

THE AKSHAYA PATRA FOUNDATION

GENERAL & TECHNICAL GUIDELINES FOR

CONSTRUCTION OF 'MDM KITCHEN FACILITY'
AT JODHPUR, RAJASTHAN, INDIA.

CLIENT



I: GENERAL CONDITIONS FOR WORK.

1.1 Contractor's General Responsibilities

The Contractor shall design execute and complete the Works and remedy any defects therein in accordance with the Contract and with the Engineers instructions, and shall remedy any defects in the Works. The Contractor shall bear the cost with material and provide all superintendence, labor, materials, plant, Contractor's Equipment and all other things, whether of a temporary or permanent nature, required in and for such design, execution, completion and remedying of any defects, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the Contract.

The Contractor shall give prompt notice to the Engineer, with a copy to the Employer, of any error, omission, fault or other defect in the design of or Specification for the Works which he discovers when reviewing the Contract or executing the Works.

1.2 Site Operations and Methods of Construction

The Contractor shall take full responsibility for the adequacy, stability and safety of all Site operations and methods of construction. Provided that the Contractor shall not be responsible (except as stated hereunder or as may be otherwise agreed) for the design or specification of Permanent Works, or for the design or specification of any Temporary Works not prepared by the Contractor. Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall be fully responsible for that part of such Works, notwithstanding any approval by the Engineer.

The Contractor shall, whenever required by the Engineer, submit details of the arrangements and methods, which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without having previously notified to the Engineer.

1.2 Inspection of Site

The Contractor shall make needful to understand the project location and all relevant details as required for efficient quotes, before the submission of tender by the Contractor, such data on hydrological and sub-surface conditions as have been obtained by or on behalf of the Employer from investigations undertaken relevant to the Works but the Contractor shall be responsible for his own interpretation thereof.

The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself (so far as is practicable, having regard to considerations of cost and time) before submitting his Tender, as to:

- (a) The form and nature thereof, including the sub-surface conditions,
- (b) The hydrological and climatic conditions,
- (c) The extent and nature of work and materials necessary for the execution and completion of the Works and the remedying of any defects therein, and
- (d) The means of access to the Site and the accommodation he may require,

And, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect his Tender.

The Contractor shall be deemed to have based his Tender on the data made available by the Employer and on his own inspection and examination, all as aforementioned

1.3 Site Meetings

The Contractor shall attend site meetings when requested by the Engineer from time to time and shall make available responsible representative conversant with the Works and with authority to accept and make decisions and act on his behalf. The Contractor shall submit to the Engineer, within 2 days prior to meeting an agenda listing site problems, variations or extra works instructed by the Engineer, the program/ progress of Works or any other matters relating to the Contract for discussion during the meeting.

The submission to and consent by the Engineer of such program or the provision of such general descriptions or cash flow estimates shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

1.4 Safety

- 1.4.1 In respect of all workmen/ labour, directly or indirectly employed by the contractor in relation to the works, the Contractor shall at its own cost and expense comply with all safety precautions in accordance with applicable law. Mere observance of these precautions shall not absolve the Contractor of its liability in case of loss or damage to property or injury/death to any person including the contractor's labour, the client/Engineer-in-charge, consultants, the architect or their representatives or any member of the public.
- 1.4.2 Protective gear such as safety helmets, safety boots, safety belts/harness and safety nets shall be provided by the Contractors at its own cost and expense. Such requirements shall also be applicable to all Sub-Contractors. It shall be the responsibility of the Contractor to ensure that such protective gear is worn at all times by all labour/ workmen employed at the site.

The Contractor shall:

- (a) Comply with all applicable safety regulations,
- (b) Take care for the safety of all persons entitled to be on the Site,
- (c) Use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons,
- (d) Provide fencing, lighting, working signs, guarding and watching of the Works until completion and taking over certificate has been issued,
- (e) Provide any Temporary Works (including roadways, footways, guards and fences), which may be necessary because of the execution of the Works, for the use and protection of the public and of owner and occupiers of adjacent land.
- (f) Any breach of Safety regulations shall be Penalized by imposing Penalties / Fine at site and the same shall be debited to the Contractor's account.

1.5 Security

Unless otherwise stated:

- (a) The Contractor shall be responsible for keeping unauthorized persons off the Site
- (b) Authorized persons shall be limited to the Contractor's Personnel and the Employer's Personnel; and to any other personnel notified to the Contractor, by the Employer or the Engineer, as authorized personnel of other contractors working on Site.
- (c) Security, Watch & Ward for the project shall be till the completion of the Contractor's scope of work and to be certified by the Project Manager.

1.6 Protection of the Environment

The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.

The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values indicated in the Specification, and shall not exceed the values prescribed by applicable laws.

1.7 Transport of Contractor's Equipment or Temporary Works

Save insofar as the Contract otherwise provides, the Contractor shall be responsible for and shall pay the cost of strengthening any bridges or altering or improving any road communicating with or on the routes to the Site to facilitate the movement of Contractor's Equipment or Temporary Works and the Contractor shall indemnify and keep indemnified the Employer against all claims for damage to any such road or bridge caused by such movement, including such claims as may be made directly against the Employer, and shall negotiate and pay all claims arising solely out of such damage.

1.8 Contractor to Keep Site Clear

During the execution of the Works the Contractor shall keep the Site reasonably free from all unnecessary obstruction and shall store or dispose of any Contractor's Equipment and surplus materials and clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required.

1.9 Dumping of unwanted Debris etc.

The Contractor shall not dump building debris, chemicals or any toxic or polluting matter at the site or any vacant land or at the roadside or into any drain or canal. All debris arising out from the Contractor's occupation shall be collected, stored and thereafter removed from the site to a permitted Contractor's dumping ground, at the sole expense of the Contractor.

2.0 Site Hygiene

The Contractor shall keep the site free from stagnant water and provide temporary drainage to ensure that no stagnant water remains at site. Dirty water shall not be allowed to drain into the Public drains. The Contractor shall not leave empty containers or receptacles capable of collecting water and forming breeding places for mosquitoes in the open and shall take all necessary steps to prevent the breeding of mosquitoes on the site.

2.1 Use of Site by Contractor

The Contractor shall not use the Site for purposes other than that of carrying out the Works and he shall obtain the approval of the Engineer for sitting of all spoil heaps, temporary roads, rail and sleeper tracks, paths, sheds and other structures.

2.2 Clearance of Site on Completion

Upon the issue of any Taking-Over Certificate the Contractor shall clear away and remove from that part of the Site to which such Taking-Over Certificate relates all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave such part of the Site and Works clean and in a workmanlike condition to the satisfaction of the Engineer. The Contractor shall not be entitled to retain on Site any such materials, Contractor's Equipment and Temporary Works as required by him for the purpose of fulfilling his obligation during the Defects Liability Period unless otherwise permitted with specific approval by the Engineer. All such materials, Contractor's Equipment and Temporary Works required for the purpose of fulfilling the Contractor's obligations during the Defects Liability Period shall be located at the Contractor's store located off Site. All such Works that may be required during the Defect Liability Period must be remobilized at the Contractor's expense.

2.3 Progress Reports

Checklists

The Engineer shall provide several Checklist formats to the Contractor for the Project. Before taking up each activity at specific section of the Structure a specific format has to be filled in and to be submitted to the Engineer. The Engineer then inspects the location, pre-construction arrangements along with safety precautions and availability of raw materials, give his approval for the commencement of the activity. One Checklist will be applicable in various stages of the activity and this cycle will complete when the activity completes to the full extent. Any rectification, if deemed necessary by the Engineer, will be mentioned in the Checklist and this has to be carried out by the Contractor to the satisfaction of the Engineer. The Contractor shall enclose copy of these completed checklists in the related Payment Application, without which, the specific area shall not be considered for payment.

2.4 Temporary Site Facilities

The Contractor shall provide temporary site facilities for Employer and his representatives as required for the project, for better performance of the project. The requirements of the facilities shall be as listed in the Special conditions of contract.

3 Alterations, Additions and Omissions

3.1 Variations

The Engineer shall make any variation of the form, quality or quantity of the Works or any part thereof that may, in his opinion, be necessary and for that purpose, or if for any other reason it shall, in his opinion, be appropriate, he shall have the authority to instruct the Contractor to do and the Contractor shall do any of the following, provided however, that no work that radically changes the original nature and scope of the Work:

- (a) Increase or decrease the quantity of any work included in the WO,
- (b) Omit any such work [but not if the omitted work is to be carried out by the Employer or by another Contractor].
- (c) Change the character or quality or kind of any such work,
- (d) Change the levels, lines, position and dimensions of any part of the Works,
- (e) Execute additional work of any kind necessary for the completion of the Works, or
- (f) Change any specified sequence or timing of construction of any part of the Works.

No such variation shall in any way vitiate or invalidate the Contract, but the effect, if any, of all such variations shall be valued as per agreed contract rates and subject to TAPF approvals. Provided that where the issue of an instruction to vary the Works is necessitated by some default of or breach of contract by the Contractor or for which he is responsible, any additional cost attributable to such default shall be borne by the Contractor.

3.2 Instructions for Variations

The Contractor shall not make any such variation without an instruction from the Engineer. Provided that no instruction shall be required for increase or decrease in the quantity of any work where such increase or decrease is not the result of an instruction given under this clause, but is the result of quantities exceeding or being less than those stated in the Bill of Quantities.

Water & Electricity

Electricity:

The construction power(temporary electrical connection) from local Electricity board will be coordinated and provided by TAPF and single point connection shall be provided at construction site with submeter. However, the usage and consumption of electricity necessary charges/electricity bill to be paid by contractor within stipulated time at EB for uninterrupted power supply and avoid any penalty for late submission of billed amount. The Contractor shall have to make his own arrangement at his own cost during the period of power cut / interruptions/stoppages of power by EB for any reason to carry out the works as per schedule

Water:

Construction water and Drinking water facility shall be under contractor scope. Necessary provisions to be made by contractor as per drinking water (for Consumption) and Construction water (as per Quality guidelines).

The Contractor shall arrange for general lighting within project site premises and inside the structure including in basements, as and when necessary for smooth progress of works, including yard lighting.

It is also the responsibility of Contractor to make alternate arrangements for electrical supply at his own cost in the event of any breakdown so that the progress of work is not affected for want of electricity. No claims for damages or refund of electricity charges shall be entertained on account of above.

Submission of Samples & Sample Approvals

Contractor shall submit the list of samples to be approved by Employer, and the schedule of sample submission in advance. The Contractor shall submit the samples with sufficient time line required for approvals, procurement with lead period etc. in mind. The Contractor shall be held responsible for any delay in submission of samples resulting in delay in completing such activities. Cost of preparing shop drawings, for specialized items as necessary, shall be the responsibility of Contractor, and no additional claims whatsoever in this regard shall be entertained.

Drawings

Drawings provided with Tender/RFQ are to be considered as reference drawings to submit the tender proposals. However, contractor to adhere the final GFC drawings which shall be issued by Client/Employer.

All the detailed drawings required for the execution of the work may not be available immediately after awarding the work. Some of the drawings which are available will be supplied in the first instance and the remaining drawings as required progressively and in accordance with the program of work shall be released, well in time for procurement of materials and execution.

The Contractor shall give adequate notice to the Engineer of any further drawings or specifications that may be required for the execution of the work or otherwise under the WO, well in advance. The contractor along with detailed construction program shall also submit a schedule of drawings as required by him.

Contractor shall be issued 3 sets of GFC drawings. Additional copies will be issued, if requested, and the same will be at the Cost of Contractor. The additional charges shall be discussed and agreed at that point of time.

Contractor shall prepare and submit shop drawings wherever required for the works, and as required by the Engineer / Employer. Contractor shall submit the relevant shop drawings in such a way that the schedule of works is not affected due to this process. Any delay in preparation of shop drawings / submission of samples resulting in delay in said works shall be at Contractors risk and cost.

Storage and safekeeping of Clients Materials / Equipment

Contractor shall be responsible for the proper storage and maintenance of all materials / equipment directly procured by Employer required for the project. No claims whatsoever in this regard shall be entertained.

Storage and safe keeping of all his own materials including construction materials, equipment, bought out items etc. shall be the responsibility of Contractor at his own cost. Proper store rooms with locking facility and security shall be arranged by Contractor at his own cost.

Technical Supervision

The Contractor shall deploy sufficient technical manpower at project location for efficient works supervision, planning, billing, and Quality Control and EHS compliance. Contractor shall submit his Organization chart with all the details and shall adhere to this approved plan throughout the project duration. Any shortage of technical manpower by the Contractor shall be deemed as lapse by the Contractor.

Temporary Service Roads and Access to site

The Contractor shall provide and maintain all temporary service roads and access to project location throughout project duration at his own cost. He shall not object to the use of these roads / access by the Employer / his representatives / sub-contractors or any other agency working at project site. The Contractor is deemed to have visited the site, got studied the place before submitting his quote.

Variation in quantities from BOQ

The quantities mentioned in the BOQ are only indicative and the Contractor shall be paid as per the actual works carried out, completed, measured and certified at site by the Engineer. The variations in quantities from BOQ shall not dilute the responsibilities of Contractor from completing such activities and no escalation whatsoever shall be entertained in this regard. The rates quoted by the contractor shall be firm for the increase / decrease in quantities till complete execution of project.

Price Escalation

The price quoted for individual items in BOQ by the Contractor shall be firm till the completion of project. No price escalation shall be entertained by the Employer on account of any reasons whatsoever and the Contractor shall execute the works on quoted price only.

Submission of as built drawings, O&M Manual etc

The Contractor shall submit the approved "As Built Drawing" blue prints 6 copies and 2 sets of Soft Copies in CD. Also the contractor is to submit the Operation and Maintenance Manual (6 Sets), Test Certificate / Test results (6sets), Product Broachers (6 sets) and Manufacturers Guarantees etc., to the Employer / Project Management Consultant.

Time is the essence of the Contract. The contractor shall ensure that the project is completed within the contract duration. Employer is entitled to claim all establishment costs including the cost of PMC and other infrastructure costs from Contractor in case the project is delayed beyond WO duration.

The Decision for value of penalty assessed by the Employer shall be final and binding. However, this shall not dilute the responsibility of Contractor in completing this scope of work

SECTION-II: GENERAL SPECIFICATIONS.

Scope of Specifications:

This specification gives general description of the works to be executed and a detailed description of materials and workmanship to be used therein. The specification shall be read in conjunction with the other forming part of the work included in the WO/PO.

Standard Specifications:

Unless specifically mentioned otherwise all relevant codes and standards published by the Indian Standard Institution and all other codes/standards which may be published by them before the acceptance of the WO/PO shall apply and govern in respect of design, workmanship, quality and properties of materials and testing.

Contractor to provide:

The Contractor shall provide a notice board, on proper support, 3.00M X 2.00 M in a position approved by the Architect. He shall paint, as approved by the Architect, the name of the work with cost, name of the Architect, Contractor etc. All letters except that of the name of the work shall be in letters not exceeding 50MM in height.

SPECIFICATION FOR RCC WORKS:

The work shall carried out as the following Indian standard codes (latest versions)

1. IS 2502 - 1963 Bending and fixing of bars for concrete reinforcement.
2. IS 456 - 1978 Plain and reinforce concrete.
3. IS 432 - 1960 Mild steel and medium tensile steel bars for concrete reinforcement.
4. IS 1786 - 1966 HYSD steel.

In addition the above specifications, following conditions are required to be followed:

- a) To avoid settlement of concrete, it is necessary to complete the compaction of lithe murum filling under the floors, prior to erection of the formwork for slabs and beams. It is preferably to complete the PCC under the floors before the formwork is erected.
- b) The surface of the form work likely to come in contact with the concrete, shall be treated with soap solution, mould oil or any other approved material so that concrete when laid, will not stick to the form work; thereby facilitating easy removal of the forms. The treatment should be carried out sufficiently before laying of the reinforcement. The forms should be watered prior to pouring of concrete. Care should be taken to prevent reinforcement coming in contact with any oily substance. If however, this does happen gunny bags etc., may be used.
- c) The steel shall be placed exactly in accordance with the drawings and instructions and shall be properly tied, to form a rigid grilling which will not be disturbed during the concreting operations. The splicing shall be kept to a minimum, the joints should be well staggered and so arranged that any given section a minimum of 2/3rd of the bars should be without laps. For splicing of bars of 20 mm dia. & above approved type of welded joints shall be used No 'extra over' shall be allowed for the welding. For bars less than 16mm splicing is to be done by overlapping. Where concrete dimensions are very small, hooks, in the directions of greater dimensions can be provided.
- d) Concrete shall not be cast unless the reinforcement as laid has been checked and certified by Architects or their authorized representatives. Architects should be intimated sufficiently in advance regarding the schedule of concreting certain part of the building so as to allow them adequate time for making the necessary arrangements for checking of the reinforcement, from work centering, etc., and also for supervising the actual concreting operation.
- e) Concrete shall be vibrated carefully until all the entrapped air is expelled. All members of concrete shall first be vibrated by Emerson vibrators and then, by surface vibrators followed by manual ramming.
- f) Concrete mixed designs: For concrete of grade below M15, nominal mixes may be used. However, for concrete of M15 and above the mix should be designed and concreting iterations should be of the 'controlled type' (M 150 is included in the mix designs. However, in absence of design mix for the same, a nominal proportion 1:2:4 may be used with water cement ratio of 0.45.

The design mix, which is on weight basis, may be converted in volumetric equivalent for convenience. Use of weight batcher is also permissible.

The mix design will be obtained from an approved laboratory, at the cost of the Contractor.

- g) Roughening of concrete surfaces should be done thoroughly, after stripping of the formwork so as to obtain proper key for plastering.
- h) The Contractor should include in his rates, the charges for fixing of metallic or other types of inserts for fixing of electrical fitting and fixture, and piping or other service. These inserts shall be fixed by the Contractor as per the drawings and the instructions of the Architect. The cost of providing and fabricating inserts will be paid separately.

CONCRETE WORKS:

01. Scope of Work:

The contractor shall furnish all labour, materials, tools, equipment and services necessary to complete all concrete works in accordance with the Drawings and as specified herein.

Materials and works shall include, but are not necessarily limited to the following:

- a) All foundations, footings and head-walls.
- b) All concrete footings, columns, beams, walls etc., where specifically excluded hereinafter.
- c) Floor Slabs, concrete platforms, chejjas, drop walls, staircases, parapets, etc.
- d) Miscellaneous concrete items such as jumps, pits, ramps, equipment bases and manholes covers.
- e) Embodiment in concrete of items furnished by Owner for example angle-frames, manhole anchor-bolts electric conduct, ducts, and pipes, foundations bolts, etc.
- f) All grouting as required.

2. Materials:

- a) **Cement:** Cement shall be of approved brand of 43 grade ordinary Portland cement conforming to the latest IS. Specifications. All cements shall be fresh when delivered and free from lumps and otherwise undamaged. Cement shall be stored in perfectly watertight, well-ventilated shades. The floor of the shed shall be at least 300 mm above the surrounding ground level.
- b) **Coarse aggregates:** These shall be hard, crushed granite/trap stone having clean, hard, strong, durable, un-coated particles free from injurious amount of soft, friable, thin elongated or laminated pieces and alkaline organic or other detrimental matters. It shall be washed, if so desired by the Architect. Aggregates shall be stored on platforms or otherwise so as to avoid inclusion of foreign materials. It shall be thoroughly wetted before being charged into the hopper of the concrete mixer. **The item shall be inclusive of material cost**

The grading shall conform to the following as far as possible.

Nominal Size of aggregate	Sieve Size							
	80 mm	63 mm	40 mm	20 mm	12 mm	10 mm	No.480.	No.240.
(in percentage)								
63 mm	100	85-100	0-30	0-50	---	---	---	---
40 mm	---	100	85-100	0-20	---	0-50	---	---
20 mm	---	---	100	85-100	---	0-20	0-50	---

12 mm	---	---	---	100	85-100	0-45	0-10	---
10 mm	---	---	---	---	100	85-100	0-20	0-50

Use	Size
Slabs and walls with more than 200mm thickness	40 mm to 10 mm
Columns and girders with least dimensions of 300 mm or more.	40 mm to 10 mm
Slabs and walls under 200 mm in thickness	20 mm to 10 mm
Columns with least dimensions under 300 mm	20 mm to 10 mm

Note : The sieve sizes of 80mm, 63mm, 20, 12mm and 10mm will correspond roughly to B.S. sieve sizes of 3", 2 1/2", 3/4", 1/2" and 3/8" in respectively.

- a) **Fine Aggregate:** Shall consist of natural sand or crushed stone sand or a mixture of both passing IS. 480 sieve. The fineness modules of sand used shall be between 2.6 to 2.8. Sand shall be sharp, coarse, clean and of approved quality and free from earth, dust or other impurity. Sand shall be washed and/or screened if required in the opinion of the Architect. The grading shall conform to the following as far as possible.

Grading Limits for Fine Aggregates (IS. 383)

Sieve No.	Equivalent B.S. sieve No.	Natural sand or Crushed gravel sand	Crushed stone sand
480	3/6 in	95 - 100	90 - 100
240	7 in	75 - 95	60 - 90
120	14 in	45 - 85	40 - 80
60	25 in	25 - 60	20 - 50
30	52 in	5 - 30	5 - 30
15	100 in	0 - 10	0 - 15

Limits for impurities in aggregates (I.S.383)

Clay, silt and fine dust in :

Natural sand or crushed
gravel sand (by weight)

4 percent

1 percent

Crushed stone sand (weight):

10 percent

1 percent

Organic impurities:

The solution obtained by emerging the
Sample in 3% solution of sodium hydroxide
For 24 hours should be of light color.

- d) **Water :** Shall be clean, fresh free from injurious amounts of acids, alkalis, oils or any other deleterious matter. If it is from sources other than a town protected water supply scheme, such sources shall be got approved by the Architects. It will conform to ISI - 456.

- e) **Reinforce steel:** Shall be of tested quality, mild steel bars or high strength deformed bars such as torsteel or T.M.T., Fe-500D grade, complying with the latest Indian Standard specifications. They shall be clean and free from rust, scale, paint or other harmful coatings. Splitter bars or bars coated with paint, etc. will be rejected.

All reinforcement steel shall be used in accordance with the latest I.S. codes such as I.S. 456 - 1978, and related codes. Welding shall be used to provide splicing for bars 20mm and above (both inclusive) No extra over shall be allowed for this. Wire used for tying and securing reinforcing steel shall be galvanized, annealed, soft iron wire of gauge No. 16, 2 wires shall be used for tying, at one place.

3. **Concrete strength:** Strength of concrete required for the following nominal mixes shall be as under:

- 1) Nominal mix M-20 grade at 28 days shall not be less than 200 kg/ sq.cm.
- 2) Nominal mix M-25 grade at 28 days shall not be less than 250kg/ sq.cm.
- 3) Nominal mix M-30 grade at 28 days shall not be less than 300kg/ sq.cm.

Test cubes shall be taken, generally from each 20 cum of concrete poured during the progress of the work, or when a day's concrete work does not amount to 20cum, as required by the Engineer in charge. From each day's quota, 6 samples shall be taken each time for testing. 3 samples shall be tested at 7 days and 3 will be tested at 28 days the strength achieved at 7 days shall not be less than 2/3 of the 28 days strength. The cubes for the tests shall be 150 mm X 150 mm X 150 mm (6" X 6" X 6") and will be tested as specified in I.S. 456-1964 Table 5 "Acceptance criteria for concrete" The result of tests in any of the recognized laboratories shall be taken as final and binding on the contractor. All arrangements for testing concrete cubes shall be made by the Contractor. All the materials and labour for making curing and transporting the cubes for necessary tests including the cost of testing shall be at the cost of the Contractor. Normally cube strengths, substantially in excess of those specified, are expected.

In case the compressive strength obtained from the test cubes of concrete, is less than the minimum specified strength the work is liable to be rejected. If however, the strengths are higher than specified due to good control or otherwise, the Contractor shall have no claim for extra payment.

4. **Formwork:**

All forms for concrete work shall be neatly constructed of finished lumber surface on the side in contact with the concrete except that the forms for the concrete which will be exposed shall be of planed timbers.

Forms and centers shall be clean, watertight, substantial and sufficiently braced to maintain their proper position during the placing, or vibrating of the concrete. Joints in forms shall be horizontal or vertical and shall be close enough to prevent leakage and loss of mortar. Forms once used shall have nails withdrawn and surface to be in contact with concrete thoroughly cleaned before using again. Forms shall be set to line and grade and so constructed and fastened as to produce true lines.

Temporary openings shall be provided at the base of columns and wall forms and other places where necessary to facilitate cleaning and washing out of debris and inspection immediately before depositing concrete.

Forms shall be designed and constructed in such a manner so as to permit removal of sides, leaving the bottoms of members undisturbed. The centering and props for the various members shall be fixed in a workmanlike manner to be approved by the Architects. They shall be of such sizes as the Architects think fit and proper. The centering shall be removed only after permission to that effect has been obtained from the Architects props shall not be less than 75 mm dia. on top and shall be supported on wedges. Planks shall not be less than 35 mm thick. For supporting the roof slab of the vault, the centering planks, runners and props, shall be of such dimensions as approved by the Architects.

The minimum period for keeping the centering in position and for watering after laying the materials shall be as follows:

	<u>Centering</u>	<u>Curing</u>
Slab in general:	10 days	To be done for 21 days and the concrete to be protected from direct rays by spreading non-conducting materials over it.

Under-side of beams:	21 days	----- do -----
Side of beams:	2 days	----- do -----
Columns:	1 day	----- do -----
Lintel Sides:	2 days	----- do -----
Lintel bottom:	15 days	--- -- do -----
Coping:	1 day	--- --do -----
Vault roof slab:	10 days	----- do -----

No centers of forms shall be struck or removed until the concrete placed therein has developed sufficient strength to safely support the loads imposed thereon, and at all times, the consent of the Architects shall be obtained before forms are removed. Under no conditions shall forms, centers, shoring etc. be removed from the above items until the minimum time as specified for the items has elapsed. Extreme care shall be exercised in removing from to avoid injury to the concrete.

The framework shall be so constructed that the maximum permissible deviation of the finished concrete shall not exceed 6 mm vertically and 12 mm in horizontal plane from the theoretical line.

The forms/shutters are to be applied with approved make de-shuttering compound before placing in position. **Use of black waste oil for shutters is not allowed.**

7. **Placing Reinforcement:**

Reinforcing bars shall be accurately bent cold and sized and located as shown on the drawings. No reinforcement shall be bent or straightened in a manner that will injure the material. Bars with kinks or sharp ends shall not be used.

Bars shall be accurately set and held in place by system of bar chairs, bolsters, wire ties of not less than 16 gauge. Spacing and location shall be as shown on drawings.

Blocks of concrete to hold the reinforcement in proper level shall be of relevant strength. The clear spacing between bars shall be not less than 1 1/2 times the maximum size of the coarse aggregate or not less than 25 mm or as may be specified otherwise by the Architect.

8. **Placing Concrete:**

Before placing concrete, the forms shall be thoroughly cleaned of all chips, shavings etc., concrete shall not be deposited in standing water.

Concrete shall be thoroughly worked around reinforcement, embedded items, and into the corners of the forms. Concreting shall be carried on at such a rate that the concrete is at all time plastic and flows readily into spaces between bars. Concrete shall be vibrated with an approved type of internal vibrator. Vibrator shall not be left in any position for more than five (5) seconds and shall not be used against forms in slabs placed on grade, in case of needle vibrator.

Construction joints shall be located and formed as directed by the Architect and shall be such as to least impair the strength and appearance of the structure. Sufficient sections shall be provided in the keys to resist shear. Construction joints in column capitals shall be considered as part of the built monolithic with the floor construction.

9. **Protection:** All the concrete shall be adequately protected from mechanical or other damage for at least seven days.

10. **Defective Concrete:** If any concrete is found defective in strength, not true to line or level, or is poured out of position, the Architects may direct that such concrete be removed and replaced or that other protective measures be taken as he determines. All such repairs and replacement shall be carried out at the Contractor's cost if any load tests are required to be conducted on a concreted member the same shall be got done at Contractor's cost.

11. **Curing of Concrete:** Concrete surfaces, exposed to air, shall be kept free from excessive drying by the use of continuous water spray, bunding, weight burlap cover or an approved curing compound for a period as specified continuously after the concrete is placed, if the curing compound shall be of the resin base type that is not detrimental to the applied part.
12. **Finishing Concrete:**

Slab and Floor Finishes:

a) **Wood Float Finish:** In finishing the tops of concrete slabs which are exposed to weather the forms shall be completely filled with concrete and the surface brought to grade with the little working as possible. Tolerance greater than 1 mm to 1 meter of surface will not be permitted. The surface shall be wood floated until it is free from blemishes and gives a smooth appearance.

b) **Floors:** Floors shall have a hardened finish, which shall be accomplished as follows:

After the forms have been filled with concrete and the surface has been brought to a true plane by means of 'Jitters Buffing' bull floating and wood floating, the floor shall be given a medium sweat finish with hand and or machine steel trowels and allowed to cure until perfectly dry.

A hardener solution or compound shall be applied where indicated strictly in accordance with manufacturer's recommendations.

c) **Walls and Ceilings:** Shall be form finished where indicated otherwise as per (d) and (e) here in after.

d) **Other surfaces:** On all other surfaces, all voids and honeycombs shall be patched after forms are removed. Patching shall be done by chipping and scarifying the defective area, and filling with grout composed of one (1) part of cement and two (2) parts of sand (by volume). The surface to be patched shall be thoroughly wetted before applying the grout. Patched areas shall match adjacent concrete in appearance.

e) **Finishing with plaster:** All concrete surface which are to receive cement plaster shall be hacked 7 mm to 10 mm deep with minimum 100 hacks per sqm.

13. **Bonding and Construction Joints:** Before depositing new concrete on or against concrete which has set, forms shall be tightened and old concrete surface shall be roughened cleaned and drenched thoroughly with water. Reinforcing steel shall be cleaned of all dried cement mortar and loose mill scale. The concrete joint to be applied with a coat of Nitobond-Ep or equivalent bonding agents, before pouring new concrete.

Concrete in each unit of construction shall be placed continuously, construction joint locations will be as shown on the plans or as approved and shall be kept to a minimum consistent with sound construction practice.

All construction joints shall be made 'Water tight by the use of key ways grouted with cement mortar. A layer of cement mortar (1:2) mixed or as specified should be laid over the surface of the old concrete before placing new concrete there on. Where shown on plans, water stops shall be provided.

14. **Grouting of steel column Bases:**

All column base plates shall be grouted with cement mortar mixed 1:2 to a thickness as specified and shall be mixed as thickly as possible consistent with fluidity. It shall be consolidated by thoroughly ramming with suitable blunt hammer, until the space has been completely filled. Non-shrink adhesive, where indicated, shall be provided as per manufacturer's recommendations.

15. **Anchors, Sleeves, Inserts etc.:**

Embed into the concrete, all the necessary anchors, sleeves, inserts, wall ties etc. as may be required for the installation of other work. All such items will be furnished to the contractor by other with the necessary instructions and templates for their placement. Bolts shall project from the face of the concrete, the distance called for on the details or a sufficient distance to allow for the proper attachment intended. All threads shall be oiled and protected by water proof caps.

16. **Clean-up:**

Any and all work of this and/or other traders soiled or damaged in the execution of the work under this section of the specification shall be thoroughly cleaned, repaired and replaced, periodically during the construction and immediately after the completion of the work covered by this section of the specification the Contractor shall remove all the scrap material, debris etc. remaining from his work from the premises leaving the premises in a clean and orderly condition.

17. **Measurement:**

All concrete work shall be measured and paid for as per I.S. 1200 specifications pertaining to the method of measurement of building work.

BRICK WORK:

Mortar Preparations:

Cement mortar for brick work and pointing shall be generally be as specified herein namely in proportion of one of cement with 6 of sand by volume, or as indicated otherwise. Mortar shall be prepared by mixing cement and sand in specified proportion in dry. The mortar shall be used within 20 minutes of mixing. No mortar that has begun to set shall be used.

Materials:

Bricks shall be best leading make workable B.B. uniform size, shape and colour and must be well burnt so as to give a clear ringing sound when struck. They shall be clean whole and free from flaws, cracks, stones or lumps of any kind, especially lime. They have sharp edges and angles and even surfaces and shall be sound and hard to resist compression. They shall be from a source to be approved by the Architects.

No brick after immersion in water for 24 hours shall absorb more than 15 percent of its weight. The minimum crushing strength of the brick would be 30 kg /sq.cm., when thoroughly soaked in water and 39 kg / sq.cm. when dry.

4. **Workmanship:**

All brick shall be kept soaked in water for at least 12 hours prior to use. The work shall be set out by the Contractor. No brick bats shall be used for the work except where required to complete a standard bond.

All joints in brickwork shall be uniformly laid. Each layer of brickwork shall be laid plumb and level and with correct break of joints. No mortar joint shall exceed 15 mm in thickness.

The works shall be kept wet for at least 10 days after laying the last course and afterwards shall be watered twice a day for one month.

Brickwork shall not be raised more than 10 courses a day unless otherwise approved by the Architect.

Brickwork shall be uniformly raised all round and no part shall be raised more than 1 meter above another, at any time. The Contractor shall provide all necessary openings for doors, windows or such other survivals and shall embed all fitting and fixtures (if separately paid for) at no extra cost.

The brickwork is to be carried out with all necessary set backs, projections, cuttings, toothings etc., which are shown on and in strict conformity with the drawings.

All uneven, irregular and bad brickwork shall be demolished if deemed necessary by the Architects and re-built at Contractor's expenses.

All joints of brickwork to be plastered or pointed, shall be properly raked to a depth of 12 mm as the work proceeds. In no case mortar which has set shall be removed from joints by hammering, chiseling or any such manner so as to cause damage to the brick, but shall be raked out with a suitable metal tool before the mortar sets.

115 mm and 225 mm brick walls shall be built fair faced on one side only. All other walls of greater thickness shall be built without exception with fair face to both sides.

Where specifically indicated, 115 mm or thinner brick works shall be executed in one of the following ways.

With R.C.C. stiffeners: Brick work shall be carried out in panel measuring approximately 1.5 x 1.5 m with R.C.C. (1:2:4) verticals of 12 cm x 12 cm and horizontal stiffeners 12 cm x 8 cm both reinforced with 4 nos., 6 mm dia. bars laid in (1:2:4) concrete properly filled in and cured. Such R.C.C. work shall not be measured separately but will be included in the rate for brickwork.

In lieu of hoop iron, the Architects may direct the use of mesh or M.S. bars as reinforced.

STONE MASONRY:

Stones shall be set level, plumb, with uniform joints set in full bed of mortar, with joints filled. The joints should not be more than 25 mm.

All stones to be well wetted except in frosty weather, Rake out mortar joints when setting.

Utmost care shall be taken during construction that surface of the stones is not spoiled by concrete or mortar dropping on the stones. The surface of the stones shall be immediately cleaned with water if any concrete or mortar does fall on the stone faces.

Stones for masonry shall be best hard stone, locally obtainable from approved quarries. The masonry, wherever required, shall be composed generally of large stones clean flat bedded, properly selected for their places and carefully laid, with a suitable proportion of smaller stones and chips to fill up the interstices. The whole work shall be hand set and solidly bedded in and surrounded with mortar on every side except the face. There shall be no hollows or dry portions in work nor pinning in the face. The face stone shall be flat-bedded, shall tail back and be bound well into the body of the wall and shall not be of height greater than either the breadth of face or length of the tail. Through stones, covering the whole width or thickness of the walls of 60cm, long where the walls are thicker than 60cm shall be inserted at every meter measured horizontally and vertically. The rates for rubble masonry shall include the extra cost of the through stones. The face of the wall shall be shaded from the sun and kept well moistened for at least 10 days after completion.

The height of course shall not exceed 60 cm in a day. When the work is stopped on the day or on holiday or when up to its full height, tables shall be formed on the surface with cement mortar and kept full

Selection of proper stones, breaking of boulders, etc. in case the wall is to be constructed from stones available at site, scaffolding if necessary, racking out joints, preparing mortar tables for stagnation of water for curing etc. should be complete.

FLOORING SKIRTING AND DADOOING:

Ceramic tiles flooring and Dadooing:

Ceramic tiles shall unless otherwise indicated be 300 mm X 300 mm X 6 mm thick in size for flooring and of 200X300X6mm for dadoing, and of best quality, Indian make obtained from approved sources.

Shahabad/Cuddappa/Kota/Polished Granite flooring / dadoing :

Shall be of selected quality, hard, sound, dense and homogeneous texture, free from cracks, decay, weathering and flaws. Stone slabs shall be of uniform colour and as approved by the Consultant. They shall be machine cut and machine polished where specified and shall conform to the required sizes. Thickness shall be as specified in the respective items. The slabs are to be of approved size and of approved shade as approved by the Architects.

Measurement will be made in square meter of area covered.

WOODWORK, CARPENTRY, JOINERY AND PAINTING:

1. Timber:

Timber to be sound, bright and well conditioned, clean, free from waves, injurious open shapes, large loose or dead knots, and cut square and straight all to be thoroughly seasoned and with only a very small proportion of bright sap and no discoloured sap whatsoever, will be allowed. The whole of the timber to be cut into required scantlings at least three months before being framed. Timber shall generally conform to the Indian Standard specifications.

Scantlings of all types of timber shall be straight. Warped scantlings shall not be used. Before use on the work, the scantlings shall be kept in a covered and well ventilated place and shall be placed in alternative longitudinal and transverse layers with air spaces of not less than 25 mm between them. The sizes of scantlings will be as per drawings, after the frames are made.

2. Workmanship:

The workmanship shall be of the best quality. All 'Wrought' timber is to be saw planed, chipped or otherwise machine worked to the correct sizes and shapes indicated on the drawings or as specified. The finished scantlings shall be of uniform width and thickness throughout. Where the nominal dimensions are stated for 'Wrought' timber, an allowance of not more than 1.6 mm shall be permitted for each 'Wrought' surface.

All carpenter's work shall be accurately set out and framed together and securely fixed in the best possible manner and with properly made joints. All joints must fit accurately, without welding or fitting. All nails, screws, plugs, pins etc., shall be provided as necessary and as directed and approved. After the woodwork has been erected, if any under shrinkage or bad workmanship is discovered the contractor shall forthwith, amend the same without any extra charge.

The joiner shall perform all necessary mortising, tenoning, grooving, matching, tonguing, housing, riveting and all other works necessary for correct jointing. He shall also provide all metal plates, screws, nails and other fixings that may be ordered by the Architect or that may be necessary for the proper execution of the joinery work specified. Joiner work specified. Joiner shall also carry out all works necessary for the proper construction of all framings, linings etc., and for their support and fixing in the buildings.

Joinery shall be constructed exactly as shown on the drawings or as instructed by the Architect. Where joints are not specifically indicated, they shall be the recognised form of joints for each position.

Loose joints are to be used where provision must be made for shrinkage or other movements acting, other than in the direction of the stresses of fixing or loading.

Glued joints are to be used where provision need not be made for shrinkage or other movements in the connection and where sealed joints are required. All glued joints shall be cross tongued or otherwise reinforced. All nails, screws etc. are to be punched and puttied. All surface to be glued or to be kept clean, free from dirt, dust, sawdust, oil and other contamination adequate pressure should be applied to glued joints to ensure intimate contact, the same is to be maintained while the glue is in settings.

All skirting, architraves, plates and other joinery works shall be accurately scribed to fit the contour of any irregular surface against which they may be required to form a close, butt connections.

The joiner shall take all necessary measures to check or prevent capillary penetration of water in the joints and open connections of external joinery works, and in all other positions where joinery works may be exposed to water.

The joiner shall ensure that all weathering surfaces, throatings, grooves and joints etc., and all open connection in external joinery works shall be properly executed and shall obtain a reasonable degree of weather resistance. The doors and windows shall be provided with M.S. holdfasts out of 50 mm x 6 mm thick flats fixed in to the jambs of walls and embedded there in cement concrete 1:2:4. The number of holdfasts shall be as indicated in the drawings. Wherever necessary, rawl plugs, bolts etc. shall be used for fixing, framing etc. Iron screws shall be used unless otherwise indicated.

All exposed woodwork in country teak shall be painted with three coats of oil paint of approved make, quality and shades.

All woodwork in contact or embedded in masonry work shall be treated with two coats of solignum or coal tar as directed by the Architect, prior, to installation. Other area of woodwork is to be applied with a coat of wood primer before installation.

3. **Fixtures and Fastenings:**

The scale, quality, materials and workmanship of all fixtures, and fastenings shall be as indicated in the Bill of Quantities and drawings and drawings or as directed by the Architect.

All fixtures and fastenings shall be new, sound and strong. They shall be of best quality. The size, shape, designs and finish shall be as shown on drawings and approved by the Architect. Samples of all fixtures and fastenings shall be got approved by the Architect and shall be deposited in the Architect's site office for reference.

All fixtures shall be fixed to be joinery in a secure and efficient manner. And of the fixtures damaged during fixing, shall be replaced by new ones in their place and the surface of joinery made good where affected, at the Contractor's. Metal sockets shall be provided to all bolts where the bolts enter brick, stone, concrete etc. These shall be securely fixed flush with the surface into mortises and cemented. Mortise plates over holes shall be used in situations where the bolts enter wood, parliamentary hinges shall be used when so shown as in the drawings as required or as directed by the Architect. But and similar hinges shall be counter sunk on the leaf edge and wood frame to a depth equal to the thickness of the flaps of the hinges.

Details of fittings & fixtures to be provided: (per door)

Holdfasts made out of 40mm X 6mm M.S. flats: 250mm long: 6 nos.
 250mm X 16mm heavy duty C.P. Alldrops : 1 no.
 125mm long heavy duty C.P. handles : 2 nos/shutter.
 125mm/150mm (depending upon the shutter size) iron oxidised I.S.I. Butt hinges:
 Single shutters : 4 nos.
 Double shutters : 3 or 4 nos.
 2000mm X 10mm Al. heavy duty tower bolts : 2 nos/shutter.
 Heavy duty brass door stoppers : 1 no. per shutter.
 Rubber/plastic bushes : 2 nos. per shutter.
 250mm X 16mm C.P. latches : 1 no.

All the fittings & fixtures for part glazed & part paneled entrance doors are to be of ornamental type brass including the hinges.

10. The rate of wood to include the cost of the following in teralia:

- Providing and fixing of various fittings and fixtures.
- Painting, applying wood preservatives etc.
- Screws, nails, holdfasts etc.
- Fixing and erecting in position all woodwork.

Woodwork in general shall be measured as per IS. 1200 unless items of the Bill of Quantities.

WATER PROOFING AND ALLIED ITEMS:

1. Water proofing of roofs (flat, sloping or curved) with Bituminous felts:

- a) **Scope of work:** Providing laying and finishing members or coating as per manufacturer's specification including all materials, labour, scaffolding, tools and equipment's etc., all complete.
- b) **Materials:** Cement and sand shall conform to IS 269 and IS 1542 respectively.

Water proofing compound shall be of approved make and quality of tar felt as per IS 1322.

The bonding material shall consist of blown type bitumen conforming to IS 702 or residual bitumen conforming to IS 73 or a mixture there of, selected to withstand local conditions of prevailing temperature and gradient of roof surface. The penetration of bitumen shall be limited to 40 when tested in accordance with IS 1203.

c) **Workmanship:** Work shall be carried out as per clauses 5.01, 5.02, 5.03, 5.04 and 5.05 of IS 1346.

The normal treatment of waterproofing as outlined in clause 6.02 of IS 1346 shall be rigidly adhered to. The sequence of laying shall also conform to clause 7 of IS 1346.

2. **Expansion joint filler material:**

a) **Scope of work:** Work includes providing and fixing expansion joint filler material between columns, in roofs, in floors and walls as shown on drawing including scaffolding, tools so as to complete the job in all respects.

b) **Materials:**

Bituminous Expansion joint filler: This shall be fiber board of required and of approved make such as 'Shalitex' Shalimar expansion joint filler, or equivalent.

Sealing compound and primer: This shall be of approved quality such that produced by Shalimar Tar Products (1935) Ltd., or equivalent.

c) **Workmanship:** The entire work shall be carried out strictly as per manufacturer's specifications. The fibrous board shall be trimmed to correct size as shown on the drawing and shall be secured in position without any distortion horizontally or vertically. The sealing compound shall be heated and placed as per manufacturer's specification on the primer, splied to the jointing surface to the desired depth and length. The exposed surface of the sealing compound shall be finished off in the form as shown on the drawing.

All the stains of the sealing compound on the brick or concrete surface shall be removed.

SPECIFICATIONS FOR PLUMBING AND SANITARY WORK:

1. Stone Ware Pipes:

Drains shall be laid in straight lines and to even gradient as shown in the drawings. Adequate care shall be exercised in setting out and determining the levels of the pipes and the contractor shall provide suitable instruments templates and equipment necessary for the purpose.

The pipes before being laid, shall be thoroughly cleaned, specially for each joint, sufficiently long to entirely surround the spigot end of the pipes, the gasket to be driven as far as possible in to the joining by means of a suitable instrument. The spigot shall be centered in the socket and after the joint has been thoroughly cleaned and moistened the socket shall be filled with neat cement paste, which shall be splayed off to form a neat filled around the pipe. Each pipe shall be properly bound in, so that the invert is to a true and even gradient. Wherever practicable, all main drains shall be commenced at the point of the out fall the necessary joints for the branch drains being inserted as the work proceeds until the mains are complete. The branch drains shall then be commence at the point of their junctions with main drains. The whole of the drainpipes shall be accurately laid and butted closely together at the joints. Any earth, cement or other material entering the pipeline shall be thoroughly cleaned out of the pipes as the work proceeds.

After sufficient interval has been allowed for the joints to set, and before filling the trench, the joints of the pipes and drains shall be proved water-tight by filling the pipes with water to a level 2 meter above the top of the highest pipes in the length to be tested closing the ends of the sections and maintaining this water level for a period of one hour. If the testing is to conform to the regulations of the local authorities it shall be done accordingly, to the satisfaction of the local authorities.

All such testing shall be done wholly at the Contractor's expenses inclusive of apparatus, provision of water etc. and the rate covers all the above works.

2. **Gully trap:** Gully trap shall be 150 mm x 150 mm or any other size, glazed stone are, laid on 15 cm. P.C.C. (1:3:6) bed with cement plaster rubbed smooth. A full size 300 mm x 300 mm or as specified cast iron frame and over, painted two coats hot tar, shall be fixed securely on top. The rate includes all these works as specified.

3. Closets:

Closets shall be earthenware of fire clay, glazed inside and outside. The bore of water shall be large and the depth of the seal shall not be less than 50 mm or as specified.

The seat of European closet shall be of plastic/PVC of approved make and colour.

A sample shall be approved by the Architect before supply is effected.

4. Flushing Cisterns:

Where not specified, the flushing Cisterns for W.C.S. and urinals shall be of best quality as approved by the Architect. The cisterns shall be hard plastic/PVC painted white 'Duco' spray paint where specified and with cover and bracket etc., complete. The capacity of cistern for Indian/European closets shall be (10 liters) cisterns of European type closet shall be of 'Low' type and approved make. They shall be fitted with unions for connection, to lead service pipes. The flush pipes shall be fixed with a slope not less than 40. Over flow from flushing cistern shall discharge in to open, clear of the building.

5. **Mode of Measurement and Payment:** The WO/PO shall be for one meter of pipe length as laid including specials. The length shall be measured net on straight and curved sections along the center line of the pipeline per pipes and specials, correct up to one centimeter.

6. Materials:

a). Water clossets, Urinal pans, Washbasins, Oval Wash Basin etc: Hindustan/Parryware/Cera/ Jaquar equivalent approved make.

b). C PVC pipes: 'ASTRAL' / equivalent approved make.

c). Fittings and accessories: 'ASTRAL' / equivalent approved make.

d). Rigid PVC PEHD water supply pipes: Prince/Oriplast/equivalent approved blue pipes.

e). Rigid PVC soil pipes and fittings: Prince/ Supreme / Astral / Ashirvad make.

f). C.P. fittings & fixtures: Mark/Jaquar / Mark / Ess-Ess /equivalent approved make.

e). Stainless Sink: AMC/Diamond / Nirali.

All sanitary-plumbing materials are to be got approved by the Architect before using it at the site.

SPECIFICATIONS FOR ROADS :

These specifications shall apply to all such highway works as required to be executed under the WO or otherwise directed by the Architect. In every case the work shall be carried out to the satisfaction of the Architect and conform to the location, lines, grades and cross-sections shown on the drawings or as indicated by the Architect. The quality of work and materials shall comply with the requirements set forth in the succeeding sections. Where the drawings and specifications describe a portion of the work in only general terms and not in complete detail, it shall be understood that only the best general practice is to prevail, materials and workmanship of the best quality are to be employed and the instructions of the Architect are to be fully complied with.

Note: 5% percentage wastages on all issued materials will be allowed; wastages above these limits will be recovered from the contractor at market rates.

ELECTRICAL WORK:

A. WIRING SYSTEM

SCOPE

1.1 The scope of work under this section generally covers internal wiring for lights, fans, exhaust fans, call bells, fan coil units, geysers, power sockets etc., The contractor shall provide all materials, labour, equipment, scaffoldings, etc., as required for the completion of wiring installation called for. The wiring shall generally be done using PVC insulated copper conductor wires in PVC/M.S./G.I conduit as called for including providing switches, sockets, plug tops, fan regulators, outlet boxes etc.,

1.2 STANDARDS APPLICABLE

1.2.1 The applicable standards for above work shall be as listed below:

IS: 732 Code of practice for electrical wiring installation (System voltage not exceeding 650 V).

IS : 1646 Code of practice for fire safety of buildings (General Electrical installation).

IS : 2667 Fittings for rigid steel conduits for electrical wiring.

IS : 3480 Flexible steel conduits for Electrical wiring.

IS : 3837 Accessories for rigid steel conduit for electrical wiring.

IS : 694 PVC insulated cables.

IS : 2509 Rigid - non-metallic conduits for electrical wiring.

IS : 6946 Flexible (Pliable) non-metallic conduits for electrical installation.

IS : 1293 3 Pin plugs and sockets.

IS : 8130 Specifications for conduits for electrical installation.

IS : 3854 Switches for domestic purpose.

IS : 3415 Fittings for rigid non-metallic conduits.

IS : 4648 Guide for electrical layout in residential building.

IS : 9537 Conduits for electrical installation.

IS : 302 General and safety requirements for household and similar electrical appliances.

IS : 3043 Code of practice for earthing.

IS : 5216 Guide for safety procedures and practices in electrical work.

Indian Electricity Act and Rules.

Regulations for the electrical equipment in buildings issued by the Bombay Regional Council of Insurance association of India.

All standards and codes mean the latest.

1.3 POINT WIRING FOR LIGHTS, FANS, EXHAUST FANS & 5A CONVENIENCE SOCKETS

1.3.1 A point wiring shall consist of the branch wiring from the distribution board together with a switch/fan regulator as required, including providing conduit and accessories, the ceiling rose or pendant holder or a swan holder, or ceiling fan hook box or socket etc., with suitable termination. Point wiring shall include, in addition, the earth continuity conductor/wire from the distribution board to the earth pin/stud of the outlet/switch box and to the outlet points.

The point wiring shall be carried out in the under mentioned manner:

- a) Supply, installation, fixing of conduits and GI pull wire with necessary accessories, junction/pull/inspection/switch boxes and outlet boxes/Fan hook box etc. Switches, switch plates and switch boxes are not required for the lights which are controlled directly from the MCB DB's.
- b) Supplying and drawing of wires of required size including earth continuity PVC insulated wire.
- c) Supply, installation and connection of flush type switches, sockets, cover plates, switch plates, and fixing fan regulator, lamp holder, ceiling rose etc.,
- d) The point shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlets boxes, ceiling roses, lamp holder, connector, extension cord wire, flexible conduits etc.,

1.3.2 POINT RATE

For purposes of measurements and payments the rate for point wiring for lights/fans etc., is divided into two parts.

a) Circuit Main

b) Point Wiring.

a) Circuit Main for Light/Fan Point

The circuit main for lights/fan/6A sockets (where 6A sockets connected to light circuit) shall include the wiring from the MCB distribution boards upto the first switch/light point/fan point. This is measured in linear meter. The scope of work under this section shall include

- i) Supply and wiring in concealed/surface conduit from DB's to first switch/light/fan point.
- ii) Providing and installing PVC insulated copper conductor earth wire.
- iii) Providing and installing GI fish wire (pull wire) in the conduit.
- iv) Termination of wires in DB's and switches using proper tinned copper lugs of crimping type.
- v) Providing and installing necessary pull/junction boxes where necessary.

b) Point Wiring

The rate for point shall include supply, installation, and connection, testing and commissioning of point wiring in conduit. The points shall be measured in No/sets for the set/group of lights controlled as mentioned in SOQ.

The exact scope of work included in the point wiring for the purposes of measurement is enumerated as stated below

- i) Wiring starting from the first switch/light/fan point, where the circuit main is terminated to the various lights/fans/sockets (where 6A sockets connected to light circuit loop), and then looping between the switches/lights/fans/6A sockets etc.,
- ii) Providing and installing all necessary switches, switch plates, sockets, pull/junction/fan hook boxes etc. as called for.
- iii) Providing and installing insulated earth continuity wire in each conduit along with the wiring system.
- iv) Providing and installing G.I. fish wire (pull wire) in the conduits.
- v) Providing and installing ceiling roses, lamp holders where necessary.
- vi) Providing and installing PVC insulated, PVC sheathed flexible three core 1.5 sq.mm extension cords including flexible conduits from light/fan outlet points mounted at ceiling point to the light/fan outlet.

Wiring for 6A Sockets, 16A Power Sockets for Equipment Wiring

Except where 6A sockets connected to the lighting loop which are measured in Number of points, the measurement for wiring of 6A/16A sockets and wiring for power outlets is done as follows :

- i) Length of circuit wire including conduit, accessories and earth wire for power wiring is measured together in linear metre.
- ii) The socket outlet with outlet box is measured in Numbers.

1.4.0 SYSTEM OF WIRING

1.4.1 Unless otherwise mentioned on the drawings, the system of internal wiring shall be as follows :

The system of wiring shall consist of single core, PVC insulated, 650/1100 Volt grade, stranded copper conductor wires/cables laid through concealed or exposed PVC/GI/MS conduits as mentioned elsewhere or as directed by owner/consultant.

1.4.2 GENERAL: Prior to laying and fixing of conduits and light outlet boxes, contractor shall carefully examine the layout drawings and prepare detailed shop drawings, indicating the exact location of light outlets, with distances marked, conduit routing, with sizes, number of wires run in each conduit, control switch location etc., The contractor shall obtain the approval of all shop drawings by the owner/consultant prior to the installation of conduits. Any discrepancy noticed in the design drawings shall be brought to the notice of the owner/consultant. Any suggestions or modification suggested by the contractor shall have approval of Client/Consultant before execution.

1.4.3 Type of Installation

Unless otherwise specified all conduits for surface wiring shall be heavy gauge rigid GI/MS conduits and all concealed installation including conduits running above false ceiling shall be heavy gauge rigid PVC.

All conduits buried in grade or in damp wet areas shall be heavy gauge G.I. conduits.

a) Concealed Wiring shall be done using PVC conduits in the following areas

- i) Staircase area lighting.
- ii) Wiring inside offices.
- iii) Wiring in the false ceiling area.

- iv) All other areas where surface conduit is not specifically mentioned.
- b) Surface Wiring shall be done using Heavy Gauge G.I/Black Enamelled M.S. Conduit.
 - i) Wiring installation in the electrical sub-station room, D.G.room.
 - ii) Pump room, sewage treatment plant room.
 - iii) Ventilation fan room, AHU room, electrical room.

c) Conduit Installation in False Ceiling Area

The PVC conduits shall run exposed using above false ceiling.

1.5 **MATERIALS:**

1.5.1 **CONDUITS**

Type of Conduit

All conduits for fire alarm system irrespective of surface or concealed shall be of G.I/M.S.

Generally concealed electrical wiring installation shall be in PVC conduits and surface wiring in G.I/M.S. conduits.

a) **PVC CONDUITS :**

Non-metallic conduits and accessories shall conform to IS 9537 (part 3) - 1983, IS 2509 & IS 3419 and each conduit shall bear the ISI Mark. PVC conduits shall be of the black, round, heavy gauge polyvinyl chloride (PVC). The conduit shall be plain end type as specified in IS 2509-1973/IS 2537-1983. The conduit internal surface shall be smooth. Only approved quality factory made bends/accessories shall be used. Minimum size of conduits shall be 20mm diameter. PVC conduits shall be rigid unplasticised, heavy gauge having minimum wall thickness of 2.0mm upto 25mm diameter conduit and 2.5mm wall thickness for all sizes above 25mm diameter.

1.5.3 **CONDUIT ACCESSORIES**

PVC CONDUIT BENDS & COLLARS

The PVC conduit bends & collars shall be of heavy duty and preferably of the same make as of conduit. This shall conform to IS 9537/1983 Part III with ISI Mark where necessary bends or diversion may be achieved by means of using bends and or circular inspection boxes with adequate and suitable inlet and outlet termination. In case of recessed installation system. The bends shall be properly secured & flush with the finished wall surface. Elbows shall not be used. No bends shall have radius less than 2 1/2 times the outside diameter of the conduit.

PVC/INSPECTION/JUNCTION/PULL BOXES

The Inspection/pull box/junction box, where used, with relevant PVC conduit installation shall be of heavy gauge PVC and conform to IS specification and shall match with the conduit sizes. The box shall be round/square rectangular with conduit stub projection for termination of conduit. The box shall be of minimum 50mm deep and the size of box shall be suitable to pull/make necessary joints of wires inside the boxes. Extra deep boxes are preferred. The boxes shall have flush type cover. The colour of plate shall match the colour of paint of the surface where installed. The boxes shall have concealed screwed socket for fixing the ceiling rose.

1.5.4 **SWITCH OUTLET & SOCKET OUTLET BOXES**

CONCEALED TYPE OUTLET BOXES

The concealed outlet boxes for switches, sockets, power outlets, telephone outlet, fan regulator etc., shall be of standard factory made and to match the exact requirement of combination of outlets. The boxes shall be fabricated out of heavy gauge CRCA cold rolled

carbon alloy sheet steel with zinc plating (G.I). The size of boxes shall match the type of outlet/switch plate to be mounted on the box. Adequate No. and size of knockout holes shall be provided to terminate the conduits in the box. These boxes shall be of standard factory made product and of same make as of switch plates and sockets. Separate screwed earth terminal shall be provided in the box for earthing.

The outlet box shall be of minimum depth of 50mm. Boxes shall be suitable for grid mounting type of accessories. Long screw shall be provided to take care of the extra plaster thickness to mount the switch plates. Provision shall be made in the box and switch plate to have the minor adjustment of alignment of switch plate to plumb level.

SURFACE TYPE BOXES

The boxes for mounting switches, sockets and other wiring devices shall be either moulded plastic or heavy gauge CRCA sheet steel painted to match the colour of wall. The box shall be suitable to terminate the G.I/M.S. surface conduit into the box. The size and shape of box shall match the exact type and combination of switch plates, receptacles and wiring devices. Deep boxes shall be used to facilitate easy termination of conduit and wires/cables. Separate screwed earth terminal shall be provided in the box for earthing.

LIGHT OUTLET BOXES :

For concealed PVC conduit installation the light outlet box shall be of PVC round/square with knock-out holes. Conduit projection shall be suitable to terminate the conduit to the box. The box shall be made of heavy gauge PVC and the sample to have the approval of Construction Manager before use. The boxes shall have concealed screwed socket to fix the ceiling rose. The boxes shall be minimum 50mm deep.

For surface conduit installation the light outlet box shall be of G.I/black enamelled M.S. boxes. The boxes shall have threaded stub projection having internal threading to terminate the conduits of different sizes. The boxes shall have concealed screwed socket for fixing the ceiling rose. The boxes shall be minimum 50mm deep.

CEILING FAN HOOK BOXES:

The ceiling fan hook box shall be fabricated of 2mm thick G.I/M.S. with adequately sized G.I/M.S. rod/hook to fix the ceiling fan. The hook shall be concealed within the fan hook box. The side extensions of rod shall be sufficiently long to provide adequate anchorage in the concrete. The size of the box shall be such that it should be totally covered by the plastic canopy of the ceiling fan. The box shall have anticorrosive primer coating.

SWITCHES

Switches shall conform to IS : 3854, and IS : 4615. Switches shall be single pole, single or two way as shown on the drawings. They shall be of the molded type rated for 250V, 5/15A. They shall be provided with insulated dollies and covers.

The switches shall be rocker operated with a quiet operating mechanism with bounce-free, snap acting mechanism in an arc resistant chamber. The switches shall have pure silver and silver cadmium contacts. The switches shall be of approved make as indicated in the 'List of Approved Makes'. Switches installed outdoors shall be industrial, metal clad type, and shall be provided in weather-proof enclosure, complete with weather proof gasketed covers.

COVER PLATES FOR SWITCHES & OUTLETS

Switches/sockets/wiring devices plates shall be of the same make as of switches/sockets/wiring devices. These shall be of best quality. Moulded plastic grid mounting type device plates/frames shall be used and these shall match with the type of switches/sockets and boxes.

COVER PLATES FOR INSPECTION/JUNCTION/PULL BOXES

The cover plate for PVC boxes shall be with minimum 3mm thick perspex/formica sheet cover and for the G.I/M.S. boxes, shall be of G.I/black enamelled M.S. plates. The shape of the plate shall match with that of the box.

RECEPTACLES

The sockets shall conform to IS 1293. Each socket shall be provided with control switch of appropriate rating. The sockets shall be moulded type rated for 250 volts and of 6 A or 16 A capacity as mentioned on the drawings. The 16 Amps sockets shall be multi pin (6 pin) automatic shutter type suitable for plugging 6 A/16 A plugs. The shutter shall open when the earth pin of the plug is inserted in the socket. Where called for, the 16 A socket shall have indicating lamp. The socket outlets and switches shall be of grid mounting type. Where called for sockets shall be provided with three pin plug top suitable to the socket and of the same make as of socket. The plug shall conform to IS 6538. The socket outlets installed outside the building/open to sky or in damp/wet areas shall be of weather-proof, water-tight type.

INDUSTRIAL TYPE SOCKETS

The socket outlets single phase or three phase installed in electrical room, D.G room etc., shall be three pin or 5 pin industrial type with MCB (1 phase or 3 phase) control. The socket and MCBs shall be mounted in a sheet steel enclosure and shall be standard factory made product.

CONDUCTORS :

All PVC insulated copper conductor wires shall conform in all respects to standards as listed under sub-head 'Regulations and Standards' and shall be of 650/1100V Grade.

PVC INSULATED WIRES (FOR LIGHT & SMALL POWER WIRING)

The PVC cables shall conform to IS : 696/1977. For all internal wiring PVC insulated cables of 650/1100V grade, single core shall be used. The wires shall have the approval of Tariff Advisory Committee.

The conductors shall be plain, circular stranded annealed copper conductors complying with BS : 6360.

The minimum number and diameter of wires for circular stranded conductor shall meet the requirements set out in the relevant British Standards.

The insulation shall be PVC compound complying with the requirements of BS : 6746. It shall be applied by an extrusion process and shall form a compact homogeneous body. The PVC compound shall comply with the requirements of IS 5831-84.

The cores of all cables shall be identified by colours in accordance with the following sequence.

Single phase	- Red
Three phase	- Red, Yellow, Blue
Neutral	- Black
Earth	- Green or Green/Yellow.

A means of identifying the manufacturer shall be provided throughout the length of cable.

Unless otherwise specified in the drawings, the sizes of the cables/wires used for internal wiring shall be as follows :

In case of circuit wiring for lights, exhaust fans, ceiling fans, bells, convenience socket outlet points:-

2.5 Sq.mm - For Lights/fans/5A socket wiring from DB's upto the outlet points including control wiring where the circuit length from the DB's to 1st outlet is less than 40 m.

In case of power socket outlet circuit.

6.0 Sq.mm - From DB's 20/32 A Industrial type sockets.

4.0 Sq.mm - From DBs to 16 A sockets.

The earth continuity conductor size as indicated in the drawing/SOQ shall be drawn through conduit along with other circuit cables/wires. The size of the earth continuity conductor shall be as follows :-

UNLESS OTHERWISE SPECIFIED MINIMUM SIZE OF EARTH CONTINUITY CONDUCTOR WIRES NOT FORMING PART OF THE SAME CABLE AS THE ASSOCIATED CIRCUIT CONDUCTOR.

Nominal cross sectional area of largest associated copper circuit conductor in sq.mm	Nominal cross sectional area of earth continuity conductor in sq.mm (PVC insulated green colour wire)
1.5	2.5
2.5	2.5
4.0	2.5
6.0	4.0
10.0	6.0
16.0	6.0
25.0	10.0
35.0	10.0
50.0	10.0

Separate circuits shall run for each water heater, pantry/kitchen equipment, window air conditioner, and similar outlets at locations as shown on drawings.

1.6 INSTALLATION OF CONDUIT

1.6.1 CONCEALED CONDUIT SYSTEM

Unless otherwise Specified, all wiring shall be in heavy gauge rigid PVC conduit embedded in wall, or ceiling and concealed in the false ceiling. The size of the conduit shall be selected in conformity with I.S. code and as specified in the table given below. Factory made conduit bends and accessories shall be used. PVC Conduit shall be jointed using Solvent Cement as recommended by the conduit supplier. The conduit in ceiling slab shall be straight as far as possible. Before the conduits are laid in the ceiling, the position of the outlet points, controls, junction boxes shall be set out clearly as per the dimensions and to minimise off-sets and bends. Before the reinforcement rods are kept in position electrical contractor shall mark in paint the position of outlet points and conduit drop on the shuttering. When the outlet boxes are kept in position and before pouring the concrete, all outlet boxes shall be filled with paper to avoid entry of concrete into the box. Conduits in ceiling shall be bonded to the reinforcement rods with G.I. bonding wire at intervals not more than 1000mm, to secure them in position. PVC deep light outlet / pull boxes shall be provided as required. The conduit in ceiling slab shall be laid above the first layer of reinforcement rods to avoid cracks in the ceiling surface. In general the conduit shall not be laid directly on the shuttering surface to avoid cracks in the ceiling surface.

Conduits concealed in the wall shall be secured rigidly by means of steel hooks / staples at min. 750 mm intervals. Before conduit is concealed in the walls, all chases, grooves shall be neatly made to proper required dimensions using electrically operated groove cutting tools to accommodate number of conduits. The outlet boxes for control switches, inspection and draw boxes shall be fixed as and when conduits are being fixed. The recessing of conduits in walls shall be so arranged as to allow atleast 12mm plaster cover on the same. All grooves, chases etc. shall be refilled with 1:4 cement mortar and finished upto wall surface before plastering of walls is taken up by the general civil contractor. Horizontal chases in walls are not allowed. Where unavoidable, prior permission of owner/consultant shall be obtained before making any chasing. Where conduits pass through expansion joints in the building, adequate expansion fitting or other approved devices shall be used to take care of the relative movement. Whenever the conduits terminate into control boxes, distribution boards etc. conduits shall be rigidly connected to the boxes/boards with check nuts on either side of the entry. After conduits, junction boxes, outlet boxes etc. are fixed in position, their outlets shall be properly plugged with PVC stoppers or any other suitable materials, so that water, mortar, vermin or any other foreign materials do not enter into the conduit system. All conduit ends terminating into an outlet shall be provided with bushes of PVC or rubber after the conduit ends are properly filed to remove burrs and sharp edges.

Necessary G.I. pull wires shall be inserted into the conduit for drawing wires before concreting. Insulated earth wires shall be run in each conduit originating from the panel board upto the Light, Socket and Switch boxes. If the Electrical Contractor forgets to install any conduit/boxes etc., before the plastering/painting work is done by other agencies, he may be permitted to install the same with prior permission of owners/ consultant and he shall be liable to make good the wall, floor, ceiling etc. at his own cost.

Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet boxes. Joints in junction or pull boxes are strictly not allowed. Where conduits cross building expansion joints, adequate expansion fittings or other approved devices shall be used to take care of any relative movement.

All conduits shall be installed so as to avoid touching of steam and hot water

pipes.

Conduits shall be installed in such a way that the junction and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the owner/consultant.

A minimum separation of 200mm shall be maintained between electrical conduits and hot water lines in the building.

No run of conduit shall exceed ten meters between adjacent draw-in points nor shall it contain more than two right angle bends, or other deviation from the straight line.

Caution shall be exercised in using the PVC conduits in locations where ambient temperature is 50 degree celsius or above. Use of PVC conduits in places where ambient temperature is more than 60 degree C is prohibited. The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made.

All jointing methods shall be subject to the approval of the owner/consultant.

Separate conduits shall be provided for the following system.

- Lighting wiring
- 16 Amp power outlets.
- 6 Amp outlets and lighting system.
- 24 Volt supply system.
- Telephone/intercom system,
- Fire Alarm system,
- Computer data cabling system.
- Equipment wiring.

CONDUIT JOINTS

Conduits shall be joined by means of plain couplers. Where there are long runs of straight conduits, pull/inspection boxes shall be provided at intervals, as approved by the owner/consultant/construction manager. The conduits shall be thoroughly cleaned before making the joints. In case of plain coupler joints, proper jointing material like a vinyl solvent cement (gray in color) or any material as recommended by the manufacturer shall be used.

BENDS IN CONDUIT

Wherever necessary, long bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside diameter of the conduit. Heat may be used to soften the PVC conduit for bending, but while applying heat to the conduit, the conduit shall be filled with sand to avoid any damage to the conduit. Kinks in the conduit bends shall not be acceptable.

BUNCHING OF CABLES

Cables of AC supply of different phases shall be bunched in separate conduits. The number of insulated wires/cables that may be drawn into the conduits shall be as per the following table. In this table, the space factor does not exceed 40%. However, in any case conduits having less than 20mm diameter shall not be used.

MAXIMUM PERMISSIBLE NUMBER OF 650 VOLT GRADE SINGLE CORE WIRES THAT MAY BE DRAWN IN TO RIGID PVC CONDUITS.

CABLE SIZE IN Sqmm	SIZE OF CONDUITS (mm) (MAX NO. OF WIRES)				
	20	25	32	40	50
1.5	4	8	14	-	-
2.5	4	6	10	-	-
4.0	3	4	8	12	-
6.0	2	4	6	8	-
10.0	1	3	5	10	-

16.0	0	2	4	5	12
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Wires carrying current shall be so bunched in the conduit that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

WIRING :

All final branch circuits for lighting and appliances, shall be single conductor cables run inside conduits. Branch circuit conductor sizes shall be as shown in the load analysis of drawing and conforming to the requirements of the I.E. Regulations and I.S. Code.

Home runs indicated on the drawings for the final branch circuits shall be kept in a separate conduit upto the panel board via switches wherever called for. No other wiring shall be bunched in the conduit unless the other circuit main of same phase runs in the same conduit.

For each lot of wire supply, Contractor shall supply a certificate issued by the Manufacturer stating its origin, date of manufacture, constitution and standards to which it complies and the test certificates.

Looping system of wiring shall be used. Wires shall not be jointed inside the conduit or pull boxes. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of owner/consultant.

Control switches shall be connected in the phase conductors only and shall be 'ON' when knob is down. Switches shall be fixed in galvanised steel boxes. Chromium plated screws shall be used.

Power wiring shall be distinctly separate from lighting wiring.

Each circuit phase wire from the distribution boards should be followed with a separate neutral wire of the same size as the circuit wire.

BUNCHING OF WIRES :

Wires carrying current shall be bunched so that the outgoing and the return wires are drawn in the same conduit. Wires originating from two different phases shall not run in the same conduit.

DRAWING CONDUCTORS :

The drawing and jointing of PVC insulated copper conductor wires and cables shall be executed with due regard to the following precautions. While drawing wires through conduits, care shall be taken to avoid scratches and kinks which cause breakage of conductors. There shall be no sharp bends.

Insulation shall be shaved off like sharpening of a pencil and it shall not be removed by cutting it square.

PVC insulated copper conductor wire ends shall be soldered (atleast 20 mm length).

Strands of wires shall not be cut for connecting terminals. The terminals shall have sufficient cross sectional area to take all strands and shall be soldered. Connecting brass screws shall have flat ends. All looped joints shall be soldered and connected through block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors of all sizes shall always be terminated using cable sockets. At all bolted terminals, brass flat washers of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections.

Only certified wiremen and cable jointers shall be employed to do jointing work. All wires and cables shall bear the manufacturer's label and shall be brought to site in original packing. For all internal wiring, PVC insulated wires of 650/1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in loop system and no joints shall be allowed in the length of the conductors. If the use of joint connections are unavoidable due to any specific reason, prior permission, in writing, shall be obtained from the owner/consultant. No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire, is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of wire. Before the wires are drawn into the conduits, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits. The minimum size of PVC insulated conductor wires for all sub-circuit wiring for light points shall be 2.5 sq.mm.

JOINTS :

All joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made in conduits and in junction boxes. Conductors shall be continuous from outlet to outlet.

MAINS AND SUB-MAINS :

Mains and sub-mains cables or wires where called for shall be of the rated capacity and approved make. Every main and sub-main wire shall be drawn through an independent adequate size conduit. An independent earth wire of the proper rating shall be provided for every single phase submain. For every 3-phase submain, 2 nos. earth wires of proper rating shall be provided along with the submain. The earth wires shall be drawn inside the conduits along with the circuit main. Where mains and sub-mains cables are connected to switchgear, sufficient extra lengths of cables shall be provided to facilitate easy connections and maintenance.

LOAD BALANCING :

Load balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

COLOUR CODE OF CONDUCTORS :

Colour code shall be maintained for the entire wiring installation: red, yellow, blue for three phases, black for neutral, green/yellow green for earthing.

The control wire from light control switches to the light/fan points shall be the same colour as that of the phase/circuit wires feeding that particular loop.

EARTHING

All earthing system shall be in accordance with IS 3043 - 1985 Code of practice for Earthing.

The type and size of earthing wire shall be as specified under the heading of cables.

Each conduit originating from the DB to various outlets shall have one earth wire (PVC insulated green colour wire).

TESTING OF INSTALLATION

Before a completed installation is put into service, the following tests shall be complied with :

INSULATION RESISTANCE

The insulation resistance shall be measured by applying 500 Volt megger with all fuses in place, circuit breaker and all switches closed.

The insulation resistance in megohms of an installation measured shall not be less than 50 megohms divided by the number of points in the circuit.

The insulation resistance shall be measured between

- Earth to Phase
- Earth to Neutral
- Phase to Neutral

EARTH CONTINUITY PATH

The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.

POLARITY OF SINGLE POLE SWITCHES

A test shall be made to verify that every non-linked, single pole switch is connected to one of the phases of the supply system.

COMPLETION CERTIFICATES

All the above tests shall be carried out in presence of Construction Manager and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be retested. The completed test result forms shall be submitted to the owner/consultant.

On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

MEASUREMENTS

Mode of measurement is as follows :

For purposes of measurement the point wiring for lights/fans/6A sockets (where 6A sockets are connected to lighting circuit loop) is divided into two parts.

- a) Point Wiring
- b) Circuit Main

a) POINT WIRING

The wiring for light/fan/6A socket (where 6A sockets are connected to lighting circuit loop) point starting from first light/switch/fan and looping between switches/ fans/sockets etc., shall be measured either in 'Number' or 'Set'.

One light/fan point controlled by one switch is measured in Number (No.)

Set of Two or more light points controlled by one switch is measured in 'Sets'.

Where set of light points wired and controlled directly from MCB DB shall be measured in 'Sets'. The rate for this item shall not include the cost of switch & switch box.

6A socket wiring where connected to the lighting circuit loop is measured in Number (No.)

b) CIRCUIT MAIN

The length of circuit main including conduit starting from MCB DB to first switch/light/fan shall be measured separately in 'Linear Metres' (Rm). (Further wiring is measured in point wiring).

CIRCUIT MAIN FOR WIRING 6A SOCKETS,16A SOCKETS AND POWER OUTLETS SHALL BE MEASURED AS UNDER

Length of circuit wire including conduit starting from MCB DB to outlets and looping between outlets shall be measured in linear metres (Rm).

The commercial type socket outlet with outlet box and cover plate shall be measured in numbers (No.)

The Industrial type socket outlet including MCB, plug top, outlet box and cover plate shall be measured in numbers (No.)

The plug tops where called for shall be measured in numbers (No.)

B. M.V.DISTRIBUTION BOARDS

SCOPE :

This section covers the design, manufacture, assembly, testing at manufacturer's works, inspection, packing for transportation, delivery at site, installation, connection, testing and commissioning of 415V switch boards with guarantee of performance for a period of twelve (12) months from the date of commissioning. The contractor shall provide all materials, labour, equipment, scaffolding etc., as required for the completion of the job.

STANDARDS APPLICABLE

The following standards and rules shall be applicable :

The Distribution Boards shall comply with the latest edition of relevant Indian Standards and Indian Electricity rules and regulations. The following Indian Standards shall be complied with :

IS 4237-83 General requirements for switch gear and control gear for voltages not exceeding 1000V.

IS 5578-85 Guide for marking of insulated conductors.

IS 11353-85 Guide for uniform system of marking and identification of conductors and apparatus terminals.

IS 2147-62 Degree of protection provided by enclosures for low voltage switch gear and control gear.

IS 2675-83 Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V.

IS 2551-82 Danger notice plates.

IS 2516 Circuit breakers Part 1. Requirements (Part I/Sec 1);and tests : Section 1. Voltages not exceeding 1000V ac or 1200V dc.

IS 4064-78 Air break switches, air break disconnectors, air break switch disconnectors and fuse combination units for voltages not exceeding 1000V ac or 1200V dc.

IS 1818-72 Alternating current isolators (disconnectors) and earthing switches.

IS 8623-77 Factory built assemblies of switchgear and control gear for voltages upto and including 1000V AC & 1200V DC.

IS 8828-78 Miniature air break circuit breakers for voltages not exceeding 1000V.

IS 9926-81 Fuse wires used in rewirable type electric fuses upto 650 Volts.

IS 8544-79 Motor starters for voltages not exceeding 1000 Volt A.C. or 1200 Volt D.C.

IS 2959-85 Contactors for voltages not exceeding 1000 Volt A.C or 1200 Volts D.C

IS 9224-79 Low Voltage fuses.

IS 12640-89 Residual current operated circuit breakers.

IS 1248-83 Direct acting indicating analogue (all parts) electrical measuring instruments and their accessories.

IS 2705-81 Current transformers. (all parts)

IS 4201-83 Application guide for voltage transformers.

IS 8197-76 Terminal markings for electrical measuring instruments and their accessories.

Indian Electricity Act and Rules.

415V SWITCH BOARDS

The 415 volt switchboard shall be metal-clad, dead front totally enclosed, indoor type, forming a self supporting continuous board. The front portion of the board shall have individual compartments arranged in tier formation to accommodate draw-out type air-circuit-breakers. The back portion of the board shall contain three-phase and neutral air-insulated busbars, cable terminations, instrument transformers, etc. The busbars and all other outgoing live terminals shall be protected to prevent accidental contact while carrying out maintenance work.

DISTRIBUTION ARRANGEMENT

For single transformer load-centres, the panel shall accommodate one transformer secondary circuit-breaker and specified number of outgoing circuit-breakers all connected to the common busbar.

For two transformer load-center, the 415 volt bus shall be sectionalised and each transformer shall be connected to the corresponding bus-section over its secondary circuit-breakers. Bus-tie circuit breaker shall be provided between adjacent bus sections and the outgoing switchgear distribution on each bus-section shall be as specified.

415 VOLT MAIN BUSBARS

Copper / Aluminium bus-bars shall be used. Busbars shall be made from rectangular sections of high wrought aluminium alloy and the current density shall not exceed 0.8 A / sq.mm and where copper sections are used the current density shall not exceed 1.4 A / sq.mm.

The continuous current rating and the short circuit values which the main busbars are able to withstand shall be as follows :-

TRANSFORMER RATING	CONTINUOUS CURRENT RATING	SHORT CIRCUIT CURRENT RMS SYMMERICAL
Kva	A	A
400	630	15000
750	1250	21600
1000	1600	36000
1600	2500	36000
2000	3200	50000

The neutral bus bars shall be designed to carry 50 percent continuous current rating of the main busbars.

415 VOLT CIRCUIT-BREAKERS

The circuit-breakers shall be triple-pole, air-break draw-out type. All current carrying contacts of the breakers shall be silver plated. Arc-chute fitted on each pole shall be easily removable for inspection of the main contacts. Inter-phase barriers of proper design shall also be incorporated.

The plug connections of main and auxiliary circuit shall be fitted with self-aligning contacts. The fixed position of the plug connections shall be easily accessible for maintenance. Automatically operated shutters shall be provided to screen the fixed portion of the plug when the breaker is fully withdrawn from the cubicle.

The continuous current ratings of the various Circuit-Breaker units at specified ambient temperature shall be as specified. The RMS Symmetrical breaking capacity of the different air circuit-breakers shall be as follows, unless otherwise specified :-

CURRENT RATING OF THE ACBs	BREAKING CAPACITY RMS SYMMETRICAL AT PF OF 0.2 TO 0.3
A	A
200	15000
400	21000
630	36000
1000	36000

1600	36000
2500	36000
3200	50000

OPERATING MECHANISM

The Circuit-breakers shall be either manually or electrically operated as specified. For emergency closing and testing, the electrically operated breaker shall be capable of manual closing. For manually operated breakers, manual, independent-type closing mechanism shall be provided. If manual dependent mechanism is provided then the breakers shall compulsorily have electrical closing and tripping devices. All types of operating mechanisms shall be trip-free throughout the breaker travel and designed to reduce mechanical shock to a minimum during operation. All electrically operated breakers shall be provided with mechanical/electrical anti-pumping device.

Each breakers shall be equipped with visible 'ON' and 'OFF' position indicator on the front door of the compartment, mechanically connected to the circuit-breaker mechanism. Separate ON and OFF indicating lamps also shall be provided.

For electrically operated circuit-breakers, satisfactory operation shall be guaranteed for closing the circuit-breakers with the operating voltage of the drive, in the range of 85 to 110 percent of the rated voltage. The electrical closing shall be either by solenoid or motor operated spring charged mechanism suitable for 240 V AC.

The circuit-breaker shunt trip coil provided shall operate satisfactorily with the operating voltage within the range of 70 to 120 per cent of the rated voltage. The shunt trip coil shall be suitable for 240 V AC. No separate control source will be available as such capacitor trip Circuit shall be provided where shunt tripping is proposed with protective relay so that ability to trip is not impaired by momentary drop in voltage at the time of a fault.

Each circuit-breaker shall be provided with four (4) normally open and four (4) normally closed spare auxiliary contacts in addition to the ones already used for various control purposes. All auxiliary contacts shall be wired internally up to the terminal block.

INTERLOCKS

The switchgear shall be provided with all necessary interlocks designed to prevent incorrect operation and to ensure safety of operating personnel and also the equipment.

The moving portion of the circuit-breakers shall be so interlocked that with the breaker closed it shall not be possible to isolate it from the connected position or to plug it in from the isolated position.

Interlocking shall be provided to prevent operation of the circuit-breaker unless it is fully plugged in or fully isolated and is locked correctly in either position.

The circuit-breaker compartment doors shall be so interlocked as to prevent access to a breaker which is in an energized and plugged in position. Special means shall however be provided for undoing this interlock in an emergency.

Inadvertent withdrawal of a circuit-breaker movable unit too far beyond its supports shall be prevented by a suitable mechanical stop.

The unit shall be provided with "test" position in which the circuit-breaker main contacts are in the fully disconnected position with only the secondary circuits remaining connected. All secondary connections including control, signaling and metering circuits between the fixed and removable sections shall be by means of flexible cable and plug and socket arrangement.

PROTECTIVE DEVICES

The circuit-breakers shall be provided on each pole with any combination of the following protective devices with ratings as called for in the specification:

- i) Direct acting over current tripping device with long time element having inverse time current characteristic for protection against overloads and instantaneous element for short-circuit tripping with alarm contact.

- ii) Direct acting over current tripping device with long time element having inverse time current characteristic for protection against overloads and short time element with definite time delay for short-circuit protection with alarm contact.
- iii) Shunt tripping device with alarm contact.
- iv) Non-directional IDMT earth fault relay.
- v) The under voltage tripping device when specified shall be designed for the following operating conditions:
 - a) The circuit-breakers shall trip for voltage value set between 70 and 35 per cent of rated system voltage.
 - b) The under voltage relay shall not prevent manual closing of the circuit-breaker above 85 percent of rated system voltage.
- vi) The CTs provided for protective devices shall have adequate VA capacity and accuracy class of 10P10.

INSTRUMENTS AND METERS

Instruments, meters and relays shall be of flush-mounted design, housed in dust-proof casing located in an accessible position on the breaker panel. All incoming circuit-breaker units shall be provided with a voltmeter and changeover switch on the live side for indicating the three-phase voltages and ammeter with a changeover switch complete with C.Ts for measuring the currents in all three phases. Ammeters with C.Ts and selector switches shall also be provided for all outgoing feeders. For motor feeders the ammeter shall be provided with a normal scale up to full-load value and a suppressed scale beyond full-load for indication of motor starting current. C.Ts provided for ammeter shall have accuracy Class of 1.0 KWH meters, 15-minute maximum demand indicators shall be provided, where specified.

CABLE TERMINALS

The cable terminal arrangement for incoming 415 volt circuit-breaker from 400 KVA transformer secondary and for all outgoing feeders shall be suitable for single-core and multi-core aluminium conductor PVC insulated cables of number, type and sizes as specified. The termination arrangement of multiple cables shall permit connection and disconnection of each individual cable without disturbing the other cables. For termination of cables suitable lugs of proper size shall be provided. Where armoured cables are to be terminated suitable armour clamps shall be provided.

LOW VOLTAGE BUS-DUCTS

Bus-ducts with 3 phase and neutral busbars shall be able to withstand the short-circuit currents as specified in item 1.04 above. It shall be designed for a rated voltage of 1,000 volts.

The bus-duct shall be of metal-enclosed, dust and vermin proof type divided into factory made sections suitable for easy assembly at site. It shall be complete with mounting arrangement and all necessary accessories required to make the installation complete.

The bus-duct shall have suitable side covers where required for easy access to all the busbars. Space shall be provided within the bus-duct for taking secondary wiring as required, The bus-bar supports and their terminal connections shall be designed to permit expansion and contraction of the bar with a variation in the site ambient temperatures. Throat connection with links shall be provided at the transformer terminal for easy removal of transformer, when necessary.

ALARM AND INDICATION

Each load-centre substation shall be provided with static audible and visible alarm indication with alarm accept and cancellation device. The system shall have arrangement for repeat alarm facilities as well as testing the alarm circuits. The scheme shall be designed to give the following indications:

- i) When any circuit-breaker trips on fault only
- ii) Temperature rise of winding
- iii) Earth fault indication

Provision shall be made for transmitting signals if required to remotely located signaling system to indicate tripping of incoming circuit-breaker on fault and operation of earth fault relay provided in the transformer neutral circuit. Provision shall also be made to transmit the alarm and tripping signals to 33 kV switchboard from which the transformer is fed or to a remote signaling panel.

REMOTE CONTROL SCHEME FOR BREAKERS

For electrically operated circuit-breakers in addition to ON-OFF control switch provided on the front side of the panel, provision shall be made where required for remote closing and tripping of circuit-breakers from an external control desk with arrangement to prevent closing of the breaker by the control switch mounted on the front of the circuit-breaker cubicle.

OTHER CONSTRUCTIONAL FEATURES

All operating handles, control switches, push-buttons, indicating lamps, instruments, meters etc shall be mounted on the front of the cubicles.

The auxiliary relays for temperature alarm and tripping shall be mounted on the incoming breaker panels. Terminal boards shall be provided at the transformer sections for all control circuit taken out from the transformers. All wiring from these terminal boards to the switchgear sections shall be provided with the equipment.

All wiring within the cubicles shall be with PVC insulated cables and shall be effectively protected from possible damage by electrical flashover. As far as possible each essential control circuit shall be contained in the respective cubicle. All wiring shall be such that it is easily identifiable and accessible for maintenance.

For equipment earthing a suitable copper earthing bus shall be provided for the complete length of the switch board and bonded to all the units including the transformer and high tension cubicles. Proper terminals shall be provided for external earth connections to be fully in conformity with IER.

A suitable universal type truck shall be provided with each load-centre substation for withdrawing the breakers from the board. The trucks shall have platforms of adequate mechanical strength for bearing the weight of the circuit-breaker units and shall be provided with necessary guide rails and stops. The height of the platform shall be adjustable to suit the levels at which the different circuit-breakers are mounted on the switchboard.

Identification labels shall be provided for each circuit-breaker and control devices to be located in readily visible positions.

All steelwork of each load-center substation shall undergo rust removal procedure before application of primer and shall be given epoxy paint finish of Aircraft Grey colour as per ISS Shade 693 or any other colour of approved shade.

The busbars of each unit substation shall be painted as per following norms:

- A Phase - Red
- B Phase - Yellow
- C Phase - Blue
- Insulated neutral - White
- Earthed neutral - Black

ABC are the three phases of AC circuit with anti-clockwise vector rotation.

TEST

All equipment shall be tested in accordance with the relevant clauses of applicable standards. All internal wiring shall be checked for correct operation before dispatch.

C M.V. CABLES AND CABLE TRAYS

SCOPE OF WORK :

This section covers the supply, installation storing, laying, fixing, jointing / termination, testing and commissioning of Medium Voltage PVC insulated or XLPE insulated PVC Sheathed armoured aluminium/ copper conductor cables laid in built up trenches, directly buried underground, on cable trays, in pipes, clamped directly to wall or structures etc. as called for in the drawing. The contractor shall provide all materials, labour, equipments, scaffoldings etc., as required for the completion of M.V. Cables, Cable Trays etc., as called for.

STANDARDS APPLICABLE

The following standards and rules shall be applicable.

IS 1554-88 PVC insulated (heavy duty) electric cables Part I for working voltages upto and including 1100V.

IS 8130-84 Conductors for insulated electric cables and flexible cords.

IS 3961-67 Recommended current ratings for cables: (Part 2): PVC insulated and PVC sheathed heavy duty cables.

IS 5831-84 PVC insulation and sheath of electric cables.

IS 7098-89 Cross linked polyethylene insulated PVC sheathed cables.

The individual cores shall have continuous numbering of the core all along its length and also be provided with identification ferrules at both ends. Individual control cables shall have 20% spare cores.

FRLS cables shall be used for fire protection system controls to prevent flame propagation, smoke reduction and to avoid toxic gas emission in the event of a fire. FRLS compound shall be tested rigorously for oxygen index as per ASTM D2863, acid gas generation to IEC 754-1, smoke density to ASTM D 2843 and flammability to SS 424 1475 class F3, IEEE 383 and IEC 332-1.

Manufacturer's name, ISI Mark, cable size and type shall be clearly embossed at regular intervals on all cables.

TYPE AND QUALITY

Medium voltage cables shall be circular, multicore annealed copper or aluminium conductor, PVC insulated, PVC sheathed and steel wire armoured or steel tape armoured construction or unarmoured.. The conductors of cable shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 sq.mm size and above. The cables shall conform to IS:1554 part-I in all respects.

M.V power cables shall have 3, 3.5 or 4 cores, as required and shall have conductors made from electrical purity aluminium conductors conforming to IS : 8130 - 84.

Conductors shall be insulated with high quality PVC base compound. Insulation and outer sheathing compounds shall conform to IS 5831 - 84.

A common covering shall be applied over the laid-up cores by an extruded sheath of un-vulcanised rubber compound.

Armouring of galvanised round steel wires or galvanised flat steel strips shall be provided over the inner sheath.

Outer sheath of PVC shall be extruded over the armouring. Cables shall be manufactured and tested in accordance with IS 1554.

Unless otherwise specified, all control cables shall be multicore, 1100V grade PVC insulated, armoured and overall PVC sheathed with stranded copper conductors of 2.5 sq.mm, conforming to IS 1554. Cores shall be identified by colour scheme of PVC insulation.

RATING :

The cables shall be rated for a voltage of 650/1100 Volts.

Core Identifications :

Cores shall be provided with the following colour scheme of PVC insulation :

1. Single Core : Green yellow for earthing.
2. Two Cores : Red and Black, Blue & Black, Yellow & Black.
3. Three Cores : Red, Yellow & Blue
4. Four Core : Red, Yellow, Blue & Black

INSPECTION : All cables shall be tested inspected at manufacturer's works. However upon receipt at site cables shall be checked for physical damages during transit.

JOINTS IN CABLES : The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoidance of straight cable jointing. This apportioning shall be got approved by the Construction Manager. before the cables are cut to lengths.

Where straight joints in cable are unavoidable, the use and location of such straight joints shall be got approved by Construction Manager.

JOINTING BOXES FOR CABLES : Cable joint boxes shall be of appropriate size, suitable for PVC insulated armoured cables of particular voltage rating.

JOINTING CABLES : All cable joints shall be made in suitable, approved cable joint boxes, jointing of cables in the joint boxes and the filling in of compound shall be done in accordance with manufacturer's instructions and in an approved manner. All straight joints shall be done in epoxy mould boxes with epoxy resin only of makes/types as indicated in the list of approved makes. All terminal leads of conductors shall be heavy soldered upto at least 50mm length.

All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commences. The seals of cables shall not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. The conductors shall be efficiently insulated with high voltage insulating tape and by using preaders of approved size and pattern. The joints shall be completely filled with epoxy compound and taped so as to ensure that the box is properly filled.

Epoxy compound shall be filled as follows :

Equal quantities of resin and hardener shall be mixed thoroughly by hand until the mixture is free from white patches and has uniform colour. No water, oil or any other liquid shall be added to the mixture to make it soft as it will affect the properties of the compound. The mixture shall be used within 30-40 minutes of mixing. The on which epoxy compound is to be used, shall be free from dust, rust, oil, grease and shall be dry. The joint neither be disturbed nor moved till the epoxy compound is completely hardened. A smooth surface can be made by rubbing a damp cloth smoothly on the compound before it sets. The joints shall be painted after they have completely hardened.

Alternatively, ready mix of epoxy cable jointing compound may also be used. In all cases manufacturers recommendations shall be strictly adhered to .

CABLE MARKERS

All underground cables and cable joints shall be marked on the surface by markers generally manufactured and tested to the requirements of relevant Bureau of Indian Standards. Approved CI cable markers shall be provided at every 30m along the route of the cables and at both ends of road crossing, indicating cable joints and cables as applicable. Special CI markers shall be provided at all buried cable joints indicating "Electrical Cable Joints". CI plates duly engraved with the size of the cable and the place it serves shall be tied to the cable at regular intervals of 5m for easy identification of cables.

TERMINATION OF CABLES

Cable termination shall be done in terminal box or cable end box or distribution boards, or apparatus/ equipments. Terminations are to be made with mechanical and glands be tinned/nickel plated, anti corrosive, three piece improved pattern which is to grip inner and outer PVC sheaths as well as the armour of the cable. The cable ends or the core conductor are to be connected by solderless lugs or sockets using crimping tool of approved make for all cables.

All terminations of cable conductors and base conductors shall be mechanically and electrically sound and shall comply with the requirements of IEE regulations.

The connectors or connecting sockets are to have such dimensions so as to limit temperature rise.

When required the water tightness of the terminal boxes may be obtained by filling with a compound preferably plastic flame-retarding

and non-dripping type within the normal range of temperatures.

When the cable is cut during the course of installation the open ends are to be sealed immediately by means of self-adhesive non-hygroscopic tape over a wax water seal to make an air and watertight joint.

INSTALLATION OF CABLES

Cable shall be laid in a manner as indicated on the drawings. Generally cables are laid in the following manner.

- i. In the underground masonry trench.
- ii. On the cable tray/or on cable ladders.
- iii. Buried underground.
- iv. Through pipe sleeves.

Various installation methods are discussed in the following paragraphs.

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. The cable drums shall be rotated in the direction as indicated by the manufacturer. Care shall be exercised in laying cables to avoid forming kinks. The drums shall be unrolled and cables run over wooden rollers, placed at intervals not exceeding two (2) meters.

GENERAL

All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of service.

When cables pass through holes in metal work, precautions shall be taken to prevent abrasion of the cables on any sharp edges.

In every vertical cable ladder, channel, duct, trunking or cable trench containing cables and exceeding three meters in length, internal barriers shall be provided so as to prevent the air at the top of the unit from attaining an excessively high temperature. In every vertical cable shaft, cable trench or any passage of cable through wall, ceiling, floor barriers against spread of fire and smoke shall be provided for compliance with IEE regulations.

Where cable passes through walls, ceiling, floor, it shall run through sleeves of PVC pipes or hume pipes of adequate diameter. After pulling the cable through sleeves, both the ends of the sleeves shall be sealed water tight with fire-resistant material to prevent spread of fire and seepage of water.

Generally along each cable route either in trench or in cable trays/ladders or in pipe separate Two Nos. of earth strips/wires shall run exposed.

Where an installation comprises medium voltage cables as well as extra low voltage circuits, precaution shall be taken in accordance with IEE regulations and shall be physically separated by minimum of 300mm distance.

Metal sheaths and armour of all cables, metal conduits, ducts, trunking, and bare earth continuity conductors associated with such cables, which might otherwise come into fortuitous contact with other fixed metal work shall be effectively bonded there to earth so as to prevent appreciable potential difference at such possible points of contact.

If it is necessary to install cables in a situation where flammable and/or explosive dust, flammable volatile liquid/vapor/gas is likely to be present or where explosive materials are handled or stored, the cabling shall be as per IEE regulations.

UNDERGROUND INSTALLATIONS

The cables shall be laid in an excavated trench. The depth of the trench shall be minimum 750mm., below the final ground level but shall be decided on the number of cables to be laid in the trench so that the vertical distance between two adjacent layers of cables shall not be less than 350mm. The width of the trench shall be decided on the number of cables to be laid in the trench so that the distance between two adjacent cables shall not be less than one cable diameter.

Before laying cables the bottom of the trench shall be well compacted and the cables shall be laid on a 100mm fine sand bedding.

The second layer of 150mm of fine sand then be spread over the cable and shall be further covered by 150mm of compacted soil. For the second layer of the cable same procedure shall be repeated.

The cables shall be protected by placing precast concrete tiles or burnt bricks over the cables on top layer of sand and for the full length of underground cables. Where more than one cable is running in the same trench, the concrete tiles/bricks shall cover all the cables and shall project a minimum of 80mm on either side of the cables.

In any case the top layer of the cables shall be minimum 600mm below the finished level of the ground.

The top of the cable trench shall be well compacted till the finished level of the ground and shall be approved by the Construction Manager. If required a laboratory compaction test shall be carried out in presence of the Construction Manager.

H.V., M.V., cables shall not be laid in the same trench/cable tray and/or along side of water main.

Cables under road crossings and any surfaces subjected to heavy traffic shall be protected by running them through hume pipes of suitable size.

The relative position of the cables laid in the same trench shall be preserved and the cables shall not cross each other as far as possible. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius of bend not less than 15 times the diameter of the cable. Minimum 3 meters long loop shall be provided at both sides of every straight joint and 5 meters at each end of the cable. Distinguishing marks shall be made at the cable ends for identification.

Insulation tapes of appropriate voltage and in red, yellow, and blue colors shall be wrapped just below the sockets for phase identification.

All the excavation and back fill including timbering, shoring, and pumping required for the installation of the cables shall be carried out as indicated on the drawing and as per requirements laid down elsewhere or as per Construction Manager's direction. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layers not exceeding 150mm. At each layer compaction test shall be carried out in presence of Construction Manager. Each layer shall be properly rammed and consolidated before laying the next layer. The contractor shall restore all surfaces, roadways, side walls, curbs, walls, landscaping or other works cut for excavation to their original condition, the satisfaction of the Construction Manager. Suitable approved type cable markers shall be installed along the cable route & where change of direction takes place.

CABLES INSTALLED INSIDE THE BUILDING

The cables inside the building shall be installed in one of the following manner, as indicated in the drawing and approved by the Construction Manager.

INSTALLED IN BUILT-UP TRENCH

The cables laid on the bottom of the structural trenches shall not lie freely upon the trench bottom. They shall be raised to prevent the possibility of their coming into contact with deleterious materials.

The cables laid in the trench shall be laid on angle iron brackets/cable tray/cable ladder/cable troughs/cable racks as indicated on the drawings, and as approved by the Construction Manager. Where cables are clamped to the wall a minimum clearance of 100mm shall be maintained between wall and cable and minimum 150mm vertical clearance shall be maintained between two cables. Where cables are laid on brackets the brackets shall not be fixed more than 500mm apart to avoid sag in the cables, where the cables are laid on cable tray/ladder/troughs/racks, minimum 300mm distance shall be observed between adjacent tier of tray/ladder/ troughs/racks, and cable shall be fixed minimum 25mm away from the wall, and minimum of one cable diameter distance shall be observed between two adjacent cables. Cables shall be properly fixed with the tray/ladder/troughs/racks with cable tie or saddles or straps.

CABLES ON CABLE TRAYS/LADDERS UNDER THE CEILING OR ON WALL

Where cables are installed under/above suspended ceiling or below ceiling or on wall, they shall be laid on a perforated G.I. cable tray/ladder type cable tray and shall be run in such positions that they are not liable to be damaged by contact with the floor or the ceiling or other fixtures.

The cable tray/ladder shall be properly fixed with tie rod to the ceiling. The concrete inserts for fixing the tie of shall be put in place while casting the slab. If insert plates are not placed in position, Anchor fasteners shall be fastened to support cable trays. The cable tray route shall be co-ordinated with other services to avoid crisscross of all the services.

While laying the cables on the tray minimum one cable diameter distance shall be observed between two adjacent cables. 25% space shall be kept spare for any future installation.

The trays shall be made of 16 SWG/12 SWG G.I. perforated sheet having minimum 50mm depth. The width of perforation shall be maximum 10mm spaced at maximum 20mm distance. The width of the cable tray shall be selected so as to accommodate required number of cables to be laid on it, with minimum separation of minimum one cable diameter between two adjacent cables. The cables shall be tied with the cable tray with nylon strip.

CABLES INSTALLED IN THE MECHANICAL ROOM

The cable reaching the motors in the mechanical room or plant room or machines room or service area shall be laid on cable tray except where indicated in masonry underground trenches.

The cable reaching the motors shall be protected by rigid galvanized conduits up to a height of 300mm above the floor.

Above that height, the cable shall be protected by means of oil tight flexible metallic G.I. conduits to the terminal box of the motor. The connection between the rigid conduit and the flexible conduit shall be done by a rewett coupling of an approved type.

The flexible conduit shall be properly fixed with the terminal box of the motor by means of double hexagonal check nut.

CABLE TRAY/LADDER

GI Cable tray shall be manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA).

Cable trays shall be of steel as per IS 226 and galvanised and the thickness of galvanisation shall be not less than 110 microns. All bolts nuts and washers shall also be galvanised and shall conform to IS 1363- 60 for quality, threading and dimensions before galvanising. Hot dip galvanising shall conform to IS 2633 Galvanising of each member shall be carried out in one complete immersion. The galvanising shall be uniform, clear, smooth, continuous and free from acid spots. Quality of zinc used for galvanising shall be of 98.8% purity.

Cable trays shall generally be of the following type :

- | | |
|--|--|
| i. for power cables of medium voltage and high voltage | - ladder type with slotted angles. |
| li .for control cables and low voltage cables | - perforated sheet extra steel slotted angle type. |

Perforated cable trays shall be generally of channel type and the perforations in the trays shall be either 8 x 15mm or 10 x 20mm oval holes. Control cables, extra low voltage cables and instrument cables shall be laid on perforated cable trays.

Ladder type cable trays shall be made out of 50 x 50 x 6mm slotted M.S. angles for the rungs and channels for the side rails. Pitch of the rungs shall be not more than 250mm centre to centre. Rungs shall be welded to the side rails.

Cable trays shall be of standard sizes :

Length 2500mm

Width 300/450/600/800/1000mm as required.

Flange of perforated tray 75/100mm

Height of side rail (ladder type) 75mm

Thickness of sheet steel - 2.0mm to 3.0mm as per width of tray.

The flange and width of the cable trays shall be decided based on the diameter and the number of cables running through each section of the cable tray.

Accessories for Cable Trays

Following accessories of cable trays, as required, shall be supplied with the cable trays.

Coupler plates

90 deg bends - Horizontal and Vertical.

Tees - Horizontal and Vertical.

Reducers

4-way cross

Tray covers

Fasteners.

Accessories also shall be hot dip galvanised, thickness of galvanising being not less than 110 microns.

TESTING

Prior to laying cables, and prior to energizing the cables, following tests shall be carried out :-

Insulation Resistance test between phases and phase to neutral and phase to earth.

Continuity test of all the phases, neutral and earth continuity conductor.

Sheathing continuity test.

Earth resistance test of all the phases and neutral.

All tests shall be carried out in accordance with relevant Indian Standard Code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Construction Manager and results shall be recorded in the prescribed forms.

STORING :

All the cables shall be supplied in drums. On receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drum in vertical position. The end of the cable shall be sealed for water tightness.

MEASUREMENT

Mode of measurement is as follows :

All power cables including fixing accessories as described in specifications and SOQ are measured in linear metre (Rm). Power cable terminations are measured in Number (No)

Control cables including terminations are measured in linear metres (Rm)

Cable trays and conduit/pipes are measured in linear metres (Rm).

D. LIGHT FITTINGS AND ACCESSORIES :

SCOPE

Scope of work under this section shall include inspection at suppliers/manufacturer's premises, appropriate, receiving at site, safe storage, transportation from point of storage to point of erection and erection of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting as required. The contractor shall supply all materials and accessories (other than those supplied by the owner), labour, tools, transportation, scaffolding etc., required for the completion of above work in all respects.

STANDARDS APPLICABLE :

The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following :

Electric light fittings General and safety requirements - IS - 1913.

Industrial lighting fittings with metal reflectors	- IS - 1777
Decorative lighting outposts	- IS - 5077
Flood Lights	- IS - 1947
Luminaries for street lighting	- IS - 2149
Bayonet lamp holders	- IS - 1258
Bi-pin lamp holders for tubular fluorescent lamps	- IS - 3323
Ballasts for use in fluorescent light fittings	- IS - 1534
Starters for fluorescent lamp	- IS - 2215
Ballast for HP MV lamps	- IS - 6616
Capacitors for use in fluorescent, HPMV & LP sodium Vapour lamps circuits	- IS - 2215
Tubular Fluorescent lamps	- IS - 2418 (Part I)
High pressure mercury vapour lamps	- IS - 2183
Tungsten filament general electric lamps	- IS - 418
High pressure sodium vapour lamps	- IS - 9974 (Part -I)

Light Fittings - General Requirements :

- a) Fittings shall be designed for continuous trouble free operation under atmospheric conditions, reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather - proof and rain proof.
- b) Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/starters etc.
- c) All fittings shall be supplied complete with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Out door type fittings shall be provided with weather proof boxes.
- d) Fluorescent lamp fittings shall be complete with all accessories like ballasts, power factor improvement capacitors, starters capacitors for correction of stroboscopic effect.
- e) Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires upto 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.
- f) All hardware used in the fitting shall be suitably plated or anodised and passivated for use in industrial plants.
- g) Earthing Each light fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earth terminal so as to ensure satisfactory earthing continuity throughout the fixture.
- h) Painting/Finish All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burrs.
- i) The housing shall be stove-enamelled or anodised as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia mandrel.

DECORATIVE TYPE FITTINGS

Decorative fluorescent fittings shall be provided with mounting/housing channel cum reflectors of CRCA sheet steel. Stove enamelled diffusers or louvers shall be translucent white polystyrene.

ACCESSORIES FOR LIGHT FITTINGS REFLECTORS :

The reflectors shall be made of CRCA sheet steel/aluminium/silvered glass/Chromium plated sheet copper as required. The thickness of reflectors shall be as per relevant standards. Reflectors made of steel shall have stove enamelled/vitreous enamelled/epoxy coating finish. Aluminium used for reflectors shall be anodised/epoxy stove enamelled/mirror polished. The finish for the reflector shall be as specified. The reflectors shall be free from scratches blisters and shall have a smooth and glossy surface having no premium light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

LAMP/STARTERS HOLDERS :

Lamp holders shall have low contact resistance, shall be resistant to wear. They shall hold lamps in position under normal conditions of shock and vibration prevalent in an industrial atmosphere. Lamp holders for fluorescent lamps shall be of spring loaded BI-pin rotar type. Live parts of the lamp holder shall not be exposed during insertion or removal of the lamp or after the lamp has been taken out.

Lamp holders for incandescent and mercury vapour lamps shall be bayonet type upto 100 W and Edison screw type for higher wattage. Starter holders for fluorescent lamps shall be so designed that they are mechanically robust and shall be capable of withstanding shocks during transit, installation and use.

BALLASTS :

The ballasts shall be designed for long life and low power loss. They shall be mounted using self-locking, anti -vibration fixtures and shall be easy to remove without demounting the fittings. The enclosures shall be dust tight and non-combustible. Ballasts shall be inductive, heavy duty type, filled with thermosetting, insulating, moisture repellent polyester compound filled under pressure or vacuum. Ballasts shall be provided with taps to set the voltage. The ballast wiring shall be of copper and they shall be free from dust.

Separate ballast shall be provided in case of multilamp fittings, except in case of 2 x 20 W fittings. Starters shall have bi-metal electrodes of high mechanical strength. Starters shall be replaceable without disturbing the reflector of lamps and without use of any tool. Starters shall have brass contacts and radio interference suppression capacitor.

CAPACITORS :

The Capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits. The capacitor shall have a value of capacitance so as to correct the power factor of its corresponding lamp circuit to 0.95 lag or better. Capacitor shall be hermetically sealed preferably in a metal enclosure to prevent seepage of impregnant and ingress of moisture.

LAMPS :

Incandescent lamps shall be clear type unless otherwise specified. Fluorescent lamps shall be "day-light colour" type unless otherwise specified and shall be provided with features to avoid blackening of lamp ends. Mercury vapour lamps shall be of high pressure, colour corrected type. Lamps shall be capable of withstanding vibrations prevalent in an industrial atmosphere, the filament/electrodes shall not break under such circumstances.

PL Lamps shall be energy effective compact single ended light sources in 9 to 11W ratings consisting of two narrow glass tubes welded together. The lamp shall be complete with integral glow switch starter and capacitor and two pin electrical connection. The lamp shall be colour rendered to give warm colour impression. The compact lamp shall have a long life and shall be energy efficient.

INSTALLATION :

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Construction Manager. Pendant fixtures specified with

overall stem lengths are subject to change and shall be checked with conditions on the job and installed as directed. All suspended fixtures shall be mounted rigid and fixed in position in accordance with drawings, instructions and the approval of the Construction Manager. Fixtures shall be suspended true to alignment, plumb, level and capable of resisting all lateral and vertical forces and shall be fixed as required.

All suspended light fixtures, fans etc, shall be provided with concealed suspension arrangement in the concrete slab/roof members. It is the duty of the Contractor to make these provisions at the appropriate stage of construction. Exhaust fans shall be fixed at location shown on drawings. They shall be wired to a plug socket outlet at a convenient location near the fan. All switch and outlet boxes, for fans and light fittings shall be bonded to earth. The recessed type fixtures shall not be supported into the false ceiling frame work. This shall have independent support from the socket of ceiling using G.I.conduit down rods/chromium plated steel chain with provision for adjusting the level of fitting. Wires shall be connected to all fixtures through connector blocks. Wires brought out from junction boxes shall be encased in flexible pipes for connecting to fixtures concealed in suspended ceiling. The flexible pipes shall be check-nuted to the junction box with a brass bush and double checknut at the fixture and flexible pipes, wherever used shall be of make and quality approved by the Construction Manager/Architect.

MEASUREMENT

MODE OF MEASUREMENT IS AS FOLLOWS :

Installation of light fittings with all associated works including fixing accessories is measured in numbers (No) Supply and installation of down rods and C.P. chain with associated works as per SOQ and specifications are measured in linear metre (Rm).

E. ADVANCE LIGHTNING PROTECTION SYSTEM:

Scope

Involves supply, installation, testing and commissioning of Advanced Lightning Protection consisting of Air Termination. Air Termination support, down conductors, earthing, performance recording equipment etc., as required complete.

1. The Advanced lightning protection system shall include:-

- (a) air termination(s)
- (b) mechanical support(s)
- (c) low impedance insulated down conductor(s)
- (d) performance recording equipment, and
- (e) a low impedance grounding system.

2. The Advanced lightning protection system shall have :-

- a. an air terminal of the type designed to minimise corona emissions and optimise streamer inception when optimum pre-determined conditions are met.
- b. shall be mounted adequately rated for wind loading. Guy sets shall be provided as appropriate to local environmental conditions.
- c. shall be designed by a reputed company in the manufacture and development of Advanced Lightning system components, of types, sizes and ratings and, who can produce support that their products have been in service for a long time and performance is in satisfactory condition.
- d. shall be installed strictly to the manufacturer's instructions.

Air Terminal

- 1. Shall respond dynamically to the appearance of a lightning down-leader, shall be designed to trigger in relation to the optimum pre-determined conditions for upward leader inception. The triggering conditions must dynamically adjust to reflect the down leader intensity, building height above ground and the other factors that effect the electric field intensification above the air terminal.

2. Shall incorporate a curved conductive surface spaced from a permanently grounded central finial. During triggering of the air terminal the curved conductive surface shall be temporarily grounded, thereby producing an increase in electric field directly above the air terminal.
3. The air termination shall be designed :-
 - a. With a range of optimal finial tip radii to match the different electric field conditions the terminal is subjected to at various installation heights above the ground level.
 - b. Arcing at the finial tip is not to be continuous and shall only occur during the process of lightning leader approach. Arcing shall not occur solely due to electro-static field created by the presence of charged overhead thunderclouds.
4. The materials used for the terminal shall be non-corroding in any type of environments. The centre grounded electrode tip shall not be less than 20mm diameter, the curved conductive surface shall be of a conductive material of thickness as defined in IEC61024.
5. The collection volume and attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.
6. The isolating material supporting the curved conductive surface from the centre grounded electrode shall be of glass/mineral reinforced polypropylene. This material used shall have the following properties, high impact strength, UV stabilized, high electrical dielectric, high comparative tracking index and operating heat capability up to 120°C continuous.
7. The protective zone provided shall be such that it becomes the preferred strike point for all discharges exceeding a peak amplitude return strike current as per IEC61024. The design shall take account of upward leader competing projections on the structure.

Strike Current	Levels of Protection	Exceedance Probability
2.9 kA	Protection Level I – Very High	99%
5.4 kA	Protection Level II- High	97%
10.1 kA	Protection Level III – Medium	91%
15.7 kA	Protection Level IV – Standard	84%

Air Termination Support

- 1 **The air terminal support shall consist of a minimum of 2m of insulating re-enforced fibreglass cylindrical mast. The conductor shall pass through the centre of the mast, with the high voltage termination contained to the upper 1m of the mast.**
2. **The support shall be securely bolted to other mast materials with guy wires used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities and pressure.**

Downconductor

The downconductor shall

- a. Consist of a plastic filler, copper conductor, inner insulation, outer copper conductor, conductive sheath, all concentrically arranged and defined by the manufacturer.
- b. Have a low characteristic impedance of 4.5Ω (Ohms) and a maximum inductance of 22 nH/m.
- c. Have the capacitance equal to 1100 or greater than 1000 pF/m and the resistance should be equal or less than $0.5 (m\Omega/m)$.
- d. To be tested in a lab to withstand a lightning impulse rating of $\geq 250KV$ peak voltage between the core & screen based 1.2/50 μs -wave shape as defined under ANSI C62.41.
- e. The outer diameter of the downconductor shall be less than 35mm.
- f. The main copper conductor shall be made of electrolytic grade copper of minimum cross sectional area of 50mm².

- g. At the end, 3m to the ground and where it is exposed to human intervention, the downconductor shall be placed in a protective rigid PVC pipe of 3mm minimum wall thickness to avoid mechanical damage.
- h. The main copper conductor shall be capable of direct connection to the base of the air termination by use of a compression coupling.
- i. The downconductor shall be installed as per the manufacturer's instructions and should not be subject to bends of less than 0.5 metres radius.
- j. The downconductor after routing, must be connected in the conductive clamps. The top 10% of the installed length must be anchored at least every 1 metre and the lower be anchored at least every 2 metres.
- k. The downconductor(s) shall be in conformity with UL-96: Lightning Protection Components (Standard for safety)

Performance recording equipment

- 1. Each protection system shall be supplied with a lightning event counter. The lightning event counter shall have an register that activates one count for every discharge where the peak current exceeds 1500A. The test wave shape shall be the 8/20us standard as defined by ANSI C62.41
- 2. The lightning event counter shall be of robust, easy to install and housed in a IP67 rated enclosure. The counter shall operate from the energy of the lightning discharge and not depend on external or battery power to operate.
- 3. The lightning event counter shall be installed to the manufacturer's instructions in a readily accessible manner so that readings can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range -10°C to +50°C.

Grounding

- 1. The grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the EB or manufacturer of the Advanced Lightning protection system.
- 2. Grounding shall be affected by copper wire or tape buried below the frost line (or to approximately 600mm deep in non freezing locations) or by deep driven UL listed copper bonded steel core ground rods with at least 10mil copper thickness.
- 3. Bonding of the grounding system to all metallic parts of the building, including structural reinforcing steel is preferred. The resistance should be measured and the 10-ohm requirements achieved before such bonding is affected.
- 4. Electrically conductive Ground Enhancing Materials may be used to achieve low ground resistance provided the materials are mixed and strictly in accordance with the manufacturer's instructions

METHOD OF MEASUREMENT

The earth conductor (G.I. or Aluminium strip) including all accessories is measured in linear metre (Rm).

The air termination including support is measured in Number (No)

Earthing stations with all associated works as described in SOQ are measured in number (No).

F. EARTHING SYSTEM

SCOPE

This section covers the requirements for providing "Earthing" connection to metal parts of equipment etc., The contractor shall supply all materials, labour, tools, plant etc., and everything necessary for the complete Earthing installation".

STANDARDS APPLICABLE

The following standards shall be applicable :

IS 3043 -Code of practice for earthing.

IEEE - 80:86.

IEEE - 142:92.

GENERAL

All the non-current carrying metal parts of electrical installation shall be earthed as per IS: 3043. All equipment, metal conduits, rising main cable armour, switch gear, distribution boards, meters, all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall be in conformity with the provisions of Rules 32, 61, 62, 67 and 68 of IER 1956.

G.I.PPIPE EARTH STATION :

Electrodes shall be made of G.I. pipe of internal diameter of 40mm dia. The pipe electrode shall be as far as practicable embedded below permanent moisture level. The length of the pipe electrode shall not be less than 2.5 m. Except where rock is encountered, pipes shall be driven to a depth of at least 2.5mtr where rock is encountered at a depth of less than 2.5mtr. The electrode may be buried inclined to the vertical and the inclinations not more than 30 deg C from the vertical. The pipe electrode shall be made of one piece. Earth leads to the electrode shall be laid in a heavy duty GI pipe and connected to the pipe electrode with brass bolts, nuts and washers. GI pipe shall be terminated in a wire meshed funnel. The funnel shall be enclosed in a masonry chamber of 450mm x 450mm dimensions. The chamber shall be provided with C.I. frame and CI inspection cover. The earth station shall also be provided with a suitable permanent identifications label tag. The earth electrode shall conform to IS:3043 latest edition. The soil around the earthing electrode shall be treated to reduce the resistivity of the soil by filling the complete depth of electrode with alternative layers of charcoal and salt.

PLATE EARTH STATION

Plate electrodes shall be made of copper (CU) plate of 3mm thick and 600 x 600mm size. The plate shall be buried vertically in ground at a depth of not less than 2.5 meters to the top of the plate, the plate being encased in charcoal to a thickness of 300mm all round. It is preferable to bury the electrode to a depth where subsoil water is present. Earth leads to the electrode shall be laid in a heavy duty GI pipe and connected to the plate electrode with brass bolts, nuts and washers. A GI pipe of not less than 19mm dia shall be clamped with bolts vertically to the plate and terminated in a wire meshed funnel. The funnel shall be enclosed in a masonry chamber of 450mm x 450mm dimensions. The chamber shall be provided with GI frame and CI inspection cover. The earth station shall also be provided with a suitable permanent identifications label tag. The earth electrode shall conform to IS:3043.

EARTHING CONDUCTORS

All earthing conductors shall be of high conductivity copper and shall be protected against mechanical damage and corrosion. The connection of earth electrodes shall be strong secure and sound and shall be easily accessible. The earth conductors shall be rigidly fixed to the walls, cable trenches, cable tunnel, conduits and cables by using suitable clamps.

Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking into consideration the anticipated fault on the medium voltage net work.

Earthing conductors for equipment shall be run from the exposed metal surface of the equipment and connected to a suitable point on the sub main or main earthing bus. All switch boards, distribution boards and isolators disconnect switches shall be connected to the earth, bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts.

All conduits cable armouring etc., shall be connected to the earth all along their run by earthing conductors of suitable cross sectional area. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse/protective device or a circuit breaker and shall not exceed 2 ohms.

PRECAUTIONS

Earthing system shall be mechanically robust and the joints shall be capable of retaining low resistance even after subjection to fault currents.

Joints shall be tinned, soldered and/or double rivetted. All the joints shall be mechanically and electrically continuous and effective. Joints shall be protected against corrosion.

TESTING

On the completion of the entire installation, the following tests shall be conducted :

- i) Earth resistance of electrodes
- ii) Impedance of earth continuity conductors as per is 3043.
- iii) Effectiveness of earthing as per is 3043.

All meters, instruments and labour required for the tests shall be provided by the contractor. The test results shall be submitted in the prescribed tabulated form in triplicate to the consultants for approval.

MEASUREMENT

Mode of measurement is as follows :

Earth strips (GI/Cu), earth conductor are measured in linear metre (Rm).

Earthing station with all associated works (G.I pipe or copper plate) is measured in number (No).

G. DATA AND VOICE NETWORKING SYSTEM

1.0 INTRODUCTION:

1.1 This tender shall act as a guide to the type of system desired for the project. The specifications described in this tender are as per the Basis of Design and are the minimum required from the contractor.

1.2 Standard literature not complying to the format and the requirements of this tender, shall not be considered or evaluated.

2.0 Installation :

2.1 Contractor shall take written approval from the Project manager for the storage of any equipment at site. The location of any stored equipment shall be coordinated with the Project manager.

2.2 Damage caused by the contractor during installation and testing must be replaced or repaired by the contractor at no cost and to the satisfaction of the project manager.

2.3 After the WO/PO is awarded, but before the contractor orders the cables and equipment components, the contractor shall submit to the project manager, samples and part numbers of the cables for approval before they are ordered. For composite cables, sample of each section of the composite cable is adequate.

2.4 The contractor shall obtain all manufacturer's instructions including current bulletins, for the installation of the cables and cabling system components provided by the contractor. Copies of these documents and all manufacturer warranty documents shall be submitted by the contractor to the project manager when the installation of the cable begins.

2.5 The contractor shall provide the necessary protection and care, to safe guard his own work as well as the work of other agencies. Care shall be taken not to damage false ceiling tiles and conduits provided for electrical wiring.

2.6 The contractor shall provide all necessary tools, hardware and test equipment needed by their labourers to install, label, test and document the total cabling system.

2.7 The installation of the data and voice systems by the contractor shall not be considered complete until all cables and components described in this specification are installed, labelled, tested and the documentation is delivered according to the specifications, and also the successful inspection from the project manager.

2.8 The contractor is fully responsible for the co-ordination of the works at the site with respect to other services.

2.9 The contractor is responsible for hoisting and transporting the materials into the building.

3.0 SCOPE OF WORK

3.1 Supply, install, test and label Data category 5/5E/6, twisted pair, 24AWG wire in locations specified on the enclosed drawings, specifications and schedule of works. This is for a local area network from each location marked on the floor plan and attachment to the patch panel on the free standing cable rack in the appropriate wiring closet.

3.2 Wiring closets and hubs are located in the room as marked on the floor plan.

3.3 All work shall be according to Category 5/5E/6 specifications as published in EIA/TIA 568-A. Additions are listed in TSB 31, 36 and 40. In addition, all installation shall be in compliance with ISDN BRI (ISO 8877). Cable connectors shall meet the IEEE 802.3 (100BASE TX) and IEEE 802.31 (10 BASE T) specifications. Where there is a gray area, the following guidelines will be the principal deciding factors.

4.0 CONDUIT AND CABLE BENDS AS CURRENTLY INSTALLED

4.1 In the case that wall / floor mounted race way is used, there shall be at least 30% of empty space. All conduit diameters must comply with the limitations of number of cables as per the following table :

Conduit diameter trade size	Wire OD of the cables			
	0.19	0.24	0.31	0.37
0.50	1	0	0	0
0.75	5	3	2	1
1.00	8	6	3	2
1.25	14	10	4	3
1.50	18	15	6	4
2.00	26	20	12	7
2.50	40	30	13	12
3.00	60	40	20	17
3.50				22
4.00				30

4.2 The bending radii shall be as follows :

Scenario	Bend Radius
< 50mm	6 x internal diameter of the conduit
> 50mm	10 x internal diameter of the conduit
Fiber pull	10 x internal diameter of the conduit

4.3 No section of conduit shall be longer than 35m or contain more than two 90° bends between pull boxes.

4.4 Any single conduit run starting from the wiring closet shall not serve for more than three outlets.

4.5 Neatness in cabling, ensuring that all cables are hidden from the open view or run in the raceway, is mandatory. Cables shall not be stapled to walls, abutments, supports, or any other objects. Concurrent data cable runs shall be bundled neatly and loosely.

4.6 Cable entrance paths or conduit runs shall be recorded electronically and that information shall be provided to the client in a tab-delimited spread sheet.

4.7 Where wall mounted raceway is run horizontally, it shall be fastened mechanically as per the manufacturer's specification and the connection joints shall be centered between the vertical standard brackets.

4.8 All wall mounted race way shall run parallel to the floor and shall be mounted at the minimum acceptable distance from the floor.

5.0 TELECOMMUNICATION OUTLETS AND CONNECTORS

5.1 Drop cable specifications:

5.1.1 All drop and patch cables shall not exceed 1.5m.

5.1.2 The total length of the drop and patch cables shall be not more than 7.5m. All patch and drop cables shall be category 5/5E/6 rated, as explained in section 6.

5.1.3 While testing for certification, drop and patch cables shall be used in place of the cables supplied with the testing equipment.

5.2 Connector specifications :

5.2.1 Each 4 pair 24AWG category 5/5E/6 cable shall be terminated in an 8 pin modular jack at the work area. These connectors shall be 100 ohm, UTP outlets that meet all criteria listed in EIA/TIA 568 sections 12.2.5 and 12.2.6.

- 5.2.2 The pin / pair assignments shall be according to the 568A designation with applicable colour code combinations. The pin/pair assignments are compatible with ISDN / BRI (ISO 8877) reference B1.24.
- 5.2.3 Each drop shall have a MOD-TAP flush mounted or box jack face plates installed for data. In most instances jacks shall contain RJ45 jacks or blanks. Where appropriate, the MOD-TAP face plates may be fitted for phone jacks (RJ11) for phone use as well as RJ-45 jacks as long as all open for fitted for blanks.
- 5.2.4 Only jacks, faceplates, gang boxes and blanks inventoried to be in the client's possession. After inspection shall be charged to the client.

6.0 WIRING DESCRIPTION FOR CAT 5/5E/6 HORIZONTAL CABLING

- 6.1 All cables with a run length of 90m or less shall consist of 24AWG thermoplastic insulated conductors formed into four twisted pair and enclosed by a thermoplastic jacket.
- 6.2 If the cable is to be plenum-rated it must be covered with teflon fire retardant for plenum (CPM) rating. All cables shall be rated by the manufacturer to be certified Category 5/5E/6 compliance.
(Note : The contractor shall submit a notice, if any of the single lengths is exceeding 90m)
- 6.3 The wire OD of the UTP copper cable shall be not more than 0.21.
- 6.4 The pair assembly shall meet the colour code according to EIA/TIA 568A.
- 6.5 Wires shall not be bent tightly or kinked at the jack or elsewhere or bent less than 6.5OD of the cable.
- 6.6 Cable shall be tested by the third party once installed and shall perform better than the minimum requirements outlined in EIA/TIA 568A- section 10.
- 6.7 If any cable fails to meet the specified requirements, during testing measurements by the third party or conflict with the contractor's test results, the cable shall be completely reinstalled at the contractor's expense including equipment, parts and time.
- 6.8 The length of the cables shall be recorded using cable test equipment. Only cable (+ a standard deviation) that has been recorded will be paid for by the Client.
- 6.9 All the excess cable shall be returned to the contractor at no charge to the client.

7.0 ELECTRICAL CONSIDERATIONS:

- 7.1 All wires shall be run as per the following table:

Condition	< 2 kVA	2 – 5 kVA	> 5 kVA
Unshielded power lines or electrical equipment in proximity to open or non metal pathways	5"	12"	24"
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	2.5"	6"	12"
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway		3"	6"

- 7.2 All wires shall be run at least 2m from electromagnetic fields such as those generated by electrical motors, convertors and invertors.

- 7.3 All wires shall be run at least 6" from fluorescent lights.
- 7.4 All concurrent wiring runs paired with electronic cabling shall not exceed 3' in length.
- 8.0 WIRING CLOSETS :
- 8.1 The wiring closets are a transition point between the horizontal distribution pathways and all or part of the back bone.
- 8.2 The wiring closets shall contain one or more floor/wall/ceiling mounted racks. Each rack shall be no taller than eight feet and exactly 19" wide. Each rack shall have at least four shelving units.
- 8.3 Multiple closets on a floor shall be interconnected by a minimum of one conduit trade size three or equivalent.
- 8.4 The wiring closets shall have a 24hour, thermostat controlled, HVAC system or shall operate in a range of 64-75deg F with 30-50% relative humidity.
- 8.5 Drainage troughs shall be placed under the sprinkler pipes to prevent leakage on to the equipment within the room.
- 9.0 MAIN CLOSET :
- 9.1 The main closet is the centralised space for telecommunication equipment.
- 9.2 This room shall house only the equipment directly related to telecommunications system and its environmental support system.
- 9.3 Each rack shall be no taller than eight feet and exactly 19" wide. Each rack shall have at least four shelving units. Additional shelving may be built at this time for all servers.
- 9.4 The wiring closets shall have a 24hour, thermostat controlled, HVAC system or shall operate in a range of 64-75deg F with 30-50% relative humidity.
- 9.5 Drainage troughs shall be placed under the sprinkler pipes to prevent leakage on to the equipment within the room.
- 10.0 DISTRIBUTION RACK SPECIFICATIONS:
- 10.1 Equipment Racks:
- 10.1.1 Each rack shall be allocated with no more than 200 wiring terminations.
- 10.1.2 Racks shall have clearances of at least 30" to the rear, 36" in front and 14" on the sides for access and cable dressing space.
- 10.2 Grounding and Bonding :
- 10.2.1 Cross connect hardware for cabling shall be mounted on frames that will accommodate a grounding conductor that will provide a path of low DC resistance to ground. The grounding conductor shall be bonded to the same grounding system that is employed by the power service as the cross connect equipment.
- 10.2.2 The grounding conductor shall not be less than 6 AWG.
- 10.3 Patch Panels (Connecting Hardware)
- 10.3.1 The transmission properties of internally wired connecting devices shall meet the transmission performance requirements specified in EIA/TIA 568A section 12.2.6.2 interfaces included.
- 10.3.2 Standard telecommunication interface jacks and plugs shall meet the requirements of EIA/TIA-TSP-31, ref B1.37.
- 10.3.3 Telecommunication interfaced jacks shall be 8 pin jacks with pin/pair assignments according to 568A designation applicable with colour code combination. These pin/pair assignments are compatible with ISDN BRI (ISO 8877).

10.4 JUMPER CABLES:

10.4.1 Cross connect jumpers and patch chords shall meet the minimum performance requirements specified in EIA/TIA 568A.

10.4.2 The use flat non twisted chords is strictly prohibited.

10.4.3 The cables shall consist of a male connectors at both the ends, RJ45 connectors as specified in IEEE 802.3(10BASE2).

10.4.4 Each jumper cable shall not exceed 3m in length.

11.0 WIRING LABLES AND WIRE MANAGEMENT

11.1 Labelling all wall jacks, cables patch cables, patch panel, patch panel jacks is mandatory. The method for applying labels shall be left to the discretion of the contractor.

11.2 Labels themselves shall be according to the Jack ID description.

11.3 The cable conduit entrance path shall be marked on the floor plans and following completion of the work, a blue print shall be provided to the client depicting all locations and label lds of each jack and patch panel.

12.0 TESTING AND SITE CERTIFICATION

12.1 The contractor shall perform all cable testing once and then the second time by a qualified technician.

12.2 All copper cables shall be tested by a certified calibrated phase 2 micro test Penta scanner according to an accepted and approved category 5/5E/6 test procedure.

12.3 All test shall be saved in memory within the tester until a Project manager can down load them to a tab delimited test file.

12.4 No test measurements shall be accepted that are not down loaded directly from the Penta scanner. Test performed by the contractor shall be verified for necessary accomplishments by the consultants.

12.5 Any test in question shall be run a third time in the presence of Project manager, the contractor and the third party testing authority. This shall be considered a final test and the contractor shall record the results accordingly.

12.6 Any cable runs that fail to meet specifications and fail the Penta scanner test shall be completely re-installed at the expense of the contractor.

12.7 Further testing expenses shall be paid by the client to the testing authority.

12.8 The contractor shall get the site certified from the OEMs for a period of at least ten years and submit the documents on the day of hand over of the project.

12.9 The contractor is responsible for any defects in the functioning of the system during defects liability period. The contractor shall submit the complete details of manufacturer's address and contact numbers to the client for any future requirements.

13.0 DOCUMENTATION

13.1 All cables implementation shall be documented.

13.2 Site built drawings in A3 size shall be submitted to the client.

14.0 GENERAL CONSIDERATIONS:

14.1 Rules, codes and regulations

14.1.1
codes and regulations.

All work and materials shall be in full accordance with the latest rules,

14.1.1 Nothing on the drawings or in the specifications shall be construed to allow work not in conformance with these rules and regulations.

- 14.1.2 The drawings and specifications shall take precedence where work and material described there in exceeds that required by rules, codes or regulations.
- 14.2 Permits, fees and inspections
 - 14.2.1 The contractor shall obtain all permits and license required and pay all fees incidental to the installation.
 - 14.2.2 The contractor shall provide the client with the schedule of inspections where applicable and submit all certification of inspection.
- 14.3 Guarantee:

All work, material and equipment shall be guaranteed to be free from defects in workmanship or material for a period of one year from the date of issue of completion certificate from the project manager. The contractor shall repair or replace all such defects in a timely manner and damage to the client's property resulting from such defects and repairs thereof. All equipment and material provided and all work accomplished under the requirements of this section shall be at no expense to the client.
- 14.4 As built drawings:
 - 14.4.1 The contractor shall keep a separate set of drawings at the job site to be used as AS BUILT drawings. These drawings are to be kept current and in a neat and clean conditions all the time. They are to be available for inspection by Project managers at any time during site visits. These drawings shall be red lined to indicate all changes in equipment, devices and outlet locations and to indicate the true locations of all concealed or underground work where different from that shown on the drawings. Each sheet of this set shall be cleared and permanently marked "AS BUILT".
 - 14.4.2 Upon completion of the project and prior to the final payment, the contractor shall purchase a fresh set of prints from client and transfer all AS BUILT information to it. All information shall be clearly drawn with ink. The contractor shall deliver two sets of final AS BUILT drawings to the architects and the client for approval.
- 15.0 Products :
- 15.1 Materials:
 - 15.1.1 Unless specifically indicated otherwise all materials shall be new and free from defects. It shall be listed by Underwriter's laboratories where applicable.
- 15.2.1 Submittals:
- 15.3 Material submittals shall be complete and submitted all at the same time. The individual group of submittal types such as wires, face plates, patch panels etc shall be prefaced with a list of contents identifying each item by its project name, manufacturer and complete catalog number. Each copy of the submittal group shall have the list of contents attached. The contractor is responsible for submitting this information in a timely manner so that material may be ordered early enough to meet the construction schedule. If the material is not ordered in time for whatever reason, pay such premium prices, special handling charges as required to meet the construction schedule. No substitution of an accepted item will be allowed due to the failure to plan for adequate material procurement lead time.
- 15.4 Cutting and patching :

The contractor shall obtain project manager's approval prior to cutting existing surfaces or surfaces under construction. All such surfaces shall be repaired or patched to the satisfaction of the architect.
- 15.5 Protection, Cleaning and Repairs :
- 15.5.1 Protect all equipment from damage and degradation during construction. Equipment stored shall be protected from dust, water and damages from the other sources.
- 15.5.2 After completion of work, prior to final review from the client, the equipment shall be thoroughly cleaned of all dirt, water, grease, plaster, paint or any construction debris. All surfaces shall be clean and in new condition. All such defacements as scratches, dents, marks and checks shall be repaired to the satisfaction of the project manager or the equipment shall be replaced at no additional cost.

H. LIST OF PREFERRED MAKES OF EQUIPMENT (Proposed Make to be Supplied by the Client)

- Make to be followed which has provided with the tender/RFQ.

COVID-19 SAFETY INSTRUCTIONS TO CONTRACTORS

1. PURPOSE:

To safeguard the workers from Corona virus (Covid-19), Contractor shall be strictly adhering the guidelines received from Govt. at all project sites and plants.

2. SCOPE:

These guidelines applicable to all Contractors only.

3. APPROVAL:

Approval from Client (wherever applicable)

4. RESPONSIBILITY:

- Contractor has to adhere to all the COVID-19 Government guidelines and must maintain daily records for every labor coming to site. TAPF will not be responsible for any complaints reported at site due to any issues with labor arising for violating the guidelines.
- Contractor will ensure that any labor that comes to site is provided with clean mask.
- Quality Engineer will monitor for adherence to COVID-19 guidelines.

5. CORONA VIRUS SYMPTOMS CHECK:

Fever ($T \geq 38$ Celsius), Running Nose, Cough, Sore Throat, Breathing Difficulties, Smell/Taste Loss.

6. ARRANGEMENT OF LOGISTICS MADE TO PROJECT SITES:

Logistic arrangements shall be made by contractor as per the Government guidelines ensuring social distance is maintained.

7. DEMONSTRATION AT PROJECT SITES

TAPF will display contact number of SPOC (Single point of Contact), Posters relating to COVID-19, emergency contact numbers etc.

8. PROCEDURE:

8.1 SECURITY GATE MANAGEMENT:

- Mandatory / Compulsory screening all persons irrespective of cadre / status entering the site non-contact Thermometer.
- Single point entry and exit for all project sites.
- Stoppage of any person into site if found fever and cough with breathing.
- All vehicles including two wheelers shall be parked in designated areas only.
- No new workers shall be allowed inside.
- If anyone leaves and re-enters the site during the shift, re-screening of the individual will be done prior to re-entry into the worksite.



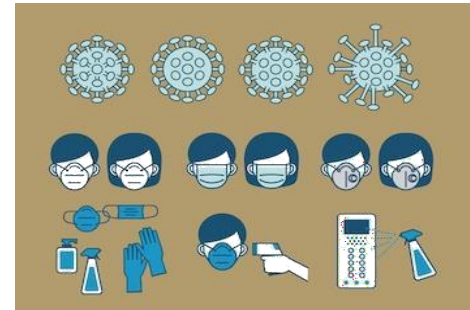
8.2 PROVISION OF HANDWASH:

- Hand wash arrangements will be made at entry / exit points.
- Everyone will be required to wash hands for at least 20 seconds with soap, before entering the site and using PPEs. Same procedure to be followed removing PPEs and exiting the premise.



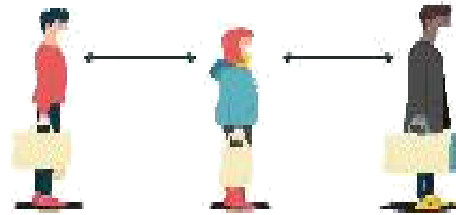
8.3 MANDATORY USE OF PPE'S:

- Mandatory use of face mask by everyone entering the premise.
- Re-usable PPEs should be thoroughly cleaned and should not be shared with others.
- Proper disposal of used nose mask while leaving the site.



8.4 SOCIAL DISTANCING:

- Always maintain social distancing (at least 1.5- 2mtr) at project sites, plants, offices, labor camp, rest shed etc.



8.5 RECORD OF WORKERS:

- Contractor has to maintain all the records related to travel history of their workers and self- declaration form. The same record shall be documented and records to shall be updated daily basis at site. The same shall be signed jointly by Contractor supervisor and TAPFQC personnel.
- Any deviation to the procedure / guidelines shall be charged with a penalty of 1000 per person per day.

8.6 EATING:

Food should be consumed at designated areas only ensuring social distancing guidelines.



8.7 CLEANING AND DISINFECTION:

- Contractor should arrange a housekeeping team to spray the disinfectant liquid.
- Entire construction site including site office, Workmen camp, pantry, pathways, toilets, entry/exit gates will be disinfected twice a day by sodium hypochlorite or phenol disinfectants.



9. PRECAUTIONS MEASURE TO BE FOLLOWED:

- On day 1, before resuming the work at site, mandatory medical check to be arranged by contractor for all workers and a health certificate must be submitted.
- The workers coming from outside should have been quarantined for a period of at least 14 days. Only medically fit workers shall be deployed at site.
- Start time on site will best aggered to avoid congestion at the entry gates. Number of workers working at a particular time/place to be reduced by making arrangements for different shifts / areas

10. GUIDELINE FOR WORKMENCAMP:

- Proper hygiene to be maintained at labour camp area, special attention to be given to washrooms / toilets by disinfecting, and maintaining dry.
- Arrangements to be made by contractor to restrict movements of laborers.
- All shall be advised to wear mask and awareness to be arranged
- Records to be maintained at worker camp by contractor and verified by Safety in charge.

11. DO'S

- Conduct warm up exercise at site.
- Wash your hands soap and water regularly.
- Wash hands before touching eyes, nose and mouth.
- Cover our nose and mouth with and kerchief/tissue while sneezing and coughing.

ARCHITECTS: HEGDE AND HEGDE

12. DON'T

- Don't come in close contact with anyone.
- Don't touch your eyes, nose and mouth.
- Don't spit in Public.
- Avoid workers frequent trips to the market to buy groceries/medical supplies.

Contractor Sign & Name
TAPF Projects Sign & Name