TENDER DOCUMENT

NIT No. DLI/CON/760/585 DT. 14.09.2017

FOR

Tender for Construction of 100 Bedded ESI Hospital Building at Beltola, Guwahati, Assam

VOLUME – II

Additional Conditions of Contract (ACC), 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 “Construction of 100 Bedded ESI Hospital Building at Beltola, Guwahati, Assam”. Accordingly, EPI had invited tender for award of 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 Mobilization Advance shall be paid as per Clause no.8 of GCC. Further, the Clause 8.2 regarding recovery of Mobilization Advance has been amended as:
“Recovery of such sums advanced shall be made by the deduction from the contractors bills commencing after first ten per cent of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time eighty percent of the gross value of the contract is executed and
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 3 metres 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:
Additional Conditions of Contract
Engineering Projects (India) Limited

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 affect their proper employment. EPI will not entertain any claim for idle time payment whatsoever.

10.0 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 clause number 13 of the GCC shall stand amended as below:

The rates quoted by the contractor shall be deemed to include all taxes and duties except GST which shall be reimbursed to him subject to raising of tax invoice and filing of return and payment of tax as per GST law, failing which EPI shall not be able to honour his claims for any payment. The contractor has quoted his rates knowing fully well that submission of return and display of the same on GSTN portal is mandatory.

However, any variation in taxes and duties after submission of due date of submission of tender shall be to the owner’s account i.e. in case of any decrease in the taxes and duties shall be passed on to the owner and any increase in taxes and duties shall be borne by the Owner. Similarly, the imposition of any fresh taxes and duties shall also be borne by the Owner.

All the above reimbursements shall be admitted to the extent these are admitted by the Owner.

11.1 The Contractor must be registered with GST and should have valid GSTIN number.
11.2. The Contractor must submit as compliances of GST Act, the invoices in GST compliant format failing which the GST amount shall be recovered/adjusted by EPI without any prior notice from the next invoices or available dues with EPI.

11.3. The Contractor is requested to update / upload the GST/Taxes data periodically so as to avail input Tax Credit (ITC) by EPI failing which it shall be recovered / adjusted by EPI without any prior notice from the next invoices or available dues with EPI.

12.0 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.

13.0 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:

<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 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 Rs 40000.00 per month</td>
</tr>
<tr>
<td>2</td>
<td>-do-</td>
<td>Electrical</td>
<td>-do-</td>
<td>1 -do-</td>
</tr>
<tr>
<td>3</td>
<td>Diploma Engineer</td>
<td>Civil</td>
<td>8</td>
<td>1 Rs 25000.00 per month</td>
</tr>
<tr>
<td>4</td>
<td>-do-</td>
<td>Electrical</td>
<td>5</td>
<td>1 -do-</td>
</tr>
<tr>
<td>5</td>
<td>Supervisor</td>
<td>Civil</td>
<td>5</td>
<td>2 15000.00 per month</td>
</tr>
</tbody>
</table>
14.0 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>Vehicle: For emergency/Safety, Earmarked vehicle 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</td>
<td>1</td>
<td>Rs 60000.00 per month or actual whichever is higher</td>
</tr>
</tbody>
</table>

All the above, facilities are temporary in nature and shall be the property of the contractor. Contractor till 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.

15.0 The clause no 35.0 of GCC shall stand amended as below

Secured advance shall be paid to the contractor for reinforcement steel only.

16.0 The Clause No.37.0 of EPI GCC shall be read along with the following conditions:

a) Ten percent (10%) of the contract value shall be released as Mobilization advance within thirty (30) days of receipt of invoice and on fulfillment of the following conditions and only on receipt of the advance by EPI from Client/Owner.

i) Unconditional and unequivocal acceptance of Letter of Intent (LOI).

ii) Submission of Security Deposit cum Performance Bank Guarantee as mentioned in Clause No.9 of GCC.

iii) Submission of detailed schedule of work.

iv) Submission of an unconditional Bank Guarantee from any Nationalised bank / Scheduled Bank in India covering the Mobilization advance amount which shall be initially kept valid till ninety(90) days after the Completion of defect liability period.

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.

b) Thereafter,
i) 1st payment, restricted to 20% of the contract value, shall be made on achievement of 1st milestone on time.

ii) 2nd payment, restricted to 20% of the contract value i.e. cumulatively 40% of the contract value, shall be made on achievement of 2nd milestone on time.

iii) 3rd payment, restricted to 20% of the contract value i.e. cumulatively 60% of the contract value, shall be made on achievement of 3rd milestone on time.

iv) 4th payment, restricted to 20% of the contract value i.e. cumulatively 80% of the contract value, shall be made on achievement of 4th milestone on time.

v) Balance 10% payment shall be made on completion of work in time.

c) In case of non-achievement of any of the milestone on time, payment shall be made to the contractor after deduction of the amounts as mentioned at clause no 22.0 of ACC.

All payments shall be released only after release of corresponding fund by ESIC to EPI. There shall be no claim by the Contractor on EPI if the payment is delayed due to delay in release of payment by the Client/Owner.

17.0 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. In 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.

18.0 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

19.0 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.

20.0 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".

21.0 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.

22.0 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 (mile stones) of 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

Signature of Contractor

12

EPI
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-I**
During currency of the project, the time line shall be monitored with the help of 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>Amount to be withheld in case of non-achievement of milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1st Milestone i.e. 20% value of works</td>
<td>5%</td>
</tr>
<tr>
<td>2</td>
<td>2nd Milestone i.e. 20% value of works</td>
<td>5%</td>
</tr>
<tr>
<td>3</td>
<td>3rd Milestone i.e. 20% value of works</td>
<td>5%</td>
</tr>
<tr>
<td>4</td>
<td>4th Milestone i.e. 20% value of works</td>
<td>5%</td>
</tr>
<tr>
<td>5</td>
<td>5th &amp; Last Milestone i.e. 10% value of works</td>
<td>10%</td>
</tr>
</tbody>
</table>

**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.) of contract value would be imposed on the Contractor.
23.1 Clause no. 76.1 alongwith 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:

23.2 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. F.No.4(1)/2013-DPE (PMA)/FTS-1835 dated 11.04.2017 of Department of Public Enterprises, Ministry of Heavy Industries and Public Enterprises, Govt. of India or any modification issued in this regard.
23.3 Clause No.76.3 stands modified as under:

JURISDICTION:

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

24.0 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 contractor 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.

25.0 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.
26.0 **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.

27.0 No Escalation shall be payable
## ANNEXURE-A

**LIST OF MINIMUM TOOLS, PLANT AND MACHINERY**

<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>Tractors with trolley</td>
<td>Two nos.</td>
</tr>
<tr>
<td>15</td>
<td>Piling rigs with tripod, boring equipment and accessories etc. all complete</td>
<td>Four sets</td>
</tr>
</tbody>
</table>

**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 in-charge 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 upto 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 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 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, mororum, 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 their 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/walls 150mm 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 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.

2.4 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 undisturbed 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%

g. The pH value shall be between 9 and 11.5

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 tremie 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 intially. 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/cm². 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 contact 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, sand stone, 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 Ordinary Portland Cement 43/53 Grade conforming to the relevant BIS cement and from any of the makes given under Preferred /Approved Make. 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>

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.

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>
<tr>
<td>10mm</td>
<td>10-35</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>0-5</td>
</tr>
<tr>
<td>2.36 mm</td>
<td></td>
</tr>
</tbody>
</table>

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\textsubscript{20}, M\textsubscript{25}, M\textsubscript{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 off 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 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>
</tr>
<tr>
<td>20mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>12.5mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>10mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>4.75mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>2.36mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>2 Sieve set (for aggregate 20 mm down)</td>
<td></td>
</tr>
<tr>
<td>40mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>20mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>16mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>12.5mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>10mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>4.75mm</td>
<td>45cms dia</td>
</tr>
<tr>
<td>Weight</td>
<td>Numbers</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>600 micron</td>
<td>20 cms dia</td>
</tr>
<tr>
<td>300 micron</td>
<td>20 cms dia</td>
</tr>
<tr>
<td>150 micron</td>
<td>20 cms dia</td>
</tr>
<tr>
<td>75 micron</td>
<td>20 cms dia</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- 2 Nos.

(xiv) Sink 1 No.

(xv) Litre : Measures

(xvi) 2 Lit 2 Nos.

(xvii) 4 Lit 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 :-

\[
Y = 8.2 + 1.609 A
\]

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 deigns 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>
<tr>
<td>c) Props to slabs:</td>
<td>14 days</td>
</tr>
<tr>
<td>i) Spanning up to 4.5 m</td>
<td>21 days</td>
</tr>
<tr>
<td>ii) Spanning over 4.5 m</td>
<td>21 days</td>
</tr>
<tr>
<td>d) Props to beams and arches</td>
<td>21 days</td>
</tr>
<tr>
<td>i) Spanning up to 6 m</td>
<td>28 days</td>
</tr>
<tr>
<td>ii) Spanning 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 Reinforcement steel of any of the approved makes 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 incharge, 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

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**LIST OF PREFERED MAKES FOR CIVIL WORKS**

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<tbody>
<tr>
<td>1.</td>
<td>Cement (Ordinary Portland)</td>
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<td>TMA / Tor Steel</td>
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<td>3.</td>
<td>Structural Steel</td>
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<td>4.</td>
<td>Precast CC Tiles</td>
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<td>Ceramic Tiles</td>
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<td>Kerb Stone (Precast CC)</td>
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<td>Water-proofing Compound</td>
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<td>15</td>
<td>Aluminium Sections for Doors/Windows</td>
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<td>Floor Hardener</td>
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<td>Primer for steel</td>
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<td>Waterproof ply &amp; Board</td>
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<td>22</td>
<td>Flush Door Shutter</td>
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<td>23</td>
<td>Rolling shutter</td>
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<td>24</td>
<td>Rolling shutter</td>
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<td>25</td>
<td>PVC Door Shutter</td>
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<td>26</td>
<td>PVC Tank</td>
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<td>27</td>
<td>WC/Wash Basin</td>
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<td>Brand(s)</td>
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<td>28. C. P. Fittings</td>
<td>CERA/ESSCO/ PARRYWARE/ HINDWARE/JAQUAR/GROHE/HANSGROHE</td>
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<tr>
<td>29. S. C. I. Pipes</td>
<td>RIF/NITCO/BENGAL IRON/IISCO</td>
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<td>30. White Cement</td>
<td>BIRLA WIHITE/JK WHITE</td>
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<td>31. Oxidized Aluminium Fittings</td>
<td>EBCO/DOOR LINE</td>
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<tr>
<td>32. Gypsum False Ceiling</td>
<td>INDIA GYPSUM/BORAL</td>
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<td>TATA/SAIL/JINDAL/NEZONE</td>
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<td>34. G.I.PIPE</td>
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<td>35. VITRIFIED TILE</td>
<td>KAJARIA/ORIENT/JHONSON/SOMANY/NITC O/ASIAN</td>
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<td>36. FALSE CEILING</td>
<td>AMSTRONG/GYPROG</td>
</tr>
<tr>
<td>37. SANITARY FITTINGS</td>
<td>CERA/PARRYWARE/HINDWARE/JAQUAR/ESSCO/GROHE</td>
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</table>

**Note:** Sample of all items shall be got approved from Engineer In-Charge before bulk procure.

**TECHNICAL SPECIFICATIONS (ELECTRICAL WORKS)**

The intent of this chapter of the specification is to define the general technical requirements of electrical works.

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.

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

1.0 INTERNAL ELECTRIFICATION OF BUILDING

1.1 SCOPE

As specified in subhead 1.00

1.2 GENERAL

The electrical installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications with up to date amendment.

- Specifications for Electrical Works Part-I (Internal) by CPWD – 2013 or latest revision
- Specifications for Electrical Works Part-II (External) by CPWD – 1994 or latest revision

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers of rating specified in BOQ/DB Schedule.

Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of minimum 9 KA rated rupturing capacity unless otherwise specified.

Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB’s shall be provided on the phase of each circuit. The individual banks of MCB’s shall be
detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Earth Leakage Circuit Breaker shall be current operated type and of 30mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn’t have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. ELCB shall be housed within the Distribution Board.

1.3 Distribution Boards shall be ready for connections and shall be inspected in the factory by HSCC Electrical Engineer before dispatch.

Before procurement of Distribution Boards, MCB's, ELCB's (incomer and outgoings) etc., the contractor has to take approval of the DB Schedule/Drawings of each DB from the HSCC Electrical Engineer. The whole unit i.e. Distribution Board, MCB's, ELCB's etc. shall come from the manufactures premises/workshop. After inspection and clearance from the HSCC Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as ELCB or MCB or DB) is required for any reason such as replacement, increase in no. of circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately but after the approval of HSCC Electrical Engineer.

1.4 METALLIC & NON MATELLIC CONDUIT WIRING SYSTEM.

1.4.1 TYPE AND SIZE OF CONDUIT.

- All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32 mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with black stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No steel conduit less than 20mm in diameter shall be used.
- 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 conduits.

1.4.2 METALLIC CONDUIT JOINTS.

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories.
Cut ends of conduit pipe shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

1.4.3 No conduit less than 20 mm in diameter shall be used

1.4.4 PROTECTION OF CONDUIT AGAINST RUST.
The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticrosive preservative or covered with approved plastic compound.

1.4.5 PAINTING OF CONDUIT AND ACCESSORIES.

After installation, all accessible surface (if any) of conduit pipes, fittings etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

1.4.6 RECESS CONDUIT.

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. Incase of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burring the conduit in mortar before plastering shall form part of point wiring work.

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and of facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided.

1.4.7 METAL OUTLET BOXES & COVERS.

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front.

The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes upto 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. All boxes shall be covered from top with Phenolic laminated sheet of approved shade. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-I of IS: 2036-1994.

1.4.8 ERECTION AND EARTHING OF CONDUITS.
The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested in presence of HSCC Electrical Engineer for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit.

1.4.9 SWITCHES.

All 5 and 15 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on modular metal boxes. All 5 Amp socket shall be 3 pin type and 15 Amp socket shall be 5/6 pin type (unless otherwise specified) suitable for 15/5 Amp. All modular switches, sockets, telephone outlets, TV outlet etc. shall be in off white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm above finished floor level unless otherwise indicated on drawings or directed by Engineer-In-Charge.

In case of computer power points, power points, telephone points etc. to be fixed on laminated partition board (furniture), same shall be fixed on laminated board (portion of laminated board meant for fixing power points) with base plate/cover plate as applicable, duly fixed with screws.

1.4.10 COVER PLATE.

All modular switches, sockets, telephone outlets etc. shall be fixed modular metal boxes with modular base plates and modular cover plates on top.

1.4.11 WALL SOCKET PLATE.

Each outlet shall have a switch located beside the socket preferably on the same cover plate/modular base. The earth terminal of the socket shall be connected to the earth wire.

1.5 WIRING.

All PVC insulated copper conductor wires shall conform to relevant IS Codes. All wires/cables shall be stranded type irrespective of its size. Cable conductor size and material shall be specified in BOQ.

All internal wiring shall be carried out with PVC insulated wires of 650/1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switchboard may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switchboards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated wire for the neutral wires. Bare copper wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture,
dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications.

Maximum number of PVC insulated 650/1100 V grade aluminium/copper conductor cable conforming to IS : 694 - 1990

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<tr>
<th>Nominal Cross-Sectional area of conductor in Sq.mm.</th>
<th>25mm</th>
<th>32mm</th>
<th>38mm</th>
<th>51mm</th>
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NOTE:

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.

2. The columns headed ‘S’ apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed ‘B’ apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3. Conduit sizes are the nominal external diameters.

1.5.1 JOINTS.

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

1.5.2 LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.
1.5.3 COLOUR CODE FOR CIRCUIT WIRING.

Colour code for circuit and sub main wiring installation shall be Red, Yellow, and Blue for three phases. Black for neutral and yellow/green or green only for earth in case of insulated earth wire.

1.5.4 CLASSIFICATION OF POINTS.

1.5.4.1 General

Classification and measurement of Point wiring shall be as per CPWD specification for Electrical Works (Part-I-Internal) 1994.

1.5.4.2 Point Wiring (Modular)

Definition of point wiring

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/fan/exhaust fan/call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is not in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below including chasing the wall (in case of recessed wiring in wall), fixing the conduit and making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires.

Scope of point wiring

Following shall be deemed to be included in point wiring.

(a) Supply & fixing conduit & conduit accessories for the same and wiring cables (including supplying and drawing wires) between the switch box and the point outlet. [See also (i) below]
(b) All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
(c) Modular Metal boxes for control switches, regulators, sockets etc. recessed or surface type, modular base plates and modular cover plates over the same.
(d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding modular metal boxes if any, provided the switchboards for loose wires/conduit terminations.
(e) In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.
(f) Control modular switch (5/6A) as specified.
(g) Ceiling rose or connector (in case of points for ceiling/exhaust fan point, prewired light fittings and call bells).
(h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
(i) Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switchboard to subsequent switch board(s).
(j) Protective (loop earthing) conductor (as specified in the BOQ) from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
(k) Bushed conduit where wiring cables pass through wall etc.
(l) Ceiling rose (in the case of pendants except stiff pendants).
(m) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings
which are not pre-wired).
(n) Back Plate (in the case of stiff pendants).

Note :- In the case of call bell points the words “from the controlling switch or MCB” shall be read as “from the ceiling rose meant for connection to bell push”.

Measurement of Point Wiring (other than socket outlet points)

i) There shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting,

ii) No separate measurement shall be made for interconnections between points in the same distribution circuit and for the circuit protective (loop earthing) conductors between metallic switch boxes.

1.5.5. Circuit and Submain Wiring

Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board up to the tapping point for the nearest first point of that distribution circuit i.e. up to the nearest first switch box.

Submain Wiring

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

Measurement of circuit wiring and submain wiring

(i) Circuit and submain wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit, exclusive of interconnections inside the switchboard etc. The increase on account of diversion or slackness shall not be included in the measurement.

(ii) The length of circuit wiring with two wires shall be measured from the distribution board to the first nearest switch box in the circuit irrespective of whether neutral conductor is taken to switch box or not.

(iii) When wires of different circuits are grouped in a single conduit, the same shall be measured on linear basis depending on the actual number and size of wires run.

(iv) When circuit wires and wires of point wiring are run in the same conduit, circuit wiring shall be measured on linear basis depending on the actual number and sizes of wires run in the existing conduit.

(v) Protective (loop earthing) conductors, which are run along the circuit wiring and submain wiring, shall be measured on linear basis and paid separately. This is not applicable if protective conductor is clubbed with the BOQ item of circuit and submain wiring.

1.5.6 Power Plug Wiring

5A Plug Wiring

Wiring for all 5 A Socket Outlets shall be done with 2X1.5 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, from the switchboard or 15A power point as the case may be.
Measurement of 5A point wiring shall be done on Linear basis from switchboard/15A power point to 5A point. Conduit of power SOCKET wiring can also be used for 5A socket outlet wiring, but both phase and neutral wires shall come directly from switchboard/power socket outlet. Looping of neutral shall not be done.

15A Power Plug Wiring

Wiring for all 15 A Socket Outlets/Gyser point shall be done with 2X4 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board or from one power socket outlet to another in case of computer power points. Looping shall not be done in general 15A power points (other than computer power points).

Measurement of power socket outlet wiring shall be done on basis under following two subheads:

i) Directly from MCB-Distribution Board to the Socket Outlets

ii) From One power socket outlet/computer power point to another (looping)

Wiring for 20A Metal Clad Socket Outlets

Wiring for all 20A Metal Clad Socket Outlets shall be done with 2X6 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board. Measurement of wiring for 20A Metal Clad Socket outlet shall be done on linear basis i.e. complete wiring directly from MCB-Distribution Board to the socket outlet.

No extra payment shall be made on account of minor changes in location of power points (15A or 20A or computer power points) due to change in the architectural layout or change due to any other reason. Height of the power socket outlets shall be 300mm from the finished floor level unless otherwise specified.

1.5.7 CONDUCTOR SIZE.

Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire/cable.

i. Light point. - 1.5Sq.mm

ii. Ceiling /Cabin/Exhaust Fan Point 1.5 Sq.mm

iii. Call Bell Point - 1.5Sq.mm

iv. Plug Point (5 A Outlet) 1.5Sq.mm

v. Circuit Wiring - 2.5Sq.mm

vi. General Power Point - 4Sq.mm
vii  20A Industrial Socket Outlet – 6 Sqmm
viii Special Power Point – 6 Sqmm
ix  A/C Box with 32A MCB- 6 Sqmm

1.5.8 LIGHTING FIXTURE AND FANS

1.5.8.1 GENERAL

a. The Contractor shall supply and install lighting fixtures including but not limited to lamps, ballasts, accessories fixing hardware necessary for installations, as shown on the Drawings, as required, and as herein specified.

b. All fixtures shall be delivered to the building complete with suspension accessories, canopies, hanging devices, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.

c. Full size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures schedule, shall be submitted to the HSCC Electrical Engineer for approval.

d. Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening.

e. Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the Drawings.

f. Manufacturer’s name and catalogue number of light fixtures, fans, switchgears etc. shall be strictly adhered.

g. Fixtures shall bear manufacturer’s name and the factory inspection label.

h. Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.

i. Revamping the fixture shall be possible without having to remove the fixture from its place.

j. Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.

1.5.9 INSTALLATION

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer-In-charge.

Pendent fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation.

Flush mounted recessed fixtures, shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation.
Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

1.5.10 LAMPS-GENERAL

Lamp shall be supplied and installed in all lighting fixtures listed in the BOQ. Lamp shall be the part of Fitting no extra Payment will be made

Lamps used for temporary lighting service shall not be used in the final fixture units.

Lamps shall be of wattage and type as shown in the BOQ.

Lamps for permanent installation shall not be placed in the fixtures, until so directed by the Engineer In-charge.

1.5.11 BALLASTS-FLUORESCENT

Ballasts shall be electronic type and having high power factor type.

Ballasts shall have manufacturer's lowest sound level and case temperature rise rating.

Ballasts shall be special cool operated type.

Ballasts for indoor fixtures shall be protected by an integral thermal automatic resetting protective unit, which shall disconnect the ballast in the event of overheating.

Ballasts shall be of the same manufacture as the lamps/fixture.

1.5.12 FIXTURE SAMPLES

Detailed catalogue for all fixtures or if so required by the HSCC Electrical Engineer sample fixtures shall be submitted for prior approval of the HSCC Electrical Engineer before orders for the fixtures are placed.

1.5.13 TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the engineer.

All non-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer In-charge.

1.5.14 CEILING FANS

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/roof members. Contractor to ensure that provision are kept at appropriate stage at locations shown on the drawing. Fan box with MS hook shall be as per CPWD specification. Ceiling fan shall be double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS standards ceiling fan shall be white in colour. Ceiling fan shall be provided with electronic regulator. Electronic Regulator shall be suitable for 240 volts A.C supply 50 Hz and shall be of continuous duty type
1.5.15 EXHAUST FANS

Exhaust fans shall be heavy-duty type with double ball bearing and conforming to IS 2312 (latest revision). Exhaust fan shall be complete with copper wound motor, capacitor, Louver/shutter, frame and mounting bracket. Exhaust fan shall be suitable fan operation on 240 volts single phase A.C supply.

2.00 EARTHING

2.01 GENERAL

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD General Specifications for Earthing work shall conform to (Internal) - 1994 and Indian Electricity Rules 1956 amended up to date and in the regulations of the local Electricity Supply Authority.

2.02 EARTHING CONDUCTOR

Earth continuity conductor along with submain wiring from Main/Sub Distribution boards to various distribution boards shall be of copper. Earth continuity conductor from distribution board onward up to outlet point shall also be of bare copper. Earth continuity conductor connecting Main & Sub Distribution boards to earth electrode shall be with galvanised MS strip.

2.03 SIZING OF EARTHING CONDUCTOR

Single phase distribution board shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors. Earthing of main switch board and sub switch boards shall be earthed with two independent earth electrodes or as indicated elsewhere. Earth conductor laid in ground shall be protected for mechanical injury & corrosion by providing GI pipe.

2.04. GI pipe shall be of medium class 40mm dia and 4.5 metre in length. Galvanising of the pipe shall conform to relevant Indian Standards. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2 metre of length from bottom. The electrode shall be buried in the ground vertical with its top not less than 20cm below ground level as per detail enclosed. Earth electrode shall not be situated less than 2metres from the building. The location of the earth electrode will be such that the soil has reasonable chance of remaining moist as far as possible. Masonry chamber of size 300 x 300 x 300mm shall be provided with water funnel arrangement a cast iron or MS frame & cover having locking arrangement at the top.

2.05 PLATE EARTH ELECTRODE

Earthing shall be provided with either GI plate electrode or copper plate electrode of following minimum dimensions.
i. GI Plate Electrode : 600mm x 600mm x 6mm thick
ii. Copper Plate Electrode : 600mm x 600mm x 3mm thick

The electrode shall be buried in ground with its faces vertical and not less than 3 metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cash iron or MS frame with cover having locking arrangement shall be provided at top of metres from the building. Care shall be taken that the excavation for earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building.

2.06 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

2.07 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 5 ohm.

2.08 Advance Chemical Gel Earthing System
The function of an earthing and bonding system is to provide an earthing system connection to which transformer neutrals or earthing impedances may be connected in order to pass the maximum fault current.

The proper earthing system also ensures no thermal or mechanical damage occurs on the equipment, thereby resulting in safety to operation and maintenance personnel. The earthing system also guarantees equipotential bonding such that there are no dangerous potential gradients developed across the system.

As it is stated in the various standards related to earthing, a safe grounding system has two main objectives:

1. To provide means to carry electric currents into the earth under normal and fault conditions without exceeding any operating and equipment limits or adversely affecting continuity of service.
2. To assure that a person in the vicinity of grounded facilities is not exposed to the danger of critical electrical shock.

The technical specification is considered inline to IS:3043-1987 (Reaffirmed 2001) – “Code of Practice for Earthing” issued by BIS (Bureau of Indian Standards), Government of India. Earthing resistance calculation is prepared in such a way that the earth pits are designed as per IS 3043 of using G.I. & Copper pipe earth electrode along with the carbon based backfill material of Carbofill grounding minerals.

G.I. pipe based earthing electrode shall be for electrical body applications & Copper pipe based earthing electrode shall be for electrical neutral applications. G.I. pipe earthing system: For a system upto a rating of 1000 KVA – the electrode shall be of Dual Pipe Technology chemrode of 3
mtrs long 50mm dia of outer pipe with the 25mm dia of inner pipe of 80-100 microns galvanized filled with highly conducting metallic compounds with the permanent sealings at both the ends with the lead terminal of 32x10mm size at the top. The length of the electrode shall be 3000mm excluding the lead terminal and the length of the lead terminal at the top shall be 100mm. The electrode shall be duly tested and certified by CPRI (Central Power Research Institute), for a RMS short-circuit current withstanding capacity of 30 KA and a peak short-circuit withstanding capacity of 60 KA.

G.I. pipe earthing system: For a system upto a rating of 2000 KVA – the electrode shall be of Dual Pipe Technology chemrod of 3 mtrs long 80mm dia of outer pipe with the 50mm dia of inner pipe of 80-100 microns galvanized filled with highly conducting metallic compounds with the permanent sealings at both the ends with the lead terminal of 50x10mm size at the top. The length of the electrode shall be 3000mm excluding the lead terminal and the length of the lead terminal at the top shall be 100mm. The electrode shall be duly tested and certified by CPRI (Central Power Research Institute), for a RMS short-circuit current withstanding capacity of 30 KA and a peak short-circuit withstanding capacity of 60 KA.

Copper pipe earthing system: For a system upto a rating of 1600 KVA – the electrode shall be of copper pipe chemrod of 3 mtrs long 63mm dia filled with highly conducting metallic compounds with the permanent sealings at both the ends. Top of the earth electrode is compressed to form an extended lead with 2 holes for connecting the strip/wire to the load.

Copper pipe earthing system: For a system upto a rating of 2000 KVA – the electrode shall be of copper pipe chemrod of 3 mtrs long 80mm dia filled with highly conducting metallic compounds with the permanent sealings at both the ends. Top of the earth electrode is compressed to form an extended lead with 2 holes for connecting the strip/wire to the load.

To ensure the moisture content and electrical conductivity, carbon based carbofill compound shall be used as a backfill compound. The carbofill compound shall be of low resistance & high conductivity in nature with carbon as a major content which dramatically lowers ground resistance system in difficult soil situations.

The carbon based backfill should not contain bentonite or concrete components, which in very dry conditions can cause shrinkage around the electrode, thus rendering it ineffective. pH adjusting agent shall maintain the pH value around the grounding material within the scope of protection. Carbon based compound carbofill should be an environment friendly and does no harm to the underground water.

Minimum 37.5 Kgs of carbon backfill compound shall be used along with each earthing electrode. The chemical backfill compound shall be tested & certified by any BIS (Bureau of Indian Standards).

On the ground level, an heavy duty weather proof environment friendly polyplastic earth pit chamber with cover of autolocking facility with the following dimensions - 254mm dia (top), 330mm dia (bottom) and 260mm height. 4 knock-out openings are provided for the easy interconnection of earth strips between the earth pits to form a grid.

At any cost, usage of salt & charcoal is strictly not permitted along with the chemical gel earthing system.

3.0 MAIN MV & FLOOR PANELS
3.1 GENERAL

Main/Sub Distribution Panels shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system.

3.2 CONSTRUCTION

Main/Sub Panels shall be:

i. Of metal enclosed, indoor, floor mounted, free standing construction (unless otherwise specified) type.

ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.

iii. Provide dust and damp protection.

iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers in case of Main Panels.

v. All panels shall be front access type.

Main/Sub Panels shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of the following:

i. A front-framed structure of rolled/folded sheet steel channel section, of minimum 2 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, moulded case circuit breaker, main horizontal busbars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2 mm thickness and 100 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. A cable chamber housing the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

iii. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

iv. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

The height of the panels should not be more than 2400 mm for MV Panels. Operating handle of breaker in top most compartments shall not be higher than 1800 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350mm.
Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centers (panels) shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main/Sub Panels shall have the following minimum clearances.

i. Between phases - 32
ii. Between phases and - 26
iii. Between phases and earth - 26
iv. Between neutral and earth - 26

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

Creep age distances shall comply with those specified in relevant standards.

All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Functional units such as circuit breakers and moulded case circuit breakers shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of bus duct for incoming breakers.

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

3.3 METAL TREATMENT & FINISH

All steel work used in the construction of the Main/Sub Panels should have undergone a rigorous metal treatment process as follows:-

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognized phosphating process to facilitate durable coating of the paint on the metal
surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating. v.

Drying with compressed air in a dust free atmosphere.

vi. Panel shall be powder coated with epoxy based powder paint after the above process so as to render the material suitable for corrosive environment.

vii. Paint shade shall be Pebble (light) grey, shade no RAL 7032 unless otherwise specified.

3.4 BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of IS-5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 25kA RMS symmetrical for one second. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and Creepage distances shall be provided on the busbar system to minimize possibilities of fault.

The Main/Sub Panels shall be designed that the cables are not directly terminated on the terminals of breaker etc. but on cable termination links. Capacity of aluminum busbars shall be considered as 0.8 Amp per sqmm. of cross sectional area of the busbar. The main busbars shall have continuous current rating throughout the length of Panels. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity up to 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxiliary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

3.5 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Main/Sub Distribution Panels to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. A cable chamber 150 mm. high shall be provided at the bottom throughout the length and depth of the MDB/SDB. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents.
without damage and without causing secondary faults.

3.6 LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Main/Sub Distribution and all Panels.

3.7 TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted.

3.8 TESTING AND COMMISSIONING

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

a) Operation checks and lubrication of all moving parts.

b) Interlocking function check.

c) Insulation test: As per CPWD Specifications.

d) Trip tests & protection gear test.

4.0 L.T. SWITCHGEARS

4.1 AIR CIRCUIT BREAKERS

4.1.1 GENERAL

Air circuit breakers shall be incorporated in Main Distribution Panels wherever specified. ACBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply.

4.1.2 TYPE AND CONSTRUCTION

Air Circuit Breakers shall be of enclosed pattern, dead front type with 'trip free' operating mechanism. It shall have microprocessor based electronic release. Air Circuit Breakers shall be EDO type (Electrically drawout type unless otherwise specified) with horizontal drawout carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawn-out positions. The carriage or cradle on which the breakers are mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all draw out mechanism in a completely fig welded assembly. There shall be no dependence upon the switchboard frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

All the current carrying parts of the circuit breakers shall be silver plated, suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The sequence of operation of the contacts shall be such that arcing contacts 'make before' and break after' the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole and these shall be such suitable for being lifted out for inspection of main as well as arcing
contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Interphase barriers shall be provided to prevent flashover between phases.

4.1.3 OPERATING MECHANISM.

Air Circuit breaker shall be provided with a quick-make, trip free operating mechanism, the operating mechanism shall be 'strain-free' spring operated. The operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such that the breaker is at all times free to open immediately and the trip coil is energised. Mechanical operation indicator shall be provided to show open and closed position of breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring. 24 volt DC supply through battery backup for closing and opening for tripping circuit.

Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

4.1.4 INTERLOCKING AND SAFETY ARRANGEMENT

Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

i. It shall not be possible for breaker to be withdrawn when in "ON" position.

ii. It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.

iii. The breaker shall be capable of being racked into 'testing', 'isolated' and 'maintenance' positions and kept locked in any of these positions.

iv. A safety catch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.

v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

4.1.5 RATING

The rating of the circuit breaker shall be as per the drawings and schedule of quantities. Rated service breaking capacity (Ics) of the breakers shall be 50kA unless otherwise specified at 415 volts. The rated making capacity shall be as per the relevant standard.

4.1.6 ACCESSORIES

The breaker shall be equipped with electronic microprocessor based release to provide over current & earth fault protection. The breaker shall be fitted with following accessories for control, signal and
interlocking.

i. Auxillary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.

ii. Shunt release for tripping the breaker remotely and shall be suitable for 240 volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.

iii. Micro switches shall be mounted on the cradle of draw out breaker to indicate the position of the breaker on the cradle.

   a. Kit for test/isolated indication.
   b. Kit for service position indication.
   c. Kit for shutter assembly.

iv. Accessories for following interlocking schemes shall be provided.

   a. Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personnel and equipment safe.

   b. Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.

   c. Lockable trip push button.

4.1.7 MOUNTING

Circuit Breakers shall be mounted as per manufacturers’ standard practice.

4.1.8 TESTING

Testing of each circuit breaker shall be carried out at the works as per IS 2516 and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

i. Impulse withstand test.

ii. Power frequency withstand test.

iii. Short circuit test.

iv. Temperature - rise test under rated conditions.

4.2 MOULDED CASE CIRCUIT BREAKERS.

GENERAL

Moulded Case Circuit Breaker shall be incorporated in the Main/Sub Distribution Boards wherever specified. MCCBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. MCCBs shall be suitable either for single-phase AC 230 volts or three phase 415 volts. All MCCBs shall have microprocessor based over current and short circuit releases with adjustable current setting from 0.4In to 1.0 In.

4.2.1 Technical Specifications
The MCCB should be current limiting type with trip time of less than 10 milli sec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ.
MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities.

CPRI / ERDA

MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses.

The breaking capacity of MCCB shall be minimum 35KA / 50 KA or as specified in BOQ. The rated service breaking capacity should be equal to rated ultimate breaking capacities (Ics=Icu).

All MCCBs upto 200A ratings should be provided with Thermal Magnetic type release with adjustable Overload and fixed short circuit protections or specified as BOQ. MCCBs of ratings 250A & above shall be provided with Microprocessor based having inbuilt adjustable protections against Over Load (L), Short Circuit (S) and Ground Faults (G) with time delay or specified as BOQ.

All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility.

MCCB should have Spreader links & Phase barriers as standard feature. Superior quality of engineering grade plastics confirming to glow wire Tests as Per IEC 60695-2-1 should be used for insulation purpose.

The handle position shall give positive indication of ‘ON’, ‘OFF’ or ‘Tripped’ thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts.

4.2.2 FRAME SIZES

The MCCBs shall have the following frame sizes subject to meeting the fault level.

| a. | Upto 100A rating | ...... | 100A |
| b. | Above 100A upto 200A | ...... | 200A |
| c. | Above 200A up to 250A | ...... | 250A |
| d. | Above 250A up to 400A | ...... | 400A |
| e. | Above 400A up to 630Aq | ...... | 630A |
| f. | Above 630A to 800A | ...... | 800A |

4.2.3 CONSTRUCTIONS

The MCCB’s cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable “ON”, “OFF” “and” “tripped” indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCBS shall be provided with rotary handle.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static release type provided in each pole & connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.
Contact trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

4.2.4  BREAKING CAPACITY

Unless otherwise specified, rated service breaking capacity of the Moulded Case Circuit Breakers shall be minimum 25kA.

4.2.5  TESTING

a. Original test certificate of the MCCB as per Indian Standards (IS) 315-C-8370 shall be furnished.

b. Pre-commissioning tests on the Main Distribution/Sub Distribution Board incorporating the MCCB shall be done as per standard.

4.3  SWITCH DISCONNECTOR FUSE UNITS

The Switch Disconnector Fuse Units shall be double break type suitable for load break duty (AC 23) quick make and break action. Hinged doors shall be duly interlocked with operating mechanism so as to prevent opening of the door when the switch is in 'ON' position and also prevent closing of the switch when the door is not properly secured. All contacts incoming and outgoing terminals of switch shall be adequately sized to receive proper size of cables. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. HRC fuse links shall be provided with visible indicators to so that they have operated. The switch disconnector fuse units shall be manufactured in accordance with IS 13947-3-1993.

FUSE

Fuse shall be of the high rupturing capacity (HRC) fuses links and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. The backup fuse rating for each motor/equipment shall be chosen as the fuse does not operate on starting of motors/equipments.

4.4  MEASURING INSTRUMENTS, METERING & PROTECTION

4.4.1  GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between-10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply.
The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

4.4.2 Digital AMMETERS

Ammeters shall be standard digital type or specified in BOQ the ammeters shall be calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

4.4.3 Digital VOLTMETERS

Voltmeters shall be standard digital type or specified in BOQ the ammeters shall be calibrated as per the latest edition of IS:1248. The range for 415 volts, 3 phase voltimeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

4.4.4 CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated acceptable minimum class of various applications shall be as given below:
Measuring : Class 0.5 to 1
Protection : Class 5P10.
Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

All Current Transformer shall be Cast resin type.

4.5 MISCELLANEOUS

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.
5.0 LT CABLES

5.1 GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

5.2 MATERIAL

The L.T. power cable shall be XLPE. Cable PVC insulated PVC sheathed type aluminium conductor armoured cable and L.T. control cable shall be PVC insulated PVC sheathed type copper conductor unarmoured cable conforming to IS: 1554: 1988 (Part-l) with up to date amendments.

5.3 INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of HSCC Electrical Engineer. Cable laying shall be carried out as per CPWD specifications.

5.4 INSPECTION

All cables shall be inspected at Factory as well as site and checked for any damage during transit.

5.5 JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

5.6 LAYING CABLES IN GROUND

Cables shall be laid by skilled experienced workmen, using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metre. Cables shall be laid at depth of 0.75 metres below ground level for LT Cables and 1 metre below ground level for HT cable. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.
Cable route marker shall be provided as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

PROTECTION OF CABLES
The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes of suitable size. Pipes for cable crossing the road shall be laid at a depth of 1000 mm.

EXCAVATION & BACK FILL
All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, road ways, side walks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in-Charge.

LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/ CEILING
Cable shall be laid on perforated M.S. Cable tray/ladders. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

CABLES ON HANGERS OR RACKS
The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good. The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

CABLES TAGS
Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

5.7 TESTING OF CABLES
Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a. Before laying.
b. After laying.
c. After jointing.
Along with the test as prescribed in IS Code, cross sectional area shall also be checked. On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

a. Insulation Resistance Test (Sectional and overall).
b. Continuity Resistance Test.
c. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

6.0 LIFT INSTALLATION

6.1 The scope of work shall cover design, supply delivery, installation, testing and commissioning of passenger lifts/bed lifts. The scope of work shall also include the following item of civil works.

a) Necessary scaffolding temporary barricade in the hoistway required during the erection of the elevators.

b) Minor building work comprising of cutting holes and making good the car and counterweight rail brackets, hall buttons and indicators including laying of sills in position.

c) Steel items such as machine beams, bearing plates buffer support channels, sill angles and fascia plates etc.

d) Suitable trap doors with steel chequered plate covers.

e) Providing and install a suitable vertical iron ladder for access to the pit.

f) Any other item required for successful completion and commissioning of lifts. (including the hoisting beam in the machine room)

6.2 The work shall be done in accordance with regulations of any local code and following ISI codes which govern the requirements of installations.


Indian Electricity Act 1910.

Indian Electricity Rules, 1956. Delhi

Lifts Rules, 1942.

6.3 SHOP DRAWINGS AND APPROVAL OF ELECTRICAL INSTALLATIONS:
The selected tenderer shall prepare a furnish shop drawings for approval by The Client, such shop drawings shall be based on the Architectural drawings and requirements laid down in specifications, local laws and regulations etc.

The detailed drawings shall be submitted within one month of placement of order. The successful tenderer shall obtain the approval of electrical Inspector and other local authorities as per requirements before submitting the drawings to Client/ Engineer. The contractor shall not proceed with in installation work till the drawings are approved by the Engineer-in-Charge. Expenses incurred such as license fee etc. towards obtaining the approval of Electrical Inspector, local authority shall be reimbursed to the contractor as per actual on production of documentary proof.

Approval of contractor's drawings shall not absolve the contractor of any of his obligations to meet the requirements of specification under this contract.

Five sets of completion drawings operation manual, maintenance manual, spare parts details shall be submitted to the Client/ Engineer after completion of work.

6.4 GUARANTEE

The tenderer shall guarantee the equipment against all defects of materials and workmanship for a period of one year from the date of commissioning of the equipment as certified by the owner. Any defects arising during the guarantee period shall be rectified and replaced by the tenderer, at his own expense, to the satisfaction of the owner.

6.5 PERMITS, INSPECTION & LICENSE FEE

The contractor shall arrange all necessary local, provincial or national government permit and shall make arrangements for inspection and tests required thereby. Expenses to be borne by purchaser.

6.6 MAINTENANCE

After the completion of the installation and before handing over of each elevator by the elevator contractor, maintenance service for the equipment furnished shall be provided for a period of twelve (12) months. This service shall include regular examination of the installation by trained employees, and shall include all necessary adjustments, greasing oiling, cleaning supplies and genuine standard parts to keep the equipment in proper operation, except any parts made necessary by misuse, accident or neglect caused by other. Contractor shall provide 24 hours Emergency local call back service facility and shall furnish full details of such facilities available.

6.7 POWER SUPPLY

The apparatus shall be designed to operate on 415 + 10% - 20% Volts, 3 Phase, 4 wires, 50 Hz A.C. Supply for illumination signal equipment shall be 240 Volts single phase 50Hz A.C.

6.8 ELECTRICAL WIRING

The necessary A.C. supply of 3 Phase, 415 Volts 50 HZ shall be made available in the main control switch unit to be provided by the contractor in the machine room. All the electrical works beyond the main supply switch shall be carried out by the contractor i.e. supply and installations of panels for drive motors, switches and control complete with wiring as per system requirement and approval of
the Engineer.

The wiring shall be carried out strictly in accordance with Indian Electricity Rules and Indian code of Practice for Electrical Wiring Installation IS-732-1963 System Voltage not exceeding 650 V). For works not covered under any of the above wiring rules, the 13th edition of Electrical Engineers (Condense) shall apply. The cable and conduits to be used shall be of suitable size and grade conforming to relevant IS specification. Wiring for LT switchboard to the motor terminal shall be with heavy duty 1.1 KV grade PVC insulated PVC sheathed, FRLS aluminium cable. All the trailing cables used for control and safety device shall conform to IS: 4289-1967, Specifications for lifts cables. The trailing cable circuits for controls, safety devices, lighting and signaling shall be separate and distinct.

Power wiring between controller and main board to various landings shall be drawn in suitable size heavy gauge conduit stove enameled/painted conforming to I.S specifications.

The Voltage and frequency of the supply shall be subjected to variations permissible under Indian Electricity Acts and Rules.

6.9 PARTICULAR SPECIFICATIONS

6.9.1 TYPE : Bed Lifts/Passenger Lifts.
6.9.2 NO. OF ELEVATORS : As Per Bill of Quantities.
6.9.3 CAPACITY : As Per Bill of Quantities.
6.9.4 SPEED : As Per Bill of Quantities.
6.9.5 FLOORS SERVED/RISE : As Per Bill of Quantities.
6.9.6 STOP : As Per Bill of Quantities.
6.9.7 OPENINGS : (All Openings on same side).
                   As Per Bill of Quantities.
6.9.8 OPERATION : Duplex/Simplex Collective as per BOQ.

13.9.9 CAR FRAME:

The car frame, which supports the car platform and enclosures, shall be made of structural steel and equipped with suitable guides and a car safety device mounted underneath the car platform. The hoist ropes shall include adjustable self/aligning hinges. The car shall be so mounted on the frame that vibration and noise transmitted to the passenger is minimized.

13.9.10 CAR SAFETY AND GOVERNER :

Suitable car safety to stop the car whenever excessive descending speed is attained shall be operated by a centrifugal speed governor connected to the governor through a continuous steel rope.

The governor shall be provided with self tensioning device to keep governor rope in proper tension even after rope stretch. Suitable means shall be supplied to cut off power from the motor and apply the brake on application of the safety.

13.9.11 COUNTER BALANCE :

A Suitable guided structural steel frame with appropriate filler weights of cast iron shall be furnished to promote smooth and economic operation.

13.9.12 TERMINAL AND FINAL LIMITS :

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal
landings within permissible over travel and final limit switches shall be provided to automatically cut off the power and apply the brake, should the car travel beyond the permissible over travel. They shall act independently of the operating devices and buffers.

13.9.13 TERMINAL BUFFERS :

Heavy duty spring buffers shall be installed as a means of stopping the car and counterweight at the extreme limits of travel. Buffers in the pit shall be mounted on steel channels which shall extend between both the car and counterweight rails.

13.9.14 CONTROLLER :

A Controller shall be provided to control starting stopping and speed of the elevator motor and also be automatically able to apply the brake if any of the safety devices operate or if power fails from any cause. In case of power failure and again restore of power the lift shall land to next floor and shall not go to basement/lowest level. Suitable software/hardware or rescue device shall be provided.

13.9.15 REVERSE PHASE RELAY :

A reverse phase relay shall be provided on the controller which is designed to protect the lift equipment against phase reversal and phase failure.

13.9.16 GUIDES :

Machined steel tee guides shall be furnished for the car and counterweight. The guide rails should be of steel solid and shall have tongued and grooved joints. Sliding clips shall be used for fastening the guides to allow building settlement without distorting the guide rails. To keep down the noise level and to reduce wear and tear of the sections, only Nylon Ribs shall be used in the guide shoes, after smoothening of the rails. The flanges shall be machined for the fish plate mounting such that rail alignment at joints almost remain constant.

13.9.17 FOUNDATIONS :

The machine shall be placed directly above the hoistway upon the machine room slab provided by the Owner.

13.9.18 ROPES :

The elevator shall be provided with traction steel ropes. Steel wire rope having a tensile strength of not less that 12.5 Ton/cm² of good flexibility shall be used for lift. The lift rope shall conform to IS: 14665 – (Part-4- Sec-8):2001.

13.9.19 MACHINE :

The machine shall be of the single wrap traction type and shall include a motor, electromechanical brake, steel worm, bronze gear, steel sheave shaft and Farrow-Molybdenum sheave all compactly mounted on a single base or bed plate. The worm shaft shall be provided with ball bearings to take the end trust and roller bearings shall be furnished for the sheave shaft to ensure alignment and ling bearing life. The driving sheave shall be grooves to ensure sufficient traction and minimize rope wear. Shall be provided for all bearings and the worm gear.

13.9.20 BRAKE :

The direct current brake shall be spring applied and electrically released and designed to provide smooth stop under variable loads. The brake should be capable of operation automatically by various safety devices, current failure, and by normal stopping of car. It should be possible to release the brake manually, such releases brake manually, such releases requiring the permanent application of manual force so as to move the lift car in short sties. For this purpose one set of
brake release equipment shall be supplied.

13.9.21 MOTOR
The motor shall be suited to the service proposed and arranged for adequate lubrication. The motor shall be class F insulation and one (1) hour rated squirrel cage induction type having high starting torque. It shall also be provided with Thermisters embedded in the stator windings for the highest degree of thermal motor protection.

13.9.22 CONTROL
The control shall be variable voltage variable frequency A.C. variable voltage, closed loop control system using solid state devices and electronic speed pattern generator to command the motor from a velocity transducer and load compensation circuits for a comfortable ride.

In Normal operation, the electromagnetic brake shall only be applied when the lift has come to a complete standstill. The brake shall only be meant for holding the lift in position at every landing, providing stopping without any jerking effect.

Each controller cabinet containing memory equipment shall be properly shielded from the pollution.

MICROPROCESSOR
The control shall employ a microprocessor working on a program such that precision leveling and highly efficient handling of passengers for least possible waiting and reduced travel time is ensured. The microprocessor system should be designed to accept programming with minimum downtime. It should be able to monitor the state of input calls (such as car calls from COP and hall calls from hall fixtures) and output commands such as starting, decelerating and stopping the elevator. It should be able to generate floor location data, thereby, providing a reference position to establish the safety zones for door opening and closing, and also to initiate leveling slowdown.

13.9.23 DUPLEX COLLECTIVE OPERATION
The operation shall be duplex collective with/without attendant for each elevator and shall consist of the following:-

IN THE CAR
There shall be furnished a flush type attractively finished stainless steel panel which contains a series of luminous buttons numbered to correspond to the landings served, an emergency stop switch and an emergency call button connected to a bell which serves as an emergency signal.

AT HOISTWAY LANDINGS
There shall be provided an UP luminous push button and a DOWN luminous push button at each intermediate landing and a single button at the terminal landings.

The car shall not start unless the door is in the closed position and all hoistway doors are closed in the locked position.

If the car is idle and one or more car or landing buttons above the landing at which the car is standing are pressed, the car shall start in the UP direction and proceed to the highest landing for which any button is pressed and stops at intermediate landing for which a car button or up landing button is pressed sufficiently in advance of the car’s arrival at such landings to permit these stops to be made. After each stop, the car shall proceed in the UP direction until it reaches the highest landing for which a call is registered. The car shall not stop on the UP trip at any landing in response to a DOWN call.
Similarly, if the car is idle and one or more car or landing buttons below the landing at which the car is standing are pressed, the car shall start in the DOWN direction, proceed to the lowest landing for which any button is pressed and stop at each intermediate landing for which a car button is pressed.

When the car is idle and a button for a landing above the car and a landing below the car are pressed, the car shall start towards the landing corresponding to the button pressed first. The call registered for the landing in the opposite direction from the car shall be answered after the car has responded to the farthest call in the direction established by the button pressed first.

A time relay shall hold the car for an adjustable interval of few seconds at the landings at which stops are made to enable passengers to enter or leave the car.

**OPERATION WITH AN ATTENDANT**

The regular car operating panel shall include buttons, switches, etc. for the collective-automatic control and shall also include.

A two-position key-operated switch marked to indicate ATT (attendant operation) A buzzer: UP and DOWN direction light jewels and A non-stop butt car operating panel shall also include an UP and DOWN button.

When the key-switch is in the position of WITH ATTENDANT, the direction light and buzzer shall become operative and the UP and DOWN direction button in the regular car operating panel shall be made effective for the attendant operation.

When an attendant operation, the car and hoistway doors shall open automatically at each stop but the closing of the doors shall be subject to the UP or DOWN direction buttons. As a visual signal to the attendant, the UP and DOWN direction jewel shall illuminate upon registration of either car or landing calls to indicate the direction of the travel of the car. The attendant shall operate the elevator normally in the direction indicated by the direction jewel but, if desired, opposite direction travel may be realized by pressure of a car button for a landing in that direction from the car.

The pressure of a direction button shall cause the doors to close and the car to start in the direction desired, provided a call is registered for that direction. If pressure of the direction button is released before the car starts, the doors will re-open and car shall not travel. It shall so arrange the pressure on direction button can be released, once the car has started.

Continuous pressure of the nonstop button shall cause the car to by-pass all landing calls and respond only to registered car calls.

13.9.24 **CAR ENCLOSURES** :

The car enclosures shall be of sheet steel and shall be of an elegant design comprising of the following:

a) Suspended ceiling with light diffuser Perspex ceiling and fluorescent light.

b) Concealed pressure fan with grille in suspended ceiling. The lift shall have sensor so that the
fan is operation only when if there is at least one person inside the lift.

c) Ceiling steel painted white.

d) Complete stainless steel car enclosure in plain finish for passenger and Bed Lifts

a) PVC flooring (with 3mm thick tiles of approved shade) for Bed Lifts

b) Mirror on one face (front face when we enter the car)

13.9.25 CAR DOOR

The car entrance shall be provided with stainless steel sliding doors in plain finish giving a clear opening of 1200mm wide by 2000mm high for bed lift. The lift car door shall have a fire resistance rating of one hour.

13.9.26 HOISTWAY DOORS

At each landing, a center/telescopic opening, stainless steel sliding door in plain finish giving a clear opening as per CPWD general specifications for electrical works –Part-III – Lifts & Escalators, shall be provided.

13.9.27 SIGNAL AND OPERATIVE FIXTURES:

The following signal and operative fixtures shall be provided for each lift in stainless steel face plates except in fireman’s switch which shall have a glass face plate.

a) CAR OPERATING PANEL

There shall be one (1) No. panel in car, with hinged stainless steel face plate and shall comprise illuminated floor buttons, door open and emergency stop controls emergency call buttons, door open and emergency stop controls emergency call button, two position key operated switch, a Buzzer, UP and DOWN direction light panels, a non stop button, and an integral interphone. The jewels and accentuator shall be of modular construction, face plate mounted, rewired using snap on lugs.

b) HALL BUTTONS AND HALL POSITION INDICATOR

There shall be provided combined signal fixture (one riser) of compact design and of attractive hairline stainless steel face plate at the elevator entrance on each floor which for terminal landings shall have a single luminous push button and for intermediate landings shall have an UP luminous push button and a DOWN luminous push button. The jewels shall be of modular construction mounted on a stainless steel face plate. Whenever a button is pressed, the jewel shall light up to indicate registration of the call and shall remain enlightened till the car arrives.

c) CAR POSITION INDICATOR IN CAR

This shall be of compact design and of attractive hairline finish stainless steel face plate with easy to read digital display of the floors, indicating through which floor the elevator is passing or on which floor the elevator is stopped. This shall also incorporate illuminated arrows showing the direction of travel.

d) BATTERY OPERATED ALARM BELL AND EMERGENCY LIGHT

A solid state siren type alarm unit operated by 2 Nos. 9 volt rechargeable Nickel Cadmium batteries shall be provided which shall give a waxing and waning siren when alarm bell in the car is pressed momentarily.
An emergency light unit using a 9 volt dry battery power pack and incandescent lamp with stainless steel face plate shall be provided inside the car which shall operate automatically in the case of power failure.

e) OVERLOAD WARNING
Overload warning radars with audio-visual indication (visual indication shall show OVERLOADED) with stainless steel face plate shall be installed in the elevator car, so that when there is overload in the car the sign shall light up a flash indicating OVERLOADED and a buzzer shall operate during this period and the doors shall remain open until the overload is removed.

f) FIREMAN'S SWITCH
A toggle switch covered by a glass cover shall be provided on the ground floor for each elevator which shall permit a fireman to call the elevator to the ground floor by canceling all car and landing calls. The elevator shall then stop at the ground floor with the door open to permit the fireman to have exclusive use of the elevator without any interference from the landing calls.

g) INTERPHONE
Interphone shall have one master unit in each machine room, one master unit on the ground floor for each 1 (outside hoistway) and one slave unit in each elevator car.

13.9.28 ELECTRIC DOOR OPERATOR FOR CAR DOOR AND HOISTWAY DOOR:
An electric door operator for opening and closing the car door shall be provided. The opening of a car and hoistway doors shall be such that the doors shall start opening meant for so that by the time the elevator stops completely, the elevator and hoistway doors shall be fully open.

The equipment shall consist of a machine on the elevator car operating the car door when the car is stopping at a landing.

The car door and hoistway door shall be mechanically connected and shall move simultaneously in opening and closing.

The car and hoistway doors shall be power opened and closed and shall be checked in opening and closing with an oil cushioning mechanism built into the gear unit.

Each hoistway door shall be provided with an interlock which will prevent movement of the car away from the landing unit.

The doors are closed in the closed position as defined in the ISI codes.

An electric contact for the car door shall be provided which shall prevent car movement from the landing unless the door is in the closed position as defined in the ISI codes. The locking arrangement shall be so designed that the electrical circuit cannot be completed unless the doors are in the closed position and mechanical latching is effected.

Necessary switches shall be provided in the elevator machine room to control the operation of the doors.

The car and hoistway, doors shall open automatically as the car is stopping at a landing. The closing of the car and hoistway door must occur before the car can be started. Doors can be
stopped and reversed during their closing motion.

13.9.29 DOOR HANGER AND TRACKS:

For the car and each landing door, sheave type two point suspension hangers complete with tracks shall be provided. Means shall be provided to prevent the door from jumping off the track and for vertical and literal adjustment of doors.

Sheaves and rollers shall be of steel and shall include shielded ball bearing to retain grease lubrication. Adjustable ball bearings rollers shall be provided to take the upward thrust of the doors. Tracks shall be of suitable steel section with smooth surface. The locking of the two leaf parting type doors should be positive.

13.9.30 SAFETY SHOE:

A safety shoe (one on each door panel) shall extent to the full height of and project beyond the front edge of the car door.

Should this shoe touch a person or an object while the car door is closing, the car and hoistway doors shall return to the open position. The doors shall remain open until the expiration of a pre-determined interval and then close automatically.

13.9.31 LANDING ENTRANCE MATERIAL’S:

These shall consist of headers, extruded aluminium sills and strut angles.

13.9.32 WIRING:

Complete wiring in the equipment.

13.9.33 AUTOMATIC RESCUE DEVICE:

Automatic Rescue Device to be provided for all the lifts with battery backup so that it can land to the nearest level in case of power failure. Automatic Rescue Device shall have suitable battery backup so that it can operate minimum seven times in a day provided the duration between usage is at least 30 minute

LIST OF APPROVED MAKES OF MATERIALS FOR ELECTRICAL WORKS:

<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 / ATUL</td>
</tr>
<tr>
<td></td>
<td>PVC</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Wire (Copper conductor)</td>
<td>FRLS/FR copper wire (FINOLEX / HAVELLS / RR KABEL / KEI</td>
</tr>
<tr>
<td>3.</td>
<td>L T Cable (underground)</td>
<td>GLOSTER / CCI / INCAB / INDUSTRIAL CABLES / RPG / UNIVERSAL / NICCO /</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Manufacturer/Equivalent</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>4.</td>
<td>Switch &amp; Socket – (Piano Type)</td>
<td>ANCHOR / KOLORS / GOLDMEDAL / HPL / HAVELLS equivalent</td>
</tr>
<tr>
<td>5.</td>
<td>Switch &amp; Socket – (Modular Type)</td>
<td>MK / CRABTREE / LEGRAND / SCHNEIDER</td>
</tr>
<tr>
<td>6.</td>
<td>Switch fuse unit (HRC Type) (re-wireable type)</td>
<td>L&amp;T / SIEMENS / C&amp;S / Havells</td>
</tr>
<tr>
<td>7.</td>
<td>MCB/ DB/RCCB/ ELCB</td>
<td>MK / L&amp;T / Legrand / C&amp;S</td>
</tr>
<tr>
<td>8.</td>
<td>Telephone cables</td>
<td>Finolex / Polycab / KEI / Havells / RR KABEL</td>
</tr>
<tr>
<td>9.</td>
<td>Computer cable: Cat – 6</td>
<td>RR KABEL / Polycab / Finolex / KEI</td>
</tr>
<tr>
<td>10.</td>
<td>Ceiling Rose</td>
<td>ANCHOR / MK / GOLDMEDAL / KOLORS</td>
</tr>
<tr>
<td>11.</td>
<td>Air Circuit Breaker</td>
<td>L&amp;T / SIEMENS / SCHNEIDER / Legrand / ABB / C&amp;S</td>
</tr>
<tr>
<td>12.</td>
<td>Industrial Socket</td>
<td>L&amp;T / SIEMENS / SCHNEIDER / Legrand / ABB / C&amp;S</td>
</tr>
<tr>
<td>13.</td>
<td>Exhaust Fan/ ceiling fan</td>
<td>Bajaj / usha / Havells / Crompton</td>
</tr>
<tr>
<td>14.</td>
<td>MDBs / BDBs / SDBs Panels</td>
<td>CPRI approved vendors, having facilities for powder coated finish and antirust treatment by min seven / eight tank process (vendor detail shall be submitted for approval)</td>
</tr>
<tr>
<td>15.</td>
<td>APFC Panel</td>
<td>SCHNEIDER / L&amp;T / Legrand</td>
</tr>
<tr>
<td>16.</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>17.</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>
<tr>
<td>18.</td>
<td>TRANSFORMER</td>
<td>Kirloskar / Crompton / BHEL / Siemens / ABB</td>
</tr>
</tbody>
</table>

1103 SPECIFICATIONS FOR FIRE HYDRANT SYSTEM
1.0 SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install wet riser fire hydrant system as required by the drawings and specified hereinafter or given in this schedule of quantities.

1.2 Without restricting to the generality of the foregoing, the fire hydrant system shall include the following:

- Mild steel mains including valves, hydrants and all other accessories. Mild steel pipe fire risers within the building.
- Landing valves, synthetic hose pipes, hose reels, hose cabinets, fire brigade connections, connection to pumps, appliances and pressure reducing devices.
- Excavation, anchor blocks and valve chambers.

2.0 GENERAL REQUIREMENTS

2.1 All materials shall be of the best quality conforming to the specifications and subject to the approval of the employer. The wet riser system shall remain pressurized at all times during operation, and as such the piping work shall be carried out to withstand the same.

2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.

2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.

2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

3.0 PIPES AND FITTINGS FOR INTERNAL WORK:

a. All pipes within the building in exposed locations and shafts including connections buried under floor shall be ERW mild steel tubes conforming to IS: 1239 (Heavy class) up to 150mm AB and IS 3589 above 150 NB’s with screwed or welded joints as specified by the engineer in charge at least 10% of welded joints shall be radiographically tested.

b. Fittings of 50mm or below shall be forged steel with socket weld ends of approved makes. For 65mm and above shall be W.I./M.S. with butt weld ends.

4.0 JOINTING

Gasket, for use in between flanged joints, to be of CAF as per IS-2712, thickness as specified in S.O.Q.

5.0 EXCAVATION
5.1 Excavations for pipeline shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipelines shall be buried to a minimum depth of 1 to 1.5 meter or as shown on the drawings.

5.2 Wherever required contractor shall support all trenches or adjoining structures with adequate supports to prevent land slides.

5.3 On completion of testing and painting, trenches shall be refilled with excavated earth in 15-cm layers and compacted.

5.4 Contractor shall dispose off all surplus earth within the site.

6.0 ANCHOR BLOCKS

6.1 Contractor shall provide suitable cement concrete anchor blocks as may be necessary for overcoming pressure trusts in under ground/external pipes. Anchor blocks shall be of cement concrete 1:2:4 mix.

7.0 VALVES

7.1 Butterfly valves above 65mm shall be of cast iron body and bronze/gunmetal seat. They shall conform to type PN 1.0 of IS: 13095.

7.2 Non return valves shall be of cast iron body and bronze / gunmetal seat. They shall be swing conform to Class 1 of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring loaded type.

7.3 Check valves shall be cast iron double flanged conforming to IS 5312-1975 with cast iron steel body and stainless steel internal trims.

Valves on pipes 65mm and below shall be heavy pattern gunmetal valves with cast iron wheel seat tested to 20kg/sqcm pressure. Valves shall conform to IS:778.

8.0 FIRE HYDRANTS

8.1 EXTERNAL HYDRANTS

Contractor shall provide external hydrants. The hydrants shall be controlled by a cast iron sluice valve. Hydrants shall have instantaneous type 63-mm dia outlets. The hydrants shall be of gunmetal and flange inlet and single outlet conforming to I.S.5290-1983 with G.I. duck foot bend and flanged riser of required height to bring the hydrant to correct level above ground.

8.2 Contractor shall provide for each external fire hydrant two nos. of 63 mm dia 15 meter long synthetic fibre non percutating hose pipe with gunmetal male and female instantaneous type couplings machine wound with copper wire hose to I.S. 636 type B and couplings to IS 903 with IS certification), gunmetal branch pipe with 16 mm nozzle to I.S. 903-1984.

9.0 INTERNAL HYDRANTS

9.1 Contractor shall provide on each landing and other locations as shown on the drawings one single headed gunmetal landing valve with 63 mm dia outlets and 80 mm inlet (I.S. 5290-1969) with individual shut off valves and cast iron wheels.

Landing valves shall have flanged inlet and instantaneous type outlet as shown on the drawings.
9.2 Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for fire brigade hoses. Contractor shall provide for each internal fire hydrant station four numbers of 63 mm dia 7.5 meter long synthetic non perculating hose pipes with gunmetal male and female instantaneous type coupling machine wound with G.I. wire (Hose to I.S. 636 type B and couplings to I.S. 903 with I.S. certification), fire hose reel, gunmetal branch pipe with nozzle I.S. 903 fireman’s axe.

9.3 Each hose box shall be, after thorough cleaning of surface, painted as per Section 28 of General Technical Specifications. The words FIRE HOSE to be painted on the inner face of the glass.

10.0 FIRST AID HOSE REELS

10.1 Contractor shall provide standard fire hose reels with 20 mm dia high pressure rubber hose of 36 meters length with gunmetal nozzle with 5mm bore, and control valve, shut of nozzle connected wall mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall conform to IS: 884-1969. The hose reel shall be connected directly to the M.S pipe riser through an independent connection.

11.0 PRESSURE GAUGES

11.1 All pressure gauges shall be of dial type with bourdon tube element of SS 316. The gauge shall be of reputed make. The dial size shall be 150-mm dia and scale division shall be in metric units marked clearly in black on a white dial. The range of pressure gauge shall be 0 to 12 kg/sq.cm.

11.2 All pressure gauges shall be complete with isolation cock, nipples, tail pipes etc.

12.0 PRESSURE SWITCHES

12.1 The pressure switch shall be industrial type single pole double throw electric pressure switch designed for starting or stopping of equipment when the pressure in the system drops or exceeds the pre-set limits. It shall comprise of a single pole changeover switch, below element assembly and differential sprinkle.

12.2 All the pressure switches shall have 1/4” B.S.P (f) inlet connection and screwed cable entry for fixing cable gland.

12.3 The electric rating of the switch shall be as under:

<table>
<thead>
<tr>
<th>Type of supply</th>
<th>Voltage</th>
<th>Non-Inductive</th>
<th>Inductive</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.C.</td>
<td>110-380</td>
<td>10 Amp</td>
<td>6 Amp</td>
</tr>
<tr>
<td>D.C.</td>
<td>24-250</td>
<td>12 Watts</td>
<td>12 Watts</td>
</tr>
</tbody>
</table>

13.0 FIRE BRIGADE CONNECTION

13.1 The contractor shall provide as shown on drawing gunmetal four ways collecting head with 63mm dia instantaneous type inlets with built in check valve and 100/150 mm dia. Outlet connection to the fire main grid and for tank filling, collecting head shall conform to IS: 904-1964.

14.0 AIR VALVES

14.1 The contractor shall provide 25 mm dia screwed inlet cast iron single acting air valve on all high
points in the system or as shown on drawings.

14.0 DRAIN VALVE

50mm dia black steel pipe conforming to IS:1239 heavy class with 50mm gunmetal full way valve for draining and water in the system in low pockets.

Pressure gauge of suitable range shall be installed on the discharge side of each pump vacuum gauge shall be provided on suction side for pumps with negative suction. The dial size shall be 250mm. The gauges shall have brass cocks.

Orifice plates shall be of 6mm thick stainless steel to reduce pressure on individual hydrants to operating pressure of 3.5kg/sq.cm. Design of the same shall be given by the Contractor as per location and pressure condition of each hydrant.

15.0 VALVE CHAMBERS

15.1 Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand 10 graded stone aggregate 40 mm nominal size) 15 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling, complete.

15.2 Valve chamber shall be of the following size: For depths

130 cm and beyond 120x120 cms
Weight of C.I. frame and cover shall be 38 kg.

16.0 PIPE PROTECTION

See Clause 15.0 & 16.0 on ‘Painting’ and ‘Coating/wrapping’ under General Technical Specifications).

17.0 PIPE SUPPORTS

17.1 All pipes shall be adequately supported from ceiling or walls by means of anchor fasteners by drilling holes with electrical drill in an approved manner as recommended by manufacturer of the fasteners.

17.2 All supports/clamps fabricated from M.S. structural e.g. roads, channels, angles and flats shall be painted as described in specifications for “Painting” under General Technical Specifications.

17.3 Where inserts are not provided the contractor shall provide anchor fasteners. Anchor fasteners shall be fixed to walls and ceilings by drilling holes with electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

<table>
<thead>
<tr>
<th>Pipe Support Spacing</th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe upto 50 mm</td>
<td>2.00 Mtr</td>
<td>3 Mtr</td>
</tr>
<tr>
<td>Pipe 65 - 100 mm</td>
<td>1.75 Mtr</td>
<td>3 Mtr</td>
</tr>
<tr>
<td>Pipe above 100mm</td>
<td>1.50 Mtr</td>
<td>3 Mtr</td>
</tr>
</tbody>
</table>

18.0 AIR VESSEL AND AIR RELEASE VALVE

Air vessel on top of each wet riser piping shall be installed before execution for approval
fabricated out of at least 8mm thick steel to withstand the pressure, with dished ends and supporting legs. This shall be of 300 mm dia and 1m high. This shall be completed with necessary flange connection to the wet riser piping and air release valve with necessary piping to meet the functional requirement of the system. The air vessel shall be of continuous welded construction and galvanized to IS: 4736-1968. This shall be tested for twice the working pressure.

19.0 TESTING

1. All piping in the system shall be tested to a hydrostatic pressure of 11.0 kg/sq.cm without drop in pressure for at least 2 hours.

Rectify all leakages, make adjustments and reset as required and directed.

20.0 HOSE CABINETS

20.1 Provide doors/hose cabinets for internal/external hydrants respectively fabricated from 16 gauge M.S. sheet with double glass front door and locking arrangement, with breakable glass key access arrangement, duly painted red as per specifications given on page 12 para 28.8 fixed to wall/floor as per site conditions. The cabinet shall have a separate chamber to store a key with breakable glass as per approved design. Hose cabinets shall be hinged double door partially glazed with locking arrangement, painted as per Section 28 of General Technical Specifications with ‘FIRE HOSE’ written on it prominently. Samples of hose cabinet for indoor and outdoor works shall be got approved from HSCC before production/delivery at site.

20.2 For external hydrants the hose cabinets shall be fabricated from 16 gauge thick M.S. sheet with double shutter glass front door and locking arrangement with breakable glass key access arrangement. The cabinet shall have ‘FIRE HOSE’ written on it prominently. Sample of hose cabinet shall be got approved from the HSCC before installation at the site.

21.0 MEASUREMENT

21.1 Mild steel pipes shall be measured per linear meter of the finished length along the center line and shall include all fittings (including flanges), welding, jointing, clamps for fixing to walls or hangers, anchor fasteners and testing.

21.2 Butterfly valves, check valves and full way valves shall be measured by numbers and shall include all items necessary and required for fixing and as given in the specifications/schedule of quantities.

21.3 Landing valves hose cabinets, synthetic non-percuting fire hose pipes, First-aid fire hose reels (with gunmetal full way valves) and gunmetal branch pipes shall be measured by numbers and shall include all items necessary and required for fixing as given in the specifications/schedule of quantities.

21.4 Suction and delivery headers shall be measured per linear meter or finished length and shall include all items as given in the schedule of quantities.

21.5 Painting/wrapping/coating of headers, pipes shall be included in the rate for pipes and no separate payment shall be made.

21.6 Brick masonry chambers shall be measured by number and shall include all items as given in the schedule of quantities/specifications.

21.7 No additional payment shall be admissible for cutting holes or chases in walls or floors,
making connections to pumps, equipment and appliances.

1104 SPECIFICATIONS FOR SPRINKLER SYSTEM

1.0 SCOPE OF WORK

1.1 Work under this section shall consist or furnishing all labour, materials, equipment and appliances necessary and required to completely install the sprinkler system as required by the drawings and specified herein after or given in the schedule of quantities.

a) Sprinkler mains, branch and external piping complete with valves, alarm, hangers and appurtenances and painting.

b) Sprinkler heads with spare sprinklers

c) Connections to risers, pumps and appliances

2.0 GENERAL REQUIREMENTS

2.1 All materials shall be of the best quality conforming to specifications and subject to the approval of the engineer.

2.2 Pipes and fittings shall be fixed truly vertical horizontal or in slopes as required in neat workman like manner.

2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.

2.4 Pipes shall be supported from walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.

2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

2.6 Sprinkler heads shall be approved by the underwriters Laboratories (U.L.) or Fire officers Committee (FOC). The finish shall be as specified in the schedule of quantities. The contractor shall give required tools for removing and fixing of different types of sprinklers free of cost as directed by the HSCC.

3.0 SPRINKLER HEADS

a) Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly yoke and the deflector. The sprinklers shall be of approved make and type.

b) Types:

i) Conventional Pattern:

The sprinklers shall be designed to produce a spherical type of discharge with a portion of water being thrown upwards to the ceiling. The sprinklers shall be suitable for erection in upright position or pendant position.

ii) Spray Pattern:

The spray type sprinkler shall produce a hemispherical discharge below the plane of the deflector.
iii) Ceiling (flush) Pattern:

These shall be designed for use with concealed pipe work. These shall be installed pendant with plate or base flush to the ceiling with below the ceiling.

c) Constructions:

i) Bulb: - Bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches a predetermined level.

ii) Valve Assembly:- Water passage of the sprinkler shall be closed by a valve assembly of flexible construction. The valve assembly shall be held in position by the quartzoid bulb. The assembly be stable and shall withstand pressure surges or external vibration without displacement.

iii) Yoke: - The yoke shall be made of high quality gun metal. The arms of yoke shall be so designed as to avoid interference with discharge of water from the deflector. The sprinkler body shall be coated with an approved anti-corrosive treatment if the same is to be used in corrosive conditions.

iv) Deflector:- The deflector shall be suitable for either upright or pendent erection. The deflector shall be designed to give an even distribution of water over the area protected by each sprinkler.

d) Colour Code:

The following colour code shall be adopted for classification of sprinkler according to nominal temperature ratings:

e) Size of Sprinklers Orifices:

The following sizes of sprinklers shall be selected for various classes or hazards. Extra light hazard

<table>
<thead>
<tr>
<th>hazard</th>
<th>10/15 mm nominal bore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary light hazard</td>
<td>15 mm nominal bore</td>
</tr>
<tr>
<td>Extra high hazard</td>
<td>15/20 mm nominal bore</td>
</tr>
</tbody>
</table>

f) Stock of replacement sprinkler:

The following spare sprinklers shall be supplied along with the system: Extra high hazard systems

<table>
<thead>
<tr>
<th>hazard systems</th>
<th>6 sprinklers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary hazard systems</td>
<td>24 sprinklers</td>
</tr>
<tr>
<td>Extra high hazard systems</td>
<td>36 sprinklers</td>
</tr>
</tbody>
</table>

Temperature Rating:

For normal conditions in temperature climates rating of 68/74 deg. C shall be used. However the temperature rating shall be as closed as possible to, but not less than 30 deg. C above the highest anticipated temperature conditions.

4.0 Installation Control Valve:- Installation control valves shall comprise of the following:

a. One man stop valve of full way pattern with gunmetal pointer to indicate where open/shut.
b. One automatic alarm valve, fitted with handle and cover.

c. One hydraulic alarm motor and gong for sounding a continuous alarm upon outbreak of fire.

d. One combined waste and testing valve including 5mtr of tubing and fittings.

e. Alarm stop valve

f. Strainer

g. Drain plug

h. Padlock & strap

i. Wall box for installation of valve

5.0 Pressure Gauges: Burden type pressure gauges conforming to IS/BS specifications shall be provided at the following locations.

a. Just above alarm valve.

b. Just below alarm valve, on the installation stop valve. c.

One pressure gauge on delivery side of each pump.

d. Required number of pressure gauges on pressure tank.

6.0 INSTALLATION OF PIPING

A. Below ground piping: Under ground piping shall be installed in masonry trenches with cover or reinforced concrete. The pipe work shall be supported at regular intervals of 2.5m with masonry or RCC supports. Wherever pipes pass through roads/pavements suitable size hue pipes shall be provided for protection of piping. Underground pipes shall be protected against corrosion with two coats of bituminous painting and wrapped with tarfelt or similar covering. If the piping is to be buried in ground with back filling of earth, a coat of epoxy painting shall be given.

B. Above ground piping:

a. All above ground piping shall be installed on suitable to pipe hangers/supports as required. The hangers shall be made of MS angles, channels etc. and painted to the required finish (with suitable synthetic enamel Paint). The spacing of piping supports shall be as follows:

i) 20mm to 32mm dia 2 mtr

ii) 40mm to 65mm dia 2 mtr

iii) 65mm to 100mm dia 1.75 mtr

iv) above 150mm dia 1.50 mtr

b) Piping shall be so installed that the system can be thoroughly drained. All the pipes shall be arranged to drain to the installation drain valve. In case of basement and other areas where the pipe work, is below the installation drain valve/auxiliary valves of the following sizes shall be provided.

i) 20mm dia valve for pipes upto 50mm dia
ii) 25mm dia valve for 65mm dia pipes

iii) 32mm dia valves for pipes larger than 65mm dia

c) Piping shall be screwed type upto 50mm dia. Welding of joints will be allowed for pipes of 50mm of larger diameter). The piping shall be pressure tested by the hydrostatic method upto a pressure of 1.5 times the working pressure the piping shall be slowly charged with water so that all the air is expelled from the piping by providing a 25mm inlet with a stop cock. The piping shall be allowed to stand full of water for a period of 2 hours and then the piping shall be put under pressure by means of manually operated test pump or by a power driven test pump. The pressure gauges used for testing shall be accurate and shall preferably the calibrated before the testing is carried out. All the leakages and defects in joints revealed during the testing shall be rectified to the entire satisfaction of the Consultant. The system may be tested in sections parts as the work of erection of piping proceeds. The piping shall withstand 1.5 times the working pressure for at least 2 hours.

7.0 FLOW SWITCH

7.1 Provide one electrically operated flow switch of appropriate dia, at the head of each circuit. Flow switches should be capable of the required flow in the circuit. The electrical cabling for the flow switches and control panel shall be provided by the contractor.

8.0 PUMP SETS

Same as wet riser & Hydrant system specification.

9.0 ANNUNCIATION SPRINKLER PANEL

The equipment for control panel should be compact neatly wired and enclosed in a suitable 14 gauge M.S. sheet/16 CRCA sheet Metal Box which is suitably treated against corrosion. The control panel should be painted with over banked enamel paint. The panel shall consist of:

a) Panel should be made in a modules of 10 zones e.g. Each module will have audible and visual indications and will monitor the circuit conditions.

   A.C. Power Supply
   Fault and Fire indication lamp.
   Alarm acknowledgment push buttons.

b) The circuits provided in the control panel for each zone shall indicate the following conditions:

i) Open Circuit in zone wiring
ii) Short Circuit in zone wiring
iii) Normal conditions
iv) Power failure
v) Low battery

c) The Automatic annunciation panel shall suitable for operation on 24V DC and shall be provided with power supply unit suitable to operate on A.C. mains of 230V with a variation of 10%. The system shall be so designed that in case of failure of A.C. main supply it shall automatically change over to battery supply.

d) Suitable protection may be provided against charging of the battery over and above the specified values.
10.0 BATTERY UNIT

i) The system shall be powered by lead acid storage stationery complete with automatic
duel rate charger boost and trick operating from 220V, 50 Hz, single phase, mains supply.
The battery capacity should be adequate for operation of the system connected to it for at
least 24 hours in the non-alarm state followed by 30 minutes operation of all sounders and
other connected equipments after a power (mains) failure.

ii) The automatic charger should operate at the boost charge when the battery terminal voltage is less
than about 2.1V 20 per cell, and operate at a trickle charge rate of 100 to 200 HA, when the
battery terminal voltage exceeds about 2.25 per cell.

iii) The power unit should have the following:

a) Voltmeter 0-30 V

b) Ammeter of suitable range c)

Indicators lights for mains

d) Indicator lights for DC output

iv) The preferred nominal DC voltage shall be 24 V and shall preferably be isolated. (IF
an isolated supply is provided a line earthing indicator should also be provided).

v) The DC system and the detection and sounder circuits shall be protected against their
attaining a voltage to earth exceeding 50V.

vi) The connection to the 220V, 50Hz, single phase system shall be through a three pin plug
socket especially provided for the connection to the annunciation panel. This connection
should in addition utilized for earthing all non-current carrying metal parts of the sprinkler
system, except those that are either doubly insulated or mounted at a height exceeding 2.2
meters.

vii) The battery unit shall be housed in a steel cabinet with suitable mounting at least
2.5mm thick suitably painted with two coats of Post Office Red, Enamel necessary vent holes
should be provided for proper ventilation.

viii) One battery unit complete with battery charger shall be provided for each control panel.

11.0 TESTING

11.1 All pipes in the system shall be tested to a hydrostatic pressure of 11.0 kg/sq.cm without
drop in pressure for at least 2 hours. Rectify all leakages, make adjustments and retest as
required.

12.0 MEASUREMENT

12.1 Black steel pipes shall be measured per linear meter of the finished length and shall include all
fittings including flanges, welding, jointing clamps for fixing to walls or hangers and testing.

12.2 Butterfly valves, check valves and full way valve and flow indicating switches shall be measured
by numbers and shall include all items necessary and required for fixing as given in
specifications.

12.3 Cabinet and the spare sprinkler heads, with spanner etc. shall be measured as per actual item
given in the schedule of quantities.

12.4 Sprinkler heads shall be measured by numbers.

12.5 No additional payment shall be admissible for cutting holes, or chases in the wall or floors, making connections to pumps, equipment and appliances.

12.6 Painting and coating/wrapping of pipes shall be included in the rates for pipes and no extra payment shall be made.

10.00 FIRE FIGHTING SYSTEM

10.01 GENERAL

1.1 Work under this contract shall be executed as shown on the drawings and given in the specifications and required at site whether explicitly shown or not.

1.2 Not-with standing the sub-division of the documents into separate sections and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and in to the contract so far as it may be practicable to do so.

1.3 Where it is mentioned in the specifications that the contractor shall perform certain work or provide certain facilities, it is understood that the contractor shall do so without any extra cost to the Employer/HSCC.

1.4 The material, design and workmanship shall satisfy the local fire regulations. The job specifications contained herein and codes referred to where the job specifications stipulate in addition to these contained in the standard codes and specifications, these additional requirements shall also be satisfied.

1.5 Portable fire extinguisher shall be provided in the building as per BOQ which should not contain halogen to minimal the use of ozone depleting substance as per GRIHA.

2.0 SCOPE OF WORK

2.1 Work under this contract consist of furnishing labour, materials, equipment and appliances necessary and required to completely do all works relating to the fire protection system as described here-in-after and shown and the drawings, consisting of:

i) Supply, installation, testing and commissioning of:

Fire hydrant system including fire pumps and ancillary equipment described later in the Volume.

Fire sprinkler system, as described later in the volume. Portable

Fire Extinguishers

ii) Preparation of plans and getting pre-installation approval by the Local Fire Authority.

Getting tested by and approval of the installation by the Local Fire Authority during the fabrication/construction stage as well as after completion. It will be the responsibility of the Contractor to get all approval and completion certificate from the Local Fire Department
without which the work will not be taken over by the owner. Fee payable to the local bodies for such activities shall be borne by the Owner on production of receipts for money paid and the all other expenses barring the fee will be borne by the Contractor.

iv) Supply of necessary spare parts during the commissioning stage.

v) Supply of any other item or services not specifically mentioned anywhere but required by the Local Fire Authority or essential for the completion & operation.

3.0 INTERPRETATION

3.1 In interpretation of specifications, the following order of decreasing importance shall be followed:

a. Statutory Rules & Regulation
b. Schedule of quantities
c. Additional specifications
d. List of approved make of materials
e. General rules and conditions

3.2 Matters not covered by the specifications given in this contract, as a whole shall be covered by relevant and latest CPWD specifications / Indian Standard Codes. If such codes on a particular subject have not been framed, the decision of the engineer shall be final and binding.

4.0 SPECIFICATIONS

4.1 Work shall be carried out strictly in accordance with the specifications attached to the tender.

4.2 Works not covered in the specifications shall be carried out as per relevant latest CPWD specifications/ Indian standard Code of practice specifications of materials.

5.0 EXECUTION OF WORK

5.1 The work shall be carried out in conformity with the contract drawings and within the requirements of architectural, HVAC, plumbing, electrical, structural and other specialized services drawings.

6.0 TENDER DRAWINGS

6.1 For guidance of the bidder, drawings as listed are enclosed with these tender documents. These drawings are broadly indicative of the work to be carried out. The Contractor on award of work will furnish shop drawings based on the working drawings issued to him, as required in advance for approval of Engineer and get the same approved by Local Fire Authority/other statutory bodies. No claim whatsoever shall be admissible on account of changes that may be introduced by the Engineer/Local Fire Authority.

6.2 The Contractor shall examine all specifications, tender conditions and drawings before tendering for the work.

6.3 Information, levels and dimensions given in the tender drawings are supposed to be correct but the contractor shall make independent inquiries and verify the same. No claims for extras shall be admissible in case of any deviations for incorrectness of the information, levels or dimensions.
6.4 The contractor shall obtain all information relating to the local regulations, bylaws, and application of any and all laws relating to him work or profession. No additional claims shall be admissible on this account.

7.0 SHOP DRAWINGS

7.1 The Contractor shall prepare and furnish all shop drawings in quadruplicate at no extra cost for approval by the Engineer before commencing fabrication/manufacture of the equipment. Such shop drawings shall be based on the Architectural & Fire fighting drawings and requirements laid down in the specifications and as per site conditions. The manufacture of equipment shall be commenced only after the shop drawings are approved in writing by the Engineer. Such drawings shall be co-ordinated with all disciplines of work.

7.2 Contractor shall verify all dimensions at site and bring the notice of the HSCC any or all discrepancy or deviations notices. The decision of the HSCC in the regard shall be final.

7.3 Large size details and manufacturer’s dimensions for materials to be incorporated shall take precedence over small-scale drawings.

7.4 All drawings issued by the consultants for the work are the property of the Consultants and shall not be lent, reproduced or used on any other works than intended, without the written permission of the Consultants.

7.5 Working drawings shall be approved by the consultant. Four sets of shop drawings shall be submitted for approval showing:

a) Any change in layout from the contract drawings.

b) Equipment layout, piping, wiring diagram and instrumentation.

c) Manufacturer’s or contractor’s fabrication drawings for any material or equipment.

8.0 COMPLETION DRAWINGS

On completion of the work and before issuance of certificate of virtual completion, the Contractor shall submit to the Engineer. General layout drawings, drawn at approved scale indicating layout of pump house piping and its accessories “As installed”. These drawings shall in particular give the following:

a. General layout of pump house.

b. Panels and other equipment location and sizes etc.

c. Complete Schematic as installed.

d. Location of Hydrants, Earth pipes, route of earthing conductors etc.

e. Route of all cables and pipes run along with detail sizes and mode of installation.

9.0 DOCUMENTS

The Contractor shall submit to the Engineer, the following documents on completion of the work and before issuance of virtual completion.
i. Warranty for equipment installed.

ii. Test certificates.

iii. History sheets of the equipments.

iv. Catalogues.

v. Operation and Maintenance manuals.

vi. List of recommended spares and consumables.

vii. Reconciliation statement.

viii. All approvals and sanctions.

10.0 MATERIALS

10.1 All materials used on this work shall be new, conforming to the specifications.

10.2 Materials shall conform to the technical specification and/or the latest CPWD Specifications /Indian Standards Specifications as amended up to date and carry certification mark, wherever so required.

10.3 Only approved make of material shall be used. The contractor shall get the samples of all the items approved from the Engineer before commencing the supply.

11.0 TESTING OF MATERIALS

11.1 Contractor shall be required to produce manufacturer's test certificates for the particular batch of materials supplied to him. The test carried out shall be as per the relevant CPWD specifications/Indian Standards.

11.2 Any weights of sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost. The decision of the HSCC shall be final and binding on the contractor.

11.3 The Engineer shall have full power to get any material of work to be tested by an independent agency at Contractor's expense in order to prove the soundness and adequacy.

12.0 INSPECTION AND TESTING

12.1 All equipment shall be inspected and tested as per an agreed quality Assurance Plan before the same is packed and dispatched from the Contractor's Works. The Contractor shall carry out tests as specified/directed by Engineer.

12.2 Contractor shall perform all such tests as may be necessary to meet requirements of Local Authorities, Municipal or other statutory laws/ bye-laws in force. No extra shall be paid for these.

12.3 The Engineer may, at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing.

12.4 Approvals or passing of any inspection by the engineer or his authorized representative shall not, however, prejudice the right of the Engineer to reject the plan if it does not comply with the specification when erected or give complete satisfaction in service.

12.5 All materials and equipment found defective shall be replaced and the whole work again tested to meet the requirements of the specifications, at the cost of the contractor. Contractor has to obtain a performance certificate/approval for the complete layout of piping/equipment erected.

13.0 WELDING
The welding procedure, types of electrodes etc. shall be in accordance with the following IS specifications.

- Welding Procedures IS: 823
- Welding Electrodes IS: 814, but of approved makes only
- Testing of Welders IS: 817

13.2 Only Welders fulfilling the requirements of IS: 817 and approved by the HSCC shall be employed by the Contractor.

14.0 JOINING MATERIAL (GASKET)

Gasket, for use in between flanged joints, to be of CAF as per IS-2712, thickness as specified in S.O.Q.

15.0 PAINTING

15.1 All above ground pipes, pipe fittings, hose cabinets structural steel work pipe supports etc. shall be painted as per specifications given below.

15.2 Painting shall be done only after the completion of fabrication work and testing.

15.3 The instructions of paint manufacturer shall be followed as far as possible otherwise the work is to be done as directed by the HSCC.

15.4 All cleaning materials, brushes, tools and tackles, painting, material etc. shall be arranged by the Contractor at site in sufficient quantity.

15.5 All rust, dust shall scales, welding slag or any other foreign materials shall be removed fully so that a clean and dry surface is obtained prior to painting. Any other oily contamination shall be removed by use of a solvent prior to surface cleaning.

15.6 First coat of primer paint must be applied by brush on dry clean surface immediately or in any case within 3 hours of such cleaning.

15.7 Primer paints - one coat (minimum thickness 100 microns) self-priming epoxy mastic.

15.8 Finishing coats:

a) For Pump Rooms - 2 coats (thickness minimum 50 microns each) of epoxy paint, fire red shade as per IS: 4.

b) For other than Pump Rooms - 2 coats of synthetic enamel paint, fire red shade as per IS: 4.

16.0 COATING WRAPPING FOR UNDERGROUND PIPES

16.1 All underground piping shall be protected by coating and wrapping as per the following procedure.

16.2 The materials and workmanship shall in general conform to IS: 10221, 1982 or as directed by the HSCC.
16.3 Cleaning - The pipes shall be thoroughly cleaned by dust, rust will scales, oil, grease etc. by stiff wire brush and scrapers. The surface shall be coated with the primer immediately after cleaning.

16.4 Priming – Suitable primer shall be applied as an undercoat. The manufacturers recommended procedure would be followed for applying the primer.

16.5 Paste Application - Paste shall be applied to fill up uneven surfaces in order to ensure smoothness for subsequent wrapping with multi-layer tape.

16.6 Tape Wrapping - The tape is to wrap while the second coat of primer is still tacky. Winding is to be done with 50% overlap so that the total thickness of 2.0mm tape would become 4.0mm. It should be ensured while wrapping that air bubbles are not trapped. The ends of tape shall be secured with nylon binding to ensure that the tape doesn’t get loosened while handling.

16.7 The total thickness including 2 coats of primer, 50% overlap of tape etc. should not be less than 4.5mm or as per manufacturer recommendations.

16.8 The ‘Holiday Test’ is to be conducted as per IS: 10221 for detecting any entrapped air or any other defect. The Contractor is to arrange for the Holiday Test and to rectify the defects if found any.

17.0 TRAINING OF DEPARTMENT PERSONNEL

17.1 The Contractor shall train the Owner’s personnel to become proficient in operating the equipment installed. Training shall be done before the expiry of the defects liability period.

17.2 The period of training shall be adequate and mutually agreed upon by the Engineer and Contractor.

17.3 The Owner’s personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.

17.4 Nothing extra shall be paid to the Contractor for training Owner’s personnel.

18.0 PERFORMANCE GUARANTEE

At the close of the work and before issue of final certificate of virtual completion by the Engineer, the Contractor shall furnish a written guarantee indemnifying the Owner against defective materials and workmanship for a period of one year after completion and handing over. The Contractor shall hold himself fully responsible for reinstallation or replace free of cost to the Owner.

a. Any defective material or equipment supplied by the Contractor.

b. Any material or equipment supplied by the Owner which is proved to be damaged or destroyed as a result of defective workmanship by the Contractor.

TECHNICAL SPECIFICATIONS VARIABLE REFRIGERANT FLOW AIR-CONDITIONING SYSTEM

SCOPE OF WORK
The scope of this Section comprises the Supply, installation, testing and commissioning of Variable Refrigerant flow (VRF) system with DC Inverter based HSS Scroll Compressors and BLDC motor only. There shall not be any fixed speed compressor. The ODU shall be connectable to multiple indoor units as per specification. Outdoor unit shall be factory assembled weather proof casing constructed from heavy gauge mild steel panels & shall have all DC Inverter HSS Scroll Compressor in each module. The VRF manufacturer shall have Indian manufacturing facility as OEM and have government certified testing facility in Indian factory. VRF manufacturer must be OEM of its compressor which is fitted in the outdoor unit.

VARIABLE REFRIGERANT FLOW (VRF) SYSTEM

TYPE

Units should be DC Inverter Technology based Variable Frequency Driven VRF air-conditioners with air-cooled outdoor units, which shall be capable of cooling as per individual or season requirement suitable for operation on 380~415V, 3 Phase, 50 Hz AC electric supply. The outdoor units shall consist of one/multiple modules with single circuit of refrigerant piping and multiple indoor units of various types & capacities. Each indoor unit should have capability to cool independently for the requirement of particular area & also as per seasonal weather changes.

The indoor unit on any circuit can be different type & capacity and also controlled individually.

GENERAL

Indoor units & outdoor units shall be factory assembled, tested and filled with first charge of R 410A refrigerant only before delivering at site & should be suitable for operation on 380V- 415V, 3 Phase, 50 Hz AC electric supply for outdoor unit and 220 ~ 240 V, 1 Phase, 50 Hz for Indoor unit.(Except Floor standing or ceiling suspended AHU)

Units should be air cooled type, DC Inverter Technology based variable frequency driven VRF type air conditioner consisting of outdoor units and multiple indoor units, each suitable to cool in summer.

All proposed outdoor unit should have minimum COP of 3.9 & 5.5 at 100% & 50% load condition respectively for Cooling in standard AHRI test conditions.

The DC inverter technology based variable frequency driven VRF equipment should be capable enough, so that the refrigerant piping between indoor and outdoor unit shall be extendable up to 1000m with maximum height difference between outdoor & indoor unit of 110m & level difference between two indoor unit maximum up to 40m.

OUTDOOR UNIT

The outdoor unit shall be a factory assembled unit housed in a sturdy weather proof casing constructed form rust-proofed mild steel panels coated with a baked enamel finish. The unit should be completely factory wired tested with all necessary controls. It should be Air Cooled type with Top Air discharge.

The System must have the following features:

- It should also be provided with duty cycling for DC inverter scroll compressors capable of changing the rotating speed of compressor by DC inverter controller to follow variation in cooling loads.
- Each outdoor unit should consist of only Inverter Scroll Compressor.
- ODU units with constant compressor not acceptable.
- It should also be provided with duty cycling for multiple inverter compressor switching starting sequence for better stability and prolonging equipment life.
- All outdoor unit must have Pump-out and pump-in feature so that in case of failure, refrigerant can be accommodated in indoor and outdoor unit respectively.
- The unit shall be provided with its own microprocessor control panel.
- The outdoor unit must have the feature of Record running parameters of last 3 minutes before failure, for fault analysis & easy, faster trouble shooting.
- All outdoor unit must have the feature of auto recharging of refrigerant.
- All outdoor unit must have Anti Corrosive Fins in Condenser for better life.
- All outdoor unit should have Oil recovery system.
- VRF system must have high Pressure oil return mechanism to feed oil directly to compressor moving parts thru a mechanical pump to ensure reliability
- The machine must have a sub cooling feature so that it prevents the flashing of refrigerant from long piping due to this effect thereby achieving energy savings.
- All outdoor unit should have Auto Backup function.
- No deration of Outdoor unit up to 39 deg C
- PCB cooling system should be reliable to operate up to 50 deg ambient
- VRF system should have dual sensing technology for Temperature and Pressure
- Smart Load control for Power saving which makes auto adjustment of refrigerant flow thru Evaporator coil as per ambient condition and inside load variation
- Inbuilt safety for High Voltage, Low Voltage, Phase missing, Phase imbalance, Phase reversal etc
- VRF manufacturer must be OEM of its compressor which is fitted in the outdoor unit.

- Capable of operation up to 53 deg ambient.

**COMPRESSOR**

The compressor shall be of highly efficient hermetic HSS scroll type and equipped with DC INVERTER capable of variable frequency drive with capacity modulation

**HEAT EXCHANGER**

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil. The aluminum fins shall be covered by anti-corrosion resin film.

**REFRIGERANT CIRCUIT**

The refrigerant circuit shall include an accumulator, liquid and gas shut off valves and a solenoid valves. All necessary safety devices shall be provided to ensure the safety operation of the system.

**SAFETY DEVICES**

The following safety devices shall be part of the outdoor unit;
High Pressure Switch, Low Pressure Switch, Fan Motor Safety Thermostat, Inverter Overload Protector, Over Current Relay, Fusible Plugs, Fuses.

**OIL RECOVERY SYSTEM:**
Each unit shall be equipped, with an oil separator to ensure stable operation with long refrigerant piping.

**INDOOR UNIT:**

**GENERAL**
The Indoor unit shall be Ceiling suspended type or other as specified in BOQ.
These units should be suitable for operation on 220V-240V, Single Phase, 50 Hz AC electric supply.
These units shall have electronic control valves to control refrigerant flow rate in response to load variation in the room.

The address of IDU shall be set automatically in case of individual and group control.

**4 Way Cassette Type**
The IDU shall be basically a 4 Way Cassette unit suitable for Ceiling suspended type mounting arrangement. Each unit shall have Cooling coil, Blower, Filter, BLDC Motor, inbuilt drain pump and accessories. All the IDUs installed to have individual Cordless Remote controls.

Indoor unit shall have cleanable type filter to an integrally molded plastic frame. The filter shall be slide away type and neatly inserted.

It shall be possible to clean the filters either with compressed air or water.
The Cooling coil shall have Aluminum fins and copper tubes. The Fan section shall be dual suction, aerodynamically designed & balanced turbo, multi blade type blower to ensure low noise and vibration free operation and having multiple speed motor. The fan shall be direct driven type, mounted directly on motor shaft having support from housing. The Cassette units to have Automatic drain pump.

The noise level for these unit should not exceed 46db(A)±2.

<table>
<thead>
<tr>
<th>1</th>
<th>Supply of Ceiling Cassette type VRF Indoor units complete with electronic expansion valve, Blower section with BLDC fan motor, controls and insulated drain pan with inbuilt drain pump, cordless remote controller. The unit shall be capable of individual vane control function when used Wired remote controller.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>4 Way Cassette Type : 12300 BTU/Hr (1.02 TR)</td>
</tr>
<tr>
<td>1b</td>
<td>4 Way Cassette Type : 15400 BTU/Hr (1.28 TR)</td>
</tr>
<tr>
<td>1c</td>
<td>4 Way Cassette Type : 19100 BTU/Hr (1.59 TR)</td>
</tr>
<tr>
<td>1d</td>
<td>4 Way Cassette Type : 24200 BTU/Hr (2.02 TR)</td>
</tr>
<tr>
<td>1e</td>
<td>4 Way Cassette Type : 29000 BTU/Hr (2.5 TR)</td>
</tr>
<tr>
<td>1f</td>
<td>4 Way Cassette Type : 36200 BTU/Hr (3.02 TR)</td>
</tr>
<tr>
<td>1g</td>
<td>4 Way Cassette Type : 42000 BTU/Hr (3.5 TR)</td>
</tr>
<tr>
<td>1h</td>
<td>4 Way Cassette Type : 48100 BTU/Hr (4.01 TR)</td>
</tr>
</tbody>
</table>

**Hi Wall Mounted Unit**
The units shall be wall-mounted type. The unit includes pre filter, fan section & DX coil section.

<table>
<thead>
<tr>
<th>Supply of Wall Mounted type VRF Indoor units complete with electronic expansion valve, Blower section with BLDC fan motor, controls and insulated drain pan, cordless remote controller.</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Wall Type Type : 9600 BTU/Hr (0.80 TR)</td>
</tr>
</tbody>
</table>
Ceiling Mounted Ductable Type Unit
Unit shall be suitable for ceiling suspended type. The unit shall include pre filter, fan section & DX coil section. The housing of unit shall be light weight galvanized steel. The unit shall have high static fan for Ductable arrangement. Each Duct type indoor unit to be fitted with inbuilt drain pump.

Supply of Ceiling Concealed Duct type (High Static) VRF indoor units complete with electronic expansion valve, Blower section with BLDC fan motor, controls and insulated drain pan with inbuilt drain pump, corded remote controller.

Centralized Type Remote Controller
A multifunctional compact PC Based centralized controller shall be provided with the system.

The controller should be an advanced air-conditioning management system to give complete control of VRF air-conditioning Equipment; it should have ease of use for the user thru Internet explorer from distant location.

It shall be able to control up to minimum 256 indoor units with the following functions:-

- a) Starting/stopping of Air-conditioners as a zone or group or individual unit.
- b) Temperature settling for each indoor unit or zone.
- c) Switching between temperature control modes, switching of fan speed and direction of airflow, enabling/disabling of individual remote controller operation.
- d) Monitoring of operation status such as operation mode & temperature setting of individual indoor units, maintenance information, and troubleshooting information.
- e) Peak power control feature for energy efficiency.

VRF system man machine interface to communicate, control and monitor with all the units connected to VRF system equipment for remote monitoring with BACnet based BMS interface. It should be capable to control 256 indoor units of VRF system. It should be BTL certified (B-ASC)

BACnet BMS Compliant VRF CONTROL SYSTEM for all indoor & outdoor machines complete with PC, network and communication controller and cabling with the following features. The control system should be capable of “external device such as fire alarm, motion detector can be connected to gateway and their function can be interlinked with air conditioner operation using BACnet”. It should also offer function which allows the customer to efficiently control VRF system from customer's own PC.
Monitor & Control from the remote site by Web browser (Temp, Fan speed, ON/OFF, Model, Lock)

- Monitor error status
- Mode lock setting
- Web based access thru multi PC
- Upper and lower limit Temp setting

**Y-JOINTS**
Supply & installation of the imported Y-Joints separation refrigeration pipe joints and headers in the appropriate orientation to enable correct distribution of refrigerant. The distribution joints should be factory insulated with pre-formed section of Expended polystyrene/Equivalent.

**REFRIGERANT PIPING**

Refrigerant piping for the air-conditioning system shall be up to 19.1mm dia. of soft seamless copper tubes & for above 19.1 mm diameter the pipe material shall be of hard seamless copper tubes with pipes material being hard drawn copper pipe.

Before joining any copper pipe or fittings, its internals shall be thoroughly cleaned. The piping shall be continuously kept clean of dirt etc. while constructing the joints by bleeding nitrogen gas while brazing.

After completion of installation of the refrigerant piping, the piping system shall be pressure tested using nitrogen gas at a suitable pressure as specify by OEM (Original Equipment Manufacturer). Pressure shall be maintained in the system for 48 hours. The system shall then be evacuated to a vacuum of not less than 500 mm Hg and held for minimum 24 hours.

The suction line pipe size and the liquid line pipe sizes shall be selected according to the manufacturer’s specified diameter. All refrigerant pipes shall be properly supported and anchored to the building/structure using steel hangers, fastener, brackets and supports which shall be fixed to the building/structure by means of inserts or expansion shields or anchor fasteners of adequate size and number to support the load imposed thereon.

All exposed copper pipes have to be covered by 24 G GI sheet.

Entire liquid and suction refrigerant pipe lines including all fittings, valves and strainer bodies etc. Shall be insulated with 19mm/13 mm thick Nitrile rubber as specified in BOQ.

**Drain Piping**
PVC Condensate Drain Pipe with min 9 mm Nitrile rubber insulation duly supported and terminated at outlet

**Inspection and Testing**
The performance tests and COP test may be carried out at the factory premises before despatch in a NABL accredited Laboratory as per AHRI testing standards and procedures for Base model up to 20 HP.
The Contractor must submit the following Technical Data sheet during Technical Data Submission:

**VRF Outdoor Unit Technical Data Sheet:**

<table>
<thead>
<tr>
<th>Details of Technical Requirement</th>
<th>To be filled up by Bidder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bidder</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>Combination of Base Model (if Any)</td>
<td></td>
</tr>
<tr>
<td>Actual Cooling Capacity at 35 Deg C (KW)</td>
<td></td>
</tr>
<tr>
<td>Actual Cooling Capacity at 35 Deg C (HP)</td>
<td></td>
</tr>
<tr>
<td>Actual Cooling Capacity at 43 Deg C (KW)</td>
<td></td>
</tr>
<tr>
<td>Actual Cooling Capacity at 43 Deg C (HP)</td>
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<tr>
<td>Total Power Consumption at 43 Deg centigrade (KW)</td>
<td></td>
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<tr>
<td>type of Power Supply</td>
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</tr>
<tr>
<td>Overall Dimension (w x d x h in mm)</td>
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</tr>
<tr>
<td>net weight (kg)</td>
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<tr>
<td>type of Refrigerant</td>
<td></td>
</tr>
<tr>
<td>Pre charged refrigerant Qty (kg)</td>
<td></td>
</tr>
<tr>
<td>Number of Accumulator</td>
<td></td>
</tr>
<tr>
<td>Type of Expansion Valve</td>
<td></td>
</tr>
<tr>
<td>Type of Compressor</td>
<td></td>
</tr>
<tr>
<td>Make &amp; model number of individual compressor</td>
<td></td>
</tr>
<tr>
<td>Compressor quantity</td>
<td></td>
</tr>
<tr>
<td>Total Qty of Inverter Compressor- for individual model</td>
<td></td>
</tr>
<tr>
<td>Total Qty of Fixed Compressor- for individual model</td>
<td></td>
</tr>
<tr>
<td>cooling capacity of each compressors (kw)</td>
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</tr>
<tr>
<td>Input Power of Inverter Compressor motor (kw)</td>
<td></td>
</tr>
<tr>
<td>Input Power of Fixed Compressor motor (kw)</td>
<td></td>
</tr>
<tr>
<td>Type of Condenser coil</td>
<td></td>
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</tbody>
</table>
### VRF Indoor Unit Technical Data Sheet

**Details of Technical Requirement**

<table>
<thead>
<tr>
<th>To be filled up by Bidder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>Type of VRF Indoor</td>
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<tr>
<td>Nominal Cooling Capacity (KW)</td>
</tr>
<tr>
<td>Nominal Cooling Capacity (TR)</td>
</tr>
<tr>
<td>Input Power (KW)</td>
</tr>
<tr>
<td>Overall Dimension (w x d x h in mm)</td>
</tr>
<tr>
<td>net weight (kg)</td>
</tr>
<tr>
<td>sound pressure level (db)</td>
</tr>
<tr>
<td>Air Flow (CFM) in high / med / Low</td>
</tr>
<tr>
<td>External Static Pressure (Pa)</td>
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</table>

### COP Data to be furnished by Contractor:

<table>
<thead>
<tr>
<th>Base Model Number of OEM</th>
<th>Load conditions</th>
<th>35 deg C Outside temperature / 27 Deg C Inside Temperature</th>
<th>43 deg C Outside temperature / 27 Deg C Inside Temperature</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C- KW</td>
<td>P- KW</td>
</tr>
<tr>
<td>100%</td>
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<td></td>
</tr>
<tr>
<td>75%</td>
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<td>50%</td>
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<tr>
<td>25%</td>
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</tr>
</tbody>
</table>

* C- Kw : Cooling in KW unit  
** P- Kw : Power consumption in KW unit  
*** COP : Co-efficient of Performance = Cooling Capacity in KW / Power consumption in KW  
**** Bidder to Furnish individual COP as per above break up for individual Base model (if any) for a single module VRF Outdoor Unit
<table>
<thead>
<tr>
<th>Category</th>
<th>Approved Makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRF System</td>
<td>Bluestar, Daikin, Mitsubishi, Toshiba, LG, Samsung, Hitachi</td>
</tr>
<tr>
<td>Copper Y Joints and fittings</td>
<td>Daikin, LG, Samsung, Toshiba, Hitachi</td>
</tr>
<tr>
<td>AHU Type Indoor Units</td>
<td>Daikin, LG, Samsung, Toshiba, Hitachi</td>
</tr>
<tr>
<td>Ceiling Units</td>
<td>Bluestar, Daikin, Mitsubishi, Toshiba</td>
</tr>
<tr>
<td>Grilles &amp; Diffusers</td>
<td>Air master/Caryaire/Systemaire</td>
</tr>
<tr>
<td>Fire damper</td>
<td>Air master / Caryaire / Systemaire</td>
</tr>
<tr>
<td>Actuator</td>
<td>Belimo/Honeywell</td>
</tr>
<tr>
<td>GI sheets</td>
<td>SAIL/Nippon /Jindal</td>
</tr>
<tr>
<td>Ducts</td>
<td>Rolastar/Zeco/Camduct</td>
</tr>
<tr>
<td>Synthetic foam</td>
<td>A Flex/ Armatflex/ K flex</td>
</tr>
<tr>
<td>HDPE pipe</td>
<td>Finolex /Polyplast/Supreme</td>
</tr>
<tr>
<td>Cables</td>
<td>CCI, Gloster, Universal</td>
</tr>
<tr>
<td>Stabilizers</td>
<td>V Guard, Sinetek</td>
</tr>
<tr>
<td>Flexible ducts</td>
<td>Caryaire/Aeroflex/Superlon</td>
</tr>
<tr>
<td>Dampers</td>
<td>Air master/Trox/Ravistar</td>
</tr>
<tr>
<td>Thermostats</td>
<td>Johnson/Honeywell/Siemens</td>
</tr>
<tr>
<td>Control Cables</td>
<td>Finolex/Varsha</td>
</tr>
</tbody>
</table>