any items of work not covered in the Preamble shall be measured as per

specifications for works methods laid down in relevant Indian Standards or as decided by the MDL Engineer.

1.3 The quantities set down against the items in this Bill of Quantities are an approximate estimate of the quantity of each kind of work included in the Contract and are given for the convenience of forming a common basis for tendering. They are not to be taken as a guarantee that the quantities scheduled will be carried out or required or that they will not be exceeded. MDL reserves the right to delete any item indicated in the bill of quantities at any time.

1.4 The quantities shall therefore not be considered as representing the final measurements, it being the intention of the Contract (except where otherwise specifically stated) that the actual quantities of work ordered and carried out shall be jointly measured on completion by the MDL Engineer or his authorised representative and the Contractor and valued and paid for at such prices and rates entered by the Contractor in the Bill of Quantities.

1.5 The rates and prices set down against the items are to be the full inclusive value of the finished work shown on the Drawing and/or described in the Specifications or which can reasonably be inferred there from and to cover the cost of every description of Temporary Works executed or used in connection therewith (except those items in respect of which specific provision has been separately made in this Bill of Quantities) and all the Contractor's obligations under the Contract including testing, giving samples and all matters and things necessary for the proper execution, completion and maintenance of the Works. No claim for additional payment shall be allowed for any error or misunderstanding by the Contractor of the work involved.

1.9 **The Specifications and the various Sections in the Bill of Quantities are intended to cover the supply of all the materials and the execution of all works necessary to complete the Works. Should there be any details of Materials or Construction which have not been referred to in the scope of work, specifications, Bill of Quantities or the Tender Drawings, but the necessity for which may reasonably be implied or inferred there from, or which are usual, or essential to the completion of all works in all trades, the same shall be deemed to be included in the rates and prices within in the Bill of Quantities**. The rates and prices shall cover the items as described in the scope of work, Bill of Quantities, tender drawings and other terms and conditions of the contract.

1.10 The Contractor's unit rates and prices in the BOQ shall include

a) All equipment, apparatus, material, indicated in the BOQ, Scope of Work, Drawings, Specifications in connection with the item in question and also associated labour as well as all additional equipment, apparatus, material, consumables usually necessary to complete the system even though not specifically shown, described or otherwise referred to and also associated labour.
b) It also includes delivering the material, item to the specified storage area at Site. Installation of the same in the specified location as per Drawing & as specified, testing and commissioning as per Specification and direction of the Engineer' at Site.
c) The unit price shall be deemed to include every thing necessary to complete the work covered by this item in accordance with the scope of work, BOQ description, Specifications and Drawings.
d) The sum total of all the individual item prices shall represent the total price of the installation ready to be handed over.
e) All equipment, machinery, apparatus and materials required as well as the cost of any tests which the Engineer may request in addition to the tests

generally required to prove quality and performance of A.C units. Further, if any equipment, machinery, apparatus and materials found to not comply/fulfil satisfactory performance/duty during such testing, then cost of replacing such materials.

f) Use of any tools, equipment, machinery, lifting tackle, ladders consumables etc. required by the Contractor to carry out his work.

g) All the necessary measures to prevent the transmission of vibration. Storage and insurance of all plant and equipment, apparatus and materials.

2. DETAILS OF MEASUREMENT

2.1. UNITS OF MEASUREMENT

The units of measurement used in this Bill of Quantities are in metric units as follows:

a. **Linear** Linear metre, centimetre or millimetre abbreviated to 'RM', 'cm' or 'mm' respectively.

b. **Numbers** Numbers abbreviated to No's or No.

2.2 INVERTER CASSETTE/SPLIT AIR CONDITIONER

For measurement and certification of work for Supply & Delivery of wall mounted Inverter Split Air conditioner and Cassette type at site, Contractor & MDL engineer will jointly verify the quantities by opening the boxes/package and verify the same with technical details furnished, damage due to transportation and handling etc before starting the installation work.

Contractor to make all the arrangement for opening and closing of boxes/packages and store the same in proper manner after inspection.

2.3 REFRIGERANT PIPING

Copper piping shall be measured in running meters as actually installed along the centre line of the pipe line including pipe fittings.

Copper piping work for refrigerant would be measured in running meters in one direction form indoor unit up to outdoor unit considering **suction & discharge tubing as one combined set** & excluding the length of copper pipe supplied by the Air conditioner manufacturer as part of the AC unit package. Suction & discharge piping will not be measured separately one from another for certification of work done.

2.4 UPVC PIPING FOR CONDENSATE DRAIN

UPVC piping shall be measured in running meters as actually installed along the centre line of the pipe line including pipe fittings.