TENDER DOCUMENT

TENDER No: DLI/CON/760/566

FOR

Tender for Civil & Electrical works in construction of 100 Bedded ESI Hospital Building at Beltola , Guwahati, Assam

VOLUME – II

Additional Conditions of Contract, Technical Specifications, Drawings
ADDITIONAL CONDITIONS OF CONTRACT (ACC)

1.0 The following Additional Conditions of Contract shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of General Conditions of Contract, the provisions in these Additional Conditions of Contract shall take precedence.

2.0 Employees’ State Insurance corporation (i.e. ESIC) has appointed Engineering Projects India limited (i.e. EPI) as project management agency (i.e. PMA) for “Civil & Electrical works in construction of 100 Bedded ESI Hospital Building at Beltola, Guwahati, Assam”. Accordingly EPI had invited tender for award of Civil & Electrical work including area development work as described more specifically under Bill of Quantities (Attached in the Price Bid) the works are to be executed at the present location of ESIC Model Hospital located within 500 m (approx.) of Jayanagar chariali on Tripura Road, approximately 1.4 km from Khanapara bus stop on GS Road.

3.0 Clause no 3.0 of GCC shall stand amended as below:

The item of work given in the tender documents are for general guidance of the contractors and the work shall be carried out by the contractor on percentage rate basis conforming with the detailed drawings, scope of work, technical specifications, additional condition of the tenders (including any addition / modification/alteration/deletion made from time to time therein found essential for completion of works). Nothing will be paid extra on this account. The contractor shall deemed to have satisfied himself before tendering as to the sufficiency and correctness of his tender for the works and the rates and prices quoted in the brief specifications, drawings, scope of work and payment method (billing schedule) which rates and prices except otherwise provided, cover all obligations under the contract and all matters found necessary for proper completion and maintenance of the works. The contractor has to quote his rates
after clearly studying the scope of work given in the tender documents. The contractor shall make alternate access to the existing building without hampering the existing building. Nothing will be paid extra on the account if any, damage caused to the existing building and shall be required to be made good by the contractor at his own cost. However the structure and items required to be demolished as instructed by EPI, shall be dismantled and demolished with proper barricades. EPI shall not entertain any claim of the contractor on account of error or omission by him.

4.0 No mobilization advance shall be paid and hence clause no. 8 of GCC shall stand deleted.

5.0 SAFETY CODE:

General
Contractor shall adhere to safe construction practice and guard against hazardous and unsafe working conditions and shall comply with safety rules as stated forth herein for information and guidance:

First Aid and Industrial Injuries
(1) Contractor shall maintain first aid facilities for his employee and labours.

(2) Contractor shall make outside agreements for ambulance service and for the treatment of industrial injuries. Names of those providing these services shall be furnished to the EIC prior to start of construction and their telephone numbers shall be prominently posted in Contractor’s field office.

(3) All critical industrial injuries shall be reported promptly to the EIC, and a copy of Contractor’s report covering each personal injury requiring the attention of a physician shall be furnished to the EIC.

General Rules
Smoking within the worksite or within radial distance of 100 ft of the worksite is strictly prohibited.
Violators of the no smoking rules shall be discharged immediately

Contractors Barricades

(1) Contractor shall erect and maintain barricades required in connection with his Operation to guard or protect.
   (a) Excavations.
   (b) Hoisting areas.
   (c) Areas adjudged hazardous Contractor's or Owner's inspectors.
   (d) Owner's existing property subject to damage by Contractor's operations.
   (e) Rail road unloading spots.

(2) Contractors employee and those of his Contractors shall become acquainted with owner's barricading practices and shall respect the provisions thereof.

(3) Barricades and hazardous areas adjacent to but not located in normal routes of travel shall be marked by red flasher lanterns at nights.

Scaffolding:

(i) Suitable scaffolding should be provided for workmen for all works that safety be done from the ground or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder shall be given an inclination not steeper more than 1 in 4 (1 horizontal and 4 vertical )

(ii) Scaffolding or staging than 4 meters above the ground or floor, swing suspended from an overhead support or erected with stationary support
shall have a guard rail properly attached, bolted, braced and otherwise rewarded at least 3 ft.
High above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

(iii) Every opening the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 metre.

(iv) Working platform, gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform of the gangway or the stairway is more than 4 metres above ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened as described in above.

(v) Safe- means of access shall be provided to all working platforms and other working places, every ladder should be securely fixed. No portable single ladder shall be over 9 metres in length while the width between side rails in rung ladder shall in no case be less than 30cms for ladder up to and including 3metres in length. For longer ladder this width should be increased at least 5 mm for each additional foot of length. Uniform steps spacing shall not exceed 30 cms. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the site of work shall be so stacked or placed to cause danger or inconvenience to any person or public. The Contractor shall also provide all necessary fencing and light to protect the workers and staff from accidents, and shall be bound to bear the expenses of defense of every suit, action or other proceedings of law that may be brought by any person for injury.
sustained owing to neglect of the above precautions and pay any damages and costs which may be awarded in any such suit or action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

Excavation and Trenching
All trenches 1.2 metres or more in depth, shall at all times be supplied with at least one ladder for each 50 metres length or fraction thereof.

Ladder shall be extended from bottom of the trench to at least 1 metre above the surface of the ground. The sides of the trenches which are 1.5 metres in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5 metres of the edge of the trench or half of the trench width whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

Demolition:
(i) Before any demolition work is commenced and also during the progress of the work.
   (a) All road and open areas adjacent to the work site shall either be closed or suitably protected
   (b) No electric cable or apparatus which is liable to be a source of danger shall remain electrically charged.
   (c) All practical cares shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so over-loaded with debris or materials as to render it unsafe.
(ii) All necessary personal safety equipment as considered adequate by the Engineer-in-charge (i.e. EIC) should be kept available for the use of the persons employed on the site and maintained in condition suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

(a) Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective gloves.

(b) Those engaged in white washing and mixing or stacking of cement bags or any materials which are injurious to the eyes shall be provided with protective goggles.

(c) Those engaged in welding and cutting works shall be provided with protective face and eye shields, hand gloves etc.

(d) Stone breakers shall be provided with protective goggles and protective clothing, and seated at sufficiently safe intervals.

(e) When workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that the manhole covers are opened and are ventilated at least for an hour before the workers are allowed to gate in to the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or board to prevent accident to the public.

(f) The Contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken,
(1) No paint containing lead or lead product shall be used except in the form of paste or ready-made paint.

(2) Suitable face masks should be supplied for use by the workers when Paints are applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

(3) Overalls shall be supplied by the Contractor to the workmen and adequate Facilities shall be provided to enable the working painters to wash them during and on cessation of.

(iii) When the work is done near any place where there is a risk of drowning, all Necessary safety equipment should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

(iv) Use of hoisting machines and tackles including their attachments, anchorage and supports shall conform to the following standards or conditions:-

(a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.
(b) Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from patent defects.
(c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 12 years should be in charge
of any hoisting machine including any scaffolding, which or give signals to the operator.

(d) In case of every hoisting machine and of every chain ring hook, shackle, swivel, and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gears referred to above shall be plainly marked with the safe working load of the conditions under which it is applicable which shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

(e) In case of departmental machine, the safe working load shall be notified by the Engineer-in-charge. As regards Contractor's machines, the Contractor shall notify the safe working load of the machine to the Engineer-in-charge whenever he brings any machinery to site of work and get it verified by the Engineers concerned.

(v) Motors, gearing transmission, electric wiring and other dangerous part of hoisting appliances should be provided with such means as to reduce to the minimum the accidental descent of the load, adequate precautions should be taken to reduce to the minimum the risk of any part or any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves, and boots as may be necessary should be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

(vi) All Scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or
equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

(vii) These safety provisions should be brought to the notice of all concerned by the displaying on a notice board at a prominent place at the work-spot. The person responsible for compliance of the safety code shall be named therein by the Contractor.

(viii) To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Contractor shall be open to inspection by the Welfare Officer, Engineer-in-Charge or safety Engineer of the administration or their representatives.

(ix) Notwithstanding the above clauses there is nothing in these to exempt the contractor from the operations of any other Act or rules in force in the Republic of India. The works throughout including any temporary works shall be carried out in such a manner as not to interfere in any way whatsoever with the traffic on any roads or footpaths at the site or in the vicinity thereto or any exiting works whether the property of the Administration or of a third party. In addition to the above, the Contractor shall abide by the safety code provision as per C.P.W.D. Safety Code and Indian standard Safety Code framed from time to time.

6.0 The clause no. 10.0 of GCC shall stand amended as below:
An amount @5% (Five percent) of the gross value of the running bill shall be deducted from each running bill by way of retention money. In case the EMD has been deposited by the Contractor in the form of demand draft, the said amount of EMD shall be adjusted first towards the retention money and further recovery of retention money shall commence when the up to date amount of retention money exceeds the amount of EMD deposited in the form of demand draft. The retention money shall become refundable to the Contractor at the end of the defects liability period free of any interest provided always that the
Contractor has rectified all the defects arising during the defect liability period pertaining to his scope of work, EPI did not have to incur any expenditure in setting right the defects, if any, pertaining to the Contractor’s scope of work, the Contractor has demolished and removed all temporary structures including foundations and withdraw fully from the worksite and EPI has received the clearance certificate from the concerned Labour Enforcement Officer/RLC pertaining to the labour etc. deployed by him at the worksite or there is nothing on record against him in the local market affecting functions of EPI. In case EPI has been required to make any expenditure on any of these accounts EPI will keep the retention money till the time all these matters are settled in full including recovery of the expenses, if any, made by EPI from the retention money. Further the Contractor has to furnish a ‘No Claim’ certificate to EPI in confirmation of his having no claim on getting refunded the retention money to EPI at the time of claiming refund of retention money.

7.0 The following shall stand added to clause no. 11.0 of GCC:
Water: The contractor shall arrange water fit for the purpose of drinking and construction at their own cost.

Power: The contractor will make his/their own arrangement for power for construction as well as his other uses conforming to the requirements of the Indian Electricity Act and Rules framed there under and the State Power Distribution Board. The temporary lines will be removed forthwith after the completion of the work or if there is any hindrance caused to the other work due to the alignment of these lines, the contractor will re-route or remove the temporary lines at his own cost. The contractor at his own cost will also provide suitable electric meters, fuses, switches etc. as required by the statutory authorities.

8.0 Work in monsoon and dewatering
The completion of the work may entail working in monsoon also. The Contractor must maintain minimum labour force as may be required for the
job and plan and execute the construction and erection according to the prescribed schedule. No extra rate will be considered such work in monsoon. During monsoon and other period, it shall be the responsibility of the Contractor to keep the construction work site free from water at his own cost.

9.0 Work on Sundays and holidays and during extended hours

Work shall be allowed on Sundays, holidays and during extended hours if it becomes necessary with prior intimation to the Engineer-in-Charge or his representative at least two days in advance. However, no extra claims will be entertained by the EPI on this account.

The contractor must arrange for the placement of workers in such a way that delayed completion of the work or any part thereof for any reason whatsoever will not effect their proper employment. EPI will not entertain any claim for idle time payment whatsoever.

10. The Contractor shall be entirely and exclusively responsible for the horizontal and vertical alignment, the levels and correctness of every part of the work and shall rectify effectually any errors or imperfections therein. Such rectifications shall be carried out by the Contractor, at his own cost, when instructions are issued to that effect by the Engineer-in-Charge.

It is highly possible that there shall be more than one agency working at the same time at the site. The contractor shall at all times remain bound to co-ordinate with the agencies, deployed by EPI for the above works, including providing free access and making required provisions for them in execution of works pertaining to their portion of works. He shall also remain bound to ensure uninterrupted progress of work by these agencies in a peaceful and smooth manner. He shall also remain bound to make the required changes/additions/alterations in the works done by him to accommodate the items under the scope of work of such other agencies deployed by EPI or the
client. The contractor is deemed to have made the estimated allowances in this respect while quoting his rates at the tendering stage.

The list of minimum tools, plant and machinery to be provided by the contractor within the period mentioned against the respective item is given at Annexure-A.

11.0 The following shall stand added to the clause nos. 17.0, 18.0 & 19.0 of GCC of EPI:

The Contractor agrees to and does hereby accept full and exclusive liability for compliance with all obligations imposed by the Employees State Insurance Act, 1984, and the Contractor further agrees to defend, indemnify and hold Owner harmless from any liability or penalty which may be imposed by the Central, State or Local authority by reason of any asserted, violation by Contractor or sub-Contractor of the Employees State Insurance Act, 1948, and also from all claims, suits or proceeding that may be brought against the Owner arising under, growing out of or by reasons of the work provided for by this contract whether brought by employees of the Contractor, by third parties or by Central or State Government authority or any political sub-division thereof.

The Owner shall retain such sum as may be necessary from the total contract value until the Contractor shall furnish satisfactory proof that all contributions as required by the Employees State Insurance Act, 1948, have been paid.

12.0 The following shall stand added to the clause no 27.0 of GCC:

Irrespective of the organizational chart approved by the EIC (Engineer-in-Charge) the contractor shall deploy the following minimum technical person at the work site failing which the amount as shown against each category will be recovered by EPI from the amount payable to the contractor:

______________________________
Signature of Contractor

EPI

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### Additional Conditions of Contract

**Engineering Projects (India) Limited**

**Signature of Contractor**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Qualification of Technical Person</th>
<th>Discipline</th>
<th>Minimum years of post qualification experience</th>
<th>No</th>
<th>Recovery rate for non-compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Graduate Engineer</td>
<td>Civil</td>
<td>10 to 15</td>
<td>1</td>
<td>Rs 40000.00 per month</td>
</tr>
<tr>
<td>2</td>
<td>-do-</td>
<td>Electrical</td>
<td>3</td>
<td>1</td>
<td>-do-</td>
</tr>
<tr>
<td>3</td>
<td>Diploma Engineer</td>
<td>Civil</td>
<td>8</td>
<td>1</td>
<td>Rs 25000.00 per month</td>
</tr>
<tr>
<td>4</td>
<td>-do-</td>
<td>Electrical</td>
<td>5</td>
<td>1</td>
<td>-do-</td>
</tr>
<tr>
<td>5</td>
<td>Supervisor</td>
<td>Civil</td>
<td>5</td>
<td>2</td>
<td>15000.00 per month</td>
</tr>
</tbody>
</table>

13.0 The clause no 28.3 of the GCC stands modified as under:

The contractor shall provide the following facilities till defect liability period.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Rate of recovery in case of Non-compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Furnished Office accommodation measuring 1500 sqft with one conference room and other rooms as per plan approved by the EIC complete with toilets, urinals, septic tank, safe and continuous drinking arrangement, lights, air-conditioner, continuous power supply arrangement</td>
<td>No</td>
<td>1</td>
<td>Rs 40000.00 per month after 60 days of LOI</td>
</tr>
<tr>
<td>2</td>
<td>Furniture and office equipment in the office</td>
<td>No</td>
<td>1</td>
<td>Rs 8000.00 per set</td>
</tr>
<tr>
<td></td>
<td>Office Table &amp; Chair (Sr. Executive)</td>
<td>No</td>
<td>1</td>
<td>Rs 8000.00 per set</td>
</tr>
<tr>
<td></td>
<td>Office Tables &amp; Chairs (Executive)</td>
<td>No</td>
<td>4</td>
<td>Rs 6000.00 per set</td>
</tr>
<tr>
<td></td>
<td>Visitors Chairs</td>
<td>No</td>
<td>20</td>
<td>Rs 3000.00 per no</td>
</tr>
<tr>
<td></td>
<td>Steel Almirah</td>
<td>No</td>
<td>4</td>
<td>Rs 8000.00 per no</td>
</tr>
<tr>
<td></td>
<td>File Cabinet</td>
<td>No</td>
<td>4</td>
<td>Rs 10000.00 per no</td>
</tr>
<tr>
<td></td>
<td>Photocopy machine (CANON IR 2325 of equivalent model) or any</td>
<td>No</td>
<td>1</td>
<td>Rs 15000.00 per month</td>
</tr>
<tr>
<td>Facility Description</td>
<td>Quantity</td>
<td>Rate/Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>----------</td>
<td>-----------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DELL/SONY/HP Make Laptop Core i3, 4 GB RAM, 01 TB, HDD latest version of software like MS Project, Windows, MS Projects with internet facility &amp; running cost of internet</td>
<td>No 2</td>
<td>Rs 50000.00 per no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laser printer or any other printer (All-In-One) able to print up to A3 size with internet compliant</td>
<td>No 1</td>
<td>Rs 65000.00 plus cost of printing from outside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photocopy machine (CANON IR 2325 of equivalent model) or any other gadget of equivalent cost as decided by Engineer-in-charge</td>
<td>No 1</td>
<td>Rs 75000.00 plus cost of photocopying from outside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sony make Digital still camera 13 Mega Pixel W-series 10 x optical zoom cyber shot (Black) or any other gadget of equivalent cost as decided by Engineer-in-charge.</td>
<td>No 1</td>
<td>Rs 30000.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerator 195L</td>
<td>No 1</td>
<td>Rs 30000.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Vehicle: Earmarked vehicle (Brand new) four wheels drive Scorpio VLX vehicle or equivalent with Driver &amp; fuel for 24 hrs. In case of break down contractor shall make alternate arrangements immediately failing which Engineer-in-charge will hire similar type vehicle and debit cost to contractor's account.</td>
<td>No 1</td>
<td>Rs 60000.00 per month or actual whichever is higher</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All the above, facilities are temporary in nature and shall be the property of the contractor. Contractor until defect liability period at his own cost will maintain the above facilities including its running costs/maintenance cost. Engineer-in-charge shall return the contractor when the (Engineer-in-charge) does not require these facilities further. The contractor shall be responsible for watch & ward of the vehicles and other facilities etc. In case of theft/damage, the contractor shall replace the same a maximum period of one week.
14.0 The clause no 35.0 of GCC shall stand deleted:

No Secured advance shall be paid to the contractor.

15.0 Compensation for delay (GCC clause No 72.0 Stands Modified):

The Contractor shall execute the works so as to complete the works within the stipulated completion time and submit an integrated programme chart showing deployment of resources for completion of the works within the said completion time stated in the contract documents for completion of items / scope of the works. It shall indicate the forecast the dates of commencement and completion of various items trades, sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the contract documents, to ensure good progress during the execution of the work. The physical report including photographs shall be submitted by the contractor on the prescribed format & the intervals (not later than a month) as decided by the Engineer-in-Charge.

The Contractor will take all necessary actions to contain time & cost overrun in the project. However, for process delays in the project, liquidated damages shall be levied on / recovered from the contractor in the following manner.

**Stage-1**

During currency of the project, the time line shall be monitored with the help of below milestones. If any milestone is not achieved by contractor with time timeline as per given programme chart, the amount shall be withheld in case of non-achievement of milestone in the following manner:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of Milestone</th>
<th>Time allowed in days/months (from date of start)</th>
<th>Amount to be withheld in case of non-achievement of milestone (Cumulative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>20% value of works</td>
<td>25% of completion time</td>
<td>2% of the contract value</td>
</tr>
<tr>
<td>b)</td>
<td>40% value of works</td>
<td>50% of</td>
<td>4% of the contract value</td>
</tr>
<tr>
<td></td>
<td>completion time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>c)</td>
<td>60% value of works</td>
<td>75% of completion time</td>
<td>6% of the contract value</td>
</tr>
<tr>
<td>d)</td>
<td>80% value of works</td>
<td>90% completion time</td>
<td>8% of the contract value</td>
</tr>
<tr>
<td>e)</td>
<td>100% value of works</td>
<td>100% completion time</td>
<td>10% of the contract value</td>
</tr>
</tbody>
</table>

The compensation for delay as above shall be leviable at intermediate stages, in case the required progress is not achieved to meet the milestones of time and progress chart provided. The total amount of compensation for delay to be paid under this condition shall not exceed 10% of the Contract value of work.

In case entire work is completed within the completion time (i.e. time for completion of work) including any allowed extension thereto, the recoveries made, if any, for not achieving the aforesaid progress milestones at intermediate stages shall be refunded to the contractor free of any interest in-line with the refund of withheld amount, if any, received from ESIC.

**Stage-II**

After completion of all milestones, an assessment would be made regarding the total time covered in achieving all the milestones Vis-a-Vis the allotted time lines to each milestone till completion of the project. If it is found more time taken by the Contractor to accomplish the project than mutually agreed timeline, liquidated damage @ (1.5) % per month subject to 10% (Max.) project cost would be imposed on the Contractor.

16.0 The clause no 45.0 of the GCC stands modified as under:

The Contractor shall, at his own expense, provide all materials hereinabove as required for completion of the works under the Contract. The Contractor shall at his own expense and without delay supply to EPI/client samples of all materials including the materials being provided by EPI to him to be used on the works and shall get the same approved by EPI. All such materials shall be in conformity with the specifications laid down or referred to in the Contract.
case the Contractor fails to submit the samples in time, EPI shall be at liberty to finalize the type and source of the materials and that shall be binding on the Contractor at no extra cost to EPI. The Contractor shall at all time remain bound to provide the samples in quantity and manner as instructed by EPI to be analyzed or tested in an approved laboratory or in the field laboratory at site. The cost of testing charges is included in the prices of the Contractor. EPI shall, however, be at liberty to get the materials tested independent of the Contractor and the Contractor shall remain bound to render all assistance to EPI in conductance of such tests including making available the materials in sufficient quantity and in time and payment of the testing charges. EPI/client shall at all times have full access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery. The Contractor shall afford every facility and assistance and cost in obtaining the right and visit to such access.

EPI shall have full powers to require the removal from the premises of all materials which in their opinion are not in accordance with the specifications and in case of default, EPI shall be at liberty to employ at the expense of the Contractor, other persons to remove such materials without being answerable or accountable for any loss or damage that may happen or arise to such materials. EPI shall also have full powers to require other proper materials to be substituted thereof and in case of default by the Contractor, may cause the same to be supplied and all costs which may require such removal and substitution shall be to the Contractor’s account.

17.0 The following shall be added to clause no 52. 6 of GCC:
The field testing laboratory to be established by the Contractor at his cost shall be equipped with the minimum number of testing equipment as per annexure-B

18.0 The Contractor shall be responsible for obtaining all approvals from Client with regard to quality of materials & workmanship and measurements etc. for their portion of work. All such approvals shall be in the name and title of EPI. The Contractor shall be responsible for reconciliation of issued material with
Client/EPI, if any, and the Contractor shall make arrangements for safe up keeping / custody of the material and final reconciliation is also to be done by the Contractor. In case there is any shortfall of any issued items during reconciliation, recovery at double the cost of materials prevailing at that time of recovery shall be made from the Contractor’s due payment.

19.0 The Contractor will not deal directly with Client and all the correspondence in matters regarding bills, claims, interpretation of the specifications, conditions and all matters related to the contract with Client, Client’s Consultants, all other agencies including Government and Statutory bodies etc. shall be done through EPI only. The Contractor shall prepare and submit expeditiously all bills, claims, details, clarifications, documents, information, etc. as required by EPI/ Client for proper execution and successful completion of the “Works”.

20.0 The work executed by the Contractor shall be subject to audit and quality control checks from Quality Control Division & Technical Audit of EPI, Client, and Inspecting Agency of the Client and Chief Technical Examiner of Central Vigilance Commission, Govt. of India. In the eventuality of any defect/ sub standard works as brought out in the report or noticed otherwise at any time during execution, maintenance period etc., the same shall be made good by the Contractor without any cost to EPI. In case the Contractor fails to rectify the defect/sub-standard work within the time period stipulated by EPI, EPI shall get it rectified at the risk and cost of the Contractor and shall recover the amount from the dues of the Contractor.

21.0 ARBITRATION: Modification of arbitration’s clause no 76.0 of GCC (Applicable for ARBITRATION BETWEEN CENTRAL PUBLIC SECTOR ENTERPRISES INTER SE / GOVERNMENT OF INDIA DEPARTMENTS / MINISTRIES)

General Conditions of Contract (GCC) Sub Clause no.76.1 and 76.3 of Arbitration Clause no.76.0 are amended as given below. Sub Clause no.76.2 will remain the same.

76.0 ARBITRATION
76.1 Before resorting to arbitration as per the clause given below, the parties if they so agree may explore the possibility of conciliation as per the provisions of Part III of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015. When such conciliation has failed, the parties shall adopt the following procedure for arbitration:

i) Except where otherwise provided for in the contract, any disputes and differences relating to the meaning of the Specifications, Design, Drawing and Instructions herein before mentioned and as to the quality of workmanship or materials used in the work or as to any other questions, claim, right, matter or things whatsoever in any way arising out of or relating to the Contract, Designs, Drawings, Specifications, Estimates, Instructions, or these conditions or otherwise concerning the works of the execution or failure to execute the same whether arising during the progress of the work or after the completion or abandonment thereof shall be referred to the Sole Arbitrator appointed by the Chairman & Managing Director (CMD) of Engineering Projects (India) Limited (EPI) or any other person discharging the functions of CMD of EPI. The person approached for appointment as Arbitrator shall disclose in writing circumstances, in terms of Sub-Section (1) of Section (12) of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015 as follows:

a) such as the existence either direct or indirect, of any past or present relationship with or interest in any of the parties or in relation to the subject-matter in dispute, whether financial, business, professional or other kind, which is likely to give rise to justifiable doubts as to his independence or impartiality; and

b) which are likely to affect his ability to devote sufficient time to the arbitration and in particular his ability to complete the entire arbitration within a period of twelve months.

The Arbitrator shall be appointed within 30 days of the receipt of letter of invocation of arbitration duly satisfying the requirements of this clause.

ii) if the arbitrator so appointed resigns or is unable or unwilling to act due to any reason whatsoever, or dies, the Chairman & Managing Director aforesaid or in his absence the person discharging the duties of the CMD of EPI may appoint a new arbitrator in accordance with these terms and conditions of the contract, to act in his place and the new arbitrator so appointed may proceed from the stage at which it was left by his predecessor.

iii) It is a term of the contract that the party invoking the arbitration shall specify the dispute/ differences or questions to be referred to the Arbitrator under this clause together with the amounts claimed in respect of each dispute.
iv) The Arbitrator may proceed with the arbitration ex-parte, if either party, in spite of a notice from the arbitrator, fails to take part in the proceedings.

v) The work under the contract shall continue as directed by the Engineer-In-Charge, during the arbitration proceedings.

vi) Unless otherwise agreed, the venue of arbitration proceedings shall be at the venue given in the ‘Memorandum’ to the ‘Form of Tender’.

vii) The award of the Arbitrator shall be final, conclusive and binding on both the parties.

viii) Subject to the aforesaid, the provisions of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015 or any statutory modifications or re-enactment thereof and the Rules made there under and for the time being in force shall apply to the arbitration proceedings and Arbitrator shall publish his Award accordingly.

76.3 JURISDICTION:
The courts in Delhi alone will have jurisdiction to deal with matters arising from the contract, to the exclusion of all other courts.

21.1 Clause no. 76.1 along with note
Deleted - There shall be no Arbitration Clause for this Contract except between Central Public Sector Undertakings inter se / Government of India Departments / Ministries as mentioned in the Clause No. 76.2 below:

21.2 Clause no.76.2

ARBITRATION BETWEEN CENTRAL PUBLIC SECTOR ENTERPRISES INTER SE / GOVERNMENT OF INDIA DEPARTMENTS / MINISTRIES

i) In the event of any dispute or difference relating to the interpretation and application of the provisions of the contract, such dispute or difference shall be referred by either party to the arbitration as per the instructions (Office Memorandum / Circulars) issued by Govt. of India from time to time with regard to arbitration between one Government Department and another one Government Department and a Public Sector Enterprise and Public Sector Enterprise inter se.
ii) Subject to any amendment that may be carried out by the Government of India from time to time, the procedure to be followed in the arbitration shall be as is contained in D.O. No. DPE/4/(10)/2001-PMA-GL-I dated 22.01.2004 of Department of Public Enterprises, Ministry of Heavy Industries and Public Enterprises, Govt. of India or any modification issued in this regard.

22.0 The final bill will be submitted by the contractor within 90 days from the date of acceptance of completion of work accompanied by the following documents:
   a) Completion certificate issued by the Engineer-in-Charge specifying the handing over of the work including list of inventories (fittings & fixtures).
   b) Computerized Bill with Measurements (3 Copies).
   c) No claim certificate by the contactor in Non-Judicial stamp paper of Rs.100.00 duly notarized.
   d) No claim certificate from the sub-agencies / venders engaged by the contractor.
   e) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc. if applicable.
   f) All operation and maintenance manuals if applicable.
   g) All statutory approvals from various state / central govt. local bodies, if required for completion & handing over of the work as included in scope of Contractor.
   h) Manufacture’s guarantee of various machines / equipments installed as part of works if applicable.
   i) NOC from concerned labour department towards compliance of labour act/rules.

23.0 Contractor has to effectively organize & implement various programs /
Initiatives / schemes scheduled under Government of India (GOI) like National skill development program , Swachh bharat abhiyan ( Clean India movement), etc. or any other programs / Initiatives / schemes as may be notified by GOI from time to time.
24.0 **SKILL DEVELOPMENT TRAINING AND EMPLOYMENT OF SEMISKILLED/SKILLED WORKERS BY CONTRACTOR.**

In compliance to directive issued vide letter dated 30.05.2016 by Department of Heavy Industries, Govt. of India and considering the nation requirement, contractor is required to impart Skill Development training to **25 Nos.** local unemployed youths / unskilled workers in trades of Plumbing, Masonry, Carpentry, Bar Binding, Welding etc. from reorganized / reputed institutes. After successful completion of training of these tradesman, the 25% of trained manpower shall be employed on projects by the contractor.

25.0 No Escalation shall be payable.

26.0 **Supply of Cement:** EPI may arrange supply of cement through Cement Corporation of India (CCI) subject to:

1. The supply rate at site are agreed between the Contractor and CCI.
2. The payment condition are agreed by the contractor and CCI.
3. No delay on account of delayed supply of cement will be acceptable as the contractor is free to procure outside cement in case of non-availability with CCI.
4. The contractor shall get cement tested from certified independent accredited agency and shall be solely responsible for quality.

27.0 **VARIATION IN TAXES, DUTIES, LEVIES & IMPOSITION OF NEW TAXES ETC:**

i) The price bid shall be inclusive of work contract tax / VAT/ GST / Labour Cess or any other tax levied on the transfer of property and goods involved in the "Works Contract" in accordance with the relevant Act in the State Act and rules made there under including amendments, if any. The liability on account of such tax as per the rates of tax prevailing as on seven days prior to last date of bid submission shall be included in the price bid. In case of any variation in the rates of tax after this date, the same shall be paid / recovered from the contractor subject to the submission of documentary evidence and proof of having made the payment at the revised rate.

ii) The price bid shall also be inclusive of all category of Service tax, wherever applicable on Construction Service as per the rates prevailing as on seven (7) days prior to the last date of submission of tender (including abatement as
applicable). In case of any variation in the rate of Service Tax or any other taxes, after this date, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition / deduction to the Contract Price.

iii) If a new tax, duty or levy is imposed under statute or law in India after the date seven (7) days prior to the last date of submission of tender and the contractor becomes liable there under to pay and actually pays the said new tax, duty or levy for bonafide use on the works contracted, the same shall be reimbursed to the contractor against documentary evidence of proof of payment, provided that the amount thus claimed is not paid / payable under price variation provision of the Contract. The reimbursement is subject to receipt of reimbursement claim from client by EPI and submission of proof of taxes paid for this work only by the contractor.

iv) The payment / reimbursement of statutory variations in the rates of tax and / or of new tax, duty or levy imposed under statute or law in India as per para (i), (ii) & (iii) above, would be restricted only to direct transaction between the EPI and the Contractor.

v) Rates shall remain firm till completion of entire works and shall be inclusive of all taxes, Service tax, Entry tax, duties, Octroi, Royalties, VAT / WCT/GST or any other similar tax in the state concerned, Labour Cess and other levies etc. as applicable.

28.0: SECURITY DEPOSIT CUM PERFORMANCE GUARANTEE (Clause no 9.0 of EPI GCC shall stands amended as under):
Within 10 (ten) days from the date of issue of letter of Intent or within such extended time as may be granted by EPI in writing, the Contractor shall submit to EPI a Security Deposit cum Performance Bank Guarantee in the form appended, from any Nationalised bank / Scheduled Bank equivalent to 10% (Ten percent only) of the Contract Value for the due and proper execution of the contract. This bank guarantee shall remain valid up to 90 (ninety) days after the end of defects liability period.
In case the Contractor fails to submit the Security Deposit cum Performance Guarantee of the requisite amount within the stipulated period or extended period, letter of intent will stand withdrawn and EMD of Contractor shall be forfeited.

29.0 PAYMENTS: The following shall stand added to Clause No.37.0 of EPI GCC:
1. Ten percent (10%) of the contract value shall be released as initial advance within thirty (30) days of receipt of invoice by owner on fulfillment of the following conditions:
   i) Unconditional and unequivocal acceptance of Letter of Intent (LOI).
   ii) Submission of security Deposit cum Performance Bank Guarantee.
   iii) Submission of detailed schedule of work.
iv) Submission of an unconditional Bank Guarantee covering the advance amount which shall be initially kept valid till ninety (90) days after the Time of Completion.

v) On establishing of the Contractor’s office at Site and mobilization of tools & plants listed in Annexure-A and testing equipment in Annexure-B.

2. 1st payment shall be made on completion of more than 20% work of contract value (But restricted to 20% of contract value).

3. 2nd payment shall be made on completion of more than 40% work of contract value (But restricted to 20% of contract value i.e. cumulatively 40%).

4. Similarly 3rd, 4th payments of 20% each shall be made on completion of more than 60% & 80% work of contract value.

Final payment shall be made on completion of work sub-payments of the above payments may be permitted by the Engineer-in - Charge.
<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Description</th>
<th>Minimum numbers required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Digital theodolite/Total station</td>
<td>One no</td>
</tr>
<tr>
<td>2</td>
<td>Leveling Instruments/ Auto level</td>
<td>One no</td>
</tr>
<tr>
<td>3</td>
<td>DG set 50 KVA</td>
<td>Two nos.</td>
</tr>
<tr>
<td>4</td>
<td>5 HP Diesel pump</td>
<td>Two nos.</td>
</tr>
<tr>
<td>5</td>
<td>Excavators (JCB/Poclaine)</td>
<td>One no</td>
</tr>
<tr>
<td>6</td>
<td>Welding machines</td>
<td>Two nos.</td>
</tr>
<tr>
<td>7</td>
<td>Diesel concrete mixer with hopper (Full bag capacity)</td>
<td>Two nos.</td>
</tr>
<tr>
<td>8</td>
<td>Water pumps</td>
<td>Two nos.</td>
</tr>
<tr>
<td>9</td>
<td>Steel bending machine</td>
<td>One number</td>
</tr>
<tr>
<td>10</td>
<td>Steel cutting machines</td>
<td>Three nos.</td>
</tr>
<tr>
<td>11</td>
<td>Tower Crane minimum 30-40 m</td>
<td>One no</td>
</tr>
<tr>
<td>12</td>
<td>Steel shuttering plates / New Water Proof Wooden Ply Shuttering.</td>
<td>One Thousand Sq Mtrs</td>
</tr>
<tr>
<td>13</td>
<td>Steel props and other supports for shuttering</td>
<td>One Thousand Sq Mtrs</td>
</tr>
<tr>
<td>14</td>
<td>Needle vibrators</td>
<td>Five nos.</td>
</tr>
<tr>
<td>15</td>
<td>Plate vibrators</td>
<td>Two nos.</td>
</tr>
<tr>
<td>16</td>
<td>Tractors with trolley</td>
<td>One no.</td>
</tr>
<tr>
<td>17</td>
<td>8/10 MT Mechanical Roller</td>
<td>Two nos.</td>
</tr>
<tr>
<td>18</td>
<td>Batching Plant (15 CUM/HR)</td>
<td>One no.</td>
</tr>
<tr>
<td>19</td>
<td>Piling rigs with tripod, boring equipment and accessories etc. all complete</td>
<td>Four sets</td>
</tr>
</tbody>
</table>
Additional Conditions of Contract
Engineering Projects (India) Limited

Note:

(a) The period mentioned above shall be reckoned from the date of start of commencement of work as mentioned under this tender.

(b) The quantities and list of equipments mentioned above are tentative and can be increased/amended as per the requirement of work OR as per the direction of Engineer-in-Charge. The contractor has to deploy all the required equipment to complete all the works within stipulated specifications & time period as contract documents.

(c) **Piling Work:**
Bored Cast in-Situ Pile: All piling works until and unless specified shall be of uniform diameter bored cast in-situ piles. The work shall be executed as per IS code 2911 (Part-I Sec.-2) – 1979 and its further amendments upto date. The work shall be carried out as per the foundation layout plan and relevant structural drawings.

Boring & boring equipments
The boring operation shall be done by percussion type drilling rigs using direct mud circulation or reverse mud circulation methods. Bailer or chisel method if used should be used with caution to avoid the effect of suction. The size of cutting tool shall not be less than the diameter of pile by more than 75mm in order to install the pile of diameter as per the drawing. Equipments to be used for piling work shall be got approved from the engineer-in-charge before erecting for piling works. Use of drilling mud for stabilizing boreholes shall be restored as per directions of the engineer-in-charge.

(d) Ready Mix Concrete: An alternative arrangement of Concreting shall make ready with the Ready Mix concrete (locally available), which must be approved by the Engineer incharge prior to the purchasing of any Grade of concrete. The
Approved design mix of the Project must be followed by RMC and to be produced batch report of the mix during consumption of concrete to the Site in-charge of EPIL. The RMC must operate in fully automatic batching plant and mix to be transported to the site of work in transit mixture for all leads having continuous agitated mixture, manufactured with the minimum cement content of the mix as specified in the approved design mix for RCC work including pumping of RMC from transit mixture to site of lying. The rate provided in the BOQ for concreting woks remains same in case of using RMC.

(e) The contractor will not be allowed to take out equipments from the site without the written permission of Engineer-in-Charge.

(Signature and seal of the Tenderer)
### LIST OF MINIMUM TESTING EQUIPMENT

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Description</th>
<th>Minimum numbers required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Compressive Testing machine (100 Tons)</td>
<td>One no</td>
</tr>
<tr>
<td>2</td>
<td>Electrically operated Digital Weighing Machine (0-5 kg)</td>
<td>One no</td>
</tr>
<tr>
<td>3</td>
<td>Slump test apparatus</td>
<td>Two nos.</td>
</tr>
<tr>
<td>4</td>
<td>Set of sieves for grading of coarse aggregates</td>
<td>One set</td>
</tr>
<tr>
<td>5</td>
<td>Set of sieves for grading fine aggregates</td>
<td>One set</td>
</tr>
<tr>
<td>6</td>
<td>Cement consistency apparatus</td>
<td>One no</td>
</tr>
<tr>
<td>7</td>
<td>Electrically operated oven (300 deg Centigrade)</td>
<td>One no</td>
</tr>
<tr>
<td>8</td>
<td>Trays for sampling</td>
<td>One set</td>
</tr>
<tr>
<td>9</td>
<td>Apparatus for testing of cement</td>
<td>One set</td>
</tr>
<tr>
<td>10</td>
<td>150X150X150 CI Cube Moulds</td>
<td>18 nos</td>
</tr>
<tr>
<td>11</td>
<td>Vicat Apparatus with needles, Test Tubes, breakers, thick glass plates etc</td>
<td>1 set</td>
</tr>
<tr>
<td>12</td>
<td>Measuring Cylinders, 1000ml, 500 ml, 100 ml</td>
<td>01</td>
</tr>
<tr>
<td>13</td>
<td>Wash Bottles, Capacity 500 ml</td>
<td>02 nos.</td>
</tr>
<tr>
<td>14</td>
<td>Sink</td>
<td>01 no.</td>
</tr>
</tbody>
</table>
Note:

a) Any other equipment for site test as outlined in CPWD/ BIS specification and as directed by the Engineer-in-Charge.

b) The quantities of equipments indicated are tentative and can be increased as per the requirement of work OR as per the direction of Engineer-in-Charge. The above equipment list is indicative and not complete. The contractor has to deploy all the required equipment to complete all the works within stipulated specifications & time period as per contract documents.

c) The contractor will not be allowed to take out equipments from the site without the written permission of Engineer-in-Charge.

(Signature and seal of the Tenderer)
TECHNICAL SPECIFICATIONS (CIVIL WORKS)

SECTION - 1

1.0. GENERAL:

1.1: The works shall be carried out in conjunction with specifications, schedule of items and the construction drawings issued from time to time. The latest edition of the specifications given in Govt. of India, Central Public Works Department (CPWD) specifications Vol. I to VI with up-to-date corrections; relevant to this work, with a cross reference to relevant codes of practice published by the Bureau of Indian Standards or published by the Indian Roads Congress in respect of matters not covered by the CPWD specifications shall be followed.

1.2: In interpreting the specifications the following sequence shall be followed unless Otherwise given in writing by the Engineer-in-charge:

(a) Nomenclature of items of the schedule of items.
(b) Drawings and working details.
(c) Technical Specifications given in the tender.
(d) C.P.W.D specifications Vol I to Vol VI with up to date correction slips.
(e) Relevant Indian Standard Codes with latest revisions.
In absence of the specifications in any of the above, the specifications furnished by the Engineer-in-charge based on sound engineering practices shall be final and binding.

1.3: The schedule of quantities, the structural and Architectural drawings shall be properly co-related and all these documents should be read and operated in harmonious conjunction. In case of any discrepancy in items given in the Schedule of Quantities appended with the tender and architectural drawings relating to the relevant item the former shall prevail unless otherwise given in writing by the Engineer-in-charge.

1.4: All the works shall be carried out in sound workmanship and true to line, level, and plumb as per the best practice of the trade.

1.5: All mandatory tests specified in C.P.W.D specifications shall be got done from the approved laboratories as desired by the Engineer-in-charge and all expenses viz. cost of samples, testing charges, including cartage, conveyance etc. whatsoever shall be borne by the contractor. If after any such test and in the opinion of the Engineer-in-Charge any work or portion of work is found to be defective and unsound the contractor shall pull down and re-execute the same at his own cost. Defective material/materials failing in mandatory test shall be removed from the site.

1.6: All materials to be supplied by the contractor shall be new. All packed items shall arrive at site in original packing only. Any items found defective or damaged shall be replaced by the contractor at his own expenses. The sources of materials stated in the specifications are those from which materials are generally available. However, materials not conforming to specifications shall be rejected even if they come from the stated source. The contractor should satisfy himself that sufficient quantity of material of acceptable specification is available from the stated or other sources. Strong scaffolding so as to withstand all loads likely to come upon it. Due care shall be taken by the contractor to ensure the execution of brick masonry walls in plumbs from outside. The contractor shall arrange sufficient quantity of scaffolding for this purpose so as to complete the project within stipulated time.

1.7: All the materials brought at site shall be stored and stacked in a proper manner. The materials requiring protection from the sun and rain shall be kept inside the temporary structures to be erected at site by the contractor. The contractor shall also follow the
manufacturer’s instructions for storing and stacking the materials. The storage facilities are to be created by the contractor at his own expense. The contractor shall consult the Engineer-in-Charge regarding collection and stacking of basic materials required for the work. They should not stack any materials in any place other than those approved by the Engineer-in-Charge within the plot area. On completion of the work the area used will be restored, properly dressed to satisfaction of the Engineer-in-Charge at no extra cost.

1.8: The contractor shall be responsible for co-coordinating the work with works of other trades sufficiently ahead of time to avoid unnecessary hold ups. Hangers, sleeves, recesses etc. shall be left in time as the work proceeds.

1.9: A site order book will be kept at the site of the work in which instructions shall be recorded by Site Engineer / Architect or their representatives. The contractor or his authorized agent shall sign the site order book to acknowledge the instructions in all events and follow the same.

1.10: The plumbing drawings issued from time to time to the contractor are diagrammatic but shall be followed as closely as actual construction work will permit. Any deviation from the drawings required as per building construction shall be made by the contractor at site with the permission of the Engineer-in-Charge. The architectural drawings shall take precedence over the services drawings as far as the civil and other trades’ works are concerned.

1.11: All works shall be adequately protected, to the satisfaction of the Engineer-in-charge, so that same is free from damage throughout the period of construction upto the time of handing over. Special care must be taken to prevent damage and scratching of all fittings and fixtures. Tool marks on exposed fixtures shall not be accepted. Protective paper on fixtures shall be removed with hot water only at the final completion of the work. Before handing over the possession of work, the contractor shall clean all elements of the complete installation, remove plasters, splashier, stickers, rust stains and other foreign matter and leave every part in acceptable condition and ready for use to the satisfaction of the Engineer-in-Charge/ Architect.

1.12: Rates for all items in which use of cement is involved, is inclusive of charges for curing.
SECTION – 2

The intent of this section of the specification is to define the general technical requirements of the major items of Building and site development works.

2.1 SITE CLEARANCE:

Before the work is started, the area coming under the building and up to an extent of 6m as required beyond the periphery of the building shall be cleared of shrubs, rank vegetation, grass, brushwood, trees and saplings of girth upto 30 cm measured at height of 1 M above the existing ground level including removal of roots of trees and saplings to a depth of 60cm below the ground level and all rubbish removed to a dumping ground within the project site as directed by the Engineer In-charge. Nothing extra shall be paid for the site clearance.

2.2 SETTING OUT OF REFERENCE MARKS:

A masonry pillar to serve as a bench mark shall be erected at a suitable point in the area, which shall be visible from the large area. These bench mark pillar shall be constructed as per the drawing to be issued by the Engineer In-charge and connected with the standard bench mark. Number of reference pillars shall be made with reference to the bench mark and levels recorded with the levels marked on them to indicate the correct formation level before the work is started. The contractor shall supply the labour and materials for constructing bench mark, setting out and making profiles and connecting bench mark with the standard bench mark at his own cost. The reference pillars, pegs, bamboos and the bench mark shall be maintained by the contractor at his own cost for checking profiles during execution.

2.3. EARTH WORK

2.3.1. Site levels: After site clearance and before commencement of excavation or filling the contractor shall take levels at 3 metre intervals in either direction or at lesser intervals as considered necessary at site for the entire plot. A record of these levels shall be signed jointly by the Contractor and the Engineer-in-charge. The records shall be kept by the Engineer-in-charge. The required labour and equipments for taking levels shall be supplied by the contractor at his own cost.

2.3.2. Earth work in Excavation:

a) Classification of soils: The earth work shall be classified under the following categories.

   i) All kinds of soils: Generally any strata such as sand, gravel, loam, clay, mud, black cotton, moorum, shingle, river or nallah bed boulders, soling of roads, paths etc. and hard core, macadam surface of any description (water bound, grouted, tarmac etc.), lime concrete, mud concrete and theirs mixtures which for excavation yields to the application of picks, shovels, jumper, sanctifiers, ripper and other manual digging implements.

   ii) Ordinary rock: Generally any rock, which can be excavated by splitting with crow bars or picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and un-reinforced cement concrete below ground level. If required light blasting may be resorted to, for loosening the materials but this will not in any way entitle the material to be classified as hard rock.
iii) **Hard rock:** Generally any rock or boulder for the excavation of which blasting is required such as quartzite, granite, basalt, reinforced cement concrete (reinforcement to the cut through but not separated from concrete) below ground level and the like.

iv) **Hard rock (blasting prohibited):** Hard rock required blasting as described under para (iii) above but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

**b) Protections:**

i) Excavation where directed by the Engineer-in-Charge shall be securely fenced and provided with proper caution signs, conspicuously displayed during the day and properly illuminated with red light during the night to avoid accident.

ii) The contractor shall take adequate protective measures to see that the excavation operations do not damage the adjoining structures or dislocate the services. Water supply pipes, sluice valve chambers, sewerage pipes, manholes, drainage pipes and chamber, communication cables, power supply cables etc. made within the course of excavation shall be properly supported and adequately protected so that these services remain functional.

iii. Adequate shoring and strutting shall be provided to prevent slip during foundation excavation and till completion of foundation work or underground structures.

iv) Dewatering during excavation, foundation work and backfilling to keep the foundation pit free from water shall be provided. No extra payment on account of the above protection works shall be paid.

**c) Blasting:**

Where hard rock is encountered and blasting operations are considered necessary, the contractor shall obtain approval of the Engineer-In-charge in writing for resorting to blasting operations. It will be the responsibility of the contractor to carry on the blasting operation with proper licenses from the competent authority and following all statutory rules. The contractor shall be responsible for any damages arising out of accident to workman, public or property due to storage, transportation and use of explosive during blasting operations. The contractor shall be responsible for safe and proper custody and accounting the explosive materials. For details the Explosive Act and Rules as amended up to date shall be referred.

**d) Backfilling in foundation trenches:**

Only selected earth from excavation shall be allowed for backfilling. The backfilling shall be done after dewatering the pit and laying the selected earth in layers of 20 cm and compacting to 90% proctor density. Backfilling when not allowed by the excavated soil partly or fully shall be done with approved quality Brahmaputra sand or hill sand and laid in layers of 20 cm and compacted up to 90% proctor density. Back filling in foundation trenches either with selected excavated soil or imported soil shall not be paid.

**e) Disposal of excavated earth:**

All surplus earth available from excavation during execution and not utilized in back filling shall be disposed off within the IIT Campus at a suitable location to be shown by the Engineer-in-Charge. This surplus earth may be allowed to be utilized for site development work outside the peripheral foundation line of the building and laid in 20cm thick layers and compacted to the required density. In such case the area to be filled up shall be prefixed by the Engineer-in-Charge and the levels of such work done shall be measured before filling is done over such layers by imported soil. Only selected approved soil from excavation shall
be allowed inside the building area for filling. Such site development work done by surplus excavated earth shall not be paid.

f) Measurements:
Measurements of excavation for foundation work including backfilling in foundation trenches:
Measurements shall be taken on the vertical lines with 300mm tolerance all around the finished concrete/brickwork/masonry work for foundation and that for plinth beams/walls150mm around the finished surfaces. No extra payment shall be made on account of removal of slipped earth and backfilling thereof, dewatering, shoring and strutting etc.

2.3.3 Earth work in filling:
a) Removal of top vegetation: The top vegetation including grass with roots, trees and saplings of girth up to 30 cm measured at height of 1 M above the existing ground level including removal of roots of trees and saplings to a depth of 60 cm below the ground level and all rubbish shall be removed to a dumping ground within the project site as directed by the Engineer In-charge. Decomposed organic soil shall be removed to the extent, which may not cause perceptible settlement to the filled formation. Nothing extra shall be paid for the site clearance.

b) Types of soil for filling: All filling work for site development & in plinth shall be done by the approved quality Brahmaputra sand or hill sand. For site filling with excavated earth, the clause no.2.3.2 (e) shall be followed.

c) Mode of filling and compaction control:
i) Where cutting and filling are involved in hill slope the cutting for site preparation will be done up to the proposed formation level or to such levels as required as per drawing and all excavated soils shall be removed as given under clause .2.3.2(e) above. Filling works shall be done in layers not more than 20cm thick along with the progress of the sub-structure work and compacted by mechanical compactor to achieve minimum 90% proctor density. Measurements for earth work in excavation for site preparation: The original site levels shall be recorded as given under para 2.3.1 above. The final levels after excavations is complete to the proposed formation level, shall be taken jointly again by the contractor and the Engineer-in-charge in the same sections where original levels were taken and the final profile drawn and volume computed.

ii) Where only filling is involved the filling work within the building area shall be taken up after completion of the sub-structure of the building up to existing ground level. The disposal of the excavated earth shall be done as per clause no. .2.3.2(e) The filling work shall follow the sub-structure work up to the formation level. The filling works shall be done in layers not more than 20cm thick along with the progress of the sub-structure work and compacted by mechanical compactor .The filling work within the building area shall mean the area covered within the outer foundation lines of building peripheral columns. The filling work for site development beyond the peripheral foundation line shall be taken up in such a manner that it would not create any hindrance in the progress of sub-structure work and the filling work inside the building and in layers not more than 20cm thick and compacted by mechanical compactor to achieve minimum 90% proctor density. Filling works for site development may be allowed to be done with the selected earth available from foundation excavation. In such case, the area to be filled up will be prefixed by the Engineer-in-charge and the level of the filling work done shall be determined before filling with imported e soil is done over that layer. Contractor shall not be entitled for payment of such filling work done with excavated soil from foundation trenches. All filling works shall be done in layers not more than 20cm and compacted by mechanical compactor.

d) Mode of measurement:
The measurement shall be given after quantity is worked out in profile with respect to spot levels at a grid of 3m taken before and after the filling work. No allowance for settlement of ground below fill will be considered.

.4 Piling work:

2.4.1 BORED CAST-in-SITU PILES: All piling works until and unless specified shall be of uniform diameter bored cast in-situ piles. The work shall be executed as per IS code 2911 (Part-I Sec.-2) – 1979 and its further amendments upto date. The work shall be carried out as per the foundation layout plan and relevant structural drawings.

2.4.1.1 Boring & boring equipments
The boring operation shall be done by percussion type drilling rigs using direct mud circulation or reverse mud circulation methods. Bailer or chiesel method if used should be used with caution to avoid the effect of suction. The size of cutting tool shall not be less than the diametre of pile by more than 75mm in order to install the pile of diametre as per the drawing. Equipments to be used for piling work shall be got approved from the engineer-in-charge before erecting for piling works. Use of drilling mud for stabilizing boreholes shall be restored as per directions of the engineer-in-charge.

2.4.1.2 Stabilization of boreholes
A minimum length of temporary casing unless otherwise specifically desired shall be inserted in each borehole in order to seal the borehole against ingress of ground water and against contamination of concrete. Additional length of casing may be used depending on the condition of the strata, ground water level etc. when concreting is carried out under water, a temporary casing shall be installed to the full depth of the borehole or 2m into non collapsible stratum, so that fragments of ground cannot drop from the sides of the hole into the concrete as it is placed. The temporary casing may not be required except near the top when concreting is done under drilling mud. Drilling mud of suitable consistency may also be used instead of additional casing for stabilization of boreholes. The slurry should be maintained at 1.5m above the ground water level if casing is not used.

2.4.1.3 Basic properties of drilling mud. The bentonite suspension used for piling work shall satisfy the following requirements:-

a. The suspension of bentonite used in piling work shall have thixotropic property which permits the material to have the consistency of fluid when introduced into the borehole. It forms a jelly at undistrubed state and becomes fluid again when agitated.

b. The liquid limit or bentonite when tested in accordance with IS-2720 (Part-V) – 1965 shall be more than 300% and less than 450%

c. The sand content of the bentonite powder shall not be more than 7%.

d. The density of the freshly prepared bentonite suspension shall be between 1.034 and 1.10gm/ml, depending upon the pile dimension and type of soil in which the piles shall be installed. However, the density of bentonite suspension after mixing with deleterious materials/ excavated materials in the borehole may be upto 1.25 gm/ml.

e. The marsh viscosity when tested by a marsh cone shall be between 30 to 60 seconds; in special case it may be allowed upto 90. It be noted that in the later case, special methods of pumping shall be used.

f. The differential free swell shall not be more than 540%
2.4.1.4 Control of drilling mud
In case a hole is bored by use of drilling mud, the specific gravity of the mud suspension near about the bottom of the hole shall, whenever practicable, be determined by suitable slurry sampler in a first few piles and at suitable interval of piles and recorded as directed by the Engineer-in-charge. Consistency of the drilling mud suspension shall be controlled throughout the boring as well as in concreting operation in order to keep the hole stabilized as well as to avoid concrete getting mixed up with the thicker suspension of the mud.

2.4.1.5 Cleaning of borehole before concreting:
In case, a bored pile is stabilized by drilling mud or by maintaining water heads within the hole, the bottom of the hold shall be cleaned very carefully before concreting work is taken up. The cleaning of the hole shall be ensured by careful operation of boring toll and / or flushing of the drilling mud through the hole / holes provided at the bottom of the boring tool. Flushing of boreholes before concreting shall be done with fresh drilling fluid/ mud.

2.4.1.6 Concrete
The mix as stated in the item shall be used for concrete subject to slump of concrete shall range from 110 to 150mm depending as per relevant IS code.

Concreting
Concreting of the piles shall be done by tremie concreting without permitting the concrete to fall freely through the drilling mud and to avoid segregation. In addition to the normal precautions to be taken in termie concreting, the following requirements are particularly applicable to the use of tremie concrete in piles

a) The concrete shall be coherent, rich in cement as specified and of slump not less than 150mm.

b) The hopper and tremie should be a closed system embedded in the placed concrete, through which water cannot pass.

c) The tremie should be large enough with due regard to the size of the aggregate. For 20mm aggregate, the tremie pipe shall be of diameter not less than 200mm. Aggregates more than 20mm shall not be used.

d) The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it or with a steel plate of adequate charge to prevent mixing of concrete and water. However, the plug should not be left in the concrete as a lump. The tremie pipe should always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal of the pipe is surged to discharge the concrete.

e) The pile should be concreted wholly by tremie and the method of deposition should not be changed part way up the pile, to prevent the laitance from being entrapped with the pile.

f) All tremie tubes shall be cleaned before and after use.

g) Normally concreting of the piles should be uninterrupted. In the exceptional case of interruption of concreting, but which can be resumed within 1 or 2 hours, the tremie shall not be taken out of the concrete. Instead it shall be raised and lowered slowly, from time to time to prevent the concrete around the tremie from setting. Concreting should resumed by
introducing a little richer concrete with a slump of about 200mm for easy displacement of
the partly set concrete. If the concreting cannot be resumed before final set up concrete
already placed, the pile so cast shall be rejected or accepted with modifications.

h) In case of withdrawal of tremie out of the concrete, either accidentally or to remove a
choke in the tremie, the tremie may be reintroduced in the following manner to prevent
impregnation of laitance or scum lying on the top of the concrete already deposited in the
bore.

i) The tremie shall be gently lowered on the old concrete with very little penetration initially. A
vermiculite plug should be introduced in the tremie. Fresh concrete of slump between
150mm and 175mm shall be filled in the tremie which will push the plug forward and will
emerge out of th tremie displacing the laitance / scum. The tremie will be pushed further in
steps making fresh concrete sweep away laitance/ scum in its way. When tremie is buried
by about 60 to 100cm, concreting may be resumed.

j) The top of concrete in a pile shall be brought at least 30cm above the cut-off level OR by
overflowing of concrete from casing top, to permit removal of all laitance and weak concrete
before capping and to ensure good concrete at the cut-off level for proper embedment into
the pile cap. Prior to pile cap/ tie beam top 30cm or any additional concrete must be
dismantled at contractor’s cost. If laitance concrete is encountered below the cut off level,
the same will be dismantled and the pile will be rebuild upto the cut off level with M30 grade
concrete by using shuttering for which no payment was made to the contractor. Only after
confirming the existence of sound concrete at the cut off level, construction of pile cap work
was allowed.

2.4.1.7 Control of piling installation: Piles shall be installed as accurately as possible as
per design, drawing either vertically or to the specified batter.

a) Control of alignment: The maximum allowable tolerance for the piling installation shall
be as follows:-
Horizontal displacement: 50mm Vertical displacement of pile toe with respect to the Top of
pile at working level: 1.5% of the length of pile

b) Control of cover: The minimum clear cover to all main reinforcement in pile shaft and to
the bottom of the pile shall be not be less than as specified in the drawing. Provision shall
be made to maintain clear cover in sides as well as at the bottom as specified during
insertion of reinforcement cage, during concreting as well as during withdrawal of tremie
pipes to the satisfaction of the engineer-in-charge

2.4.1.8 Effective length of piles for measurement: The effective length of piles shall be
measured from the bottom of the borehole to the bottom of the pile cap (cut-off level) as
specified in the drawing. When concrete is placed by tremie method, concrete shall be cast
to the piling platform level (working level) to permit overflow of concrete for visual inspection
or to a minimum of one meter above cut-off level whichever is higher. In circumstance
where cut-off level is below ground water level the need to maintain a pressure on the unset
concrete equal to or greater than water measure should be observed and accordingly length
of extra concrete above cut-off level shall be determined. However measurement shall be
given for effective length only.

2.4.1.9 Defective piles:
In case, defective piles are formed, they shall be removed or left in place whichever is
convenient without affecting the performance of the adjacent piles or the cap as a whole.
Additional piles shall be provided to replace them as directed at the contractor’s cost. Any
deviation from the designed location, alignment or load capacity of any pile shall be noted and adequate measures taken well before the concreting of the pile cap and plinth beam if the deviations are beyond the permissible limit. For all the defects attributable to the contractor in this connection shall be rectified at the contractor's cost.

2.4.1.10 Pile load Tests: The pile load test shall have to be carried out as per the latest edition of IS-2911-Part—IV.

**Information to be submitted:** The tenderer should submit the following information along with the tender.

a) Full details of method of installing the piles  
b) Details of pile installing rings  
c) Proposed construction program matching with the capacity of equipment and taking into consideration the various idle and non-productive periods on account of shifting of equipment and testing and possible delays keeping in view the completion date as stipulated in the tender.

d) Execution plan: within 15 (fifteen) days of receiving the letter of intent the contractor will submit 6 (six) copies of drawings showing the sequence of pile boring. The drawings will be prepared on the basis of a master plan giving identification nos. of piles, which will be furnished by the Engineer-in-charge  
e) Test results : The test data and result for the various ingredient of reinforcement cement concrete cubes and cylinders, driving of the shell, static load test on single pile and group and on working piles will be submitted regularly and as and when directed by the Engineer-in-charge. For resulting the ingredients of RCC the relevant clauses of the “technical specification for cement concrete (plain and reinforced)” will apply.

2.4.1.11 Rates  
The rate for the item of installation of pile shall include the cost of all materials consumed in the work or incidental to it as well as testing of materials, the cost of plants and equipment, labour, supervision, transport, taxes, insurance, royalties and revenue expenses, securities and safety measures, approaches, power, fuel, lubricants, services, preliminary and enabling works, camps, stores etc. and overheads and profits complete. The rates shall be include the entire cost of driving, supplying and installing concrete including the cost of providing extra concrete above cut off level and subsequent dismantling and removing the same. Rate for providing reinforcement including cutting, bending, binding and placing in position shall be quoted separately. The work to be provided for by the contractor for installing cast-in-situ piles is given under clause 2.1 and elsewhere in this specification. In case no specific items is provided in the schedule to cover any particular item of work, it is implied that the contractor will include the cost of executing such work in the rates quoted for connected items in the schedule.

b) Load Test  
Measurement will be taken for static/ dynamic, lateral load or pull out tests on single piles or groups as per specification and schedule of items on each occasion of test.

c) Other Items  
The mode measurement of the other connected item of work like excavation, casting pile caps and beams etc. will be governed by the relevant clauses of the Technical Specification.
2.5. BRICK WORKS:

2.5.1. Bricks:

a) Bricks shall be the best quality locally available, well burnt but not over burnt, free from salt Peter action and generally conform to specification for brick class designation 75, crushing strength shall not be less than 75 kg/cm$^2$. Bricks shall not absorb water more than 20% of their own dry weight after 24 hours immersion in cold water, rectangular faces with parallel sides, and sharp, straight and right angled edges, have a fine compact and uniform texture. The bricks shall be free from cracks, chips, flaws, stones or lumps of any kind and shall not show efflorescence either dry or subsequent to soaking in water. They shall not have any part un-burnt.

b) The size of brick shall conform to the sizes as specified. Bricks of one standard size shall be used in the whole work unless specially permitted by the Engineer in-charge.

c) After immersion in water, absorption by weight shall not be exceed 20% of dry weight of the brick when tested according to IS: 1077. Unless otherwise specified the load to crush the brick when tested according to IS: 1077 shall not be less than 75 Kg/sqcm.

d) Prior approval of Engineer in-charge shall be obtained from time to time for the brands of bricks to be used in the work after compliance with the above specifications and tests.

2.5.2 Mortar: Only specified mortar as per BOQ shall be used for brick work as per the relevant items.

2.5.3 Construction details:

a) Soaking: All bricks shall be immersed in water for 24 hours before being used into work so that they will be saturated and will not absorb water from the mortar.

b) Bats: No bats or cut bricks shall be used in the work unless absolutely necessary around irregular openings or for adjusting the dimensions of different courses and for closures, in which case, full bricks shall be laid at corners, the bats being placed on the middle of the courses.

c) Laying: The bricks shall be laid in mortar to line, level and shapes shown on the plan, slightly pressed and thoroughly bedded in mortar and all joints shall be properly flushed and packed with mortar so that they will be completely filled with mortar and no hollows left anywhere. Bricks shall be handled carefully so as not to damage their edges. They should not be thrown from any height to the ground but should be put down gently. All courses shall be laid truly horizontal and all vertical joints shall be made truly vertical. Vertical joints on one course and the next below should not come over one another and shall not normally be nearer then quarter of a brick length. For battered faces beading shall be at right angles to the face. Fixtures, plugs, frames etc. if any, shall be built in at place shown in the plans while laying the courses only and not later by removal of bricks already laid. Care shall be taken during construction to see that edges of bricks at quins, sills, heads etc., are not damaged. The verticality of the walls and horizontality of the courses shall be checked very often only by plumb bob and spirit level respectively.
d) Bond: Unless otherwise specified, brick work shall be done in English Bond. All walls, coming in contract with reinforced concrete columns, beams etc., should be properly bounded by inserting reinforcements. Extra labour shall be included in the rates (reinforcements will be measured and paid separately against reinforcement item provided in the BOQ).

e) Joints: Joints shall not exceed 10 mm thickness and this thickness shall be uniform throughout. The joints shall be raked out not less than 10 mm deep when the mortar is green where pointing is to be done. When the brick surface are to be plastered, the joints shall be raked to a depth of 5 mm when the mortar is green, so as to provide good key to plaster.

f): Curing: All brick works shall be kept well cured at least for 14 days after laying.

g) Half Brick work: Half brick work of 115mm thick shall be provided with reinforcement of two numbers 6mm dia. approved quality M.S. bars at every third course as per technical specification/item. Reinforcement provided shall be paid separately.

h) Measurements:
Brickwork with 230mm thick shall be measured in cubic metre. Any extra work over the specified dimension will be ignored unless otherwise specifically mentioned in the drawing. Wall of half brick thickness or less shall be measured separately and paid in sqm, half brick thickness shall be taken as 115mm. Brick wall beyond half brick thickness shall be measured in cum. When a fraction of half brick occurs due to architectural reasons or otherwise as per the requirements of the owner the same shall be measured as half brick work provided such fraction is more than 2 cm. Fraction up to 2 cm thickness shall be made up in mortar and paid for as per specified thickness under brick work.

2.6 RANDOM RUBBLE MASONRY

2.6.1: General- The random rubble masonry work shall be done as per specifications, drawings and as directed.

2.6.2. Stone: The stone shall be of the type specified such as granite, trap, limestone, sandstone, quart-zite, etc. and shall be obtained from the quarries, approved by the Engineer-in-Charge. Stone shall be hard, sound, and durable and free from weathering decay and defects like cavities, cracks, flaws, sand holes injurious veins, patches of loose or soft materials and other similar defects that may adversely affect its strength and appearance. As far as possible stones shall be of uniform colour, quality or texture. Generally stone shall not contain crypts crystalline silica or chart, mica and other deleterious materials like iron oxide, organic impurities etc. Stone with round surface shall not be used. The percentage of water absorption shall generally not exceed 5% of its weight. For laterite this percentage is 12%. Weep holes shall be kept at 1.00 m intervals in zig-zag pattern below FFL with 50mm PVC pipes of approved brand (cost to be included in the rate).

2.6.3 Mortar: Mortar used in the masonry work shall be as specified in the items. Mortars coming over the finished stone surfaces during the execution shall be washed fully so that the stone edges on the finished surface of the masonry work are clearly visible.

2.6.4 Curing: The masonry work in cement mortar shall be kept constantly moist on faces for minimum period of 7 days after the mortar is well set.

2.6.5 Measurement: Measurement will be taken on the finished work in cubic metre.

2.7. CONCRETE (PLAIN AND REINFORCED)
2.7.1 Scope: This specification establishes the materials, mixing, placing, curing, etc. of all types of cast-in-situ and pre-cast concrete used in foundation under-ground and over-ground structures, floors, etc. Any special requirement as shown or noted in the drawings shall supersede over the provisions of this specification.

2.7.2 Materials:

a) Cement: Cement shall be Portland Pozzolana cement from reputed manufacturers of cement, having an annual production of at least one million tons or more conforming to IS: 1489 (Part I & II). The cement shall be stored in a dry waterproof godown. As and when desired by the Engineer-in-charge the contractor shall be required to produce the test certificate from the approved test house at his own cost. The mandatory tests of cement shall be carried out by the contractor at his own cost in IITG Laboratory.

b) Fine Aggregate: For all concrete work, it shall be coarse sand conforming to the grading as given below: (zone I or II only applicable to concrete). Quality of sand shall be got approved by the Engineer-in-charge before bulk purchase. Silt content shall not exceed 4% by weight. The grading of fine aggregate shall be as follows:

<table>
<thead>
<tr>
<th>IS Sieve Designation</th>
<th>Percentage Passing by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grading Zone I</td>
</tr>
<tr>
<td>10 mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>90-100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>60-95</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>30-70</td>
</tr>
<tr>
<td>600 micron</td>
<td>15-34</td>
</tr>
<tr>
<td>300 micron</td>
<td>5-20</td>
</tr>
<tr>
<td>150 micron</td>
<td>0-10</td>
</tr>
</tbody>
</table>

c) Coarse aggregate: For concrete it shall be broken/crushed stone graded coarse aggregate. Coarse aggregate up to 20 mm size. Grading shall be within the limit as given below:

<table>
<thead>
<tr>
<th>ISSieve Designation</th>
<th>Percentage passing for graded aggregate of nominal size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40 mm</td>
</tr>
<tr>
<td>80mm</td>
<td>100</td>
</tr>
<tr>
<td>63mm</td>
<td>100</td>
</tr>
<tr>
<td>40mm</td>
<td>95-100</td>
</tr>
<tr>
<td>20mm</td>
<td>30-70</td>
</tr>
</tbody>
</table>
2.36mm

Note: If directed by Engineer-in-charge, the aggregate (fine as well as coarse) shall be washed to remove all dust, dirt, clay particles etc., at contractor's expenses.

d) Water: Water to be used in concrete, brick work, plasters shall be clean, fresh and non-saline. Sample of water shall be got tested before use according to relevant IS code if required by Engineer-in-charge.

2.7.3 Grade of Concrete:
Whenever grade of concrete is mentioned as M_{20}, M_{25}, M_{30} etc., as per items only design mix concrete shall be used. The mix shall be designed to produce the required grade of concrete having required workability and characteristic strength as per IS: 456. As long as a quality of materials do not change a mix design done earlier shall be considered adequate for later work. However, in case the quality of materials changes, the Engineer-in-charge may ask for a new design mix. The concrete mix design will be carried out by the contractor at his own cost in Approved Laboratory. While designing the mix durability requirements as given in IS:456 shall be taken into account. Proportioning of the mix shall mean the process of determining the proportions of various ingredients to be used to produce concrete of required strength, workability, durability and other properties. The Engineer-in-charge shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strength than required, the Engineer-in-charge shall order fresh trial mixes to be made by the contractor. No claim to alter the rates of concrete work shall be entertained due to such changes in mix variations. Any variation in cement consumption shall be taken into consideration for material reconciliation only. Preliminary mix designs shall be established well ahead of start of work. The design mix shall conform to the guidelines of IS: 10262.

a) Mixing: All cement concrete (plain or reinforced) shall be mixed in mechanical mixers. Wherever designation of concrete is given as M-20 or M-30, only design mix shall be followed.

b) Consolidation: Concrete for all reinforced concrete works in footings, columns, beams, slabs and the like shall be deposited and well consolidated by vibrating, using portable mechanical vibrators. Concrete in other items such as in chajjas, lintels, shelves etc., shall be laid and well consolidated by beating and tamping Care shall be taken to ensure that concrete is not over vibrated so as to cause segregation and bleeding.

c) Finish to concrete work:
(i) All concrete while being poured against form work shall be worked with vibrators, rods, trowels as required so that good quality concrete is obtained.

(ii) All exposed surface of RCC lintels, beams, columns etc. shall be plastered to match with adjoining plastered face of walls after suitably hacking the concrete surface.
(iii) All soffits of RCC slabs, loft slab, cupboard slab, shelves and working platform in kitchen etc. and other exposed surfaces of RCC work not continuous to brick work shall be plastered with cement to give an even and smooth surface.

2.7.4 Curing: Concrete shall be cured by keeping it continuously moist for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete and in hot weather after 4 hours. The water used for curing shall be of the same quality as that used for making of concrete. Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances such as hose, sprinklers etc. A layer of sacking, canvas, hessian, or other approved material, which will hold moisture for long period and prevent loss of moisture from the concrete, shall be used as covering. Type of covering which would stain, disfigure, or damage the concrete, during and after the curing period shall not be used. Only approved covering shall be used for curing. Exposed surfaces of concrete shall be maintained continuously in damp or wet condition for at least the first 14 days after placing of concrete. The contractor shall have all equipment and materials required for curing on hand and ready to use before concrete is placed. For curing the concrete in pavements, floor, flat roofs or other level surfaces, ponding method of curing is preferred after the expiry of first 24 hours during which (i.e. first 24 hours) the concrete shall be cured by use of wet sacking, canvas hessian, etc. The minimum water depth of 25mm for ponding shall be maintained. The method of containing the ponded water shall be approved by the Engineer-in-charge. The ponded areas shall be kept continuously filled with water, and leaks, if any, shall be promptly repaired. Alternatively, membrane curing may be used in lieu of moist curing with the permission of the Engineer-in-charge. Such compounds shall be applied to all exposed surfaces of the concrete by spraying or brushing as soon as possible after the concrete has set. Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer so as to obtain as efficiency of 90% as specified by BS: 8110. This film of curing compound shall be fully removed from the concrete surface after the curing period specified earlier. The Engineer-in-charge may not allow curing by curing compounds for those surfaces where use of curing compound may be detrimental to future finishes according to him.

2.7.5. Sampling and testing of concrete:

a) Samples from fresh concrete shall be taken as per IS- 1199-1959 (method of sampling of concrete) and cubes shall be made, cured and tested in accordance with IS: 516-1959 (method of test for strength of concrete). For testing cement concrete the contractor shall arrange for all the tools / moulds for making necessary cubes and shall bear all the charges for making the cubes, curing and testing through an approved laboratory. Further, the contractor shall make available laboratory equipment as listed below. A temporary room of adequate size not less than 10 sqm to have these facilities shall also be constructed by the contractor at his expense. After completion of work the contractor shall remove the equipment, dismantle the room and clear the site:

<table>
<thead>
<tr>
<th>Aggregate Size</th>
<th>Size of Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sieve set (for aggregate 40 mm down)</td>
<td></td>
</tr>
<tr>
<td>80mm</td>
<td>60cms dia</td>
</tr>
<tr>
<td>63mm</td>
<td>60cms dia</td>
</tr>
<tr>
<td>40mm</td>
<td>45cms dia</td>
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<tr>
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</tr>
<tr>
<td>12.5mm</td>
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</tr>
<tr>
<td>4.75mm</td>
<td>45cms dia</td>
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<td></td>
<td>2.36mm</td>
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<tr>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Sieve set</strong></td>
<td>2</td>
</tr>
<tr>
<td>(for aggregate 20 mm down)</td>
<td></td>
</tr>
<tr>
<td>40mm</td>
<td></td>
</tr>
<tr>
<td>20mm</td>
<td></td>
</tr>
<tr>
<td>16mm</td>
<td></td>
</tr>
<tr>
<td>12.5mm</td>
<td></td>
</tr>
<tr>
<td>10mm</td>
<td></td>
</tr>
<tr>
<td>4.75mm</td>
<td></td>
</tr>
<tr>
<td>600 micron</td>
<td></td>
</tr>
<tr>
<td>300 micron</td>
<td></td>
</tr>
<tr>
<td>150 micron</td>
<td></td>
</tr>
<tr>
<td>75 micron</td>
<td></td>
</tr>
</tbody>
</table>

(iii) Electronic Weighting machines
(iv) Physical balance of capacity 200 gms with weight box (accuracy 0.5 gm.)
(v) Counter scale of 20 kg. Capacity.
(vi) Weights

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Weight</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5kg</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2kg</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>500gm</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>200gm</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>100gm</td>
<td>2</td>
</tr>
</tbody>
</table>

(vii) Slump cones 2 Nos.
(viii) 15 cm moulds 18 Nos.
(ix) Electric/ Kerosene heater 1 No.
(x) Pans etc. As directed by the Engineer-in-charge.
(xi) Vicat apparatus with needles, test tubes, breakers, thick glass plates etc.
(xii) Measuring cylinders 1000 ml, 500 ml.
(xiii) Wash bottles Capacity 500 ml- 2Nos.
(xiv) Sink 1 No.
(xv) Litre : Measures
(xvi) 2Lit 2 Nos.
(xvii) 4Lit 1 No.
(xviii) 0.5 Lit 1 No.
(xix) Compressive test machine of suitable capacity 1 No.

b) **Compressive strength**: 7 days compressive strength test may be carried out in addition to 28 days compressive strength test for a quicker idea of the quality of concrete. In all cases the 28 days, compressive strength alone shall be the criteria for acceptance or rejection of the concrete.

c) **Test Specimen**: Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for such purposes as to determine the strength of concrete at 7 days or to check the testing error.

d) **Test strength of samples**: The test strength of the sample shall be the average of the strength of three specimens. The individual variation shall not be more than +/- 15 percent of the average.
e) Cement boiling test: Accelerated compressive test as per IS-9013/78 shall be carried out to determine the quality of cement received at site in each consignment. This shall be done as per details below. The test result shall be recorded, signed and kept in a register with the Engineer-in-charge.

f) Prepare 9 cubes with cement concrete mix proposed to be used for the job. Keep the same water cement ratio that will actually be used. Slump could be a good indication.

g) After the cubes are cast, 3 moulds containing the cubes to be tested by accelerated curing method must be covered on the top with a machined plate. The plate should be of the same size as cube mould plates.

h) After 24 hours of casting, the three cubes shall be boiled with the top plates on. In the field, these could be boiled in a drum with at least 75mm water standing over the cube moulds. The boiling must be uniform and constant for exactly 3 and 1/2 hours. Thereafter, the cubes must be taken out of the boiling water, de-mould and cooled for 1 hour and tested. Exact timings are extremely important and must be followed. The anticipated 28 days compressive strength can be calculated from the regression equation given below:

\[ Y = 8.2 + 1.609A \]

where \( Y \) = the predicted 28 days cube result in N/mm\(^2\)

\( A \) = accelerated cube result in N/mm\(^2\)

2.7.6. Bearing Plaster: This shall consist of cement plaster 1:3 (1 cement : 3 fine sand) 20mm thick finished with a coat of neat cement laid on top of walls as bearing for RCC lintels, beams and slabs. When dry, a thick coat of lime wash shall be given before starting shuttering. The shuttering shall be started after minimum one day of bearing plaster so that it is set. In respect of projected balconies, projected slabs at roof level and projected verandah, the payment of the RCC work shall be made under item, of RCC slabs, the payment for centring and shuttering of such items shall similarly be paid under the item of Centering and Shuttering of RCC slab nothing extra shall be paid for the side shuttering at the edges of these projected balconies and projected verandahs. All exposed edge shall however, be finished as per specification and nothing extra shall be paid for this. In the item of RCC walls, railing and roofs etc. nothing extra shall be paid for making designs as per patterns given by Architects or thickness of sections. The rates for railing are inclusive of all the labour and the materials including execution as given description of the item, portion of railings, which is embedded in the masonry, or RCC shall not be taken for measurements. The compaction of the Pre-cast concrete shall be done by vibrating table or external vibrator, as approved by the Engineer-in-charge. The rate quoted for the item shall include the element both for form work and mechanical vibration.

2.7.7 Measurement
Measurement will be taken on the concrete surface in cubic metre.

2.8. FORM WORK
2.8.1. Materials and design
a) The form work shall be made of sufficiently rigid steel and/or ply board Joints of the shuttering must not allow loss of liquid from concrete. In shuttering the joints shall be perfectly closed and lined with craft paper or other types of approved materials. The form work shall be constructed as to remain sufficiently rigid during placing of the concrete. All shuttering and framing must be adequately stayed and braced to the satisfaction of the Engineer-in-charge for properly supporting the concrete during the period of hardening. The forms shall have sufficient strength and rigidity to hold concrete and withstand the pressure, lines and levels. The surface of all forms in contact with concrete shall be clean, rigid,
watertight and smooth. Suitable devices shall be used to hold corners, adjacent ends and edged of panels of other forms together in accurate alignment.

b) The form work shall conform to the shape, lines and dimensions to suit the R.C.C members as shown on drawing. Form work shall be adequately designed to support the full weight of workers, fresh placed concrete without yielding to settlement or deflection and to ensure good and truly aligned concrete finish in accordance with the construction drawings. A camber in all direction of 6 mm for every 5 metre span in all slab and beam centering shall be given to allow for unavoidable sagging due to compression or other causes.

c) The form shall be so designed that the sides of the beams shall be first removed leaving the soffit of beams and supporting props in position. Props shall be designed to allow accurate adjustment & to permit of their being removed without jarring the concrete.

d) Temporary opening shall be provided at the base of columns forms and at other points where necessary for facilities of cleaning and observations immediately before concrete is deposited.

2.8.2 Vertical shuttering: The vertical shuttering shall be carried down to such solid surface as is sufficiently strong to afford adequate support and shall remain in position until the newly constructed work is able to support itself. Props of approved quality shall be used. Tubular steel props shall be preferable. In case timber props and bullies are allowed to use these shall be of minimum 10 cm diameter and shall be straight and adequately strong. The spacing of such struts shall be designed to carry loads imposed on it without undue deflection of the members supported by the props and shall be approved by the Engineer in-charge. Any alterations suggested by the Engineer-in-charge shall be carried out at Contractor’s expenses. Bracing shall be provided as directed without extra cost.

2.8.3 Water tightness of shuttering: The Contractor shall ensure that the forms are checked for water tightness just before concreting operation starts and shall make good any deficiencies. If instructed by the Engineer in-charge building paper or any other approved materials will have to be used without any extra charge for the same.

2.8.4 Cleaning and treatment of forms: All rubbish, particularly wood chipping, shaving and saw dust, shall be removed from the interior of the forms before the concrete is placed and the form work in contact with the concrete shall be cleaned and thoroughly wetted. Interior of all moulds and boxes must be thoroughly washed out with hose pipe or otherwise so as to be perfectly cleaned and free from all extraneous matter before deposition of concrete. Prior approval of the form work should be taken from Engineer in-charge before placing reinforcement on the form work.

2.8.5 Stripping: Form shall be left in place until their removal is authorized by the Engineer in-charge and shall then be removed with care so as to avoid injury to concrete. Under no circumstances shall form be struck until the concrete reaches as strength of at least twice the stress to which the concrete may be subjected at the time of striking.

2.8.6 Stripping time: Stripping time shall be as follows:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>Stripping time</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Vertical formwork to columns, walls, beams</td>
<td>48 Hours</td>
</tr>
<tr>
<td>b) Soffit formwork to beams (Props to be re-fixed immediately after removal of formwork)</td>
<td>14 Days</td>
</tr>
</tbody>
</table>
c) Props to slabs:

<table>
<thead>
<tr>
<th>Spanning</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 4.5 m</td>
<td>14 days</td>
</tr>
<tr>
<td>over 4.5 m</td>
<td>21 days</td>
</tr>
</tbody>
</table>

d) Props to beams and arches

<table>
<thead>
<tr>
<th>Spanning</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 6 m</td>
<td>21 days</td>
</tr>
<tr>
<td>over 6 m</td>
<td>28 days</td>
</tr>
</tbody>
</table>

2.8.7 Formwork in Lifts for Continuous Surface:
Where forms for continuous surface are placed in successive units, (as for example in columns or R.C.C walls the forms shall fit tightly over the completed surface so as to prevent leakage of mortar from the concrete and to maintain accurate alignment of the surface.

2.8.8. Removal of Form Work:
Form work shall be removed in such a manner as would not cause any shock or vibration that would damage the concrete surface shall be exposed to ascertain that the concrete has sufficiently hardened.

a) Where the shape of the element is such that form work has re-entrant angles, the framework shall be removed as soon as possible after the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.

2.8.9. Measurement: Measurements shall be taken of the area of shuttering in contact with the concrete surface. Dimensions of the form work shall be measured correct to a cm. Centering and shuttering where height exceeds 4.0 meter in one floor shall be measured and paid for separately under the relevant items.

2.9 STEEL REINFORCEMENT:

2.9.1 Only Fe500 Super Ductile reinforcement steel of TATA TISCON, JINDAL PANTHER, SAIL conforming to Fe500D grade of IS 1786:2008 as per item shall only be used. As and when desired by the Engineer-in-charge the contractor shall be required to produce the test certificate from the approved test house at his own cost. The mandatory tests of reinforcement shall be carried out by the contractor at his own cost in Approved laboratory.

2.9.2 Cleaning of reinforcement: Before steel reinforcement is placed in position, the surface of the reinforcement shall be cleaned out of rust, dust, grease and any other objectionable deleterious substances.

2.9.3 Bar bending schedule of reinforcement: On receipt of structural drawing, Contractor shall prepare bar bending schedule of reinforcement and shall obtain approval of the Engineer in-charge.

2.9.4 Placing and security: Reinforcement bars shall be accurately placed and secured in position by 20 gauge soft black annealed steel wire and firmly supported or wedged by pre-cast concrete blocks of suitable thickness at sufficiently close intervals so that they will not sag between the supports or get displaced during the placing of concrete or any other
operation of the work. At intersection point binding of reinforcement point shall be in both the direction. Contractor shall maintain reinforcement in its correct position without displacement and correct specified cover.

2.9.5 Welding: Welding of bars shall not be carried out unless specifically authorized in writing by Engineer in-charge as per I.S. Code of Practice in place of splicing. However, no extra payment shall be allowed for the same.

2.9.6 Inspection of reinforcement: No concreting shall be commenced until Engineer incharge has inspected the reinforcement in position and until his approval has been obtained. A notice of at least 72 hours shall be given to the Engineer in-charge by the contractor for inspection of reinforcement. If in the opinion of the Engineer in-charge, any materials are not in accordance with the specification or the reinforcement is incorrectly spaced, bent or otherwise defective, the contractor shall immediately remove such materials from the site and replace with new material and rectify any other defects in accordance with the instruction of the Engineer in-charge and to his satisfaction.

2.9.7 Cover for reinforcement: To be followed as per IS Code of practice if not specified.

2.9.8 Net measurement: Reinforcements shall be placed as shown on the structural drawings and payment will be made on the net measurements in accordance with the drawing and taken at the site. Only such lapse, dowels, chairs and pins in reinforcement as approved by the Engineer in-charge or shown in drawings shall be paid for. The contractor shall allow in the quoted rates for all wastage, which will not be paid separately.

2.10. CEMENT PLASTER (INTERNAL & EXTERNAL)
2.10.1 Preparation of Surface: The walls to be plastered shall have all joints raked out to a depth of 10 mm, if not already done. R.C.C. surface shall be properly hacked to get good key to the plaster. All dust and oily matter, if any, shall be brushed and cleaned and surface to be plastered shall be kept wet for 6 hours before plastering is commenced.

2.10.2 Proportion of Mortar: It shall be as specified in the items in the BOQ.

2.10.3 Application of Plaster: The mortar shall be applied evenly with force on the surface to be plastered. The mortar surface shall be finished at once by being rubbed over with a trowel till the cement appears on the surface. All corners, angles and junctions shall be truly vertical and horizontal as the case may be, carefully and neatly finished. Rounding of corners and junctions where required shall be done without extra charge. The mortar shall adhere to the surface intimately when set and there should be no hollow sound when struck. The thickness of plaster shall be minimum 6 mm/ 12 mm/ 15 mm as specified in the items.

2.10.4 When neat cement finish is specified over the plaster surface, a coat of pure Portland cement slurry, 1.5 mm thick shall be applied and well rubbed to the plaster surface while the plaster surface is still fresh.

2.10.5 When no finish is specified, the plastered surface shall be rubbed well to an even plane with a wooden float for external surface and finished smooth with a steel trowel for internal surface.

2.11. STEEL WORK:
Steel work made of MS angle and MS flat welded built-up section, complete shall be carried out as per drawing. All steel work shall be painted with a priming coat of approved steel primer. All works shall be carried out to proper line and specifications. All welding of steel work shall be tested for the quality of weld as laid down in IS 8222-1970 before erection.
Where ever it appears shall mean continuous fillet welding unless otherwise directed by Engineer-in-Charge or shown in the drawing. Machine girding at shop shall be done over the weld to remove the excess deposit and scales.

### 2.11.1. Measurement
Unit of measurement shall be given in the B.O.Q

**LIST OF PREFERED MAKES FOR CIVIL WORKS**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Preferred Makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cement (Ordinary Portland)</td>
<td>ACC/ AMBUJA/ULTRATECH/STAR/TOP CEM / VALLEY STRONG</td>
</tr>
<tr>
<td>2. TMA / Tor Steel</td>
<td>SAILJI8NDAL PATHAR / TATA TISCON</td>
</tr>
<tr>
<td>3. Structural Steel</td>
<td>SAIL / TATA/ JINDAL</td>
</tr>
<tr>
<td>4. Precast CC Tiles</td>
<td>HINDUSTAN TILES/NIMCO PREFAB/NITCO KONKRETE / AMSTRONG OR EQUIVALENT</td>
</tr>
<tr>
<td>5. Ceramic Tiles</td>
<td>NITCO/ORIENT/SOMANY/KAJARIA/ANGEL/JOHN SON/GLORY/AMSTRONG</td>
</tr>
<tr>
<td>6. RCC Pipes</td>
<td>AKSHAY/KK/HINDUSTAN/PRAGATI</td>
</tr>
<tr>
<td>7. Manhole Covers (SFRC)</td>
<td>KK / HINDUSTAN</td>
</tr>
<tr>
<td>8. Kerb Stone (Precast CC)</td>
<td>NIMCO PREFAB/SUBHASH FERRO CONCRETE/HINDUSTAN TILES</td>
</tr>
<tr>
<td>9. Chain link Wire mesh</td>
<td>MITTAL/SHAKTI-WELD MESH</td>
</tr>
<tr>
<td>10. PVC Piles / Fittings</td>
<td>SUPREME/PRAKASH/ ORI PLAST / FINOLEX</td>
</tr>
<tr>
<td>11. Float Glass and Mirror</td>
<td>MODIGUARD/ASAHI/SAINT GOBAIN/GUARDIAN</td>
</tr>
<tr>
<td>12. Water-proofing Compound</td>
<td>CICO/CHEMISTIK/FOSROC/MBT/STP/DEGUSSA/ OR EUIVALENT</td>
</tr>
<tr>
<td>13. Cement / Concrete Additives</td>
<td>CICI/ CHEMISTIK/ FORSOC/MBT/DEGUSSA/SIKA</td>
</tr>
<tr>
<td>14. Distemper-Dry / Oil Board</td>
<td>ICI/ASIAN, BERGER</td>
</tr>
<tr>
<td>15. Aluminium Sections for Doors/Windows</td>
<td>SNOWCHEM/CHEMISTIK/FOSROC/SIKA</td>
</tr>
<tr>
<td>16. Floor Hardner</td>
<td>SNOWCEM/ICI NEROLAC/BERGET/ASIAN</td>
</tr>
<tr>
<td>17. Cement Paint</td>
<td>SNOWCEM/ICI NEROLAC/BERGER/ASIAN</td>
</tr>
<tr>
<td>18. Primer for steel</td>
<td>ICI/ASIAN/BERGER/NEROLAC</td>
</tr>
<tr>
<td>19. Synthetic Enamel Paint</td>
<td>ICI/ASIAN/BERGER/NEROLAC</td>
</tr>
<tr>
<td>20. Plastic Emulsion</td>
<td>ICI ASIAN/BERGER/NEROLAC</td>
</tr>
<tr>
<td>21. Waterproof ply &amp; Board</td>
<td>DURO/GREENPLY/CENTURY/KITPLY</td>
</tr>
<tr>
<td>22. Flush Door Shutter</td>
<td>KITPLY/SWASTIK/DURO</td>
</tr>
<tr>
<td>23. Rolling shutter</td>
<td>DIANA/RAYMUS/RAMA</td>
</tr>
<tr>
<td>24. Rolling shutter</td>
<td>STP/KKITD IR EQUIVALENT IS APPROVED</td>
</tr>
<tr>
<td>25. PVC Door Shutter</td>
<td>RAJSHRI/SINTEX OR EQUIVALENT IS APPROVED</td>
</tr>
<tr>
<td>26. PVC Tank</td>
<td>SINTEX/ELECTROPLAST/STAR/LOTUS</td>
</tr>
<tr>
<td>27. WC/Wash Basin</td>
<td>CERA/PARRYWARE/HINDUSTAN/JAGUAR</td>
</tr>
<tr>
<td>28. C. P. Fittings</td>
<td>PARKO/HINDUSTAN/SEIKO/ORIENT/JAGUAR</td>
</tr>
<tr>
<td>29. S. C. I. Pipes</td>
<td>RIF/NITCO/BENGAL IRON/IISCO</td>
</tr>
<tr>
<td>30. White Cement</td>
<td>BIRLA WHITE/JK WHITE</td>
</tr>
<tr>
<td>31. Oxidized Aluminium Fittings</td>
<td>EBCO/DOOR LINE</td>
</tr>
<tr>
<td>32. Gypsum False Ceiling</td>
<td>INDIA GYSUM/BORAL</td>
</tr>
<tr>
<td>33. M.S.PIPE</td>
<td>TATA/SAIL/JINDAL/NEZONE</td>
</tr>
<tr>
<td>34. G.I.PIPE</td>
<td>TATA/JINDAL/NEZONE</td>
</tr>
<tr>
<td>35. VITRIFIED TILE</td>
<td>KAJARIA/ORIENT/JHONSON</td>
</tr>
<tr>
<td>36. FALSE CEILING</td>
<td>AMSTRONG/GYPROG</td>
</tr>
</tbody>
</table>

Note: Sample of all item shall be got approved from Engineer In-Charge before bulk procure.
1.0 The intent of this chapter of the specification is to define the general technical requirements of internal electrical wiring works.

1.1 STANDARDS

The work shall be carried out in conformity with this specification, the relevant specifications / code of practice of the Indian Standards Institutions, approved drawings and instructions of the Engineer-in-Charge or his authorized representative issued from time to time. In addition to the above, all works shall conform to the requirements of the following:

a) Indian Electricity Act and Rules.

b) Regulations laid down by Chief Electrical Inspector of the state, power supply authority.

c) Relevant Indian Standards and National Electrical Code.

d) Any other regulation laid down by the local authorities.

1.2 Specification of items / works including definition of terms, measurement, classification etc. not covered in this specification shall be governed by the latest General Specification for Electrical works of CPWD.

1.3 EQUIPMENT SPECIFICATIONS

All materials, fittings, applications, accessories to be supplied by the Contractor shall be of best quality and shall conform to the specification given hereunder. The equipment shall be manufactured in accordance with the current Indian Standards Specification. Samples of all materials before being used shall be procured by the Contractor to the Engineer-in-Charge or his authorized representatives. The material shall be used / installed only after approval by the Engineer-in-Charge.

1.3.1 Switches

All switches for wiring shall be manufactured in accordance with IS:3854 and shall be piano type unless otherwise specified.

1.3.2 Receptacles

Only three pin-type receptacles manufactured in accordance with IS:1293 shall be used with third terminal connected to the earth. All receptacles shall be provided with a switch mounted on the same enclosure. Receptacles shall be of flush mounting type except for the rating above 15/16 amps. unless otherwise specified.

1.3.3 Outlet / Switchboard boxes

Outlet boxes for socket, switches fixtures and regulators etc. shall be of minimum 18 gauge (for size up to 20 cm x 30 cm) and 16 gauge (for size above 20 cm x 30 cm) or specified in the schedule of items. Junction / outlet boxes shall be used in roof slab where concealed wiring has been adopted. The junction / outlet / switch
boxes shall be painted with anticorrosive paint before installation. Cover plates shall be of Formica or approved equivalent with colour to suit the wall. Cover plates shall be fixed by cadmium plated brass screw and suitable c.p. brass cup washers. An earth terminal with stud and washers shall be provided in each MS box for termination of protective earth conductors.

1.3.4 Conduit and Fittings

Conduits shall be of metallic or non-metallic type as specified:

a) All rigid metallic conduit pipes shall be of steel and be ISI marked. The minimum wall thickness shall be 1.6 mm (16 SWG) upto 32 mm dia and 2 mm (14 SWG) above 32 mm dia. The conduit shall be solid drawn or reamed by welding and finished with galvanised or stove enamelled surface.

b) All non-metallic conduit pipes and accessories shall be of suitable material complying with IS:2509-1973 and IS:3419-1976 for rigid conduits and IS:6946-1973 for flexible conduits. The interior of the conduits shall be smooth and free from obstructions. The rigid pipes shall be ISI marked. The minimum wall thickness of the rigid non-metallic conduits shall be 1.6 mm upto 25 mm dia conduit.

c) No conduit less than 20 mm in diameter shall be used.

d) All metallic conduit accessories shall be only threaded type, pin grip or clamp type accessories are not acceptable.

e) Accessories for non-metallic rigid type of conduits shall be normally of grip type.

1.3.5 Casing and Capping

a) Casing and capping shall be of good quality PVC, free from defects like deformations, unevenness, blisters, cavities, etc.

b) The casing shall be of square or rectangular body with top of the side walls suitable for tightly fitting slide-in type capping with double grooving. All surfaces shall have smooth finish inside and outside.

1.3.6 Wires and Cables

f) Wiring cables

- Wires shall be PVC insulated 1100 V grade as per IS:1554.
- Conductors shall be of stranded copper.
- The smallest size of conductor for lighting circuits shall have a nominal cross-sectional area of not less than 1.5 sq.mm, while minimum size of power wiring shall be 2.5 sq.mm.
- All wires shall be ISI marked.

g) Flexible cable

- Flexible cables shall be PVC insulated having a minimum size of 14/0.0193 mm.
- All flexible wires shall be mechanically protected by tough rubber or PVC sheath.
c) **Underground cables**

- **Power cables**: Power cables for use in 415 V system shall be of 1100 V grade, aluminium stranded conductor, PVC insulated, PVC sheathed single wire armoured and overall PVC sheathed. All power cables for 11 kV and 33 kV shall be aluminium conductor, XLPE insulated, screened, PVC bedded galvanized steel flat armoured (non-magnetic material in case of single core cable) and PVC sheathed cable. All 415 V cables shall conform to IS:1554 and HT cables shall conform to IS:7098. Unarmoured cables will be used only where specified.

- **Control cables**: Control of cables shall be 1100 V grade, 2.5 sq.mm copper conductor, PVC insulated, PVC sheathed, single wire armoured with overall PVC sheathed as per IS:1554.

**d) Communication cables**

Communication cable shall comprise 1 pair unarmoured, 2-pair, 5-pair and multipair armoured cable of size as specified in the schedule. Minimum conductor size shall be 0.5 mm dia for telephone system and 0.71 for other communication system.

1.3.7 **Switchgear and Control Gear**

a) **General**

- All items of switchgears and distribution boards shall be metal clad type except those forming part of cubicle type switch boards.
- The types, ratings and make of the switchgear and protective gear shall be as specified in this specification and the schedule of works.
- RCCBs (ELCBs) shall conform to the ratings specified in the schedule of works.
- Each distribution boards shall have one independent and separate terminal block each for the neutral and the earth conductors.
- Each distribution boards shall be provided with earthing terminals for body earthing – one for single phase and two for three-phase.
- All DBs (single phase or three phase) shall be of 4, 6, 8 or 12 ways as specified. Number of ways as stated above, in case of three phase DB shall mean ways per phase.
- Bus-bars used shall be of electrolyte copper of appropriate size.

b) **MCB Type Distribution Board (MCBDB)**

- MCB type distribution boards shall be either single phase or 3-phase type horizontal or vertical, depending upon whether outgoing circuits are single phase or 3 phased / 1 phase.
- All MCBDBs shall have provision for accommodating MCB type isolators and RCCB (ELCB) at incoming in single pole or multiple configuration.
- All MCBDBs unless specifically mentioned and/or having different circuit configuration than the standard manufacturing range shall be factory fabricated and completely pre-wired and ready for installation at site.
- MCBDBs shall be fabricated out of 1.6 mm thick sheet steel with stove enamelled paint finish and shall be wall mounted type if not specified otherwise.

- The boards shall have adequate provision for entry of incoming and outgoing cables / wires through knockout holes with or without detachable plates.

c) Medium Voltage Switchboard

Medium voltage switchboards or MV switchgear panels shall be as per the schedule of items and as per the following specific requirements in addition to the general requirements as per the latest editions of applicable Indian Standards.

The switchboard shall be free-standing, metal enclosed, compartmentalized, modular type, dust and vermin proof suitable for indoor installation. Switchgear enclosure shall provide degree of protection not less than IP-31 as per IS:2147. The switchgear shall be assembled out of vertical panels of uniform height not exceeding 2450 mm. The maximum height of the operating handle / switches shall not exceed 1800 mm and minimum height not below 300 mm.

The switchgear shall be designed to ensure maximum safety during operation, inspection, connection of cables, relocation of outgoing circuits and maintenance with the energized bus-bar system and without taking any special precautions. The switchgear shall permit maximum interchangeability and shall be extensible on either side.

The switchboard shall be sheet steel clad with the frame fabricated out of 14 SWG cold rolled sheet steel and doors / covers out of 15 SWG cold rolled sheet steel; having integral base frame for each panel. All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made of galvanized, zinc passivated or cadmium plated high quality steel bolts, nuts and washers, secured against loosening.

The switchgear shall be suitable for bottom cable entry. Provision for incoming connection through busduct shall be made as per requirement of the specification and schedule of rates.

Individual circuit breakers, switch fuse units, MCCBs, bus-bars, cable termination compartment shall be housed in separate enclosed compartments separated from each other by metallic barriers.

Circuit breaker panel shall be in single front execution only. Not more than two breaker cubicles shall be housed in single vertical panel except for the incomer and bus-coupler, which shall each be housed in independent vertical panels. Motor starters, switch fuse units, MCCBs shall be in suitable arrangement in single or double front as specified in the schedule of items. All auxiliary devices for control, indications, measurement and protection such as push-button, control and selector switches, indicating lamp, metering instruments protective relays except bimetallic relays shall be mounted on the front side of the respective compartment. Components requiring frequent inspection during operation shall be easily accessible.

Main bus-bars shall be of high conductivity aluminium or electrolytic copper as specified having uniform current rating throughout their length. Horizontal and vertical bus-bars shall be sized depending upon the maximum expected current and to limit the maximum operating temperature at specified design ambient temperature to 85°C for normal operating condition and to 200°C for short-circuit condition considering installation in a poorly ventilated area.

Adequately sized auxiliary copper / aluminium bus-bars running horizontally in a separate enclosure shall be provided for space heaters, control supply and
metering requirements. Necessary tee-off connections shall be used for distributing auxiliary supply to each vertical panel.

All bus-bars shall be colour coded and designed to withstand specified short circuit currents for one second.

Aluminium earth bus with 300 sq.mm minimum size or equivalent copper bus shall be provided throughout the length of the switchboard with provision for interconnecting to earth grid. All non-current carrying metallic parts of the mounted equipment shall be earthed. Door and movable parts shall be earthed using flexible copper connections.

Inside the switchboards the wiring for power, control, signaling protection and instrument circuits shall be done with PVC insulated copper, conductors having 660 / 1100 V grade insulation. Minimum size of the control wire shall be 1.5 sq.mm copper for circuits having fuse rating 10 Amps. Or less. For control circuit with higher fuse rating min 2.5 sq.mm copper conductor shall be used.

“Elmex” type terminals shall be acceptable for wiring upto 10 sq.mm size and for conductors larger than 10 mm$^2$, bolt type terminals with crimping lugs shall be provided. Each wire shall be terminated at a separate terminal. A minimum of 10% spare terminal shall be provided for all CT terminals.

For modules rated above 100 amps., preferably copper strip connection shall be used.

The air circuit breakers shall be fully drawout type, Circuit breaker panel shall have three distinct positions : viz – ‘service’, ‘test’, ‘full out’ position complete with necessary safety interlocks, scraping, earth connection, shutters, safety barriers and suitable guides for easy movement of the trolley. Access to the cables shall be from the rear side after opening the door of the separate cabling compartment. Circuit breakers shall be trip free type having antipumping features and electrically operated mechanism suitable for control supply specified in the schedule of items / specification. Circuit breaker trip coils shall be rated for satisfactory operation with 50% to 110% of rated voltage and the closing coil shall be rated for 85% to 110% of the rated voltage.

All switch fuse units shall be load break, heavy duty, air break type (double break) with the operating handle mounted on compartment door, complete with necessary interlocking mechanism.

All fuses shall be non-deteriorating HRC cartridge, pressure fitting link type.

All relays shall be back connected, drawout type suitable for flush mounting and fitting with dust tight covers along with hand reset type built in flag indication.

Current transformers for metering shall have an accuracy class 1.0 and instrument safety factor less than 5. Protective current transformers shall have an accuracy class 5 P and accuracy limit factor greater than 10.

All indicating instruments shall be flush mounting type and of 96 x 96 mm square pattern, except the digital instruments. Digital instruments if required shall be as per schedule of items / specific technical specifications.

All control / selector switches shall be rotary back connected type having a cam operated contact mechanism.

**1.3.8 Miniature Circuit Breaker**

a) Miniature circuit breakers shall be of approved make and rating as specified.
b) “L” series MCBs shall be used only for normal lighting circuits.

c) “G” series MCBs shall be used for all motor loads, air conditioners, halogen and other discharge lamps and all power circuits.

1.3.9 Moulded Case Circuit Breaker

a) Moulded case circuit breakers shall be of approved make. Adjustable type MCCBs shall be used unless otherwise specified in the schedule of items / specific technical specification.

b) Current rating and the short circuit rating of the MCCBs shall be as per schedule of items.

1.3.10 Medium Voltage Bus-duct

c) Enclosure

The enclosure of the medium voltage bus-duct shall be of 14 SWG sheet steel with removable cover in one side and shall be totally enclosed, dust and vermin proof. The cover shall be fitted with dust preventing gaskets, secured with sufficient number of cadmium plated iron screws to ensure that the cover is dust tight. Suitable openings shall be provided for cable / conduit entries as required.

The enclosure shall be painted with one coat of primer paint after cleaning the surface and after dressing and degreasing. Two coats of finish paint shall thereafter be applied by spray painting process. This shall be done in the works before bringing the materials to site.

b) Bus-bars and Supports

Bus-bars shall be made of electric grade copper conforming to relevant Indian Standards and shall be supported on robust non-hygroscopic insulators at regular intervals to withstand the specified short circuit current. Bus-bars shall be suitably insulated with PVC sleeves / tapes. An aluminium / copper earth bus of suitable size to be specified shall be run along the bus-duct having necessary provision for connection to the earthing network.

1.4 Building Wiring System

Wiring system to be adopted shall be as specified under ‘specified technical requirements’ and shall conform to the general requirements as specified hereunder.

1.4.1 Conduit Wiring System A.

General

a) Surface or concealed conduit wiring system with ERW or GI or polyethene conduit as specified shall be adopted.

b) Conduit work whether surface or concealed shall be completed before the cables are drawn in.

c) Conduit pipes shall be jointed by means of screwed couplers and screwed accessories (in case of metallic conduits) only. In case of non-metallic conduits joints shall be properly sealed.
d) All bends in the wiring system shall be done either by bending the pipes neatly without any crack or by inserting suitable accessories like bends, elbows or similar fittings. Radius of bends in conduit pipes shall not be less than 7.5 cm.

e) All metallic parts of conduits and accessories in recessed wiring system shall be painted with anticorrosive paint before their installation.

f) In all conduit wiring system, a protective earth conductor as specified shall be drawn inside the conduit to provide for earthing of non current carrying metallic parts of the installation. Earth wires shall be terminated in the switch boxes and / or the earth terminal blocks at the DBs. In case, the earth wire specified is of large size which may not be possible to be carried inside the conduits may also be laid external to the conduit subject to approval of the Engineer-in-Charge.

In case of the metallic conduits entire conduit system shall be electrically and mechanically continuous.

g) Maximum number of PVC insulated 650 / 1100 V grade cables that can be drawn in one conduit is given sizewise in Table-1, which shall not be exceeded. Conduit sizes shall be selected accordingly.

h) When crossing through expansion joints in buildings, the conduit sections across the joint may be through flexible conduits of the same size as the rigid conduit.

B. Additional Requirements for Surface Conduit Wiring System

a) Conduit pipes shall be fixed by heavy gauge non-metallic saddles in case of non-metallic conduits and 24 gauge (up to 25 mm dia) / 20 gauge (for larger dia) steel saddles in case of metallic conduit system.

b) Saddles shall be fixed at an interval not more than 60 cm in case of non-metallic conduits and not more than 1 m in case of metallic conduit. However, on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm (for metallic conduit) / 15 cm (for non-metallic conduit) from the surface of such fittings.

c) Where conduits are required to be laid along the trusses / joist etc., the same shall be secured by means of saddles / girder clips etc. As per instruction /approval of the Engineer-in-Charge.

d) In all the cases when conduits are laid in masonry / concrete work, saddles shall be properly secured by inserting polyethylene plugs approved by the Engineer-in-Charge.

C. Additional Requirements for Recessed Conduit Wiring System

a) Fixing of Conduits in RCC works.

i) The conduit pipes shall be laid in position and firmly secured to the steel reinforcement bars by steel binding wires before concreting is done.

ii) Instead of using standard bends or elbows the conduit itself should be bent in long radius to facilitate easy drawing of conductors.

iii) Inspection and junction boxes should be suitably located to avoid long conduit runs and such boxes shall be properly identified to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

iv) Special care shall be taken in laying the conduits and during the concreting work to avoid damage to the conduits.
b) Laying of conduit in wall

i) Conduits shall be laid in the wall before plastering work in neatly made chase.

ii) The conduits shall be secured by means of staples / saddles / J-hooks at intervals not more than 60 cm.

iii) The joints between the conduits and the switch boards / distribution boards shall be properly sealed.

<table>
<thead>
<tr>
<th>Size of cable</th>
<th>Size of conduit, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Cross-Sectional Area mm²</td>
<td>20</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>1.5</td>
<td>4</td>
</tr>
<tr>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
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<tr>
<td>6</td>
<td>—</td>
</tr>
<tr>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>16</td>
<td>—</td>
</tr>
</tbody>
</table>

1.4.2 Casing Wiring System

Casing wiring system may be adopted as specified by using metallic or PVC casing and capping. All specifications for casing wiring system shall be as per the "General Specifications" for Electrical Works (Part-I internal), 2005 of CPWD.
1.4.3 Earthing

a) Materials

i) Earth electrodes shall be any of the following type as specified.
   a) Pipe / rod earth electrode
   b) Plate earth electrode
   c) Strip electrode

Pipe electrode shall be of G.I. heavy class with minimum 38 mm dia and 2.5 m long as per details shown in the drawing. Rod electrodes may be of steel or copper of 2.5 m minimum length. Minimum dia shall be 16 mm in case of steel and 12.5 mm in case of copper. The electrodes shall have no joints.

Plate electrodes may be of galvanised iron / steel or copper. In case of galvanised iron or steel thickness shall not be less than 6.30 mm, which in case of copper plate electrodes, thickness shall not be less than 3.15 mm. Minimum size of plate electrodes for both GI and copper shall be 60 cm x 60 cm. Strip electrodes shall not be smaller than 25 mm x 1.6 mm if of copper and 25 mm x 4 mm if of galvanised iron. If round conductors are used as earth electrodes, their cross sectional area shall not be smaller than 3.0 mm$^2$ if of copper and 6 mm$^2$ if of G.I.

ii) The main earthing conductor (from earth electrode to the main switch board or earth bus) shall be of G.I. or copper as specified. The sizes shall also be as per specification. However, in no case the size of the main earthing conductor be less than
   a) 5 mm dia (6 SWG) for G.I. or 4 mm dia (8 SWG) for copper wire.
   b) 25 mm x 4 mm in case of G.I. strip.
   c) 20 mm x 3 mm in case of copper strips.

iii) The earth continuity or loop earthing conductor shall be of copper, aluminium or G.I. as specified. The minimum size of the earth continuity conductor shall be as follows :
   a) 2 mm dia (14 SWG) in case of bare copper (1.5 mm$^2$ in case of insulated)
   b) 2.24 mm dia (13 SWG) in case of bare aluminium 2.5 mm$^2$ in case of insulated)
   c) 2.5 mm dia (12 SWG) in case of G.I.

b) Installation

i) Electrodes shall be as far as practicable, be embedded below permanent moisture level to a depth of at least 1.25 m. If rock is encountered, the depth of burial may be less than the specified value, subject to approval of the Engineer-in-Charge. In such case, the electrodes may be buried inclined to the vertical with inclination not more than 30º from the vertical.

ii) In case where more than one electrode has been specified, the distance between two electrodes shall preferably be not less than twice the length of the electrode.

iii) Plate electrodes shall be buried such that its top edge is at a depth not less than 1.5 m from the surface of the ground.
iv) Earth electrode normally shall not be located closer than 1.5 m from any building and should not be installed in proximity to a metal fence to avoid the possibility of the fence becoming live due to voltage gradient of the electrodes. If the metal fence is unavoidable, it should be earthed.

v) The strip electrodes shall be buried in trenches or ditches not less than 0.5 m deep and the length of the buried conductor shall be sufficient to give the required earth resistance. It shall, however, be not less than 15 m.

1.4.4 Installation of Fixtures / Fan

i) Fixtures shall be firmly supported from the structures, support clamps, etc., may be bolted or welded to the existing steelwork or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures will be fixed to or supported from concrete surfaces with the help of anchor fastener. In such cases special care shall be taken to see that anchoring is firm.

In case of concrete structures where metal inserts are not available, fixtures having smaller weights shall be supported by nylon sleeve / steel sleeve anchors inserting in neatly drilled holes or appropriate size as shown in the typical drawing. Nylon or steel sleeve / rawl plugs should be inserted by making 1.5” deep, 0.25 dia, cylindrical hole using electric hand drill. In no case wooden plugs shall be allowed. This procedure shall be followed for fitting all types of electrical fittings, switchboard, conduits etc. on surface in wall / ceilings.

ii) Fan clamps shall be of suitable design according to the nature of construction of the ceiling on which these clamps are to be fitted. In all cases the fan clamps shall be fabricated from new metal of suitable sizes and they shall be as close fitting as possible. Fan clamps for reinforced concrete roof shall be buried with the casting and due care shall be taken that they shall serve the purpose. Fan clamps for wood beams shall be of suitable flat iron fixed on two sides of the beam and according to the size and section of the beam one or two mild steel bolts passing through the beam shall hold both flat iron together. Fan clamps for steel joints shall be fabricated from flat iron to fit rigidly to the bottom flange of the beam. Care shall be taken during fabrication that the metal does not crack while hammering to shape. In cases where false ceiling exists, the fans shall be firmly connected to the structure / ceiling and not to the false ceiling.

1.4.5 Lightning Protection

i) Lightning protection shall be done in accordance with the tender specification, IS:2309-1989 and National Electrical Code.

ii) The materials for the air-termination, down conductors etc. For the lightning protective system shall be copper or G.I., as per specification. Recommended shape and minimum sizes of the conductors for use above ground and below are given below:

<table>
<thead>
<tr>
<th>Materials and shape</th>
<th>Minimum size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round copper wire</td>
<td>6 mm dia</td>
</tr>
<tr>
<td>Stranded copper wire</td>
<td>50 mm$^2$ (or 7 / 3.0 mm dia)</td>
</tr>
<tr>
<td>Copper strip</td>
<td>20 x 3 mm</td>
</tr>
<tr>
<td>Round galvanised iron</td>
<td>8 mm dia</td>
</tr>
<tr>
<td>Galvanised iron strip</td>
<td>20 x 3 mm</td>
</tr>
</tbody>
</table>
**Shape and minimum size of conductors for use below ground:**

- **Round copper wire**: 8 mm dia
- **Copper strip**: 32 x 6 mm
- **Round galvanised iron wire**: 10 mm dia
- **Galvanised iron strip**: 32 x 6 mm

**iii) Air Termination**

1. Air termination network may consist of vertical, horizontal or a combination of both vertical and horizontal conductors.

2. Vertical conductors shall project at least 30 cm above the object and shall have one point.

3. Horizontal air termination shall be so interconnected that no part of the roof is more than 9 m away from the nearest horizontal conductors.

4. Horizontal air terminations should be laid down the contours such as ridges, parapets and edges of flat roofs and where necessary over flat surfaces in such a way as to join each air termination to the rest and should themselves from closed network.

5. All metallic finials, chimneys, ducts, vent pipes, railings, gutters and the like, on or above the main surface of the roof of the structure shall be bonded to and form part of, the air termination network. If portions of a structure vary considerably in height any necessary air termination of air termination network of the lower portions, in addition to their own conductors be bonded to the down conductors of the taller portions.

6. All air terminals shall be effectively secured against overturning either by attachment to the object to be protected or by means of substantial braces and fixings which shall be permanently and rigidly attached to the building.

**iv) Down Conductors**

1. The number and spacing of the down conductors shall be as per the tender specification as directed by the Engineer-in-Charge. However, there shall be minimum 2 down conductors for structures up to 400 sq.m area and one extra down conductor for every additional 300 sq.m or part thereof.

2. Down conductors should be distributed round the outside walls of the structure. They shall preferably be run along the corners and other projections. Lift shafts shall not be used for fixing down conductors.

3. Down conductors shall be laid in such a way that they follow the most direct path possible between the air termination and the earth termination, avoiding sharp bends, upturns and kinks. Joints shall as far as possible be avoided in down conductors. Adequate protection may be provided to the conductors against mechanical damage. Metal pipes should not be used as protection for conductors.
4. Metal pipes leading rain water from the roof to the ground may be connected to the down conductors. Such connections should have disconnecting joints for testing purpose.

5. Any extended metal running vertically through the structure should be bonded to the lightning conductor at the top and the bottom unless the clearances are in accordance with IS:2309-1989.

6. Where the provision of suitable external routes for down conductors is impracticable or inadvisable, as in buildings of cantilever construction, from the first floor upwards, down conductors may be used in an air space provided by a non-metallic, non-combustible internal duct. Any covered recess not smaller than 75 x 15 mm or any vertical service duct running the full height of the building may be used for this purpose, provided it does not contain an unarmoured or non-metal sheathed cable.

v) Joints and bonds

a) Joints

The lightning protective system shall have as few joints in it as necessary. In the down conductors below ground level these shall be mechanically and electrically effective and shall be so made as to exclude moisture completely. The joints may be clamped, screwed, bolted, crimped, riveted or welded. With overlapping joints the length of the overlap should not be less than 20 mm for all types of conductors. Contact surfaces should first be cleaned and then inhibited from oxidation with a suitable non-corrosive compound. Joints of dissimilar metal should be suitably protected against bimetallic action and corrosion.

In general, joints for strips shall be tinned, soldered, welded or brazed and at least double-riveted. Clamped or bolted joints shall only be used on test points or on bonds to existing metal, but joints shall only be of the clamped or screwed type.

b) Bonds

External metal on or forming part of a structure may have to discharge the full lightning current. Therefore, the bond to the lightning protective system shall have a cross-sectional area not less than that employed for the main conductors. On the other hand, internal metal is not so vulnerable and its associated bonds are at most only likely to carry a portion of the total lightning current, apart from their function of equalising potential. These latter bonds may, therefore, be smaller in cross-sectional area than those used for the main conductors. All the bonds should be suitably protected against corrosion. Bonds shall be as short as possible.

vi) Testing Points

Each down conductor shall be provided with a testing point in a position convenient for testing but inaccessible for interference. No connection, other than one direct to an earth electrode, shall be made below a testing point. Testing points shall be phosphorbronze, gunmetal, copper or any other suitable material.

vii) Earth Terminations

1. Each down conductor shall have an independent earth termination. It should be capable of isolation for testing purposes. Suitable location for the earth termination shall be selected after testing and assessing the specific resistivity of the soil and with due regard to reliability of the sub-soil water to ensure minimum soil moistness.
2. Water pipe system should not be bonded to the earth termination system. However, if adequate clearance between the two cannot be obtained, they may be effectively bonded and the bonds should be capable of isolation and testing. The gas pipes, however, should in no case be bonded to the earth termination system.

3. It is recommended that all earth terminations should be interconnected. Common earthing, besides equalising the voltage at various earth terminations also minimises any risk to it of mechanical damage.

viii) Earth Electrodes

Earth electrodes shall be constructed and installed in accordance with section 2.5.3.

ix) Fasteners

Conductors shall be securely attached to the building or other object to be protected by fasteners which shall be substantial in construction, not subject to breakage and shall be made of galvanised steel or other suitable material. If fasteners are made of steel, they should be galvanised to protect them against corrosion. If they are made of any other material suitable precautions should be taken to avoid corrosion. Some samples of fasteners are shown in IS:2309-1969.

x) Earth Resistance

Each earth termination should have a resistance in ohms to earth not exceeding numerically the product of 10 and the number of earth terminations to be provided. The whole of the lightning protective system should have a combined resistance to earth not exceeding 10 ohms before any bonding has been effected to metal in or on the structure or to surface below ground.

1.4.6 Testing of Wiring Installation

After completion of wiring a general inspection is carried out by the Engineer-in-Charge or his representative to verify that the provisions of the specification and Indian Electricity Rules, 1956 have been complied with. After inspection, the following tests shall be carried out before an installation or an addition to the existing installation is put into service.

The following tests shall be done

a) The insulation resistance shall be measured by applying between earth and the whole system of conductor or any section thereof with all fuses in place and all switches closed and except in earthed concentric wiring, all lamps in position or both poles of installation otherwise electrically connected together, a DC voltage of not less than twice the working voltage, provided that it does not exceed 500 volts for medium voltage circuits. Where the supply is derived from thee-wire (AC or DC) or a polyphase system the neutral pole of which is connected to earth either direct or through added resistance, the working voltage shall be deemed to be that which is maintained between the outer or phase conductor and the neutral.
b) The insulation resistance in megohms of an installation measured as in (a) shall be not less than 50 divided by the number of points on the circuit, provided that the whole installation need not be required to have an insulation resistance greater than 1 M ohm.

c) Control rheostats, heating and power appliances and electric signs, may, if desired, be disconnected from the circuit during the test, but in that event the insulation resistance between the case or framework, and all live parts of each rheostat, appliance and sign shall be not less than that specified in the relevant Indian Standard specification or where there is no such specification shall be not less than 0.5 M ohm.

d) The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire to the neutral on to the other pole of phase conductors of the supply. Such a test shall be made after removing all metallic connections between the two poles of the installation and in these circumstances the insulation resistance between conductors of the installation shall be not less than that specified in (b).

e) On completion of an electrical installation (or an extension to an 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. In addition to this a completion certificate, as enclosed under Appendix – I.

Earthing

For checking the efficiency of earthing the following tests are recommended.

a) The earth resistance of each electrode is measured.

b) The earth resistance of earthing grid is measured.

c) All electrodes are connected to the grid and the earth resistance of the entire earthing system is measured.

These tests shall preferably be done during the summer months.

1.5 Cable Laying

1.5.1 Route

i) Before the cable laying work is undertaken, the route layout of the cable shall be submitted to the Engineer-in-Charge and the work shall be undertaken only after approval of the route layout.

ii) a) Whenever cables of different voltages are laid following points shall be noted while laying along well demarcated or established roads, the LV / MV cables shall be laid further from the kerb line than HV cables.
b) Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted such that this requirement cannot be met, LV / MV cables shall be laid above HV cables.

c) Where cables cross one another, the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

iii) Proximity to communication cables.

Power and communication cables shall be as far as possible cross each other at right angles. The horizontal and vertical clearance between them shall not be less than 60 cm.

1.5.2 Methods of Laying

The cables shall be laid direct in ground, pipe, closed or open ducts, cable trays or on surface of wall etc. The method(s) of laying required shall be specified in the tender / schedule of work.

1.5.3 Laying direct in ground

i) This method shall be adopted where specified in the schedule of works. Normally this method shall be adopted when the cable route is through open ground, along roads, lanes, etc. and where no frequent excavations are likely to be encountered and where re-excavation is easily possible without affecting other services.

ii) Trenching

a) Width and depth of the trench shall be as shown in the drawing. When more than one tier of cables is unavoidable and vertical formation of laying is adopted, the depth of the trench shall be increased by 30 cm for each additional tier to be formed.

b) The trenches shall be excavated in reasonably straight lines. Wherever there is a change in the direction, a suitable curvature shall be adopted complying with the minimum bending radius specified in Table – 11. Where gradients and changes in depth are unavoidable, these shall be gradual. The bottom of the trench shall be level and free from stones, brick bats etc.

<table>
<thead>
<tr>
<th>System voltage</th>
<th>Minimum bending radius</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single core</td>
</tr>
<tr>
<td></td>
<td>Unarmoured</td>
</tr>
<tr>
<td>11 KV</td>
<td>20 D</td>
</tr>
<tr>
<td>22 KV</td>
<td>25 D</td>
</tr>
<tr>
<td>33 KV</td>
<td>30 D</td>
</tr>
</tbody>
</table>
“D” is the overall diameter of the cable.

The excavation should be done by suitable means – manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.

c) Adequate precautions should be taken not to damage any existing cable(s), pipes or any other such installations in the route during excavation. Wherever bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Engineer-in-Charge.

Existing property, if any, exposed during trenching shall be temporarily supported adequately as directed by the Engineer-in-Charge. The trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein, if required.

If there is any danger of a trench collapsing or endangering adjacent structures, the sides should be well shored up with sheeting as the excavation proceeds. Where necessary, these may even be left in place when backfilling the trench.

Excavation through lawns shall be done in consultation with the department concerned.

iii) Laying of Cable in Trench

a) Sand cushioning

The excavated trench shall be provided with a layer of clean, dry sand cushion of not less than 8 cm in depth, before laying the cables therein.

However, sand cushioning may not be provided for MV cables, where there is no possibility of any mechanical damage to the cables due to heavy or shock loading on the soil above if so specified in the tender document and as per approval of the Engineer-in-Charge. Sand cushioning shall however be invariably provided in the case of HV cables.

b) The cable drum shall be properly mounted on jacks, or on a cable wheel at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.

c) The cable shall be pulled over in rollers in the trench steadily and uniformly without jerks and strain. The entire cable length shall be far as possible laid off in one stretch. PVC / XLPE cables less than 120 sq.mm size may be removed by “Flaking” i.e. by making one long loop in the reverse direction.

Note :

For short runs and sizes up to 50 sq.mm of MV cables, any other suitable method of direct handling and laying can be adopted without strain or excess bending of the cables.

d) After the cable has been so uncoiled, it shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 m apart and drawn straight. The cable shall then be lifted off the rollers and laid in a reasonably straight line.
e) **Testing before covering**

The cables shall be tested in presence of the Engineer-in-Charge for continuity of cores and insulation resistance and the cable length shall be measured, before closing the trench.

f) **Sand covering**

Cables laid in trenches in a single tier formation shall have a covering of dry sand of not less than 17 cm above the base cushion of sand before the protective cover is laid.

In the case of vertical multi-tier formation, after the first cable has been laid, a sand cushion of 30 cm shall be provided over the base cushion before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cm as stated above. Cables in the top most tier shall have a final sand covering not less than 17 cm before the protective cover is laid.

Sand covering as stated above need not be provided for MV cables where a decision is taken by the Engineer-in-Charge as per subclause (iii-a) above, but the inter tier spacing should be maintained with soft soil instead of sand between tiers and for covering.

Sand cushioning shall however be invariably provided in the case of HV cables.

g) **Extra loop cable**

At the time of original installation, approximately 3 m of surplus cable shall be left on each terminal end of the cable and on each side of the underground joints. The surplus cable shall be left in the form of a loop. Where there are long runs of cables such loose cable may be left at suitable intervals as specified by the Engineer-in-Charge.

Where it may not be practically possible to provide separation between cables when forming loops of a number of cables as in the case of cable emanating from a substation, measurement shall be made only to the extent of actual volume of excavation, sand filling etc and paid for accordingly.

h) **Mechanical protection over the covering**

Mechanical protection to cables shall be laid over the covering to provide warning to future excavators of the present of the cable and also to protect the cable against accidental mechanical damage by pick-axe blows etc. as follows:

a) Unless otherwise specified, the cables shall be protected by second class brick of nominal size 22 cm x 11.4 cm x 7 cm or locally available size, placed on top of the sand (or, soil as the case may be). The bricks shall be placed breadthwise for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and projects at least 5 cm over the sides of the end cables.

b) Where bricks are not easily available, or are comparatively costly, there is no objection to use locally available material such as tiles or slates or stone / cement concrete slabs. Where such an alternative is acceptable, the same shall be clearly specified in the tender specifications.
iv) **Backfilling**

a) The trenches shall be then backfilled with excavated earth, free from stones or other shall edged debris and shall be rammed and watered, if necessary in successive layers not exceeding 30 cm depth.

b) Unless otherwise specified, a crown of earth not less than 50 mm and not exceeding 100 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of the earth, however, should not exceed 10 cms. so as not to be a hazard to vehicular traffic.

c) The temporary restatements of roadways should be inspected at regular intervals, particularly during wet weather and settlements should be made good by further filling as may be required.

d) After the subsidence has ceased, trenches cut through roadways or other paved areas shall be restored to the same density and materials as the surrounding area and repaved in accordance with the relevant building specifications to the satisfaction of the Engineer-in-Charge.

e) Where road berms of lawns have been cut out of necessity, or kerb stones displaced, the same shall be repaired and made good, except for turfing / asphalting, to the satisfaction of the Engineer-in-Charge and all the surplus earth or rock shall be removed to places as specified.

v) **Laying of single core cables**

a) Three single core cables forming one three phase circuit shall normally be held in close trefoil formation and shall be bound together at intervals of approximately 1 m.

b) The relative position of the three cables shall be changed at each joint at the time of original installation, complete transposition being effected in every three consecutive cable lengths.

vi) **Route markers**

a) **Location**

Route markers shall be provided along with the runs of cable at locations approved by the Engineer-in-Charge and generally at intervals not exceeding 100m. Markers shall also be provided to identify change in the direction of the cable route and locations of underground joints.

b) **Plate type marker**

Route markers shall be made out of 100 mm x 5 mm G.I. / aluminium plate welded / bolted on 35 mm x 35 mm x 6 mm angel iron, 60 cm long. Such plate markers shall be mounted parallel to and at about 0.5 m away from the edge of the trench.

c) **CC marker**

Alternatively, cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm in size) as shown in figure 2 shall be laid flat and centered over the cable. The concrete markers, unless otherwise instructed by the Engineer-in-Charge, shall project over the surrounding surface so as to make the cable route easily identifiable.

d) **Inscription**

The words IITG-MV / HV CABLE as the case may be shall be inscribed on the marker.
1.5.4 **Laying in Pipes / Closed Ducts**

i) In locations such as road crossing, entry into buildings, paved areas etc., cables shall be laid in pipes or closed ducts. Stone ware pipes, GI, CI or spun reinforced concrete pipes shall be used for cables as specified in the schedule of works.

ii) Following guide of the pipe fill shall be used for sizing the pipe size:

   a) 1 cable in pipe : 53% full
   b) 2 cables in pipe : 31% full
   c) 3 or more cables : 43% full
   d) Multiple cables : 40% full

iii) Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.

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

v) At road crossings, the top surface of pipes shall be at a minimum depth of 1 m from the pavement level. When pipes are laid cutting existing road, care shall be taken so that the soil filled up after laying the pipes is rammed well in layers with watering as required to ensure proper compaction. A crown of earth not exceeding 10 cm should be left at the top.

After the subsidence has ceased, the top of the filled up trenches in road ways or other paved areas shall be restored to the same density and material as the surrounding area in accordance with the direction of the Engineer-in-Charge (Civil) up to his satisfaction.

vi) All G.I. pipes shall be laid as per layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the Contractor), all the burrs from the pipes shall be removed. G.I. pipes with bends shall be buried in soil / concrete in such a way that the bends shall be totally concealed. For G.I. pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. pipes shall be undertaken well before paving is completed and necessary coordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the Contractor at no extra cost.

1.5.5 **Laying in Open Ducts.**

a) Open ducts with suitable removable covers (RCC slabs or chequered plates) are generally provided in substations, switch rooms, plant rooms, workshops etc. for taking the cables. The cable ducts should be of suitable dimensions for the number of cables involved.

b) Laying of cables with different voltage ratings in the same duct shall be avoided. Where it is inescapable to take HV & MV cables same trench, they shall be laid with a barrier between them or alternatively, one of the two (HV / MV) cables may be taken through pipe(s).

Splices or joints of any type shall not be permitted inside the ducts.
c) The cables shall be laid directly in the duct such that unnecessary crossing of cables is avoided.

d) Where specified, cables may be fixed with clamps on the walls of the duct or taken in hooks / brackets / cable trays through in ducts.

e) Where specified, ducts may be filled with dry sand after the cables are laid and covered as above, or finished with cement plaster, specially in high voltage applications.

1.5.6 Laying on Surface

The method may be adopted in places like switch rooms, workshops, tunnels, rising (distribution) mains in buildings etc. This may be necessitated in the works of additions and / or alterations to the existing installation, where other methods of laying may not be feasible. Cables may be laid in surface by any of the following methods as specified:

a) Directly clamped by saddles or clamps
b) Supported on cradles
c) Laid on troughs / trays, duly clamped.

1.5.7 Laying on Cable Tray

This method may be adopted in places like indoor substations, air-conditioning plant rooms, generator rooms etc. or where long horizontal runs of cables are required within the building and where it is not convenient to carry the cable in open ducts. This method is preferred where heavy sized cables or a number of cables are required to be laid. The cable trays may be either of perforated sheet type or ladder type as specified.

1.5.8 Jointing

j) Location

a) Before laying a cable, proper locations for the proposed cable joints, if any, shall be decided, so that when the cable is actually laid, the joints are made in the most suitable places. As far as possible, water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible places, ducts, pipes, racks etc. shall be avoided for locating the cable joints.

b) Joints shall be staggered by 2 m to 3 m when joints are to be done for two or more cables laid together in the same trench.

ii) Joint pits

a) Joints pits shall be of sufficient dimensions as to allow easy and comfortable working. The sides of the pit shall be well protected from loose earth falling into it. It shall also be covered by a tarpaulin to prevent dust and other foreign matter being blown on the exposed joints and jointing materials.

b) Sufficient ventilation shall be provided during jointing operation in order to disperse fumes given out by fluxing.

iii) Safety precaution

a) A caution board indicating “CAUTION – CABLE JOINTING WORK IN PROGRESS” shall be displayed to warn the public and traffic where necessary.
b) Before jointing is commenced, all safety precautions like isolation, discharging, earthing, display of caution board on the controlling switchgear etc. shall be taken to ensure that the cable wound not be inadvertently charged from live supply. Metallic armour and external metallic bonding shall be connected to earth. Where “Permit to Work” system is in vogue, safety procedures prescribed shall be complied with.

d) Jointer

Jointing work shall be carried out by a licensed / experienced (where there is no licensing system for jointers) cable jointer.

1.5.9 Testing

i) Testing before laying

All cables, before laying, shall be tested with a 500 V megger for cables of 1.1 KV grade, or with a 2500 / 5000 V megger for cables of higher voltage. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance from conductors to earth / armour and between conductors.

ii) Testing before backfilling

All cables shall be subjected to the above mentioned tests, before covering the cables by protective covers and backfilling and also before taking up any jointing operation.

iii) Testing after laying

After laying and jointing, the cable shall be subjected to a 15 minutes pressure test. The test pressure shall be as given in Table – III. DC pressure testing may normally be preferred compared to AC pressure testing.

**TABLE – 3**

<table>
<thead>
<tr>
<th>Working Volts in KV</th>
<th>AC 15 minutes test</th>
<th>DC 15 minutes test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between conductors</td>
<td>Conductor to earth</td>
</tr>
<tr>
<td>Up to 1.1</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>3.3</td>
<td>6.0</td>
<td>3.5</td>
</tr>
<tr>
<td>6.6</td>
<td>12.0</td>
<td>7.0</td>
</tr>
<tr>
<td>11</td>
<td>20.0</td>
<td>11.5</td>
</tr>
<tr>
<td>22</td>
<td>40.0</td>
<td>23.0</td>
</tr>
<tr>
<td>33</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

b) In the absence of facilities for pressure testing as above, it is sufficient to test for one minute with 1,000 V megger for cables of 1.1 KV grade and with 2500 / 5000 V megger for cables of higher voltages.

1.5.10 Measurement

All measurement will be made as per guidelines laid under the latest edition of the General Specifications for Electrical works (Part – I and II) of CPWD. All the works
in progress will be jointly measured by the representative of the Engineer-in-Charge and the Contractor’s authorized agent. Such measurements will be got recorded in the measurement book by the Engineer-in-Charge or his authorized representative and signed in token of acceptance by the Contractor or his authorized representative.

1.6 List of Construction Equipment / Testing Instrument
The Contractor shall have all necessary construction equipment, tools and tackles, testing instruments to carry out the erection works and to commission the system as specified. A list of construction equipment which contractor possesses with quantity shall be indicated in the bid along with model numbers and make. These shall include but not limited to the following and these shall be brought to site by Contractor before the start of work.

A. Equipment
1. Portable grinder
2. Portable welding machine
3. Portable gas cutting / welding set
4. Pipe threading machine
5. Pipe bending machine (hydraulic)
6. Portable drill machine suitable to take up drilling for different sizes as per requirement
7. Dewatering pumpsets (diesel driven)
8. Power hacksaw
9. Conduit dye set
10. Hydraulic crimping machine
11. Hand crimping tool
12. Portable electric blowers, vacuum cleaners
13. Miscellaneous items such as sling, pulleys tarpaulins, wooden sleepers, ladders, etc. as required
14. Safety belts, safety goggles, hand gloves
15. Separate tool kit for each electrician

B. Test Instruments
1. Insulation tester 0-500-1000 V hand driven
2. Insulation tester 2500 / 5000 V motor driven
3. Phase sequence indicator
4. Earth megger
5. Single phase variac
6. 3 phase variac
7. AVO – meter / multimeter
8. Portable ammeter, wattmeter, P.F. meter
9. Portable voltmeter
10. Clip on meters of different ranges
11. Tachometer
12. Kelvin’s double bridge for measurement of very low resistance
13. DC high pot test kit
14. LUX METER to measure illumination levels
APPENDIX – I
FORM OF COMPLETION CERTIFICATE
Internal electrical installation

I / we certify that the installation detailed below has been installed by me / us and tested and that the best of my / our knowledge and belief it complies with Indian Electricity Rules, 1956, as well as the specification of the IIT Guwahati,

Electrical installation at .................................................................

Voltage and system of supply ...........................................................

1. Particulars of work :

   a) Internal electrical installation

      | No. | Total load | Type or system of wiring |
      |-----|------------|--------------------------|
      |     |            |                          |

      i) light point
      ii) fan point
      iii) plug point
         a) 3 pin 5 amp
         b) 3 pin 15 amp
      iv) others

      Description | HP / KW | Type of starting |
      Motors       |        |                |
      i)           | i)     |                |
      ii)          | ii)    |                |
      iii)         | iii)   |                |

      v) other plants

   b) i) total length of underground cables and its size

      c) No. of joints

      End joint
      Tee joint
      St. through joint

      c) Earthing
i) Description of earthing electrode

ii) No. of earth electrodes

iii) Size of main earth lead

2. Test results:

a) Insulation resistance

i) Insulation resistance of the whole system of conductors to earth

ii) Insulation between the phase conductor and neutral

Between phase R and neutral
Between phase Y and neutral
Between phase B and neutral

iii) Insulation resistance between the phase conductors in case of polyphase supply

Between phase R and neutral
Between phase Y and neutral
Between phase B and neutral

b) Polarity test

Polarity of non linked single pole branch switches

c) Earth continuity test:

Maximum resistance between any point in the earth continuity conductor including metal conduits and main earthing lead …………………. Ohms.

d) Earth electrode resistance

i) …………………………… Ohms

ii) …………………………… Ohms

iii) …………………………… Ohms

e) Lightning protective system

Resistance of the whole of lightning protective system to earth before any bonding is effected with earth electrode and metal in / on the structure …………………………… Ohms.

Signature and name of Junior Engineer (E) / AE(E)

Signature and name of the Contractor
SPECIFIC TECHNICAL REQUIREMENTS:

1. All wiring for light and power circuits shall be in PVC conduits recessed in wall / ceiling.

2. All wires for point wiring and the single core wires specified for sub main and circuit wirings shall be 1.1 KV grade PVC insulated FR copper multistrand wires of approved brand. The underground cables indicated in the drawings shall however, be PVC insulated and sheathed armoured aluminium underground cables of approved brands.

3. All 6A receptacles shall be flush type and shall have 5 pins with 1 pin for earth connection and 2 pins each for phase and neutral connections. 16A receptacles shall have 6 pins (suitable for connecting both 6A and 16A plug tops) with 2 pins each for phase, neutral and earth connections.

4. Samples of all the materials to be used in the work shall be submitted to the Superintending Engineer (Elect.), IITG for approval. No material other than those approved by the IITG shall be used in any of the works.

In case of any materials other than those approved by the SE (Elect.) is detected, the same shall be replaced by the Tenderer with the approved quality, free of cost, failing which, the owner shall have right to withhold all pending bills due to the Contractor, until the rectification / replacement work is completed.

5. Experienced & professional sub-contractors shall be engaged for specialized works like – air conditioning, audio system and fire detection & alarm system. Prior approval of the sub-contractors from the Engineer-in-Charge is mandatory.

6. All materials, equipments and accessories shall be of makes listed as enclosed. Makes of any item(s) not specified under the list, but required in the work shall be approved by the Engineer-in-Charge prior to use in the works.

LIST OF APPROVED MAKES OF MATERIALS:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of Materials</th>
<th>Manufactures / Brand names</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conduits pipes &amp; accessories –</td>
<td>BEC / AKG (ISI marked)</td>
</tr>
<tr>
<td></td>
<td>MS</td>
<td>BERLIA / AKG</td>
</tr>
<tr>
<td></td>
<td>PVC</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Bushes</td>
<td>Rubber / PVC of superior quality.</td>
</tr>
<tr>
<td>3</td>
<td>Wire (Copper conductor)</td>
<td>FR copper wire (FINOLEX / HAVELLS / RR KABEL / ANCHOR) / BBRIA / KEI</td>
</tr>
<tr>
<td>4</td>
<td>Cable (underground)</td>
<td>GLOSTER / CCI / INCAB / INDUSTRIAL CABLES / RPG / UNIVERSAL / NICCO / HAVELLS / POLYCAB / CRYSTAL / FINOLEX / KEI</td>
</tr>
<tr>
<td>5</td>
<td>Cover plate</td>
<td>Hylum sheet 3 mm thick of colour &amp; design as approved</td>
</tr>
<tr>
<td>6</td>
<td>Cover plate fan box</td>
<td>Formica of approved shade 2 mm thick</td>
</tr>
<tr>
<td>7</td>
<td>Switch &amp; Socket -</td>
<td>ANCHOR / KOLORS / GOLDMEDAL/HPL/HAVELLS (ISI) or equiv.</td>
</tr>
<tr>
<td></td>
<td>Flash Piano type -</td>
<td>MK / CRABTREE / LEGRAND / SCHNEIDER / PHILIPS</td>
</tr>
<tr>
<td></td>
<td>Modular type -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Brands</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>Switch fuse unit (HRC Type) (rewirable type)</td>
<td>ENGLISH ELECTRIC / L&amp;T / SIEMENS / CONTROL &amp; SWITCHGEAR</td>
</tr>
<tr>
<td>9</td>
<td>a) Fuse bases for HRC fuse for feeder pillar</td>
<td>SIEMENS / L&amp;T / STANDARD E.E. / L&amp;T / SIEMENS</td>
</tr>
<tr>
<td></td>
<td>b) HRC fuses</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>MCB</td>
<td>LEGRAND / SIEMENS / SCHNEIDER / L&amp;T / ABB / HAVELLS / HAGER</td>
</tr>
<tr>
<td>11</td>
<td>Distribution Board MCB type</td>
<td>LEGRAND / SIEMENS / SCHNEIDER / L&amp;T / ABB / HAVELLS / HAGER</td>
</tr>
<tr>
<td>12</td>
<td>Telephone cables</td>
<td>DELTON / FINOLEX / POLYCAP</td>
</tr>
<tr>
<td>13</td>
<td>Computer cable: Cat – 6</td>
<td>AMP / D-LINK / LEGRAND / RR KABEL / KRONE / DIGILINK</td>
</tr>
<tr>
<td>14</td>
<td>Computer jack : RJ-45</td>
<td>AMP / D-LINK / LEGRAND / SYSTIMAX / KRONE / DIGILINK</td>
</tr>
<tr>
<td>15</td>
<td>Screws</td>
<td>Good quality brass screws</td>
</tr>
<tr>
<td>16</td>
<td>Ceiling Rose</td>
<td>ANCHOR / MK / GOLDMEDAL / KOLORS</td>
</tr>
<tr>
<td>17</td>
<td>ELCB / RCCB</td>
<td>LEGRAND / SIEMENS / L&amp;T / ABB / HAVELLS / SCHNEIDER / HAGER</td>
</tr>
<tr>
<td>18</td>
<td>MCCB</td>
<td>L&amp;T / SCHNEIDER / CONTROL &amp; SWITCHGEAR / CROMPTON GREAVES / ABB / C&amp;S / HAVELLS / LEGRAND / HAGER</td>
</tr>
<tr>
<td>19</td>
<td>Air Circuit Breaker</td>
<td>L&amp;T / SIEMENS / SCHNEIDER / CROMPTON GREAVES / ABB / CONTROL &amp; SWITCHGEAR.</td>
</tr>
<tr>
<td>20</td>
<td>Industrial type Metal clad sockets &amp; plugs</td>
<td>LEGRAND / SIEMENS / SCHNEIDER / L&amp;T / HAVELLS / ABB.</td>
</tr>
<tr>
<td>21</td>
<td>Meter, Metering, Equipment &amp; C.T.s</td>
<td>A) AUTOMATIC ELECTRIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B) CONZERV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C) RISHAV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d) MECO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E) HPL</td>
</tr>
<tr>
<td>22</td>
<td>Electronic Energy Meter</td>
<td>HPL / CONZERV / L&amp;T / RISHAV / SEQUER</td>
</tr>
<tr>
<td>23</td>
<td>Exhaust Fan</td>
<td>ALSTOM / ORIENT / CROMPTON / HAVELLS</td>
</tr>
<tr>
<td>24</td>
<td>Ceiling Fan</td>
<td>ORIENT / CROMPTON / BAJAJ / HAVELLS / BERLIA</td>
</tr>
<tr>
<td>25</td>
<td>Electronic Step Fan Regulator</td>
<td>ANCHOR / KOLORS / MK or equiv.</td>
</tr>
<tr>
<td>26</td>
<td>Lugs</td>
<td>“DOWELLS’’ crimping type</td>
</tr>
<tr>
<td>27</td>
<td>MDBs / BDBs / SDBs</td>
<td>CPRI approved vendors, having facilities for powder coated finish and antitrust treatment by seven / eight tank process (vendor detail shall be submitted for approval)</td>
</tr>
<tr>
<td>28</td>
<td>APFC Panel</td>
<td>SCHNEIDER/L&amp;T equivalent subject to approval.</td>
</tr>
<tr>
<td>29</td>
<td>Bus Trunking System</td>
<td>CONTROL &amp; SWITCHGEAR / LEGRAND / SCHNEIDER or equiv. Subject to approval.</td>
</tr>
<tr>
<td>30</td>
<td>Light fittings</td>
<td>Makes &amp; catalogue reference shown in the BOQ or equivalent from the brands – PHILIPS / CROMPTON / BAJAJ / WIPRO / HAVELLS – subject to approval.</td>
</tr>
<tr>
<td>31</td>
<td>Passenger lift</td>
<td>SHINDLER / OTIS / KONE / MISTUBISHI / JHONSON (Subject to be approval of the dept &amp; subject to availability of the service center at Guwahati)</td>
</tr>
</tbody>
</table>