AN ISO 9001 & 14001 COMPANY

TENDER DOCUMENT

TENDER No: DLI / CON/ 710/ 520

FOR

‘Construction of balance work for 1st Phase (B+G+IV) of Administrative Building of New Town Kolkata Development Authority at Plot No. DG/13, Premises No.04-3333, Action Area – 1D, New Town, Kolkata.’

VOLUME – II

ADDITIONAL CONDITIONS OF CONTRACT, TECHNICAL SPECIFICATIONS & DRAWINGS
ADDITIONAL CONDITIONS OF CONTRACT (ACC)

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

2.0 INTRODUCTION

New Town Kolkata Development Authority, has undertaken the construction of Administrative Building, at Plot No. DG/13, AA-1D Premises No. 04-3333, Action Area – 1D, New Town Kolkata.

New Town Kolkata Development Authority (NKDA) is developing their own office in the heart of this township which is eventually become a multiple/corporation office. The Authority has a dream that this multifunctional city will get a unique landmark building as its office with good aesthetics, which will enhance urbanscape.

In addition to providing of office facilities along with Auditorium, Conference room & Cafeteria, the building will also have landscaping features like fountain, water bodies, terrace garden etc. Internal roads & pathway area lighting will be of standard with good architectural views. Within the project area there will also be security & management staff room.

3.0 Description of the Project:

- The project site is located at Premises no: 04-3333, DG-13, Action area-1D, New Town, Kolkata
- The area of the plot is approximately 7001.888 Sq.m.
- Total Built up Area is 14009.016 Sq.m. The first phase built up area is 9619.269 Sq.m.
- Proposed FAR to be consumed is 2.001. The first phase FAR will be 1.37
- Proposed Ground Coverage is 19.71%.

4.0 Scope of Work:

The brief scope of work as mentioned below included in this tender shall include (but not limited to) Civil, Electrical, Sanitary, Plumbing, ACP cladding, HT substation, landscaping, Horticulture work etc. for “Construction of Balance Work for 1st Phase (B+G+IV) of Administrative Building of New Town Kolkata Development Authority at Plot No. DG/13, Premises No.04-3333, Action Area – 1D, New Town Kolkata”. Major piling work of the said project is already executed.

Apart from above, any other services not covered above but required as per direction of EPI are deemed to be included in the scope of work. The work is to be carried out on item rate basis as per bill of quantities and tender conditions.

The major buildings/ spaces to be covered (with all services) under design scope are as follows:

A. Buildings/ Structures:

a) Reception lounge.
b) Workstations.
c) Conference room.
d) Bank facilities.
e) Auditorium
f) Archive.
g) Cafeteria
h) Gymnasium.
i) Kitchen and pantry.
j) Toilet Block (Ladies & Gents)
k) Security & Manager 's Office
l) Security Block
m) Electrical Substation
n) Pump room.
o) UG & OH water tank

B. Outdoor Areas:

a) Boundary Wall & Gate
b) Roads, & Pathways
c) Grass paver / Green Areas
d) Planter box
e) Fountains
f) Water bodies
g) Infrastructural Services

The scope of services include construction of the above with site grading and landscaping as well as all infrastructural facilities like water supply, sanitary & plumbing, electrical etc.

5.0 QUALIFICATION OF TENDERERS

To be eligible for this tender the bidders should fulfill the requirements for eligibility as mentioned in the Notice Inviting Tender (NIT) and should submit detailed data and credentials set out in Cl 19.0 of ITT (Vol-I) of the Tender. The Tenderers are required to fulfill all the eligibility criteria as stipulated in NIT and elsewhere in the Tender documents. The price bid of tenderers who fulfill the eligibility criteria as per evaluation of EPI shall only be opened. The decision of EPI in this regard shall be final & binding on the tenderers.

The set of tender document shall contain one set of hard copy of tender drawings the original hard copy of tender drawing shall be returned alongwith the tender document duly signed and stamped by the tenderer and shall form part of agreement.

The tenderer who have downloaded the tender documents and drawings from EPI’s website shall also submit one set of hard copy of tender documents along with set of tender drawings duly signed and stamped by the tenderer and shall form part of agreement.

6.0 DISQUALIFICATION

The tenderers may note that they are liable to be disqualified and not considered for the opening of Price Bid if;
a) Representation in the forms, statements and attachments submitted in the pre-qualification document are proved to be incorrect, false and misleading.

b) They have record of poor performance during the past 10 (ten) years such as abandoning the work, rescinding of contract for which the reasons are attributable to the non-performance of the contractor, inordinate delay in completion, consistent history of litigation / arbitration awarded against the contractor or any of its constituents or financial failures due to bankruptcy etc. in their ongoing / past projects.

c) They have submitted incompletely filled in formats without attaching certified supporting documents and credentials to establish their eligibility to participate in the Tender.

d) If the tenderers attempt to influence any member of the selection committee.

EPI reserves its right to take appropriate action including disqualification of tenderer(s) as may be deemed fit and proper by EPI at any time without giving any notice to the contractor in this regard. The decision of EPI in the matter of disqualification shall be final and binding on the Tenderers.

7.0 SPECIFICATIONS

i) All works are to be carried out in accordance with the General Conditions and Specifications including mode of measurement of State P.W.D Schedules in force at the time of acceptance of the tender.

ii) The specification for work not covered by the specifications laid down in the PWD (WB) Schedules, DSR or Schedule of MES, CPWD shall be followed.

iii) Items of Works not covered in the above schedules should be governed by I.S.I code of Practice, National Building Code, Technical specifications as laid in this tender document, and as per best practice according to the Engineer-in-Charge and the Consultant.

iv) In addition to the above, the Technical specifications as mentioned in the Tender documents shall be applicable.

v) This contract shall be governed by the Indian Laws for the time being in force. The contract is confidential and must be strictly confined to the purposes of the contract.

vi) The contractor shall provide everything necessary for the proper execution of the works according to the intent and meaning of the specifications and drawings taken together whether the same may or may not be particularly shown or described therein provided that the same can be reasonably be inferred there from and if the contractor finds any discrepancy in the specifications & drawings and between the drawings, he shall immediately and in writing refer the same to the employer who shall decide which is to be followed.

vii) The work order/LOI will be issued by EPI and handing over of the site and date of commencement of the contract shall be within 10 (ten) days of issue of such letter.

8.0 PRICE ESCALATION

No price escalation is payable.
9.0 MOBILIZATION ADVANCE – Clause no. 8.0 (8.1 – 8.6) of General Conditions of Contract (GCC) stands deleted.

10.0 RETENTION MONEY - Clause no. 10.0 of GCC shall be modified as under:-

The retention money shall be deducted from each running bill of the Contractor at 8% (Eight Percent Only) of the gross value of the Running Account. The Earnest Money Deposited by the tenderer in the form of Demand Draft will be treated as part of the Retention Money. The Retention Money shall be refunded to the Contractor after expiry of defects liability period or on payment of the amount of the final bill whichever is later.

11.0 TAXES AND DUTIES – Sub-clause no. 13.1 of Clause 13.0 of GCC shall be modified as under. Sub-clauses no. 13.2, 13.3, 13.4 & 13.5 of clause no.13.0 stand good.

“The contractor shall be responsible for the payment, wherever payable, at his own cost of all taxes such as excise duty, custom duty, sales tax, including the purchase tax, consignment tax, work contract tax, service tax, VAT or any other similar tax in the state concerned, turnover tax, toll tax, octroi charges, royalty, cess, labour cess, professional taxes, levy and other tax (es) or duty (ies) which may be specified by Local / State / Central Government from time to time on all materials, articles which may be used for this work. The rates quoted by him in the Tender in Bill of Quantities shall be inclusive of all such taxes, duties, etc. The imposition of any new and / or increase in the aforesaid taxes, duties, levies (including fresh imposition of work contract tax, turnover tax, sales tax on work contract, VAT or any other similar tax) etc. during the currency of the contract shall be borne by contractor and shall not be paid or reimbursed to the contractor by EPI. In the event of non-payment / default in payment of any octroi, royalty, cess, labour cess, professional taxes, turnover tax, sales tax, including the purchase tax, consignment tax, work contract tax, VAT or any other similar tax in the state concerned, customs, excise or any other levy / tax including labour dues etc. by contractor, EPI reserves the right to with-hold the dues / payments of contractor and make payment to Local / State / Central Government authorities or to labourers as may be applicable. The contractor should submit along with the Tender Registration Certificates with Sales Tax on works contract authority etc. otherwise appropriate recovery shall be made from his bills”.

Income tax and vat will be deducted as per govt. order issued from time to time and would be applicable on the date of making payment of the bills. Building and other construction workers cess @1% will be deducted from the progressive bill in pursuance with GO no. 599A/4M-28/06 dated 27.09.2006

12.0 SECURED ADVANCE AGAINST NON-PERISHABLE MATERIALS – Clause no. 35.0 of GCC stands deleted.

13.0 EXTRA OR DEVIATION ITEMS

To be derived from PWD (WB) current schedule of rates or DSR or MES or item rate analysis. If not possible, derived as cost as per market analysis. After the rates approved by client, EPI will keep margin of 7% and pay 93% of the approved cost.
14.0 COMPLETION AND TAKING OVER

As soon as the project is finally completed, the Contractor shall inform EPI and EPI shall in turn inform to NKDA. NKDA shall nominate a Board of Officers for checking/ verification of completed work as per the scope of work for final taking over the project.

15.0 A final certificate of rectification of all defects pointed out by the handing over taking over board detailed by NKDA/EPI and / or during defect liability period shall be obtained from the nominated officer of NKDA/EPI prior to releasing of the Security deposit by EPI.

16.0 Clause No. 72.4.1 of GCC stands modified as under:

Within 10 (Ten) days of date of Letter of Intent, the contractor shall submit a Time and Progress Chart (CPM/PERT/Quantified Bar Chart) and get it approved by the Engineer-in-Charge. The Chart shall be prepared in direct relation to the time stated in the contract documents for completion of items / scope of the works. It shall indicate the forecast (milestones) 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 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 compensation for delay as per clause 72.1 (revised as per ACC) shall be leviable at intermediate stages also, in case the required progress is not achieved to meet the time deadlines of the completion period and / or milestones of time and progress chart provided always that the total amount of compensation for delay to be paid under this condition shall not exceed 10% of the tendered value of work.

In case entire work is completed within the total time period of completion or extended period of completion allowed, the compensation for delay due to not achieving progress at intermediates stage, if any, shall be refunded without any interest charges.

17.0 COMPLETION SCHEDULE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Period from the date of Start</th>
<th>Cumulative value as a percentage of total value of work to be completed.</th>
<th>Description of work to be completed during the period specified under column no. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>From the date of start up to the end of 2nd month</td>
<td>10%</td>
<td>Completion of foundation upto grade beam level.</td>
</tr>
<tr>
<td>2</td>
<td>From the start of 3rd month up to the end of 8th month</td>
<td>55%</td>
<td>Completion of Structure of all buildings.</td>
</tr>
<tr>
<td>3</td>
<td>From the start of 9th month to end of 10th month</td>
<td>75%</td>
<td>Completion of 50% flooring, plastering, internal services of electrical, plumbing &amp; start of other services like fire fighting, lift, HVAC etc.</td>
</tr>
</tbody>
</table>
4. From the start of 11th month to end of 11th month
90% Completion of all civil, finishing, electrical, plumbing & other services like fire fighting, lift, HVAC etc.

5. From the start of 12th month to end of 12th month
100% Completion of all works including fittings and fixtures, testing and handing over of buildings & external development works.

**Note:** In case of mismatch in financial and physical progress as at col. No. 3 & 4, above at any milestone stage, the financial progress shall be considered for levy of compensation of delay, if any. All infrastructural development works shall be completed within the stipulated time frame.

### 18.0 PLANT & MACHINERY

All plant & machinery required for execution of work shall have to be arranged by the contractor at his own cost. However, the Contractor has to deploy following minimum plant & machinery at site immediately after award of work:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Minimum numbers required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Batching Plant of suitable capacity for concreting</td>
<td>One</td>
</tr>
<tr>
<td>2.</td>
<td>Digital theodolite &amp; auto level</td>
<td>Two</td>
</tr>
<tr>
<td>3.</td>
<td>Leveling Instruments</td>
<td>Two</td>
</tr>
<tr>
<td>4.</td>
<td>Vibrators (Petrol / Electrical)</td>
<td>Ten</td>
</tr>
<tr>
<td>5.</td>
<td>Needles of Vibrator</td>
<td>Sixteen</td>
</tr>
<tr>
<td>6.</td>
<td>Weigh Batch Concrete Mixers</td>
<td>Six</td>
</tr>
<tr>
<td>7.</td>
<td>DG Set (125 KVA)</td>
<td>Two</td>
</tr>
<tr>
<td>8.</td>
<td>Loader cum excavator</td>
<td>Two</td>
</tr>
<tr>
<td>9.</td>
<td>Tripper/Dumper</td>
<td>Four</td>
</tr>
<tr>
<td>10.</td>
<td>Builder hoist</td>
<td>Two</td>
</tr>
<tr>
<td>11.</td>
<td>Scaffolding &amp; Shuttering materials (Steel)</td>
<td>6000 Sqm</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.

### 19.0

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 stage wise payment schedule.
c) No claim certificate by the contactor.
d) No claim certificate from the sub-agencies / venders engaged by the contractor.
e) ‘As built’ drawings.
f) Periodical services and measurement books.
g) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc.
h) All operation and maintenance manuals.
i) 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.
j) Manufacture’s guarantee of various machines / equipments installed as part of works.

20.0 Clause no. 45.1 of GCC stands modified as under:

EPI shall procure the cement from approved make of client and recovery shall be on actual basis plus 3% towards EPI charges. The cement shall be stored by the successful bidder in suitable cover and lockable stores well protected from climate and atmospheric effect. The cement godown shall be constructed by successful bidder as per CPWD specifications at his own cost. The cement will remain under double lock one from EPI and other from the bidder the cement in bags shall be stored in godowns in easy countable positions. Cement bags shall be used on first in first out basis. Cement stored beyond 90 days will be required to be tested at bidders cost before use in works.

21.0 Clause no. 45.2 of GCC stands modified as under:

EPI shall procure the steel form approved make of client and recovery shall be on actual plus 3% towards EPI charges. The steel shall be stored and stacked in such manner so as to facilitate easy identification, removal etc. The successful bidder shall take proper care to prevent direct contact between the steel and the ground/ water for which he shall provide necessary arrangement at his own cost including ensuring proper drainage of area to prevent water logging as per directions of the E-I-C. If required, the steel shall also be protected, by applying a coat of neat cement slurry over the bars for which no extra payment shall be made.

22.0 FACILITIES

The sub-clause 28.3 of the clause no. 28 of General Conditions of Contract (GCC) for Furnished Office Accommodation & Mobility and Communication to be Provided by Contractor to EPI shall be replaced and read as under:-

The contractor shall make his rates in Bill of Quantities sufficiently comprehensive to cover the cost of the facilities as per details shown below and the contractor shall not be entitled for any extra payment for the same.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. OFFICE WITH FACILITIES – The contractor is to provide office with following facilities till defect liability period.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A) OFFICE ACCOMMODATION</strong></td>
<td>Sq. ft.</td>
<td>1500</td>
</tr>
<tr>
<td>Furnished Office/ Office cum Residential accommodation with furniture as per direction of EPI with basic amenities like toilets, drinking water arrangement, lights, fans etc. for exclusive use of EPI’s Engineers &amp;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Staff. Maintenance of the same till Defect Liability Period shall be borne by the contractor. The Specifications and Design of accommodation shall be as approved by EPI.

### B) OFFICE EQUIPMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Computer (Pentium-IV, i7, i5 Core2 Duo) with minimum 250GB HDD along with UPS &amp; Operator. (In case computer operator is not provided by the contractor, recovery of Rs. 8000/- per month shall be made from the Contractor’s bill in this regard) and latest Version of Software’s like MS Project, Windows, MS Office, AutoCAD etc.</td>
<td>Nos. 1</td>
</tr>
<tr>
<td>b) Laser Printer or any other Printer of equivalent amount. All-in-one printer (Fax, Print, Scan, Copy)</td>
<td>Nos. 1</td>
</tr>
<tr>
<td>c) Refrigerator (165 Ltrs) or any other gadget of equivalent cost as decided by EPI.</td>
<td>Nos. 1</td>
</tr>
<tr>
<td>d) Aqua Guard (Drinking water) or any other gadget of equivalent cost as decided by EPI</td>
<td>Nos. 1</td>
</tr>
<tr>
<td>e) Air Conditioner with Cooling &amp; Heating (1.5 Ton Capacity)</td>
<td>No. 1</td>
</tr>
<tr>
<td>f) Digital Camera</td>
<td>No. 1</td>
</tr>
<tr>
<td>g) Photocopy machine (A3-Laser Printer + A3-Digital copier + Scanner + Network)</td>
<td>No. 1</td>
</tr>
</tbody>
</table>

Running & maintenance of the equipments mentioned above are to be done by the contractor at his own cost.

### C) CONSUMABLES

All consumables like Stationary, Toner / ink etc. shall be provided by Tenderer till end of defect liability period. (Stationary items are inclusive of visiting cards, rubber stamps, letter pads, photocopy papers & other items of daily office use). Amount shall be restricted to Rs. 5000/- per month.

### D) CONVEYANCE AND OTHER FACILITIES

Vehicle (Brand New) Four wheel drive Scorpio DX vehicle or equivalent with Driver and accessories valuing Rs. 30,000/- each vehicle. Monthly running shall be restricted to 3000 Kms each.

### E) TELEPHONE WITH STD & INTERNET FACILITIES AND INSTRUMENTS

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Mobile Phone</td>
<td>Nos. 3</td>
</tr>
</tbody>
</table>

Monthly operational expenditure on account of all telephones/Internet facility shall be restricted to Rs. 4000 per month.

The cost of each Mobile Phone instrument shall be restricted to Rs. 6,000/-

Office Boy Cum-Cook on full time basis for EPI | Nos. 1    |

The vehicle shall be brand new and shall be provided with driver on full time basis. Consumables like diesel/petrol/oil lubricants and spare parts etc. shall be provided by the Tenderer at their cost. The vehicles shall be maintained in good working condition. In case of breakdown, replacement of vehicle shall be provided by Tenderer. Registration, transportation etc. shall be borne by the Tenderer. In case a vehicle is not required by EPI, a recovery of Rs. 50,000/- (Rupees Fifty thousand Only) per month per vehicle shall be made from the Tenderer for this purpose till the end of defect liability period.
In case Driver, POL, maintenance of any vehicle is not required by EPI, a recovery of Rs. 20,000.00 per month per vehicle shall be made from the Tenderer for this purpose till the end of defect liability period.

The above gadgets facilities should be brand new and of reputed make and all facilities shall be provided and maintained properly (including payment of water & electricity bills etc. for office accommodation only) by the Tenderer at Project site or at any other office related with execution of this project till completion of work, handing over, defect liability period in all respect at his own cost. The Tenderer shall also make stand-by arrangement for water & electricity to ensure uninterrupted supply.

The equipment/items shall be the property of Tenderer at the end of contract. The Tenderer shall be responsible for watch and ward of site office and other facilities etc. In case of theft/damage of any equipment/items, the Tenderer shall immediately replace the same within a maximum period of two days.

The Tenderer shall provide 'Sign Board(s)' as per design approved by EPI and/or Client.

In case the above facilities are not provided by the Tenderer within 10 (ten) days of award of work or replacement is not provided within the specified period, EPI shall arrange the same at the risk and cost of the PARTY and make the recoveries from the bills of the Tenderer for the same. The decision of EPI shall be final and binding on the Tenderer in this regard.

23.0 SITE LABORATORY & OFFICE FOR EMPLOYER (NKDA)

1. A waterproof and air-conditioned, lockable, office-accommodation for EMPLOYER (NKDA) consisting of two (2) rooms each of approx. 15 sq. meters shall be constructed by the successful bidder. These offices shall be provided with all sanitary, water supply and electrical services and shall be kept in clean and tidy conditions. Necessary display boards, office furniture, almirahs and telephone facilities will be provided therein, all at bidder’s cost till defect liability period.

2. The Display Boards for the Project shall be supplied and erected as per given sizes, specifications and descriptions and at specified locations, as approved by EMPLOYER/EPI.

3. A field Laboratory will be established in a room of suitable size equipped with the following, with adequate labour and materials required for carrying out tests therein:

   (i) Set of standard sieves for testing grading of sand and a 75 micron sieve for testing silt content.
   (ii) Sieves with openings respectively of 5mm, 10mm, and 20mm for testing grading of aggregates.
   (iii) Balance of capacity 10 Kg reading to 5 gm, with weights.
   (iv) Primus stove and pans for drying of sand and aggregates.
   (v) Glass measuring flasks of 1/2 and 1 litre capacity
   (vi) Flask for determining moisture content of sand.
   (vii) Slump cone for slump test.
   (viii) Minimum 24 steel moulds for 150 x 150 mm test cubes. It may be necessary to provide more steel cube moulds depending upon concreting programmed.
(ix) Work benches, shelves, desks, sinks and any other furniture and lighting as required by the ENGINEER-IN-CHARGE.
(x) Cube testing machine.
(xi) Any other equipment not specifically mentioned above which can reasonably be held necessary for the completion of the contract works to the satisfaction of the ENGINEER-IN-CHARGE. NOTE: The requisite tests shall be conducted in field Laboratory as per P.W.D. Specifications and other related I.S. Codes. All such tests shall be conducted in presence of the ENGINEER-IN-CHARGE and the proper Test Records shall be maintained by CONTRACTOR with the attestations by the ENGINEER-IN-CHARGE. The CONTRACTOR shall bear all expenses for installing, running and maintenance of this Field Laboratory.

24.0 The Tenderer must understand that the items marked in schedule of work are actual items to be executed. Alteration, omission, deduction or addition from / to these items is at the discretion of the employer without effecting the terms of the contract. The rates have to be quoted on the basis of percentage (%) above, below or at par on the estimated value of the work.

25.0 ENVIRONMENTAL CONSIDERATIONS

The Contractor shall be concerned with the impact of his work upon the Environment. This applies to the effect upon the residential community, adjacent industrial facilities and upon the area outside the site boundary. Areas of concern will include but are not limited to:

a) Use of clean fuels to minimize air polluting emissions.
b) Control of other air pollutants.
c) Recovery and recycling of usable materials.
d) Control of vehicle noise
e) Control of noise from power facilities.
f) Limitation of vibrations.
g) Preservation of natural land to the extent possible.
h) Preservation of archaeological features.

26.0 Financing/ Bank charges for guarantees furnished/to be furnished to NKDA by EPI which have to be paid for the entire contract as a whole shall be borne by the contractor.

27.0 Custody of Drawings

All the approved Drawings shall remain in the sole custody of the Engineer-in-Charge but two copies thereof shall be furnished to the Contractor free of charge. The Contractor shall provide and make at his own expenses any further copies required by him. At the completion of Contract the Contractor shall return to the Engineer-in-Charge all drawings provided under the Contract.

One copy of the Drawings, furnished to the Contractor as aforesaid, shall be kept by him on the site and the same shall at all reasonable times be available for inspection and use by the Engineer-in-Charge and his Representatives and by any other person authorised by the Engineer-in-Charge.
28.0 Disruption of Progress

The Contractor shall give written notice to the Engineer-in-Charge on progress of the works likely to be delayed or disrupted unless any further approval of drawing or order, including a direction, instruction or approval, is issued by the Engineer-in-Charge within a reasonable time. The notice shall include details of the drawing or order required and of why and by whom it is required and of any delay or disruption likely to be suffered if it is late.

29.0 Delays and Cost of Delay for Drawings

If, by reason of any failure or inability of the Engineer-in-Charge to issue within a time reasonable in all the circumstances any approval of drawing or order requested by the Contractor in accordance with clause (6) of this section, the work remains suspended or delayed then the Contractor shall be granted necessary extension of time only. But he shall have no claim to extra payment or compensation whatsoever on the grounds of above delay.

30.0 Delay in Getting Site of Work

If at any time after the issue of work order, the work, and/or any part thereof cannot be started or shall remain suspended due to public opposition, non-availability of site, delay in shifting public utilities or for any other reason whatsoever within the period of completion of work, the Contractor shall be granted necessary extension of time. But he shall have no claim to extra payment or compensation whatsoever on the grounds of above delay.

If, however, the above hindrances are not removed within the schedule time and the Contractor is not agreeable to execute further works in the extended time, the Contract may be terminated and the Contractor shall have no claim to any payment on account of idle labour, establishment etc. or compensation whatsoever on account of any profit or advantage which he might have derived from the execution of the aforesaid work in full or in part.

31.0 Survey : Layout and Access

The Contractor shall satisfy himself regarding the correctness of the site Layouts, levels etc. as shown in the drawings or given in the specifications. Before starting the work he shall also carry out at his own cost survey of the whole work site jointly with the Department. Discrepancies noticed between Departmental drawing and the joint survey shall be informed in writing to the Engineer-in-Charge and got corrected by the Engineer-in-Charge. Such deviations as may arise out of the joint survey shall not vitiate the provisions of contracts and shall not entitle the Contractor to any extra payment of claim in any way.

After the joint survey a survey plan shall be prepared by the Contractor at his cost and got approved by the Engineer-in-Charge. Reference line and points shall be established by the Contractor at his own cost so as to serve as reference and “Dimensional Checking” of works. He shall prepare and submit a plan in quadruplicate to the E.I.C. showing such reference points with their full description at his cost.

The Contractor shall provide for all arrangements labour, equipments and materials needed for carrying out survey, setting out, layout checking, inspections measurements, testing at his own cost for which no separate payment will be made.
The Contractor shall also provide proper approach and access to all the works and stores including clearance of sites at his own cost.

32.0 Arrangement of Land

If on account of restriction of space within the project site, the Contractor experiences difficulties (on installation of plant and machinery and also) in stacking construction materials within the project site, he may have to arrange for lands (Road side flank, private land etc.) adjacent to the project site on his own and at his cost. The Contractor will not be entitled to any payment or any other incidental charges caused due to such arrangement.

33.0 Fire Fighting Arrangement

The Contractor shall provide at his own cost suitable arrangement for fire fighting. For this purpose he shall provide requisite number of Fire Extinguishers and adequate number of buckets, some of which are to be always filled with sand and some with water. These equipments shall be provided at suitable prominent and easily accessible places and shall be properly maintained.

34.0 Terms & Stages of Payment

The Contractor is entitled to prepare and submit the running account bill before EPI, when work done value is more than Rs 1.50 Crore (Rupees One Crore and Fifty Lakh only).

35.0 Reduced Rates and Part Rates

35.1 Reduced rates as decided by the E.I.C. shall be allowed for the works, which in the opinion of the E.I.C. are not done in strict conformity with specification and schedule of works but are acceptable. The relevant item rates in such cases shall be reduced and approved by the Tender Accepting Authority, on the basis of analysis, which shall be binding to the contractor.

Works which are not in conformity with the specification and not acceptable in the opinion of E.I.C. will not be paid for and the cost of rectification or dismantling of such unacceptable work will have to be fully and solely borne by the Contractor.

35.2 Part payments for items, which are not fully complete as per specification of the contract, may be made by EPI/NKDA in cases when it is ensured that the items can be completed as per specification, in following days, by the contractor, when so allowed by the E-I-C. Application of this provision shall be very restricted and can only be exercised under specific case wise approval of the E-I-C strictly.

36.0 Time of Completion

The entire work as per offer shall be completed within 12 (twelve) months from the date of issue of work order. The time of completion is firm and final and supersedes any other time mentioned elsewhere in any clause(s) of tender document.

The period of completion given includes the time required for mobilization and testing as well,
rectifications, if any, re-testing and completion in all respects to the entire satisfaction of the Engineer-in-Charge including the monsoon season.

The Contractor shall scrupulously adhere to the targets/program as envisaged in his micro-plan of work program by deploying adequate personnel and construction tools and tackles and he shall also supply all materials of his scope of supply in time to achieve the targets set out.

The Contractor shall give every day a report on category-wise labour and equipment deployed along with the progress of work done on previous day. The progress of work shall be proportionate to completion time.

Time is the essence of this contract and the allotted work must be completed within the specified time. Extension of time may be granted in very exceptional circumstances if the work gets delayed due to the reasons beyond the control of the successful bidder. This clause of extension of time will have precedence over any other similar clauses if they are at variance with this clause. There will be penalty for non-completion of the work in time as indicated elsewhere.

37.0 A standard benchmark with reference to which the whole work is to be carried out shall be constructed by the CONTRACTOR. The level shown on the outline drawings are with reference to standard benchmark. The CONTRACTOR shall establish reference benchmark at suitable spots. The construction and maintenance of the benchmarks shall be the responsibility of the CONTRACTOR. No payments shall be made for this work.

38.0 INFORMATION TO BE SUPPLIED BY THE CONTRACTOR DURING THE CONSTRUCTION PERIOD.

A senior representative of the CONTRACTOR shall attend weekly meetings at the site and in addition, meetings as arranged by the EMPLOYER to discuss the progress of work and sort out problems if any and ensure that the work is completed in the stipulated time. The CONTRACTOR shall submit to the Engineer-in-Charge, every fortnightly:

a. Detailed industrial statistics regarding the labour employed by him daily.
b. A fortnightly progress report along with requisite photographs.
c. Special incident at site.
d. Whether the work is progressing according to schedule, or not. If not, what are the problems and the remedial measures to be taken to regain schedule.
e. Record of the approvals by EMPLOYER
f. Record of the discussions by EMPLOYER
g. Fortnightly Construction Schedule
h. Monthly Construction Schedule
i. Detailed Schedule indicating when the REPRESENTATIVE’S presence is required at site.

39.0 The Contractor shall comply with all the provisions of the following statutory acts or any modifications thereto and the rules made there under from time to time.

- Indian Factories Act 1948
- Payment of Wages Act 1936
- Minimum Wages Act 1948
- Employers Liability Act 1938
40.0 Should a report be made by an Inspecting Officer, as defined in the Contract Labour (Regulation and Abolition) Act 1970, the Developer shall have the right to deduct from any money due to the Contractor any sum required, or estimated to be required, for making good the loss(es) suffered by a worker or workers by the reason of non-fulfillment of the Conditions of the Contract relating to the benefits of workers, non-payment of wages or of deduction made from their wages which are not justified by the terms of the Contract or non-observance.

The Contractor shall indemnify the employer against any payments to be made as hereunder and for the observance of the provisions of the aforesaid Acts.

In the event of the Contractor committing a default or breach of any of the provisions of the aforementioned Acts, as amended from time to time, of furnishing any information or submitting or filling in any Form/Register/Slip under the provision of these Acts which is materially incorrect, then on the report of the Inspecting officers, the Contractor shall, without prejudice to any other liability, pay to the employer a sum not exceeding Rs. 1000.00 as Liquidated Damages. This shall be applied to each incident for every default, breach or furnishing of, submitting, making and/or filling-in materially incorrect statements, the exact amount shall be fixed by the Engineer-in-charge.

In the event of the Contractor's default continuing in this respect, the Liquidated Damages may be increased to Rs 100.00 per day for each day that default occurs upto a maximum of one percent (1%) of the Contract Amount.

The Engineer-in-charge shall deduct such amounts from the interim application for Payment or the Security Deposit of the Contractor and credit the same to the Welfare Fund constituted under these Acts. The decision of the Employer in this respect shall be final and binding.

41.0 The Conditions as laid hereunder to be strictly complied during construction and operation phase regarding environmental clearance as per provisions of Environmental Impact Assessment Notification, 1994 with subsequent amendments.

42.0 Requirement of Technical Staff for the work

<table>
<thead>
<tr>
<th>Cost of the work (Rs. In Lakh)</th>
<th>Contract Period (Months)</th>
<th>Requirement of technical Staff</th>
<th>Minimum Experience (Works)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 500</td>
<td>12</td>
<td>1. Sr. Manager Projects with degree in corresponding discipline of Engineering</td>
<td>10</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Qualification</td>
<td>Experience (Years)</td>
<td>Rate of Recovery</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Sr. Manager Projects with degree in corresponding discipline of Engineering</td>
<td>10</td>
<td>Rs.60,000/- per month</td>
</tr>
<tr>
<td>2</td>
<td>Graduate Engineer</td>
<td>5</td>
<td>Rs.40,000/- per month</td>
</tr>
<tr>
<td>3</td>
<td>Graduate Engineer or Diploma Engineer</td>
<td>Nil/3</td>
<td>Rs.25,000/- per month</td>
</tr>
<tr>
<td>4</td>
<td>Planning /Quantity Supervisor</td>
<td>3</td>
<td>Rs.25,000/- per month</td>
</tr>
<tr>
<td>5</td>
<td>Site Safety Officer</td>
<td>10</td>
<td>Rs.25,000/- per month</td>
</tr>
<tr>
<td>6</td>
<td>Safety Supervisor</td>
<td>3</td>
<td>Rs.15,000/- per month</td>
</tr>
</tbody>
</table>

**Rate of Recovery in case of non compliance of above stipulated following rates:**

43.0 The condition as laid hereunder to be strictly complied during construction and operation phase regarding environmental clearance as per provisions of Environmental Impact Assessment Notification, 1994 with subsequent amendment.

**PART – A. SPECIFIC CONDITIONS**

A. **Construction Phase**

All required sanitary and hygienic measures should be in place before starting construction activities and to be maintained throughout the construction phase.

1) During the construction phase average water requirement of about 185 cubic meters per day would be met from tankers. Water usage during construction should be optimized to avoid any wastage.

2) The Workers employed during the construction phase will have to be provided adequate drinking water and sanitary facilities. The safe disposal of wastewater and solid wastes generated during the construction phase should be ensured.
3) All the topsoil excavated during construction activities should be stored for use in horticulture/ Landscape development within the project site.

4) Disposal of muck including excavated material during construction phase should not create any adverse effects on the neighboring communities and should be disposed off by taking necessary precautions for general safety and health aspects.

5) Use of diesel generator sets during construction phase should be of enclosed type and should conform to E (P) A Rules prescribed for air and noise emission standards.

6) Vehicles to be hired for bringing construction material at site should be in good condition and should conform to applicable air and noise emission standards and should be operated only during non peaking hours.

7) Ambient noise levels should conform to residential standards both during day and night. Incremental pollution loads on the ambient atmosphere and noise quality should be closely monitored during construction phase.

8) Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate watercourses and the dump sites for such material must be secured so that they should not leach into the ground water.

9) Regular supervision of the above and other measures should be in place although the construction phases so as to avoid disturbance to the surroundings.

10) Use of energy efficient construction materials to achieve the desired thermal comfort should be incorporated.

B. Operation phase:

1) The project proponent shall obtain necessary permissions from the New Town Kolkata Development Authority before drawing the water from the sources for the purpose of the proposed construction activity.

2) Noise barriers will be provided at appropriate locations so as to ensure that the noise levels do not exceed the prescribed standards.

3) The solid waste generated should be properly collected, segregated before disposal to the City municipal facility.

4) Any hazardous waste including biomedical waste from the site should be disposed of as per applicable Rules & norms with necessary approvals of the West Bengal Pollution Control Committee.

5) Incremental pollution loads on the ambient air quality, noise and water quality should be periodically monitored after commissioning of the project.
PART – B  GENERAL CONDITIONS

1) Provision should be made for the supply of kerosene or cooking gas / pressure cooker to the laborers during construction phase.

2) All the laborers to be engaged for construction works should be screened for health and adequately treated before the issue of work permits.

3) Financial provision should be made by the project proponent in the total budget of the project for implementation of the suggested safeguard measures.

4) NKDA/EPI reserves the right to add additional safeguard measures subsequently, if found necessary and to take action including revoking of the environment clearance under the provisions of the environmental (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

The agency is to obtain license from the registering officer & assistant labour commissioner of of the respective division /office under the contract labour (Regulation and abolition) act 1970 and rule framed there under and to submit the same to the concerned EIC within seven days from the date of issue of work order.

Any typographical mistake /omission, if found, may immediately be brought to the notice of the authority for rectification. In case of any inadvertent typographical mistake in the specific price scheduler of rate, the same will be treated to be so corrected as to confirm with the prevailing relevant schedule of rates and/or technically sanctioned estimate.

44.0 Insurance

Without limiting his obligations and responsibilities, the agency shall insure in the names of the Employer and the agency against all loss or damage from whatever cause arising for which he is responsible under the terms of the contract and in such manner that the employer and Agency are covered for the period of execution as well as during the period of Maintenance for loss or damage arising from a cause, and for any loss or damage occasioned by the agency in the course of any operations carried out by him for the purpose of complying with his obligations as follows:

(a) The entire contract value (including the Contract Price Plus 10% of the Contract price for the period of completion of the works which includes till the works are handed over to the owner).

(b) All equipments, plants etc. brought on to the site by the Agency and the replacement value of the same. These shall include materials belonging to the Employer but issued to or intended to be issued to the Agency for use in the work, if any.

(c) Damage insurance against loss or damage by fire or any other disaster to the works due to Civil commotion, riots, war, earth quake, terrorist attack and other disturbances during construction until its completion.

Such insurance as mentioned in para (a), (b) and (c) above shall be effected with an insurer and in terms approved by the Employer. The Agency shall bear the cost of all such insurance and
whenever required, produce to the Engineer-in-charge or his representative the policy or policies of insurance and the receipts for payment of the current premiums.

45.0 Electricity & water

To be arranged by contractor on his own cost.

46.0 Liquidation Damages

Liquidation damages equivalent to an amount equal to 1% (one percent) on the full tendered amount / contract sum for the whole work for every day that the due quantity of work remains incomplete or unfinished, provided that the entire amount of liquidity damages to be paid under the provision of the clause shall not be exceeding on the 10% on the accepted tender amount / contract sum of the work as shown in the tender.

47.0 Freight, Insurance, packing, forwarding, loading & unloading to be included in the quoted rate.

48.0 Security Deposit cum Performance Guarantee

The Lowest Bidder who has submitted EMD amount shall be converted as initial security deposit cum performance guarantee. However the lowest bidder who has submitted BG towards EMD instead of DD then, they are required to deposit 2% security deposit cum performance guarantee in the form of Demand Draft / Banker's Cheque of any Nationalized / Scheduled bank of India.

49.0 Stock of Materials

The Agency have to procure all the materials required for the works well in advance based on the programme of the work as submitted, and he shall have to maintain a stock book showing receipt, consumption and balance of major materials like cement, reinforcing steel, sand, stone chips, bricks etc. daily with such other information as may be directed by the Engineer-in-Charge. The Agency must satisfy Engineer-in-Charge regarding the stock of materials collaborating with the programme of the works. The cost carriage for transporting all materials shall be borne by the contractor.

50.0 Watching and Lighting

The Agency shall in connection with the works provide and maintain at his own cost all light, guards, fencing and watching when and where necessary or as required by the Engineer-in-Charge, for the protection of the works, or for the safety and convenience of the existing plant, contractor’s employees, employers supervisors or for any other reason deemed fit by the Engineer-in-Charge.

51.0 Discrepancies

Should any discrepancy appear in any of the documents and drawings included in this contract or between different parts of the same documents or any ambiguity or insufficiency of information the Agency shall point out the same to the Engineer-in-Charge in writing and receive his
instructions, explanations or decision in the matter. Decision of Engineer-in-Charge is final and binding on the Contractor.

52.0 Materials to be Supplied by Agency

The Agency shall supply all materials required for successful completion of the work. The quality of such materials as stated above shall conform to the requirements of the BIS (Bureau of Indian Standard), P.W.D. or any other approved standard specification. In all cases, the latest modification or revision of such specifications will be applicable for use. All sampling, testing and transportation of such materials shall take place under the direction of the Engineer-in-Charge at the testing laboratory as may be designated by the Department at the cost of the Contractor. Tests will be made in accordance with the standard methods of testing of the I.S. or other standard specifications. The Engineer-in-Charge has full power to reject or condemn any workmanship or materials that he may deem unsuitable. All materials not conforming to the requirements of these specifications shall be considered as defective and shall be rejected for use and shall be removed by the Agency from the site of the work within 24 hrs at his own cost.

In case of non-compliance with such orders, the Engineer-in-Charge shall have the full authority to cause such removal at the cost and expense of the Agency and the Agency shall not be entitled to any loss or damage on that account. The Engineer-in-Charge will have full right to inspect the store of materials supplied by the Agency for the use of this contract work. All materials and workmanship shall be of the respective kinds described in the contract and in accordance with the Engineer-in-Charge’s instructions and shall be subjected from time to time to such tests as the Engineer-in-Charge may direct at the place of manufacture or fabrication, or on the site or at such other place or places as may be specified in the contract, or at all or any of such places. The Agency shall provide such assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing any work and the quality, weight or quantity of any materials used and shall supply samples of materials before incorporation in the works for testing as may be selected and required by the Engineer-in-Charge, be it at site or at the manufacturer/Vendor’s premises. Agency will have to procure materials from manufacturers / vendors as may be approved by the E.I.C. No variation will be allowed. Agency will have to furnish original documentary evidence of procurement of the materials from the specified vendors if required by the EIC. Cost of samples – all samples of materials/articles to be tested as may be required by the Engineer-in-Charge shall be furnished by the Agency at his cost. If the rates for completed items of work are inclusive of supply of stone materials, the Agency shall arrange for procurement of such stone materials required for the work by his own resources and it shall be clearly understood that the Department shall not sponsor any traffic movement by wagon for stone materials.

53.0 Workmen’s Compensation

In every case in which by virtue of the provisions of the Workmen’s Compensation Act, 1923, and any other relevant Acts and Rules, compensation to a workman employed by the Agency, is payable, then this should be done by the Contractor. If the Department is obliged to make any compensation under the said Rules and Acts, then the amount shall be recovered without prejudice, from the bills and dues of the Agency. The Department shall not be bound to contest any claim made against it in respect of workmen’s compensation under Section 12 sub section 1 of the said Act, except on the written request of the Agency and upon his giving to NKDA / EPI
full security for all the costs for which NKDA / EPI might become liable in consequence of contesting such claims.

54.0 Contractor’s Employees

No labour below the age of eighteen years shall be employed on the work. Any labour supplied by the Agency to be engaged on the work on day work basis either wholly or partly under the direct order or control of his representative shall be deemed to be a person employed by him. The Agency shall comply with the provision of all labour legislation including the requirement of the Payment of Wages Act and the rules framed there under and modifications thereof in respect of men employed by him in carrying out the contract. The Agency shall comply at his own cost with any order or requirement of any Health Officer of the State or any local authority and the Engineer-in-Charge regarding the maintenance of proper environmental sanitation of the area where the labourers are housed or accommodated, for the prevention of any communicable diseases. The Agency shall provide, maintain and keep good sanitary condition and provide facilities for potable water at all times for the use of men engaged on the work and shall remove and clear away the same on completion of the work. Adequate precaution shall be taken by the Agency to prevent nuisance of any kind in the site of work.

The Agency shall provide efficient medical attendant and care for his staff and for the workmen employed to the satisfaction of the Engineer-in-Charge or his representative. The Agency shall arrange to provide first aid and treatment facilities to the labourers engaged on the works and shall within 24-hours of the occurrence of any accident at or about the site in connection with the execution of the work, report each accident to the Engineer-in-Charge and also to the competent authority where such report is required by law.

55.0 Safety Measures and Public Convenience

The Agency shall in the course of execution of the work take all necessary precautions for the protection of all persons and property at his cost. The entire site of works shall be well illuminated from sunset to sunrise at his cost. The Agency shall take adequate measures to protect the work and prevent accidents during the Project work and prevent accidents during the construction. He shall provide and maintain 27 temporary side-walks access to construction site and where necessary, danger signals, Road closed sign, watchman and necessary appliances for properly safeguarding life and site of work for safety. The lamp must kept lit from sunset till at least one hour after sunrise. He shall protect all excavations equipment and materials with barricades and danger signals so that no life may be endangered. The Agency shall so conduct his operation as to cause the least possible obstruction and inconvenience to the other users and contractors in adjacent site. He shall have under construction not more than such amount of work as he can handle properly with due regard to the right of others.

56.0 Loss and Damage

Neither the department nor the Engineer-in-Charge or his representative shall be answerable or accountable in any manner for any loss or damage that may happen to the work or any part thereof or to any of the materials or other things used in the performing the work, or for injury to any person, either a workman or any member of the public, or for damage to any property for any cause which might have been provoked by the Agency. The Agency shall properly guard against all these injuries or damages to persons or property resulting from his operations under this
contract at any time before issuance of the certificates of completion and maintenance. He shall indemnify and save harmless the Department form all suits or actions of every description brought for, or on account of, any injury or damage received or sustained by any person or persons by reason of the construction of the work, negligence in guarding the same, the use of improper materials or of any act of omission or deviation from the contract.

57.0 Supervision of Work

The Engineer-in-Charge shall have the power at any time and from time to time by notice to the Contractor to delay or suspend the progress of the work or any part of the work during unsuitable weather for any other adequate reasons and on receipt of such notice, the Agency shall forthwith suspend further progress of the work until further notice from the Engineer-in-Charge. The Agency shall recommence work immediately on receiving a notice to do so from the Engineer-in-Charge. The whole or any part of the time lost for such delay or suspension shall, if the Department in its absolute discretion thinks fit but not otherwise, be added to the time allowed for completion. The Agency shall have no claim to extra payment or compensation whatsoever on the grounds of above delay.

58.0 Occupying Prior to Completion

The Employer/Department expressly reserves the right to occupy at any time and for so long a time as the Engineer-in-Charge deems fit in issuing a notice to the Agency, require any portion or portions of the site of works, whether the works to be executed thereof be commenced or in progress or temporarily suspended or completed and to employ thereon agents and workmen other than the contractor or his men in the execution of matters not included in the contract. The Agency shall not obstruct such agents and workmen, and without extra charge and without relief from any liabilities or responsibility, or such allowance provide them free access to the work and to such facilities as in the judgment of the Engineer-in-Charge may be reasonably required.

59.0 Supplementary Specification

Whenever reference is made in these documents to certain special specifications, the reference shall be construed to include all subsequent amendments, changes or additions that are published and in effect at the date of signing of this contract. The department reserves the right to issue additional conditions, specification etc. if necessary which will be incorporated with tender documents already sold to Tenderer for the purpose of this work.

60.0 Land for Contractor’s Establishment

For the purpose of constructing Agency’s Storeyard, godowns, site office and ancillaries, he may utilise portion of the land belonging to the Employer at such location as would not interfere with the execution of works. For all these, the Agency shall have to obtain the requisite permission of the Engineer-in-Charge. The Agency shall for this purpose submit to the Engineer-in-Charge for his approval a plan of the proposed layouts for the site facilities. The Engineer-in-Charge reserve the right to alter and modify the Agency’s proposals as he may deem fit. In case sufficient land is not available with the Employer, the Agency will have to arrange for private land of his cost to meet his requirements.
61.0 First-Aid Facilities

The Agency shall provide at his own cost for medical attention to be promptly available when necessary. He shall for this purpose provide a number of First-Aid stations at suitable location within easy reach of the workmen and other staff engaged in the Works. Each First-Aid station shall be properly equipped and will remain in charge of a suitably qualified person. The Agency shall also provide for transport of serious cases to the nearest hospital. All these arrangements shall be to the approval of the Engineer-in-Charge. The Contractor shall provide, to the satisfaction of Government or Local Authority concerned, adequate medical attendance for his employees and labours.

62.0 Construction Records

The Agency shall keep and supply to the Engineer-in-Charge the up-to-date records of the dimensions and positions of all permanent works (showing therein any approved deviation between the drawing and the work as actually executed). The information available from the records must be adequate and complete to enable preparation of completion drawing by the Contractor at his own cost from these records.

63.0 Satisfactory completion of various items

The various items of the sub-work are to constitute the whole work complete in every respect as per satisfaction of the Engineer-in-Charge. Each sub-work will be considered as complete when it is completed as per drawing & specifications, as per standards, as a successful component part of the whole work.

64.0 Reports and Returns

The Agency shall maintain at Site daily records of progress with regard to the works carried out, labour engaged and construction equipment deployed. These will form the basis of preparing periodic reports and returns as may be required by the Engineer-in-Charge and in the manner as directed by him.

65.0 Insurance of works, etc.

Without limiting his obligations and responsibilities, the Agency shall insure in the names of the Employer and the Agency against all loss or damage from whatever cause arising for which he is responsible under the terms of the contract and in such manner that the employer and Agency are covered for the period of execution as well as during the period of Maintenance for loss or damage arising from a cause, and for any loss or damage occasioned by the Agency in the course of any operations carried out by him for the purpose of complying with his obligations as follows:

The entire contract value (including the Contract Price plus 10% of the Contract Price for the period of completion of the works which includes till the works are handed over to the owner).

All equipments, plants etc. brought on to the site by the Agency and the replacement value of the same. These shall include materials belonging to the Employer but issued to or intended to be issued to the Agency for use in the work, if any.
Damage insurance against loss or damage by fire or any other disaster to the works due to civil commotion, riots, war, earthquake, terrorist attack and other disturbances during construction until its completion.

Such insurance as mentioned in para (a), (b) and (c) above shall be effected with an insurer and in terms approved by the Employer. The Agency shall bear the cost of all such insurance and whenever required, produce to the Engineer-in-Charge or his representative the policy or policies of Insurance and the receipts for payment of the current premiums.

66.0 Damage to Persons and Property
The Agency shall, except; if an so far as the contract provides otherwise, indemnify the Employer against all losses and claims in respect of injuries or damage to any person or materials or physical damage to any property whatsoever which may arise out of or in consequence of the execution and maintenance of the works and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto except any compensation or damages for or with respect to:

a) The Permanent use or occupation of land by the works or any part thereof.
b) The right of the employer to execute the works or any part thereof on over, under, in or through any land.
c) Injuries or damage to persons or property, which are the unavoidable result of the execution or maintenance of the works in accordance with the contract.
d) Injuries or damage to persons or property resulting from any act or neglect of the Agency, his agents, servants or other contractors, not being employed by the Agency or for or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or where the injury or damage was contributed to by the Agency, his servants or agents such part of the compensation as may be just and equitable having regard to the extent of the responsibility of the Employer, his servants or agents or other contractors for the damage or injury.

67.0 Accidents or Injury to Workmen:
The Employer shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other person in the employment of the Agency or any sub-contractor, have and except any accident or injury resulting from any act or default of the employer, his agents, or servants. The Agency shall indemnify and keep indemnified the Employer against all such damages and compensation, save and except as aforesaid and against all claims, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

68.0 Insurance Against Accident etc. to Workmen:
The Agency at his cost shall insure against all liabilities as indicated in clause 38, 40 and 42 with an insurer, and shall continue such insurance during the whole of the time that any person is employed by him on the works and shall, when required, produce to the Engineer-in-Charge or his representative such policy of insurance and the receipts for payment of the current premium. Provided always that, in respect of any persons employed by any sub-contractor, the Agency’s obligation to insure as aforesaid under this sub-clause shall be satisfied if the sub-contractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy, but the Agency shall require such sub-contractor to produce to the
Engineer-in-Charge when required, such policy of insurance and the receipt for the payment of the current premium.

69.0 Notification to Insurer:

It shall be the duty of the Agency to notify the insurers under any of the insurances referred in any matter or count which by the terms of such insurances are required to be notified and the Agency shall indemnify and keep indemnified the Employer against all losses, claims, demands, proceedings, costs, charges and expenses whatsoever arising out of or resulting from any default by him in complying with the requirements of this sub-clause whether as a result of the avoidance of such insurance or otherwise.

70.0 All Insurance at Contractor’s Cost:

The insurances referred to in this Tender document shall be entirely at the cost and expense of the Agency.

71.0 Remedy on Contractor’s Failure to Insure:

If the Agency shall fail to effect and keep in force the insurances referred to Clauses hereto, or any other insurance which he may be required to effect under the terms of the Contract, then and in any such case the Employer may effect and keep in force any such insurance and pay such premium or premium or premiums as may be necessary for that purpose and from time to time and deduct double the amount so paid by the Employer as aforesaid from any money due or which may become due to the Contractor, or recover the same as a debt due from the Contractor.

72.0 Idle Labour

No claim for idle labour would be entertained under any circumstances.

73.0 Inspection Facilities

The Agency shall provide necessary facilities for inspection of work for quality control by the Engineer and for the purpose of carrying his instructions as may be recorded in writing in site Order Book.

74.0 Testing & Testing Equipment

Testing of materials to be used in the permanent work or of the quality of finished items shall have to be done from approved laboratory at the expense of the Agency. Should the E.I.C. consider it necessary to satisfy himself as to quality of work, the Agency shall offer sample of work done as necessary, pull down reasonable part of the work required for such inspection and testing. The Agency shall bear the cost of pulling down and shall make good the same at his own cost and to the full satisfaction of the E.I.C. without any extra cost. The Agency shall provide at his own cost necessary equipments for such testing which by nature of work may have to be done at work site. These include sufficient number of slump cones, standard 150 mm metal cube moulds, Cube crushing test machine, set of I.S. sieves, weighing balances, graduated measuring
cylinders, equipment for in-situ density test, holding detector, thermometers and any other miscellaneous equipment that may be required by the Engineer-in-Charge. The Agency shall also provide at his cost facilities for curing of concrete cubes for testing purpose and he shall afford at his own cost necessary facilities in providing requisite materials and assistance that may be required by EIC including transportation charges to laboratory.

75.0 Labour Act

The Agency should obtain the license under the provision of the Contract Labour (Regulation and Abolition) Act 1970 and the Contract Labour (Regulation and Abolition) General rules, 1971 including the provisions of amendments made there under of the same.

76.0 Local Employment

No labour should be imported from any district other than where work is to be executed without prior consent of the Executive Engineer. Imported labor can only be engaged with permission of the Executive Engineer when the exigency or progress of work so demands and sufficient local labours are not available. For importing special class of labor for any specialized work no extra cost will be paid to the agency.

77.0 Import License and Imported Equipments

Use of any imported equipment for the work is not envisaged. However, if it becomes absolutely necessary, requisite Foreign Exchange and import license shall have to be arranged for by the contracting agency independently and NKDA / EPI will not take any responsibility in this regard. A certificate stating the necessary of the particular materials for the work entrusted to the Agency may be issued at its discretion by NKDA / EPI on request. Delay in getting any materials will not be entertained for extension of time limit of contract.

78.0 Water Supply, Sanitation & Power

The Agency shall have to make his own arrangement for supply of electrical power and water at all stages of execution of work. Arrangement for obtaining water for the work as well as for the labourers and sanitation facilities for labourers shall have to be made by the Agency at his cost. The quality of water shall be conducive for construction works in terms of soluble, insoluble materials and chloride content. The cost of erection/installation for obtaining either electricity or water from W.B.S.E.B. or Municipality or any other agency shall have to borne by the Contractor for which no extra claim can be placed before NKDA / EPI. However, NKDA / EPI may provide power and water if the same is available at site. If the contractor draws power and water from NKDA / EPI’s point then he is required to pay the prevailing charges for power and water connection and usage. But supply of power and water should not be considered as the responsibility of NKDA / EPI. Nevertheless electrical power from NKDA / EPI’s point may not be continuously available due to various reasons including load shedding. In that case water supply from NKDA / EPI's point will also stop and the Agency will make his own arrangement for water and power through generator at his cost.
79.0 **Storage and Safety of Equipments**

The equipment at site shall have to be stored in waterproof shed with proper security arrangement made by the agency. The Agency shall insure at his cost all the equipment against pilferage and breakage at site during storage and erection under their custody till the work is completed and handed over to the Employer.

80.0 **Language for Correspondences**

All written materials and correspondence in connection with the contract shall be in English.

81.0 **Agency’s Local Address**

The Agency shall furnish the postal address of his site Office. Any notice or instruction to be given to the Agency under the terms of contract shall be deemed to have been served if it has been delivered to his authorised agent or representative of site or sent by registered letter to the site office or to the address.

82.0 **Recoveries**

Any recovery from the Agency advised by the Employer/Government shall be recovered from any bill or money retained from this contract.

83.0 **Reduced Rates and Part Rates**

a) Reduced rates as decided by the E.I.C. shall be allowed for the works, which in the opinion of the E.I.C. are not done in strict conformity with specification and schedule of works but are acceptable. The relevant item rates in such cases shall be reduced and approved by the **Tender Accepting Authority**, on the basis of analysis, which shall be binding to the contractor. Works which are not in conformity with the specification and not acceptable in the opinion of E.I.C. will not be paid for and the cost of rectification or dismantling of such unacceptable work will have to be fully and solely borne by the Agency.

b) Part payments for items, which are not fully complete as per specification of the contract, may be made by NKDA / EPI in cases when it is ensured that the items can be completed as per specification, in following days, by the contractor, when so allowed by the E-I-C. Application of this provision shall be very restricted and can only be exercised under specific case wise approval of the E-I-C strictly.

84.0 **Site Clearance before final acceptance of the work.**

Before final acceptance, all items of work shall be completed, ready to operate and in a cleaned condition. All debris, unused material and temporary structures shall be removed from the site of work. Tools and construction machinery (except which is needed for repair and adjustment of the work consequent to operational tests) shall not remain on the site.
85.0 **Minimum Wage Act**

The Agency is required to follow the provisions of Minimum Wage Act.

86.0 **Precedence of Contract Documents**

If any stipulation indicated in any component of contract documents are at variance in any respect with those in the other, the decision of the Executive Engineer will stand final and binding.

87.0 **Action for Non-Compliance**

Failure to comply with above conditions and specifications will result in the department taking action at the risk and cost of the agency. Execution of agreement binds the Contractor for complying with requirements of the above conditions and specifications without any extra payment on any account.

88.0 **Deduction of Tax**

Deduction of VAT, Income Tax and any other taxes are payable as per prevailing tax Laws at the prescribed rate at the time of making payment to the Contractor.

89.0 **Typographical Error**

Typographical errors detected or pointed out are subject to corrections by E-I-C. Any party on account of such error can derive no benefit. Any Typographical error shall immediately be brought to the notice of the authority for rectification. NKDA / EPI reserves the right to rectify mistake / omissions if detected, at any point of time even during execution of work.

90.0 **Completion of Work and Guarantee**

The work shall be deemed to be completed when all works itemized in the Schedule of work and the entire work as per drawing or otherwise undertaken have been completed in all respect including successful testing. The Contractor shall guarantee for successful operation of the project for 12 months from the date of successful completion of the project and shall within the operation and maintenance period remove/rectify/make good any such deficiency forthwith at his own cost. During the guarantee period after the trial run period the firms representative shall visit the site once in a month and advise in writing the engineer in charge about the condition, state of health, operation and maintenance procedure of the project. The successful tenderer shall also give the following guarantee in respect of the equipment supplied by him.

All equipments shall be free from any defects due to faulty design of the components, material and / or workmanship and shall operate satisfactorily with highest performance efficiency.

Formal acceptance of the work or equipment covered under the contract will not be made by the engineer until all the work done by the contractor have satisfactorily passed all tests required and run for a reasonable period to his satisfaction.

If during testing of work including equipment prior of formal acceptance of the same or the material there of fails in respect of meeting the specification guarantee or otherwise, the
contractor shall replace all the accessories etc. in such a condition which will meet the guarantee performance and shall be up to the specification, in both material and workmanship. The contractor will provide back to back guarantee to NKDA / EPI for all kind of supplied equipments for electrical, HVAC, firefighting, electromechanical works etc. The Final Bill for the work shall be processed by EIC on completion of work in all respect including submission of all test certificates by the Contractor in quadruplicate.

91.0 Operational Maintenance

Contractor shall provide operational maintenance for 12 months from the date of successful completion of the project and shall within the operation & maintenance period train the NKDA / EPI officials regarding operation and maintenance work.

92.0 Defect Liability Period

92.1.1 Defects Liability Period shall be twelve calendar months after actual completion of the works. Any defects in material of workmanship observed in the entire work during execution or work or within defect liability period shall be notified in writing by the Employer to the Contractor and shall be rectified by him at his own cost within time as specified by Employer.

92.1.2 To facilitate prompt attention to the defects the contractor shall employ a team of tradesmen like Masons, Plasterers, Carpenters, Plumbers, Fitters and Labors covering all trades along with necessary materials and spares. A supervisor will also be available along with the maintenance team to take instructions from Employer. The maintenance team will be available throughout the defects liability period. The composition of the tradesmen will vary according to the nature of recurring defects noticed in the buildings. In case of default the Employer may employ any other person to rectify or make good such defects. All expense consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Employer and shall deduct from RA bills or Security deposit as the case may be.

92.1.3 Should any defective works have been done or material supplied by any subcontractor employed, the contractor shall be liable to make good in the same manner as if such work or material has been done or supplied by the contractor. The contractor shall remain liable under the provisions of this clause notwithstanding the signing by engineer in charge of any certificate or passing any account.

93.0 Safety Requirements:

Agency shall use safety belts, whenever his workmen will have to work at a high altitude to avoid risk of any accident or fall Hard Top Hats to be used by the Agency’s workmen at the places wherever required. Necessary Fire Protection arrangements by installing portable fire extinguishers on suitable locations at work site and material storage area. The Agency shall also use Safety devices like Welder’s apron, hand gloves, goggles, helmets etc. and other accident preventive arrangement at work site as per prevailing safety code.
94.0 I.E. Act.

The Contractor is required to comply with the I.E. Act and Rules framed the under. He will have to produce to the EIC evidence of possession of Electrical Contractor’s license with current validity and also copy of Electrical Supervisor’s Certificate with qualification, registration no. etc. in respect of employees involved in electrical works.

95.0 Foreclosing of Work

If at any time after the acceptance of the tender the Employer shall for any reason whatsoever not require the whole or any part of the works, to be carried out, the Employer shall give notice in writing of the fact to the contractor, who shall have no claim to any payment of compensation or otherwise, whatsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of the foreclosing of whole or part of the work.

96.0 Measurements:

The contractor along with representative of E-I-C shall measure the work done according to PWD mode of practice and enter into their measurement book, sign and submit it in triplicate to the engineer in charge for verification and certification. The measurement so taken shall be checked by the concerned Assistant Engineer in charge of the work.

If any alterations or additions (other than those authorized) have been covered up by the Contractor without his having given notice of his intention to do so, the engineer-in-charge shall be entitled to appraise the value thereof and in the event of any dispute the decision of the Employer thereon shall be final and binding.

Payments for Works: On account payment will be made till completion of the work. Rate quoted shall be inclusive of all taxes, octroi, toll, sales tax, professional tax, works contract tax, Service taxes, royalties, VAT or any other new taxes or levies etc. and shall be payable by the contractor. The employer will not entertain any claim whatsoever in this respect. Income tax will be deducted from the RA Bills/Final Bill.

97.0 Progress Photographs

The Contractor shall at his own cost and expenses, arrange to take periodic still digital photographs to show the progress of work or interesting features thereof. The time and the position where from a photograph is to be taken would be as per direction of the Engineer-in-Charge or his representative. Coloured prints of each of these still Photographs to an enlarged size of about 25 cm x 15 cm shall be supplied to the Engineer-in-Charge in albums by the Contractor at his cost and these shall become the property of the Employer. Each photograph shall be suitably captioned with the date of the photograph, location and other relevant particulars. The Contractor in C.D shall submit soft copy of photographs showing monthly progress, stages of work with dates to EIC. Any circulation of these photographs to any other source other than NKDA / EPI, shall be treated as breach of security and shall make them liable for prosecution and consequences. Restrictions to photography or security restrictions that may be applicable to any particular area must be carefully and rigidly observed. The number of hard photographs (each consisting of two prints) for the complete works is not expected to exceed 25 (twenty-five).
Construction of First Phase (B+G+IV) of Administrative Building of New Town Kolkata Development Authority
At
Plot No. DG/13, Premises No. 04-3333 , Action Area-ID,
New Town, Kolkata

TECHNICAL SPECIFICATION
FOR ARCHITECTURAL, CIVIL,
SANITARY AND PLUMBING WORKS
# TECHNICAL SPECIFICATIONS

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SECTION-A
BROAD ARCHITECTURAL SPECIFICATION

1.0.0 Introduction:
New Town Kolkata Development Authority intends to undertake the construction of First Phase (B+G+IV) of administrative Building of New Town Kolkata Development Authority in Premises No- 04-0333, Plot No- DG/13, AA-ID.
New Town Kolkata Development Authority is keen to develop their own office in the heart of this township which is eventually become a multiple/corporation office. The Authority has a dream that this multifunctional city will get a unique landmark building as its office with good aesthetics, which will enhance urbanscape.
In addition to providing of office facilities along with Auditorium, Conference room & Cafeteria, the building will also have landscaping features like foundation, water bodies, terrace garden etc. Internal roads & pathway area lighting will be of standard with good architectural views. Within the project area there will also be security & management staff room.

1.0.1 Description of the Project:
- The project site is located at Premises no: 04-3333, DG-13, Action area-1D, New Town, Kolkata
- The area of the plot is approximately 7001.888Sq.m.
- Total Built up Area is 14009.016 Sq.m. The first phase built up area is 9619.269 Sq.m.
- Proposed FAR to be consumed is 2.001. The first phase FAR will be 1.37
- Proposed Ground Coverage is 19.71%.

1.0.2 Scope of Work:
The major buildings/ spaces to be covered (with all services) under design scope are as follows:

A. Buildings/ Structures:
   a) Reception lounge.
   b) Workstations.
   c) Conference room.
   d) Bank facilities.
   e) Auditorium
   f) Archive.
   g) Cafeteria
   h) Gymnasium.
   i) Kitchen and pantry.
   j) Toilet Block (Ladies & Gents)
   k) Security & Manager’s Office
   l) Security Block
   m) Electrical Substation
n) Pump room.
o) UG & OH water tank

B. Outdoor Areas:
a) Boundary Wall & Gate
d) Planter box
e) Fountains
f) Water bodies
g) Outdoor Illumination & DG
h) Infrastructural Services

The scope of services include construction of the above with site gardening and landscaping as well as all infrastructural facilities like water supply, sanitary & plumbing, electrical, fire detection & fire fighting, auditorium-related services like acoustics, stagecraft & stage lighting.

1.0.3 Architectural specifications:

In external wall Exterior grade acrylic paint with high heat reflective index will be used. Structural glazing, ACP cladding and louvers will be used as per architectural drawings.

1) Reception Lounge/Entry lobby:
   a) Flooring: Uneven nonskid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).
   b) Internal Wall: Decorative wall tiles of approved brand laid over 20 mm thick screed in C.M. (1:4).
   c) Skirting: Same as flooring
   d) Ceiling: False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.
   e) Door & Window: The main exit doors will be fire doors as per specification for 2hr. fire rating. Other doors will be wooden framed and paneled polished door.
   f) Roof: Flat roof.

2) Workstations:
   a) Flooring: Uneven nonskid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).
   b) Internal Wall: Acrylic emulsion paint over wall putty.
   c) Skirting: Same as flooring
   d) Ceiling: False ceiling with concealed metal (G.I.) frame work; providing & fixing in
position Fibre Cement Design board as detailed in technical specification.

e) Door & Window: Aluminum framed window with all structural glazing and wooden flush doors.

f) Roof: Flat roof.

3) Executive Offices:

a) Flooring: IPS flooring over which a PVC flooring (with wooden finish appearance) has to be laid.

b) Internal Wall: Decorative wall paper/ Textured paint (Fine/Super fine)

c) Skirting: Same as flooring

d) Ceiling: False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

e) Door & Window: Aluminum framed window with glazing/structural glazing and wooden flush doors.

f) Roof: Flat roof.

4) Conference Room:

a) Flooring: IPS flooring over which a laminated teak finish has to be lain.

b) Internal Wall: Decorative wall paper/ Textured paint (Fine/Super fine)

b) Skirting: Same as flooring

c) Ceiling: False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

d) Door & Window: Aluminum framed window with structural glazing and wooden flush doors

e) Roof: Flat roof.

5) Bank:

a) Flooring: Uneven non-skid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).

b) Internal Wall: Acrylic emulsion paint over wall putty.

c) Skirting: Same as flooring

d) Ceiling: False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

e) Door & Window: Aluminum framed window with all structural glazing and wooden flush doors

f) Roof: Flat roof.

6) Archive/ Library:

a) Flooring: Uneven nonskid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).
b) **Internal Wall:** Acrylic emulsion paint over wall putty.

c) **Skirting:** Same as flooring

d) **Ceiling:** False ceiling with concealed metal (G.I.) frame work; providing & fixing in position 6mm thick high pressure steam cured non-asbestos fiber cement ceiling board.

e) **Door & Window:** The main exit doors will be fire doors as per specification for 2hr. fire rating. Other doors will be wooden framed and paneled polished door.

f) **Roof:** Flat roof.

7) **Cafeteria:**

a) **Flooring:** Uneven nonskid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).

b) **Internal Wall:** Acrylic emulsion paint over wall putty.

c) **Skirting:** Same as flooring

d) **Ceiling:** False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

e) **Door & Window:** The main exit doors will be fire doors as per specification for 2hr. fire rating. Other doors will be wooden framed and paneled polished door.

f) **Roof:** Flat roof.

8) **Gymnasium:**

a) **Flooring:** 8mm thk. PVC (Wooden Finish) floors over 25 mm. thk. P.C.C.

b) **Internal Wall:** Acrylic emulsion paint over wall putty.

c) **Skirting:** Same as flooring

d) **Ceiling:** False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

e) **Door & Window:** The main exit doors will be fire doors as per specification for 2hr. fire rating. Other doors will be wooden framed and paneled polished door.

f) **Roof:** Flat roof.

9) **Kitchen & Pantry:**

a) **Flooring:** 1st quality ceramic tiles (non skid) laid on 20 mm thick screed in cm. (1:4) over RCC slab. In case of sunken floor sub base of P.C.C.(1:2:4) over cinder filling will be adopted before laying of ceramic tiles with screed in cm.

b) **Internal Wall:** Ceramic tiles of approved brand laid over 20 mm thick screed in C.M. (1:4).

c) **Skirting:** Same as flooring

d) **Ceiling:** Acrylic emulsion paint over wall putty.

e) **Door & Window:** Aluminum framed window with glazing and wooden flush doors.

f) **Roof:** Flat roof.
10) Toilet block:
   a) Flooring: 1\(^{st}\) quality ceramic tiles (non skid) laid on 20 mm thick screed in cm. (1:4) over RCC slab. In case of sunken floor sub base of P.C.C. over cinder filling will be adopted before laying of ceramic tiles with screed in cm.
   b) Internal Wall: Ceramic tiles of approved brand laid over 20 mm thick screed in C.M. (1:4).
   c) Skirting: Same as flooring
   d) Ceiling: Acrylic emulation paint over wall putty.
   e) Door & Window: P.V.C. doors.
   f) Roof: Flat roof.

11) Managers room, Service areas:
   a) Flooring: Ceramic nonskid tiles of approved brand size not less than 400 x 400 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).
   b) Internal Wall: Acrylic emulsion paint over wall putty.
   c) Skirting: Same as flooring
   d) Ceiling: Acrylic emulation paint over wall putty.
   e) Door & Window: Aluminum framed window with glazing and wooden flush doors.
   f) Roof: Flat roof.

12) Staircase:
   a) Flooring: Green kota stone of 20-25 mm thick over 15 mm thick screed in cm (1:2) with white cement slurry and jointed with white cement slurry.
   b) Internal Wall: Acrylic emulsion paint over wall putty.
   c) Skirting: Same as flooring
   d) Ceiling: Acrylic emulation paint over wall putty.

13) Roof: Finish with Ceramic tiles.

14) Sanitary fixtures: White Ceramic

15) Sanitary Fittings: Brass

16) Grills & railing: Made of MS flats, MS square or MS pipes as per design

17) Stagecraft:
   a) Front Curtain: The front curtain should be double gathered guillotine type (upward rise) synthetic satin / velvet complete with front frills , electrical operating mechanism along with limit
switches. (to be approved by employer) fitted and fixed maintaining proper alignment with procenium opening.

b) **Box bar for batten & frill:** Box bar for batten & frill should be 62mm X 40mm Al. with 100mm dia. 1 way, 2 way, 3 way pulleys properly fixed on grid structures with 10mm dia polypropylene rope fully motorized (to be approved by employer) fitted and fixed maintaining a perfect horizontal position and connected to pulleys at grid and motor or as directed by engineer in charge/employer.

c) **Wing mechanism:** Wing mechanism made with cloth legs complete with traveling arrangement and 1.5m box and satin black markin cloth. (to be approved by employer) fitted and fixed maintaining at perfect horizontal position or as detected by engineer in charge/employer.

d) **Lighting bars:** Lighting bars should be made with 38 mm nb. medium MS black pipe along with motorized mechanism fully motorized fitted and fixed maintaining a perfect horizontal position and connected to pulleys at grid and motor or as detected by engineer in charge/employer.

e) **Frills:** Frills should be made of black markin cloth for masking (to be approved by employer) and properly fitted to frill bar as detected by engineer in charge/employer.

f) **Black curtain:** Black curtain should be complete with motorised mechanism and cloth (to be approved by employer) motorized fitted and fixed maintaining a perfect horizontal position and connected to pulleys at grid and motor or as detected by engineer in charge/employer.

g) **Cyclorama screen:** Cyclorama screen should be complete with frame structure (usable for projection) (to be approved by employer) placed on stage as detected by engineer in charge / employer.

h) **Grid structure:** The grid structure should be provided at stage top and catwalk with 50mm dia. MS black pipe/ rectangular section fitted from front to back over 40mm dia pipe/rectangular section held from the existing RCC structure and 50X50X6 MS angle & 25mm thick wooden gangway as detected by engineer in charge / employer.

i) **Stage flooring:** Stage flooring should be made of with 1800 X 150 X 40 mm seasoned hollock/gamar wood planks on 100 X 75mm teak wood runners complete with waxing. The teak wood runners should be properly fixed with the p.c.c. base of the stage. The seasoned hollock/gamar wood planks should be fixed on top of teak wood runners leaving some trap doors for power point as detected by engineer in charge / employer. The seasoned hollock/gamar wood planks will then be properly waxed to finish.

j) **Projector:** A top mounted EPSON or equivalent make ultra-bright, large-venue projector for film projection (to be approved by employer) with not less than White Light Output 10,000 lumens, Colour Light Output 10,000 lumens, XGA resolution, with arc correction, point correction facilities. Fitted and fixed from false ceiling or as directed by engineer in charge / employer.

**Acoustic treatment & auditorium interiors:**
Side walls will be treated with fully perforated Armstrong or Anutone make board of 12.5mm on GI frame with chicken mess wire backing with 25mm 16kg/m3 density glass wool (mid absorbent zone)
k) Front sidewall treatment up to 3m from the stage with ply board of 12.5mm on GI frame with polish. (Reflecting zone having 0.5 reflection)

l) Back wall treatment with fully perforated Armstrong or Anutone make board of 12.5mm on GI frame with chicken mess wire backing with 50mm 36kg/m3 density glass wool. (Extreme highly absorbent zone)

m) Side wall & black wall skirting treatment up to 5ft from the ground level with 12mm ply board on GI frame with decorative bit & polish.

n) Providing false ceiling with fine fissured mineral fibre Armstrong or Anutone make boards in GI grid for main ceiling.

o) Providing heavy drapery on doors & windows

Notes.
Everything should follow the drawings & design strictly as much as possible

Executive Engineer-I
New Town Kolkata Development Authority
SECTION-B

TECHNICAL SPECIFICATION FOR ARCHITECTURE, CIVIL, SANITARY AND PLUMBING WORKS

Unless otherwise stated in the schedule of works or detailed specifications as enumerated in this volume of the tender document, all specifications, items of works, mode of measurements etc. for civil works should be as per the current PWD (West Bengal) Schedule of Rates for Building, Sanitary and Plumbing and other Works. The detailed specifications as elucidated in this section should follow the provisions pertaining to specifications, items of works, mode of measurements etc. as stipulated in current PWD (West Bengal) Schedule of Rates. The specification for works not covered PWD (WB) Schedules, DSR or Schedule of MES,CPWD shall be followed. Items of Works not covered in the above schedules should be governed by I.S.I code of Practice, National Building Code , technical specifications as laid in this tender document, and as per best practice according to the Engineer-in-Charge and the Consultant.

1. EARTH WORK

1.1 SCOPE OF WORK

The works covered by this section of the specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with earthworks of all underground supplies and services and for all structural units, stock piling, of specifications and applicable drawings, and subject to terms and conditions of the contract. The scope of this section of specifications is also covered with detailed specifications as laid down herein.

1.2. GENERAL CONSIDERATIONS

1.2.1. The Contractor shall acquaint himself with the nature of the ground, existing structures, foundations and subsoil, which might be encountered during excavation of earthworks. The Employer does not guarantee or warrant in any way that the material to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the report, drawings or in any other contract documents or to material obtained from boring or trail holes. The contractor shall be deemed to have made local and independent inquiries and shall take the whole risk of the nature of the ground subsoil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.
1.2.2. All excavations, cutting, and fills shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the period of maintenance the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the period of maintenance any damage or defects in cuttings and fills, structures and other works, caused by slips, falls or basins or any other ground movement due to the Contractor's negligence shall be made good by the Contractor at his own cost.

1.2.3 Before excavation is started, the area coming under cutting / excavation shall be thoroughly grubbed and cleared off shrubs, vegetation, grass, bush wood, debris, trees / sapling of girth upto 300 mm. The roots shall be removed upto depth of 600 mm below ground. The rubbish shall be removed outside the site as directed by the Engineer-in-charge.

1.3. APPLICABLE CODES

The following Codes shall be followed:

1.3.2. IS: 1498-1970 Classification and identification of soils for general engineering purposes.
1.3.3. British Standard 1377-Methods of test for Soils for Civil Engineering Purposes.
1.3.4. British Standard 5930- Code of Practice for Site Investigations.
1.3.5. IS: 1200 for method of measurement of building works.( Item for Excavation and Earth Work .The Item shall be measured as per plan area of PCC, working space shall not be taken into measurement, deemed to be included into rates)
1.3.6. Local Building Regulations and Statutory Regulations.

1.4. SITE PREPERATIONS

1.4.1. The Contractor shall set out the works and shall be responsible for true and perfect setting out of the same and for correctness of the positions, levels, dimensions and alignments of all parts thereof. If at any time any error in this respect shall appear during the progress of the works, the Contractor shall, at his own expense, rectify such error, to the satisfaction of the Engineer-in-charge. The Contractor shall construct and maintain accurate benchmarks so that the engineer-in-charge can easily check the lines and levels.

1.4.2. The Contractor shall Construct and maintain such ditches, in addition to those shown on the plans, as will adequately facilitate drainage of areas under construction.

1.4.3. The Contractor shall perform a joint survey with the Engineer-in-charge's representative of the area where earthwork is required, plot the ground levels on the drawings and obtain approval from him before starting the earthwork.

1.5. DETAILED METHODOLOGY

1.5.1. EXCAVATIONS

1.5.1.1. Excavation shall include the removal of all material of every name and nature. Excavations shall be carried out in accordance with excavation plans and sections shown on the Drawings and as directed by the engineer-in-charge.
1.5.1.2. The major portion of excavations shall be carried out by mechanical excavators and excavated materials disposed off to stock on spoil as per drawings or as directed by the engineer-in-charge. The excavation, which cannot be done by mechanical means including leveling, trimming and finishing to the required levels and dimensions shall be done manually. The material suitable for fill and back fill shall be stock piled within the free haulage limit of the boundary of the works.

1.5.1.3. The Contractor shall give reasonable notice that he intends to commence any excavation and he shall submit to the engineer-in-charge full details of his proposals. The engineer-in-charge may require modifications to be made if he considers the Contractor's proposals to be unsatisfactory and the Contractor shall give effect to such modifications but shall not be relieved of his responsibility with respect to such work.

1.5.1.4. For major excavations, the Contractor shall submit for the prior approval of the engineer-in-charge full details and drawings showing the proposed method of supporting and strutting etc. The design, provisions construction, maintenance, and removal of such works shall be the responsibility of the Contractor and all cost in these respects shall be included in his quote.

1.5.1.5. The Contractor's attention is drawn particularly to his obligations under the general conditions in respect of those works which are in close proximity to existing buildings.

1.5.1.6. The Contractor shall preserve the complete excavation from damage from slips and earth movements, ingress of water from any source what so ever and deterioration by exposure to the sun and the effects of the weather.

1.5.1.7. All excavation of every description, in whatever material encountered shall be performed to the elevations and dimensions shown on the drawings in such a manner as to avoid interruption to work in other parts of the site. The Contractor shall be responsible for injury to the permanent works caused by excavation on other parts of the works.

1.5.1.8. Excavation shall extend to sufficient distance from walls and footing to allow for placing and removal of forms, installations of services and for inspection, except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces. Undercutting will not be permitted. The additional excavation for placing and removal of forms, installation of services, for inspection and generally for working area on slopes for stability shall not be measured for payment and shall be deemed to be included in the rates for excavation as measured net.

1.5.1.9. All excavations in foundations shall be taken to 150mm and shall be trimmed carefully to a smooth and level surface, immediately after trimming to the final elevation a layer of building concrete shall be placed to the thickness shown on the drawings. All excavations for foundations which have been trimmed and disturbed shall be compacted and covered by concrete by the end of the day. It is specifically brought to the notice of the Contractor that any excavation taken down to the trimmed elevation which is left overnight or for any length of time thereafter, uncovered by the blinding concrete, shall be required to be trimmed to such lower elevation as directed by the engineer-in-charge and any extra work or any consequent increase in the quantities caused thereby shall not be paid to the Contractor.

1.5.1.10. No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the engineer-in-charge and his permission to proceed given.

1.5.1.11. If excavation for sub-structures is carried below the required level, as shown in the drawings or as directed by the engineer-in-charge, the surplus depth shall be filled in with concrete of same grade as of blinding concrete at the sole cost of the Contractor.

1.5.1.12. All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry and
the Contractor shall have sufficient equipment for this purpose. Adequate precautions shall be taken to prevent any corrosion due to undercutting from underneath the previously constructed adjoining foundations.

1.5.1.13. Shoring, where required during excavation, shall be installed to protect the bank, adjacent paving, structures and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor elects to adopt, with prior approval of the engineer-in-charge, for upholding the sides of excavation and also for planking and strutting to excavation against the side of roadways and adjoining properties in existing hardcore of any other material. The Contractor will be held responsible for upholding the sides of all excavations and no claim for additional excavation, concrete or other material will be considered in this respect.

1.5.1.14. Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation and that are to be retained, as well as utility lines constructed during excavation and backfilling, and if damaged, shall be required to be repaired by the Contractor at his expense. Any existing utility lines which are not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired by the Contractor and adjustment in payment will be made as approved by the engineer-in-charge. When utility lines which are to be removed, are encountered within the area of operations the Contractor shall notify the engineer-in-charge in ample time for necessary measures to be taken to prevent interruption of the service.

1.5.1.15. Excavated material suitable for use as filling material shall be stock piled within the free haulage limit to 100m from site of works as directed by the engineer-in-charge. This stock piled material shall be transported back to places requiring fill or backfill. Surplus or material unsuitable for use as filling shall be disposed of by the Contractor at locations approved by the engineer-in-charge within specified haulage limit of 8 Kms.

1.5.1.16. The excavation work shall include excavation in above water table and excavations below water table. The Contractor shall submit the proposal for dewatering from the areas of excavation for the approval of Engineer and shall provide all plant, equipment, pumps, sheeting, and well points as required to keep the water table below 1.0m from the deepest foundation as shown on the drawings till the completion of foundation works.

1.5.1.17. The Contractor shall make independent inquiries and perform and make independent observations to ascertain the water table in the areas of excavations during the period when the construction works are in progress. The Contractor shall take whole risk of any nature for fluctuation of the water table from his own findings. The Employer is not bound in any way and shall not be responsible for any information given by him or any information, observations or values obtained from his reports, drawings and documents.

1.5.1.18. Excavation for pits, cable trenches and equipment foundation and other structures shall be taken out to the levels and dimensions as the engineer-in-charge may direct.

1.5.1.19. Before starting the excavations, the Contractor shall ensure the correct alignment of the pipe line on the ground, the depth and width of excavation of the trench, all in accordance with the drawings and instructions of the engineer-in-charge. The Contractor shall make profiles with cement concrete pillars.

1.5.1.20. Excavation shall be carried out true to line, grade and width as shown on the drawings or as directed by the engineer-in-charge ensuring proper laying of the pipe line, the bedding fill, construction of chambers for appurtenant and any other structures. The trench bottom shall be graded to provide even and substantial bearing.

1.5.1.21. The Contractor at his cost shall provide to the satisfaction of the engineer-in-charge all timbering, approved supports and shores and bracings to the sides of the excavated trench and foundations in such a manner to secure the sides of the trench and excavations from falling or adverse
movement. All responsibility connected with such shoring shall rest with the Contractor. Adequate clearance / working space on both sides of the structure/pipeline shall be provided for which no payment shall be made.

1.5.1.22. Without the written permission of the Engineer-in-charge no more than 50.0m the trench shall be opened in advance of the completed pipeline.

1.5.1.23. The bottom of all excavations shall be carefully leveled. Any pockets of soft or loose material in the bottom of the pits and trenches shall be removed and the cavities so formed filled with lean concrete at the Contractor's expense.

1.5.1.24. The engineer-in-charge may require the Contractor to excavate below the elevations shown on the drawings or he may order him to step above the elevations shown depending upon the suitable foundation material encountered.

1.5.1.25. If for any reasons, the levels grades or profiles of the excavations are changed adversely, the Contractor shall at his own cost be liable to bring the excavations to the required levels and profiles as shown on the drawings or as directed by the engineer-in-charge.

1.5.1.26. Dewatering

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Engineer-in-charge, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Engineer-in-charge to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved be the Engineer-in-charge. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a build up of water in the opinion of the Engineer-in-charge obstructs the progress of the work, leads to unsanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

1.5.1.27. Timbering / Planking and Strutting

When the depth of a trench in a soft but firm soil exceeds 1.5 mtr., stepping, sloping, and or planking and strutting of side shall be done as order in writing by Engineer-in-charge. In case of loose and slushy soil/sandy soil, the depth at which these precaution are to be taken shall be determined by Engineer-in-charge according to the nature of soil.

It shall be the responsibility of the contractor who shall take all necessary steps to prevent the side of trenches from collapse. Regarding the necessity or otherwise of timbering or any other safety measure, the contractor shall be responsible to obtain the decision of the Engineer-in-charge, in writing, failing
which the contractor shall be liable for any damage for due to non adoption of proper timbering for other
safety measure.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining
structures or for any other reasons and where the planking across sides of excavations/pits cannot be
strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from
such struts shall be suitably distributed on the bed to ensure no yielding of the strut. If however,
Engineer-in-charge directs any timbering to be left-in, keeping in mind the type of construction or any
other factor, Contractor shall be paid for at the scheduled item rate for such left-in timbering.

Unless otherwise separately provided for in Schedule of Quantities, the timber shoring is deemed to
have been included in the unit rates quoted for excavation. If separately provided for, then the actual
effective area of shored faces as approved by Engineer-in-charge shall be measured in sq. mtrs. The
area of planking embedded in the bed/sides of excavation will not be considered, nor the area supporting
inclined struts in case of large pits/open excavation. All planks, boards, wallings, verticals, struts, props
and all other materials required for shoring and subsequent safe dismantling and removal shall be
included in the quoted unit rates.

**1.5.2. EXCAVATION TOLERANCES**

Excavation shall be performed within the tolerances for excavation limits indicated on the drawings.
Where no tolerance limits are indicated excavation shall be performed to tolerances established by the
engineer-in-charge as accepted for the design and type of work involved.

**1.5.3. BACKFILLING**

1.5.3.1 After completion of foundation footing, foundation, walls, and other construction below the
elevation of the final grades and prior to backfilling, forms shall be removed and the excavation shall be
cleaned of trash and debris.

1.5.3.2 The backfilling shall include filling under the floors, around the foundations, trenches, pipes,
conduits, ducts and channels and bedding for pipes.

1.5.3.3 The backfilling work shall include loading, unloading, transporting, placing, stocking, spreading of
earth, watering, rolling, ramming and compacting complete as specified herein.

1.5.3.4 Filling shall be approved selected material from excavation or other predominantly granular
material and free from slurry, mud, organic or other unsuitable matter and capable for compaction by
ordinary means.

1.5.3.5 The excavated material if found suitable shall be stock piled within the free haulage limit of the
site of the works. This material shall be used for backfilling if approved by the engineer-in-charge and
shall be transported by the Contractor anywhere required for the purpose of backfilling work in this
contract.

1.5.3.6 The Contractor shall provide the approved quality fill and backfilling material as required to
complete the fill/backfilling work.

1.5.3.7 Filling in trenches and foundation shall be placed in 150 mm layers and compacted at optimum
moisture content by mechanical means or other means as approved by the engineer-in-charge.

1.5.3.8 Fill in around pipes and cables shall be carefully placed with fine material to cover the pipe or
cable completely before the normal in filling is done.
1.5.3.9 Material for back filling shall be as approved by the Engineer-in-charge and shall be placed in layers of 150 mm measured as compacted material and saturated with sufficient water and compacted to produce in-situ density not less than 95% of the maximum density at optimum moisture content, achieved in Test No.15 of BS 1377:1975 or similar clause of relevant IS Code.

1.5.3.10. All filled areas shall be left neat, smooth and well compacted with the top surface consisting of the normal site surface soil unless otherwise directed.

1.5.3.11. Depending on the depth of fill the engineer-in-charge may instruct increased thickness of successive layer to be placed.

1.5.3.12. Fill shall not be placed against foundation walls prior to approval by the engineer-in-charge. Fill shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the fill shall not be operated closer to the wall than a distance equal to the height of the fill above the top of footing.

1.5.3.13. In case the Contractor is instructed to arrange for the fill material the quality of the fill material will be subject to the approval of the engineer-in-charge. The engineer-in-charge may require the Contractor to carry out various tests of the fill material. All such tests shall be made at an approved laboratory at the cost of the Contractor. Once a material from a specific source has been approved, the material for the same quality and from that source only shall be used. Any fill material from borrow pits which has not been approved or the quality of which differs from the approved material shall be rejected outright. The engineer-in-charge reserves the right to order removal of any such materials brought to the site of works at his discretion at Contractor's expense. in order to ensure satisfactory compaction, it will be necessary to carry out, depending upon the type of material, particle size distribution tests, determination of organic content tests, maximum and minimum density tests and determination of optimum moisture content for the filling material.

1.5.3.14. The method of compaction, namely type of compactor, type of roller, weight of roller and number of passes proposed by the Contractor for any particular fill material shall be subject to the approval of the engineer-in-charge after completion of satisfactory field tests, subsequent to the laboratory analyses, using the materials and equipment proposed to be used for the earth work in conditions similar to those likely to be encountered during construction. The final selection of the soil moisture content, the thickness of layers, the type of compaction equipment and the number of passes shall be decided after these tests, which shall be conducted at Contractor's expense.

1.5.3.15. Having established the method of compaction to be used, no departure from this approved method shall be permitted without the prior approval of the engineer-in-charge. Adequate control of the fill and compacting operations shall be ensured by in-situ density tests and in order to obtain significant results, not less than two measurements shall be carried out per one hundred square meters of area compacted. The frequency of tests shall be determined on site and may be varied at the discretion of the engineer-in-charge. Compaction shall not be less than 95% in-situ density with respect to the maximum density, at optimum moisture content.

1.5.3.16. The exact thickness of layers and the method of placing and compacting the fill shall be determined by the field tests, as stated above, but not withstanding the results of these trails, fill shall not be placed in layers exceeding 150 mm in thickness. In order to maintain control of the thickness of layers, timber profiles shall be used wherever feasible. The travelers of such profiles for each layer of fill shall be checked by the supervisory staff of the engineer-in-charge. The Contractor shall provide adequate supply of water and sufficient capacity of mechanical water carriers to ensure uniform and uninterrupted operation of compaction. The engineer-in-charge may forbid the Contractor to proceed with placing and/or compaction of fill and/or order removal and re-compaction of such fill when he finds that the Contractor has insufficient or defective equipment or that the fill has been improperly laid and/or compacted.
1.5.3.17. If it is found necessary to alter the moisture content of the fill material in any way, then very strict control shall be exercised over the wetting and/or the drying process and frequent moisture content tests.

1.5.3.18. The fill material should be well graded non-cohesive and nearly silt-free (silt content between 5 to 10 percent) salt free and free of organic materials (less than 2%). It should also be free of stones. It should be of such nature and characteristics that it can be compacted to the specified densities in reasonable length of time. It shall be free of plastic clays, of all materials subject to decay, decomposition or dissolution and or cinder or other material which corrode piping and other metals.

**SAND**
Sand shall be clean and free from dust, organic and foreign matter and corresponding to grading Zone V or IV, meeting the approval of the Engineer.

**MOORUM**
Moorum shall be of approved quality and shall be brought from approved source.

**FILLING WITH SAND**
At places where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours and drained to ensure maximum hydraulic compaction. Any temporary work required to contain sand under flooded condition shall be on Contractor’s account. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer-in-charge has inspected and approved the fill.

1.5.4. **TOLERANCES**

The stabilization of compacted backfill/fill surfaces shall be smooth and even and shall not vary more than 100mm in 3 meters from true profile and shall not be more than 12.5mm from true elevation.

1.5.5. **DISPOSAL OF SURPLUS MATERIAL**

1.5.5.1 The rejected unsuitable material and surplus excavated material shall be disposed of beyond the compound in conformity with the municipal / corporation rules for such disposal, loading into truck and cleaning the site in all as directed by the engineer-in-charge.

1.5.5.2 The disposal of surplus excavated material shall include loading, unloading, transporting, stacking, spreading as directed by the engineer-in-charge.

1.5.5.3. All excavated material not so used shall only be disposed of in areas identified by the Contractor approved by the engineer-in-charge. Such areas will be well drained and the deposited material left in a tidy and stable condition subject to approval of E-I-C.

1.6. **ROUTINE TESTS**

1.6.1. Testing of fill materials:

1.6.1.1. Tests shall have to be executed by an independent testing agency at the cost of the agency if desired by E-I-C.
1.6.1.2 Tests should comply with the following IS Standards.
1.6.1.3. Sampling
1.6.1.4. Sample preparation
1.6.1.5. Sieve analysis
1.6.1.6. Liquid limits
1.6.1.7. Plastic limit and plasticity index
1.6.1.8. Moisture content
1.6.1.9. Moisture density relationship
1.6.1.10. Sand equivalent
1.6.1.11. Specific gravity
1.6.1.12. Sand core density
1.6.1.13. Rubber balloon density
1.6.1.14. Classification
1.6.1.15. Carry out moisture density tests on representative samples prior to placing.
1.6.1.16. Carry out gradation of materials prior to placing as the work proceeds.
1.6.1.17. Carry out site density tests of materials as the work proceeds and as follows:

1.6.2. FREQUENCY OF TESTS
1.6.2.1.. One test for each 500 Cum. placed for structural fill and 3000 Cum for general fill.
1.6.2.2. One tests whenever there is a change of gradation or placement conditions.
1.6.2.3. Execute site density tests for compaction at a minimum depth of 100 mm below compacted surface.
1.6.2.4. Execute a gradation test with each site density test and whenever there is an apparent change in material being placed.
1.6.2.5. Execute the following site density tests and laboratory moisture density tests to evaluate compaction achieved:
   One test for every 200-400 cu.m. of backfill in trenches or surrounding structures.
   One test for every full shift of compaction operations on mass earthwork.

1.7. MODES OF MEASUREMENTS

1.7.1. GENERAL

Except otherwise specified herein or elsewhere in the Contract documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the bill of quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the bill of quantities.

1.7.1.1 Dewatering, where required, to keep the foundation trenches dry during construction of works.
1.7.1.2 Timber shoring, planking, strutting and providing slope for up-holding the sides of excavations.
1.7.1.3 Any fill with approved material necessitated because of over excavation due to fault or negligence of the Contractor.
1.7.1.4 Stock piling of the excavated material at approved locations with 300m free haulage limit and transporting back suitable material to places requiring fill or backfill.
1.7.1.5 Specified foundation bed preparation.
1.7.1.6 Excavation involved in providing sufficient working space around sides of foundation and service line trenches.
1.7.1.7 Providing approved quality fill/backfill material from outside sources. Royalty for borrow areas and haulage of material shall not be paid for separately.
1.7.1.8 Rolling, leveling, watering and compacting the fill and backfill to required density.
1.7.1.9 All laboratory and field tests stipulated in these specifications.
1.7.1.10. Disposal of rejected unsuitable and surplus excavated material within 200m free haulage limit measured from the fence boundary of site of works following the shortest route as directed by the engineer-in-charge.

1.7.2 EXCAVATION

1.7.2. MEASUREMENT

Quantities of excavation shall be calculated / measured from the pre-work levels of natural ground taken jointly by the Contractor and the engineer-in-charge before commencement of the work.

The quantities set out for excavation and its subsequent disposal shall be deemed to be the bulk before excavating and no allowance shall be made for any subsequent variations in bulk or for any extra excavation unless otherwise shown on the drawings quantity of excavation shall be measured on the basis of vertical excavations required for the nominal concrete dimensions of the structural members of foundations. Lean concrete shall not be construed as structural concrete.

Quantities of excavation for service line trenches shall be measured for payment on the basis of vertical excavation faces for the specified width as shown on the drawings. Measurement for acceptably completed excavation works shall be made on the basis of number of cubic meter of material excavated for foundation and service trenches as shown on the drawings or as directed by the engineer-in-charge.

1.7.3. BACKFILL / FILLS

1.7.3. MEASUREMENT

Measurement for acceptable completed backfill/ fill works shall be made on the basis of number of cubic meter of compacted backfill/ fill in position, or as shown on the drawings or as directed by the ENGINEER-IN-CHARGE.

2. ANTI-TERMITE TREATMENT

2.1. GENERAL CONSIDERATIONS

2.1.1. All the buildings shall be adequately protected against attack by sub terrain termites by suitable chemical treatment measures. The work shall be carried out by a specialist pest control agency approved by engineer-in-charge. The work to be carried out by the specialist firm shall carry a guarantee for the satisfactory performance of the treatment for a min. Period of ten (10) years.

2.1.2. Prevention of termite from reaching the superstructure can be achieved by creating a chemical barrier between the ground and the building by treating the soil beneath the building and around the foundations. To have proper check for uniform, spraying of chemical, graduated containers shall be used. Proper check should be kept that the specified quantity of chemical is used for the required area during the operation.

2.2. APPLICABLE CODES

The Anti termite treatment shall be carried out generally in accordance with the stipulation laid down by the following:

IS 6313 (Part I) - Code of practice for anti termite measures in buildings Constructional Measures

IS 1200 (Part I) – Method of Measurement of buildings and civil engineering works
2.3. SITE PREPERATIONS

In order to ensure uniform distribution of the chemical emulsion and to assist penetration, the following site preparation shall be carried out:

2.3.1. Remove all trees, stumps, logs, or roots from the building site.

2.3.2. Remove all concrete formwork if left anywhere, leveling pegs, timber off cuts and other building debris from the area to be treated.

2.3.3. If the soil to be treated is sandy or porous, preliminary moistening will be required to fill capillary spaces in order to prevent the loss of emulsion through piping or excess percolation.

2.3.4. In the event of water logging of foundation, the water shall be pumped out before application of chemical emulsion and it should be applied only when the soil is absorbent.

2.3.5. Surface areas to receive the anti-termite treatment should be suitably leveled and compacted strictly in accordance with the manufacturers’ recommendations. All cutting, trenches and excavation should be completed with back filling in place. Borrowed fill must be free from organic debris and shall be well compacted. If this is not done, supplementary treatments should be made to complete the barrier.

2.4. MATERIAL SPECIFICATIONS

The earth filling immediately under the soling (under floors) bottom and side fills of all foundations (excepting foundations) and soil along external perimeter of all buildings shall be chemically treated against termites. The chemical to be used for the treatment shall be Dieldrin, Aldrin, Heptachlor or Chlordane or as specified conforming of the requirement and concentration lay down in IS 6313 (Part II) - latest edition.

MOUND TREATMENT
For a mound volume of about one cubic meter, four litres of an emulsion in water with 0.50 percent Chloropyrifos may be used

SOIL TREATMENT
1.0 % of Chlorpyrifos emulsifiable concentrates (IS 8944) in water emulsion is effective when applied uniformly over the area.

2.5. DETAILED METHODOLOGY

2.5.1. TIME OF APPLICATION

Soil treatment shall start when foundation trenches and pits are ready to take mass concrete in foundations. Lying of mass concrete shall start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or when soil is wet with rain or sub-soil water. The foregoing applies also in the case of treatment to the filled earth surface within the plinth before laying the sub grade for the floor.
2.5.2. DISTURBANCE

The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.5.3. TREATMENT OF COLUMN-PITS, WALL-TRENCHES AND BASEMENT- TANKS

EXCAVATION.

2.5.3.1. The bottom surface and the sides (up to a height of above 300 mm) of the excavation made for column pits, wall trenches and basements shall be treated with the chemical at the rate specified in IS 6313 (1981) Part II of 1981.

2.5.3.2. After the column foundations and the retaining wall of the basement come up, the backfill in immediate contact with the foundation structure shall be treated at the rate specified in IS 6313 of the vertical surface of the sub-structure for each side. If water is used for ramming the earth fill, the chemical treatment shall be carried out after the ramming operation is done by rodding the earth at 150mm centers close to the wall surface and spraying the chemical with the above dose. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that the earth in contact with these surface is well treated with the chemicals.

2.5.3.3. In the case of R.C.C. framed structures with columns and plinth beams and R.C.C. basements/ tanks with concrete mixes rich and dense (being 1:1.5:3 or richer), it is unnecessary to start the treatment from the bottom of excavation for columns and plinth beams. The treatment shall start at the depth of 500mm below ground level. From this depth the back-fill around the columns, beams and R.C.C basement wall shall be treated at the rate as per IS 6113 Part II. The other details of treatment shall be as laid down in the clause 3.6.2 above.

2.5.4. TREATMENT OF TOP SURFACE OF PLINTH FILLING

The top surface of the filled earth within plinth wall shall be treated with chemical emulsion at the rate as per IS 6313 Part II (surface area) before the sand/sub grade is laid. Holes up to 50 to 75mm deep at 150mm centers both ways shall be made with crowbars on the surface to facilitate saturation of the soil with chemical emulsion.

2.5.5. TREATMENT OF INNER WALL SURFACES

To achieve continuity of the vertical chemical barrier on inner wall surfaces from the ground level, small channel 30 x 30mm shall be made at all the junctions of wall and columns with the floor (before laying the subgrade) and rod holes made in the channel up to ground level 150mm apart and the chemical emulsion poured along the channel as per rate of application, mentioned in IS 6113 Part II (1981) so as to soak the soil right up to bottom. The soil shall be tamped back into place after this operation.

2.5.6. TREATMENT OF SOIL ALONG EXTERNAL PERIMETER OF BUILDING

During progress of work, provide holes in the soil with iron rods along the external perimeter of the building at intervals of about 150mm and depth 300mm and filling these holes with chemical emulsion at the rate (as per IS 6313 Part II) per meter of perimeter of the external wall.

2.5.7. TREATMENT FOR EXPANSION JOINTS

Anti-termite treatment shall be supplemented by treating through the expansion joint after the sub-grade has been laid as per IS-6313 Part II of 1981. The soil beneath the expansion joints shall receive special attention when the treatment under 2.5.3 above is in progress. This treatment shall be supplemented by
treating through the expansion joint after sub-grade has been laid at the rate of 2 liters per meter length of the expansion joint.

2.6. WORKMANSHP

Only professionals with min. 5 years experience in this type of work shall be employed to carry out the anti-termite treatment required.

2.7. EQUIPMENT AND ACCESSORIES REQUIRED

To facilitate proper penetration of the chemical into the soil, a pressure pump of adequate capacity and sprayers shall be employed to apply the solution.

2.8. MODES OF MEASUREMENTS

The measurements shall be made in square meter on the basis of plinth area of the building at ground floor only for all operations described in schedule of quantities. Nothing extra shall be measured. The rate shall include cost of all material and labour involved in all operations described above.

2.9. SAFETY PRECAUTIONS

2.9.1. PRECAUTIONS DURING TREATMENT

2.9.1.1. Utmost case shall be taken to see that the chemical barrier is complete and continuous. Each part of the area shall receive the prescribed dosage of chemical emulsion

2.9.1.2. The treatment should not be carried out when it is raining or when the soil is wet with rain or sub soil water.

2.9.1.3. Once formed, the treated soil barrier shall not be disturbed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.9.2. PRECAUTIONS FOR HEALTH HAZARDS AND SAFETY MEASURES

2.9.2.1. All chemicals used for anti-termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapors or spray mists or swallowed. Person using or handling these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully the safety precautions given below.

2.9.2.2. These chemicals are usually brought to site in the form of amplifiable concentrates. The containers should be clearly labeled and should be stored carefully so that children and pets cannot get at them. They should be kept securely closed.

2.9.2.3. Particular care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided. Workers should wear clean clothing and should wash thoroughly with soap and water, especially before eating and smoking. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water. If chemicals splash into the eyes they should be flushed with plenty of fresh water and immediate medical attention should be sought. The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed nearby during the mixing. Care should be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs that serve as sources of drinking water.
2.10. GUARANTEE

2.10.1. On completion of the treatment in all respects, a guarantee that the building is safe from subterranean species of termite infestation for a period of 10 years is required on stamp paper in a format which shall be approved by the employer who shall have the final decision.

2.10.2. In the event of re-infestation of the said structure at any time during guarantee period, an undertaking is required to carry out such treatment as may be necessary to render the structure free from termite infestation without any extra cost including any remedial work, resulting sleeves, cutout etc.

3. CONCRETE WORK

3.1. SCOPE OF WORK

The work covered by this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials, and in performing all operations in connection with the supply and installation of plain and reinforced concrete work, complete in strict accordance with this section of the Specifications and relevant documents, subject to the Conditions of the Contract.

3.2. GENERAL CONSIDERATIONS

3.2.1. Full co-operation shall be given to other agencies, if any, to install embedded items and/or any associated services.

3.2.2. Embedded items shall have been inspected, and tests for concrete and other material or for mechanical operations shall have been completed and approved, before concrete is placed.

3.2.3. Formwork shop drawings shall be designed and prepared by the Contractor at his own cost. Approval of shop drawings as well as those of mock-ups /actual samples of finished concrete shall be obtained before Work is commenced.

3.2.4. Contractor shall prepare BAR BENDING SCHEDULES, and get the same approved by the engineer-in-charge, prior to commencement of work.

3.3. APPLICABLE CODES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS - 299</td>
<td>Specification for Ordinary, rapid hardening and low heat Portland Cement</td>
</tr>
<tr>
<td>IS - 455</td>
<td>Specification for Portland blast furnace slag Cement</td>
</tr>
<tr>
<td>IS - 1489</td>
<td>Specification for Portland pozzolona Cement</td>
</tr>
<tr>
<td>IS - 4031</td>
<td>Method of physical tests for hydraulic Cement</td>
</tr>
<tr>
<td>IS - 650</td>
<td>Specification for Standard sand for testing of Cement</td>
</tr>
<tr>
<td>IS - 383</td>
<td>Specification for Coarse and Fine aggregate for use in mass concrete</td>
</tr>
<tr>
<td>IS - 515</td>
<td>Specification for natural and manufactured aggregate for use in mass concrete.</td>
</tr>
<tr>
<td>IS - 2387</td>
<td>Method of test for aggregates for concrete.</td>
</tr>
</tbody>
</table>
IS - 516  Methods of test for strength of concrete.
IS - 1199  Methods of sampling and analysis of concrete
IS - 3025  Methods of sampling and test (physical and chemical) for water used in industry.
IS - 2645  Specification for integral cement water proofing compounds
IS - 1791  Specification for batch type concrete mixers
IS - 2438  Specification for roller pan mixer
IS - 2505  Specification for concrete vibrators, immersion type
IS - 2506  Specification for screed board concrete vibrator
IS - 2514  Specification for concrete vibrating tables
IS - 3344  Specification for pan vibrators
IS - 4656  Specification for form vibrators
IS - 2722  Specification for portable swing weigh batchers for concrete (single & double bucket type)
IS - 456  Code of practice for plain and reinforced concrete
IS - 1343  Code of practice for prestressed concrete
IS - 3370  Code of practice for concrete (Part I to IV structures for storage of liquids
IS - 3935  Code of practice for composite construction
IS - 3201  Criteria for design and construction of precast concrete trusses.
IS - 2210  Criteria for the design of R.C. shell structures and folded plates.
IS - 3558  Code of practice for use of immersion vibrators for consolidating concrete
IS - 3414  Code of practice for design and installation of joints in buildings
IS - 2571  Code of practice for laying in situ cement concrete flooring

In addition to the above mentioned codes the engineer-in-charge may specify any other standard for special materials and construction.

3.4. SUBMITTALS

3.4.1. MATERIALS REPORTS

Prior to start of delivery of materials required for cement concrete the following shall be submitted by the Contractor to the Engineer for approval.

i) Recommended suppliers and/or sources of all ingredients for making concrete including cement, fine and coarse aggregates, water and additives including samples thereof.
ii) Quality Inspection Plan to ensure continuing quality control of ingredients by periodic sampling, testing and reporting to the Engineer on the quality of materials being supplied.

3.4.2. MIX DESIGN

i) The Contractor shall design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements as specified.

ii) Well in advance to commencement of concreting work the contractor shall submit the proposal of mix design and test results from approved laboratory thereof as a report for the approval of the Engineer.

iii) However NKDA reserves the right to adopt a design mix as designed by and reputed educational institution like Jadavpur University, BESU etc. which the contractor needs to adhere to during the work.

3.4.3. PLANT AND EQUIPMENT

The contractor shall submit the proposed programmed, methods and details of plant and equipment to be used for batching, mixing of concrete and transportation of concrete to the Engineer, well in advance prior to start of work. The contractor will have to set up a batching plant within the site prior to start of the work.

3.4.4. CERTIFICATES

i) With each mix design, the Contractor shall submit laboratory test reports on concrete cubes and as well as on ingredients along with manufacturer’s certificates attesting that ingredients have been taken from materials to be used at the actual construction work and conforms to specifications for approval of the Engineer.

ii) In case the source, brand or characteristic properties of the ingredients are required to be varied during the term of the contract, a revised laboratory mix design report shall be submitted to the Engineer.

3.4.5. REPORTS FOR INSPECTION AND TESTING

During concreting operations, the contractor shall conduct inspection and testing as described in relevant subsection hereinafter and all reports thereon shall be submitted in a summary form to the Engineer.

3.4.6. SCHEDULES

The Contractor shall prepare working schedules for dates and quantity, location of pouring of concrete for each item of work and submit same to the Engineer at least 48 hours before commencement of such work.

3.5. MATERIAL SPECIFICATIONS

Before bringing to the site, all materials for cement concrete shall be approved by the Engineer. All approved samples shall be retained in the office of the Engineer before placing orders for the materials with suppliers. The materials brought on to the works shall conform in every respect to their approved samples.

Fresh samples shall be delivered to the Engineer whenever type or source of any material changes. The contractor shall check each fresh consignment of materials as it is brought on to the works to ensure that they conform to the specifications and/or approved samples.

The Engineer shall have the option to have any of the materials tested to find whether they are in accordance with specifications. All bills, vouchers and test certificates which in the opinion of the Engineer are necessary shall be produced for his inspection when required.
Any materials which have not been found to conform to the specifications and not approved by the Engineer shall be removed from the site by the contractor within the time stipulated by the Engineer.

3.5.1. CEMENT

i) The cement used shall be Ordinary Portland Cement conforming to IS 8112: 1989 (43 grade).

ii) Whenever possible all cement of each type shall be obtained each from one constant source throughout the contract. Cement of different types shall not be mixed with one another. Different brands of cement, or the same brand of cement from different sources, shall not be used without prior notification and approval.

iii) The cement shall be supplied either packed in bags or in silos installed for the purpose of supply. Packed cement shall be delivered to the site in original sealed bags which shall be labeled with the weight, date of manufacture, name of manufacturer, brand and type. Cement received in torn bags shall not be used. Moreover bags of cement which vary in weight by more than 3% shall not be accepted.

iv) In fair faced elements, the cement used in the concrete for any complete element shall be from a single consignment. All cement for exposed concrete shall be from the same approved source and uniform in color.

v) With each and every delivery of cement the contractor shall provide the manufacturer’s certificate that the cement conforms to the relevant Indian Standard.

The Contractor shall provide facilities for making 7 days tests from time to time in accordance with IS:3535: 1986, IS:4031 (Latest edition) and IS:4032 : 1985 and shall allow for carrying out such tests as may be required by the Engineer and for reporting the results.

3.5.2. AGGREGATES

i) Aggregates from natural sources shall be in accordance with IS – 383: 1970. The Contractor shall submit to the Engineer certificates of grading and compliance from the suppliers for all consignment of aggregate. In addition from time to time, the Contractor shall test that aggregate at site in accordance with IS – 2386: 1963 (Parts 1, 2 & 3). The contractor shall allow for and provide all necessary apparatus for carrying out such tests and for supplying test records to the Engineer. The aggregates shall be free from salts or other harmful chemical impurities.

ii) The contractor shall ensure that aggregates are free from iron pyrites and impurities which may cause discoloration.

iii) FINE AGGREGATE

a) The fine aggregate shall be pit sand or stone dust or other Badarpur sand as approved by the Engineer. It shall be free from clay, loam, earth or vegetable matter and from salt or other harmful chemical impurities. It shall be clean, sharp, strong, angular and composed of hard silicious material. Fine sand shall be within the limits of Grading Zone-IV given in Table I. When the grading falls outside the percentage limits given for sieve other than 600 micron, 300 micron and 150 micron (I.S.) sieve but not more than 5%, it shall be regarded as falling within this Zone. The 5 per cent shall be summation of excess on all other sieves.
<table>
<thead>
<tr>
<th>I.S. Sieve Designation</th>
<th>Percentage Passing for Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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>

b) For coarse sand the grading of sand as determined by the method prescribed in IS – 2386 (Part-I): 1963 shall be within the limits of Grading Zone III given in Table I. When the grading falls outside the percentage limits given for sieves other than 600 micron, 300 micron and 150 micron (I.S.) sieves but not more than 5 percent, it shall be regarded as falling within this zone. The 5 percent can be excess summation on one or more sieves.

c) The maximum quantity of silt as determined by the method prescribed in I.S - 2386 (Part 2): 1963 shall not exceed 8 percent.

d) COARSE AGGREGATE

a) The coarse aggregate shall be crushed stone, approved river shingle or pit gravel having nominal maximum size of 20 mm and down as approved by Engineer.

b) Coarse aggregate obtained from crushed or broken stone shall be angular, hard, strong, dense, durable, clean and free from soft, friable, thin flat, elongated or flaky pieces.

c) River shingle or pit gravel shall be rounded, sound, hard, clean, nonporous, suitably graded in size with or without broken fragments and free from flat particles of shale, clay silt, loam and other impurities.

3.5.3. WATER

i) Water used in the works shall be potable water and free from deleterious materials. Water used for mixing and curing concrete as well as for cooling and/or washing aggregate shall be fresh and clean, free from injurious amounts of oil, salts, acids, alkali, other chemicals and organic matter.

ii) Water shall be from the source approved by the Engineer-in-Charge and shall be in accordance with clause 5.4 of IS-456: 2000.

iii) Before starting any concreting work and wherever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete for approval of the Engineer. No water shall be used until tested and found satisfactory.

3.5.4. ADMIXTURES AND ADDITIVES

i) Chemical admixtures shall conform to IS-9103:1979 and are not to be used unless permitted by the E-I-C. In case their use is permitted, the type, amount and method of use of any admixture proposed by the contractor shall be submitted to the Engineer for approval.
ii) The contractor shall further provide the following information concerning each admixture to the E-I-C.

a) Normal dosage and detrimental effects if any of under dosage and over dosage.
b) The chemical names of the main ingredients in the admixture.
c) The chloride ion content if any expressed as a percentage by weight of admixture.
d) Whether or not the admixture leads to entrapment of air when used in the manufacturer's recommended dosage.
e) Where two or more admixtures are proposed to be used in any one mix, the manufacturer's written confirmation of their compatibility.

iii) In reinforced concrete, the chloride ion of any admixture used shall not exceed 2 percent by weight of the admixture as determined in accordance with IS-6925: 1973 and the total chloride ion in all admixtures used in concrete mix shall not exceed 0.83 percent by weight of cement.

iv) The admixtures when used shall conform to IS-9103:1979. The suitability of all admixtures shall be verified by trial mixes.

v) The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances.

vi) Retarding admixtures when used shall be based on lignosulphonates with due consideration to clause 5.2 and 5.3 of IS-7861 (Part 1): 1975.


3.6. PROPORTIONING, BATCHING & MIXING OF CONCRETE

3.6.1. PROPORTIONING

AGGREGATE
The proportions, which shall be decided by conducting preliminary tests shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weight batchers conforming to I.S. 2722 capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stockpiles. The grading of coarse and fine aggregate shall be checked as frequently as possible, as determined by engineer-in-charge to ensure maintaining of grading in accordance with the samples used in preliminary mix designs. The material shall be stockpiled well in advance of use.

CEMENT
The cement shall be considered by weight, for design mix.

WATER
Only such quantity of water shall be added to the cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete as per specified water-cement ratio. The water added to the mix shall be such as not to cause segregation of materials or the collection of excessive free water on the surface of the concrete.

DEFINITION OF WATER/CEMENT RATIO
The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix.
The actual water cement ratio to be adopted shall be determined in each instance by Contractor and approved by the engineer-in-charge.

PROPORTIONING BY WATER/CEMENT RATIO

The W/C ratio specified for use by engineer-in-charge shall be maintained. Contractor shall determine the water content of the aggregates as frequently as desired by the engineer-in-charge as the work progresses and as specified in IS 2386 (Part III) and the amount of mixing water added at the mixer shall be adjusted as directed by the engineer-in-charge so as to maintain the specified W/C ratio. To allow for the variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

3.6.2. BATCHING AND MIXING OF CONCRETE

3.6.2.1. The proportions of the materials for the concrete mix as established by the preliminary test for mix design shall be followed for all the concrete in the works and shall not be changed except when specifically permitted by the engineer-in-charge.

3.6.2.2. If approved by the engineer-in-charge concrete may be produced by volume batching the ingredients except the cement. Fine and coarse aggregate shall be proportioned volumetrically by subsequent conversion of the weights of volumes knowing their bulk densities as stipulated in Para 9.2.2 or I.S. 456-2000. All concrete shall be mixed in mechanically operated batch mixers complying with I.S. 1791 of approved make with suitable provisions of correctly controlling water delivered to the drum. The quality of water actually entering the drum shall be checked with reading of gauge or valve setting before starting the job. The test shall be made while mixer is running. The volume of the mix material shall not exceed the manufacturer's rated mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the end of 15 seconds of the specified mixing time. Each batch shall be mixed until the concrete is uniform in colour for the minimum period of 2 minutes after all the materials and water is in the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The weighing gauge of mix shall be periodically checked or as directed by the engineer-in-charge. The contractor should carry any rectifications immediately if found necessary.

3.6.2.3. Mixer and the weight batcher shall be maintained in clean and serviceable condition. The accuracy of the weight batcher shall be periodically checked. Both mixer and the weight batcher shall be set up levelled on firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty. Fine and coarse aggregates shall be weighed separately.

3.6.2.4. Each time the work stops, the mixer shall be cleaned out and before the next mix is commenced, the first batch shall have 10% additional cement.

3.6.3. BATCHING AGGREGATE BY VOLUME

3.6.3.1. Obtain approval before using this method.

3.6.3.2. Batch cement by weight and water by either weight or volume.

3.6.3.3. Measure aggregate in metal container whose depth is not less than their greater width and the size of which is such as to enable the whole to be easily checked.

3.6.3.4. Concrete shall be mixed in concrete mixers until a uniform distribution of the material, and a uniform colour and consistency is obtained.
3.6.3.5. Concrete mixing shall in no case be less than two minutes.

3.6.3.6. Each batch shall be so charged into the mixer that approximately 10% of the water enters the drum before the cement and aggregate. Water shall be added gradually while the drum is in motion, so that all the water is in the drum until the first quarter of the minimum time.

3.6.3.7. The amount of concrete mixed in drum shall not exceed the rated capacity of the mixer and the whole of the material shall be removed before a fresh batch enters the drum.

3.6.3.8. Do not modify the mixed concrete either by addition of water or cement or other means.

3.7. CLEANLINESS

3.7.1 The mixer and handling plant should be washed with clean water at the end of the work and at intervals of 30 minutes during mixing.

3.7.2. If old concrete mix remains in the mixer drum, the drum should be rotated with clean aggregate and water before mixing the cement.

3.8. PLANNING OF CONCRETING OPERATION

3.8.1. Engineer-in-charge shall be informed 24 hrs in advance before the pour of each concrete to allow for inspection of reinforcement, sizes and levels of the members to be concreted, concrete cover, cleanliness, filling of gaps and supporting props.

3.8.2. The spaces to receive concrete should be cleared free from debris and should be free from water. Following issues are to be noted while planning of concrete pours:

3.8.3. Slabs: to be cast in strips and not in alternate bays.

3.8.4. Walls: to be cast in successive pours working away in both directions from the center without shrinkage gaps except for final closure.

3.8.5. Starters: shall be the same as for the main member and shall be vibrated / rammed into place and prepared as for other joints. Starters to be cast for walls monolithically with foundation. In case of columns, they can be cast after concreting of foundation / slab.

3.9. ORDINARY CONCRETE (PLAIN CEMENT CONCRETE)

3.9.1. Ordinary cement concrete where specified shall be used

3.9.2. Proportions 1:3:6, 1:2:4, 1:1.5:3, etc., in the specification refers to the quantity of cement by volume, dry coarse sand by volume, quantity of coarse aggregate by volume.

3.9.3. Cement shall be weighed based on 1 cum. of cement weighs 1440 kgs or 1 full bag of cement 50 kgs corresponding to 35 lts. by volume.

3.9.4. Correction factors to be applied for bulking of sand when the sand is either wet or moist.

3.9.5. Water cement ratio used shall be just sufficient for the workability of concrete.

3.9.6. Minimum strength of concrete shall be obtained as below:
### Comprehensive strength of concrete shall be obtained by testing 15 cm. cubes at 28 days curing.

3.9.7. Testing: 6 cubes shall be taken from any mix, 3 of them to be tested at 7 days, 3 at 28 days.

3.9.8. Strength of concrete at 7 days shall be 2/3rds of the strength of concrete at 28 days.

3.9.9. Strength of concrete at 28 days shall be as mentioned in table above and the criteria for accepting concrete are only the strength of concrete at 28 days.

#### 3.10. REINFORCED CEMENT CONCRETE

RCC comprises of formwork, reinforcement and concrete. Payment of Reinforced Cement Concrete shall be item wise as specified in the BOQ. Concrete shall be classified by its compressive strength at the 28th day. The concrete grade shall be as designated in Table 2 of IS: 456-2000.

Bill of Quantities shall specify various types of concrete aimed to be used in the Project. It shall be the Contractor’s responsibility to carry out Design mixes and approval of the same from the Developers Representative well in advance of the actual pouring of concrete at the Site in the permanent works.

The basic aim of Mix Design shall be to find the most economic proportion of cement, aggregate and water which will give the desired target mean strength of concrete, workability and durability for specified grade of concrete. Also it is important that the Mix should be easily workable with the help of equipment available at the Site. The operations involved are measurement of materials, their mixing, placing, compacting, finishing required and curing. The design shall be carried out strictly to IS Specifications and IS Codes of Practice, namely IS: 456-2000 and S P –23-1982.

In order to ensure that not more than the specified proportions of test results are likely to fall below the characteristic strength, the concrete mix has to be designed for higher average compressive strength for a specified grade of concrete and the same is defined a target mean strength.

#### 3.10.1. DESIGN MIX AND TRIAL MIXES

Design Mix and weigh batching will be done as approved by the engineer-in-charge. The Contractor shall submit to the Engineer-in-charge/ Client the tentative Mix Design it proposes to use at the site.

On receipt of the above, the engineer-in-charge may immediately order to carry out work or site test before the final approval. This shall be done with the mixer, weigh batches, etc. and materials actually used in the Project.

This shall give the Contractor additional chance to check for itself actual workability and make sure that the mix proposed by it will be satisfactory with regards to slump, water-cement ratio and workability.

Test cubes shall be of size 150mm x 150mm x 150mm. These are to be legibly marked with location and date of concreting. Where concrete (in works) is to be vibrated or not vibrated, the cubes are to be cast as per IS Standards.

Where the concrete in the works is un-compacted, the concrete is to be poured into the mould in three layers and compact each layer is to be compacted with a 16mm dia tamping rod. Six (6) cubes shall be taken from each of the three batches to test the mix. Cube shall be cast, stored, cured, transported and tested as per IS:516-1959. The test may be carried out at the Site or at laboratory as approved by the engineer-in-charge.
TRIAL MIX

Within 7 days of signing the contract and before commencing work on site, the agency is to prepare trial mixes for each type of concrete and submit 6 preliminary test cubes from each mix to the testing authority.

The testing authority shall test three test cubes at 7 days and three at 28 days for each type of mix where the difference between the higher and the lowest test results from any one trial mix at 7 days exceeds 15% of the average and any cube weaker than the minimum requirement, make further trial mix is to be made, increasing the proportion of cement if necessary to obtain the required strength.

If any test results from any one-trial mix fails to exceed the minimum strength at 28 days:
- Site materials from which the trial mix was prepared is to be removed.
- New materials are to be provided and prepared and test further trial mixes are to be tested until specified requirements are achieved.
- The Design Mix shall hold good so long as the materials continue to be of the same quality and from the same source. Minor adjustments are to be done daily based on the tests of materials used.

Compression strength on 150mm. Cubes

<table>
<thead>
<tr>
<th>Grade of concrete at 28 days</th>
<th>Preliminary test minimum kg/sq.cm</th>
<th>Work test minimum kg/sq.cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>M10</td>
<td>135</td>
<td>100</td>
</tr>
<tr>
<td>M15</td>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>M20</td>
<td>260</td>
<td>200</td>
</tr>
<tr>
<td>M25</td>
<td>320</td>
<td>250</td>
</tr>
<tr>
<td>M30</td>
<td>380</td>
<td>300</td>
</tr>
<tr>
<td>M35</td>
<td>440</td>
<td>350</td>
</tr>
<tr>
<td>M40</td>
<td>500</td>
<td>400</td>
</tr>
</tbody>
</table>

Control concrete shall be proportioned to obtain the required strength by conducting lab tests using the coarse aggregate, sand and cement based on the design mix.

Control concrete shall have suitable workability for proper consolidation.

At places having heavy reinforcement when compacting concrete is a problem, the control concrete shall be designed with special care to the required strength and workability at no extra cost.

Testing facilities to access the moisture content of aggregate at frequent intervals, testing of concrete cubes and testing of aggregate shall be done at the site by establishing testing laboratories. Concrete shall be weigh batched. The dials of weigh-batching units shall be checked with standard weights periodically.

Under special circumstances the conversion of weights to volumes may be allowed by the Engineer-in-charge.

The minimum cement content to be used for the job is as follows:

<table>
<thead>
<tr>
<th></th>
<th>43 GRADE</th>
<th>53 GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 15</td>
<td>280 Kg/cum</td>
<td>280 Kg/cum</td>
</tr>
<tr>
<td>M 20</td>
<td>318 Kg/cum</td>
<td>290 Kg/cum</td>
</tr>
<tr>
<td>M 25</td>
<td>350 Kg/cum</td>
<td>300 Kg/cum</td>
</tr>
<tr>
<td>Grade of Concrete</td>
<td>Assumed Standard Deviation N/Sq.mm</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------</td>
<td></td>
</tr>
<tr>
<td>M 10</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>M 15</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>M 20</td>
<td>4.6</td>
<td></td>
</tr>
<tr>
<td>M 25</td>
<td>5.3</td>
<td></td>
</tr>
<tr>
<td>M 30</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>M 35</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>M 40</td>
<td>6.6</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** These are minimum quantity of cement to be used irrespective of the design mix.

Further the Contractor has to provide and maintain all the equipment and stock at the Site throughout to carry out the following tests in a small Site laboratory or get these tests done from approved laboratories without extra cost to the Contract.

i) Grading of aggregate
ii) Silt content of sand
iii) Moisture content of aggregate
iv) Slump test of concrete mix
v) Concrete cube test

The Contractor shall maintain full records for all above tests in a register. The format of the records shall be prepared in consultation with the Engineer-in-charge/Client. It shall have full access to the Contractor's site laboratory. The Contractor shall include charges for these in its rates and no extra whatsoever shall be payable on this account of designing, testing, maintaining laboratory, etc.

**3.10.2. ASSUMED STANDARD DEVIATION**

Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in Table below may be assumed.

**3.10.3. STANDARD DEVIATION BASED ON TEST RESULTS**

3.10.3.1. Number of test results - Total number of test results required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results, as early as possible, when a mix is used for the first time.

3.10.3.2. Standard deviation to be brought up to date - The calculation of the standard deviation shall be brought up to date after every change of mix design and at least once a month.

**3.10.4. DETERMINATION OF STANDARD DEVIATION**

3.10.4.1. Concrete of each grade shall be analyzed separately to determine its standard deviation.

3.10.4.2. The standard deviation of concrete to a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified for test strength of sample.

3.10.4.3. Estimated standard deviation $S = \sqrt{\frac{\sum x^2}{n-1}}$ where $n$ = number of sample test results.
3.10.4.4. When significant changes are made in the production of concrete batches (for example changes in the materials used, mix design, equipment of technical control), the standard deviation value shall be separately calculated for such batches of concrete.

3.10.5. MIXING OF CONCRETE

Weigh Batching shall be followed if mixed at the site for all structural concrete works. The Contractor shall provide Concrete Batch Mixers, Vibrators, Weigh Batchers conforming to relevant IS Specifications and from approved and recognized manufacturers. The capacity and number of mixers and vibrators required at the Site from time to time shall be to the approval of engineer-in-charge. No equipment from the site shall be removed without the prior written approval of the engineer-in-charge. The Contractor shall maintain a platform weighing scale of capacity 300 kg with fraction of 100 gm at the site.

The machine will have to be got calibrated by the Contractor once in every two weeks or after 200 cum of concrete whichever is earlier, and records of these calibrations shall be maintained. The dials of the weigh batchers shall be checked with standard weights periodically.

3.10.6. CONSISTENCY

The concrete which will flow freely into the forms and around the reinforcement without any segregation of coarse aggregates shall be used. The consistency shall depend upon the type of vibrator etc. to be used. The controlling factor for the same is the Slump Test.

When considered necessary by the engineer-in-charge, the workability of the concrete shall be ascertained by compacting factor test and VEE BEE consist meter method as per IS:1199-1959.

3.10.7. TEMPERATURE OF CONCRETE

The placing temperature of concrete shall not be more than 38 degrees Celsius. If it is more, the engineer-in-charge may order addition of ice or chilled water to the concrete. Also the Contractor shall take following precautions:
1. Mixer and Weigh Batchers shall be painted white color.
2. Aggregate storing bin shall not be exposed to the sun.
3. Water shall be sprinkled on aggregate well before concreting to keep the temperature low.

Similarly, during the cold weather, concreting shall not be done when the temperature falls below 4.5 Degrees Celsius. The concrete placed shall be protected against by suitable covering. The concrete damaged by frost shall be removed and work redone with no extra cost.

3.10.8. SHRINKAGE CRACKS

Concreting shall be avoided in very warm weather. Under such circumstances, the placed concrete shall be covered with damp Hessian cloth within two hours of placing of concrete.

To achieve good result the concrete shall be immediately covered with a plastic sheet and not allowed to any direct wind contact to eliminate shrinkage cracks.

3.10.9. WORKMANSHIP

All works shall be true to level, plumb and square and all corners and edges in all cases shall be unbroken and neat.

Any work not to the satisfaction of the Engineer-in-charge will be rejected and the same should be rectified or removed and replaced with work of the required standard of workmanship at no extra cost.
3.10.10. TRANSPORTATION

Concrete shall be transported with the help of pumps of sufficient capacity to achieve necessary heights wherever required from the mixer to the place of laying as rapidly as possible by methods which will prevent the segregation or loss of any of the ingredients and maintaining the required workability. The pumps can be either compressor type or boom type. All the pumping equipments have to be maintained and kept operational by the contractor.

3.10.11. PLACING OF CONCRETE

Placing of concrete shall be done using pumps only at all levels. The pumps shall be of sufficient capacity to achieve necessary heights wherever required.

The slump of concrete placed with the help of pumps shall not be more than 100mm unless otherwise instructed by the Engineer-in-charge/ Client. Concreting shall commence only after formwork is approved and reinforcement is recorded and permission to proceed with concreting has been approved in writing from the Engineer-in-charge/ Client.

Formwork should be clean, free from dust, pieces of wood or any other foreign material. It should be treated by form releasing agent prior to the laying of reinforcement and concrete, based on sample approved by the Engineer-in-charge/ Client prior to start of construction at Site. Concrete shall be as gently deposited as is practically possible, in its final position to avoid remanding and shall be so deposited that segregation of aggregates do not occur. In case of deep trenches and footings, it may be done with the help of chutes. Concrete from wheelbarrows shall not be dumped away from the face of concrete already been placed. It shall be dumped into the face of concrete already in place. Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the Engineer-in-charge/ Client. No concreting shall be done within half an hour of the closing time of the day, unless permitted by the Engineer-in-charge/ Client.

Concrete shall not be dropped into position from a height greater than 1.0 meter unless otherwise directed by the Owner/ Employer/ Consulting Engineers/ Consultant. Concrete shall be placed into the forms in layers not exceeding 300 mm (approx.) in thickness. Concrete after placing shall be protected by use of covering as approval by the Owner/ Employer/ Consulting Engineers/ Consultant during first stage of hardening against high winds, hot and/or rain or surface water. No shock or vibration shall be allowed to be imparted to forms supporting fresh concrete.

For concreting of slabs and beams wooden plank or catwalks of chequered MS plates or bamboo mats or any other suitable materials supported directly on the centering by means of wooden blocks or lugs shall be provided to convey the concrete to the place of final deposition without disturbing the reinforcement in anyway. In no case labour or any other persons are allowed to walk over the reinforcement.

In case of columns and walls, it is desirable to place concrete without any construction joints. The progress of concreting in the vertical direction shall be restricted to one meter per hour.

3.10.12. COMPACTION OF CONCRETE

Concrete shall be thoroughly compacted into a dense mass as depositing shall proceed by means of suitable vibrators. The vibrator shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during whole period occupied by placing of concrete. Care should be taken not to over-vibrate the concrete. While vibrating no holes should be visible in concreting. Compaction should be completed before the initial setting time. Compaction shall be done till air bubbles cease to appear. Concrete already set shall not be disturbed by successive vibration.

Hand tamping shall not be permitted. But only in exceptional cases, depending on the thickness of the members and feasibility of vibrating the same, the Engineer-in-charge/ Client may permit hand tamping.
Hand tamping or compaction shall be done with the help of tamping rods so that concrete is thoroughly compacted and completely worked around the reinforcement embedded fixtures, and into the corners of the form work.

The layers of concrete shall be so placed that the bottom layer does not finally set before the top layers are placed. The vibrators are so applied so that the centre of mass is being compacted at the time of placing of concrete.

3.10.12.1 VIBRATION OF CONCRETE:

a) Water Cement Ratio: The water cement ratio (by weight) for all vibrated concrete (except controlled concrete) shall generally be 0.45 and it shall be not varied unless otherwise directed. In respect of “CONTROLLED CONCRETE”, the water cement ratio shall be as determined in laboratory mix design suitable for vibrated concrete.

b) Placing: Concrete shall be placed in layers not over 45 to 60 cm (18 to 24 inches) deep and each layer shall be vibrated into places by methods which will not permit the ingredients to separate. Surfaces shall be smooth and free from voids caused by stone pockets, where necessary vibration shall be supplemented by hard packing to secure these results.

c) Number & Size of Vibrators: (Either Needle or Surface Vibrator) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 3000 impulses per minutes when operating under load. The vibration shall be sufficiently tense to cause the concrete to flow or settle rapidly in the space and visibility affect the concrete over a radius of at least 450 mm (18") when used in concrete having slump of 25 mm. A sufficient number of vibrators (at least one vibrator for a rate of concreting of 1.5 cm (50 cft) per hour shall be employed so that at the required rate of placement, vibration throughout the entire volume of each layer of concrete and complete compaction are secured without segregation.

d) Manipulation of vibration: Internal vibrators shall be kept constantly moving in the concrete and shall be applied at points uniformly placed not further apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of grout from surrounding concrete. The vibration shall be such that the concrete becomes uniformly plastic and there shall be at least 200 seconds of vibrations per sq.ft of surface of each layers of concrete, computed on the basis of visibly affected radius and taking overlap into consideration.

Care shall be taken to ensure that at no time the vibrators and/or vibration action is used to push the concrete ahead. Vibrators shall be applied systematically to overlap zones of influence.

It shall be ensured that the needle vibrators are not applied directly on the reinforcement on the formwork which may destroy the bond between concrete and reinforcement.

When electric vibrators are in use the standby petrol, diesel or kerosene vibrator should always be available at the concreting point.

3.10.13. CONSTRUCTION JOINTS

Construction joint shall be avoided as far as possible. If provided, concreting shall be carried out continuously up to the construction joints as directed by the Engineer-in-charge/ Client and/or at the
location and arrangement shown in the structural drawings. However, the number of such joints shall be kept to a minimum and they shall be as straight as possible.

a) **COLUMNS**:
Joints shall be framed horizontally at the top of foundation and (75 mm) below the lowest soffit of the beams meeting at the head of the column. Concrete in the head of a column where one more beams meet shall be placed without a joint.

b) **BEAMS**:
Concrete in the beams shall be placed without a joint but if the provision of joint is unavoidable the joint shall be vertical and at one third of the span or at position approved by the Owner/ Employer/ Consulting Engineers/ Consultant.

c) **SLAB**:
A joint in the slab shall be vertical and parallel to the principal reinforcement, where it is unavoidable and at right angles to the principal reinforcement the joint shall be vertical and at one third of the span.

d) **TREATMENT OF CONSTRUCTION JOINTS**

i) When work is resumed on the surface which has hardened, the surface shall be roughened. It shall be thoroughly cleaned wetted and covered with a 4 mm layer of cement-sand paste in the ratio of 1:1 added with anti-shrinkage compound like “Convex-100” or similar produce as per manufacturer’s specification. This 4 mm layer of paste shall be freshly mixed and placed immediately before the placing of the concrete.

ii) Where the surface has not fully hardened the laitance shall be removed by scrubbing the wet surface with wire bristle but care being taken to avoid dislodgement of aggregates. The surface shall be thoroughly wetted and all free water removed. Surface shall then be coated with neat cement sand paste as specified above.

iii) Care shall be taken to obtain good bond between the hardened freshly placed concrete. Ramming and moulding of concrete around water bars shall be carefully carried out. Labour and materials for treatment of concrete joints fare to be included in the of respective items.

Before commencement of concreting after a break, adjacent concrete stopper and surfaces shall be cleaned, chipped free of any loose mortar and roughened to expose the aggregate and than brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

3.10.14. **EXPANSION JOINT**

As indicated in drawing or as directed by the engineer-in-charge.

3.10.15. **CURING**

Curing of concrete is most important. There shall be no compromise on this activity as it is for the Contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Engineer-in-charge/ Client. As said above after concrete has begun to harden, i.e. about 1 to 2 hours after laying, it shall be protected from quick drying with moist or damp hessian cloth or any other material approved by the Engineer-in-charge/ Client. After 24 hours of laying of concrete, the surface shall be cured by flooding with water or covering with moist hessian cloth for period of 7 days to keep it moist. For the next seven days surface shall be kept wet all the time by sprinkling water continuously.
In order to properly monitor the curing activity, the Contractor shall write legibly with paint, the date of casting the concrete of each member of the structure which shall remain clearly visible at least till the completion of curing at least.

3.10.16. FINISHING

Concrete surface shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted:

- Roof shall be troweled even and smooth with a wooden float, before the concrete begins to set.
- Surface that will receive plaster shall be roughened immediately.
- Surfaces that will be in contact with masonry shall be roughened immediately.
- Surfaces that will receive floor finishes, tiling, etc. shall be roughened while it is still green.
- Every care shall be taken not to disturb the freshly laid concrete.
- For Ramps and Basements concrete shall be broom-finished.

On finishing standards and quality/ workmanship, the decision of the Engineer-in-charge/ Client shall be final and binding on all parties.

3.10.17. INSPECTION AND CORRECTIVE MEASURES

Immediately on removal of formwork, the RCC surface shall be examined by the Engineer-in-charge/ Client. Till such time, no remedial measures shall be carried out by the Contractor. All remedial actions including breaking, if any, shall be on the instructions of the Engineer-in-charge/ Client. In case of any violation of this rule, the concrete poured stands rejected. The decision of the Engineer-in-charge/ Client in this regard shall be final and binding to all parties.

Sagged, bulged, patched, honeycombed work to an extent detrimental to structural safety or aesthetics according to the engineer-in-charge shall stand to be rejected and the Contractor shall rectify by breaking or redoing, if required, as directed by the Engineer-in-charge/ Client and all expenses incurred due to this shall be to the Contractor’s account.

Surface defects minor in nature may be accepted as a special case by the Engineer-in-charge (but can’t be considered as a precedence) whose decision in this matter is final and binding on the Contractor. Once accepted, the defects shall be rectified as follows and all expenses incurred due to the rectification process, shall be to the Contractor’s account.

3.10.17.1. Surface defects which require repair when forms are removed, usually consist of bulges due to the movement of forms, ridges at form joint, honey combed areas, damage, resulting from the stripping of forms and bolt holes. Bulges and ridges are required to be removed by careful chipping or tooling and the surface is then rubbed with a grinding stone. Honey combed and other defective areas must be clipped out, the edges being cut as straight as possible and perpendicularly to the surface, or preferably slightly undercut to provide a key at the edge of the patch.

3.10.17.2. If permitted in writing by the E-I-C’s Representative, shallow patches are first to be treated with a coat of thin grout composed of one part of cement and one part of fine sand added with polymer modified cementations material as per manufacturer’s specification, and then filled with mortar (mixed with non-shrink additives) similar to that used in concrete. The mortar should be placed in layers not more than 10 mm thick and each layer is to be given a scratch finish to secure a bond with the succeeding layer. The laid layer is finished to match with the surrounding concrete by floating, rubbing or tooling on formed surfaces by pressing the form material against the patch while the mortar is still plastic.

3.10.17.3. Or as an alternative to the above, as directed by the Engineer-in-charge/ Client, the patchwork shall be treated with epoxy based proprietary items like non-shrinking grouts etc. available in the
market. In such cases, the methodology as indicated by the manufacturer of the item shall be followed if permitted in writing by the Engineer-in-charge.

3.10.17.4. Large and deep patches require filling up with concrete held in place with forms. Such patches should be reinforced and carefully drawled to the hardened concrete.

3.10.17.5. Or as an alternative to the above, epoxy based proprietary items like grouts as directed by the Engineer-in-charge/ Client, shall be used. The methodology as specified by the manufacturers shall be strictly adhered to.

3.10.17.6. Holes left by bolts are to be filled with non-shrink grouts, as specified and directed by the Engineer-in-charge/ Client. carefully packed in to places in small amounts. The mortar is mixed as dry as possible to allow enough water to go into it, so that it will be tightly compacted when forced into the place.

3.10.17.7. Tiered holes extending right through the concrete may be filled with mortar or non-shrink grout, as the case may be, with pressure gun.

3.10.17.8. Normally, patches appear darker than the surrounding concrete when uniform surface colour is important, this defect shall be remedied by adding 10 to 20 percent of while Portland cement to the patching mortar, the actual quantity being determined by trial.

3.10.17.9. The same amount of care shall be taken to avoid the material in the patches as with the whole structure. Curing shall be started immediately after packing is done to prevent early drying. A membrane curing compound is these cases will be most convenient.

3.10.18. CRACKS

Cracks observed shall be examined. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to the Engineer-in-charge and the following procedure shall be followed:

3.10.18.1. Cracks not propagating/developing further and according to the engineer-in-charge not detrimental to the strength of the construction shall be grouted with non-shrinking epoxy based cement slurry or as directed by the Engineer-in-charge/ Client.

3.10.18.2. Cracks developing further and felt detrimental to the strength of construction shall be tested as per the relevant Indian Standards.

3.10.18.3. Based on results, the engineer-in-charge shall order remedial measures or order the contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequent works thereto as directed/ specified.

3.10.18.4. Cost of above shall be borne by the contractor if the failure is on its part unless it is due to a design fault, decided at the discretion of the Engineer-in-charge/ Client.

Decision of the Engineer-in-charge/ Client in the matter shall be final and binding on all parties. This decision shall not be open for arbitration.

3.10.19. QUANTUM OF CUBE TESTING

The minimum frequency of cube testing shall be as follows. Each set of sample shall consist of 6 cubes.

<table>
<thead>
<tr>
<th>Concrete Quantity</th>
<th>Number of Sample sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 cum a day</td>
<td>1</td>
</tr>
</tbody>
</table>
Three cubes shall be tested on the 7th day and three cubes on the 28th day.

### 3.10.20. ACCEPTANCE OF WORK

It shall be in accordance with IS: 456-2000, SP-23 and SP-24. The guidance brief is elaborated below. Part or element of work shall be deemed to be accepted, provided the results of the 28th day cube testing confirm to the criteria stated as under:

1. **3.10.20.1.** The average of the three consecutive cubes strength shall not be less than specified strength.
2. **3.10.20.2.** No individual cube strength shall be less than 90% of the specified strength.
3. **3.10.20.3.** If the individual cube strength exhibit more than 133% of the specified strength such a cube shall be specified as freak and the criteria in above two points shall be applied to remaining two cubes and their acceptability determined.
4. **3.10.20.4.** If cubes fail at 7 days, defective concrete can be dismantled, removed and replaced without awaiting 28 day test results.
5. **3.10.20.5.** If the concrete tests fail to meet the acceptance strength required for respective grades of concrete, the Engineer-in-charge/Client may take one of the following actions:
   1. Instruct Contractor to carry out such additional tests (e.g. Core tests, load tests, ultrasound, etc.) and/or remedial measures to ensure the soundness of the structure at the Contractor’s expense.
   2. The work will be rejected and any consequential action as needed shall be taken at the Contractor’s expense, including cutting out and replacing a part or whole of work.

### 3.11. READY MIX CONCRETE

#### 3.11.1. GRADES AND STRENGTH REQUIREMENTS OF CONCRETE

**GENERAL**

Ready mix Concrete shall consist of the material described under site batched concrete sections, using separate coarse and fine aggregate in an appropriate combination determined in the course of the of mix design already adopted. The overall grading shall be such as to produce concrete of the specified quality which will work readily in to position without segregation. The ready mix concrete shall conform to IS:4926 and shall be delivered in agitating trucks. The RMC may contain flyash as per the acceptable norms. (Maximum 20% of cement content)

**SLUMP**

The water shall be added to the cement and aggregate during mixing to produce concrete having a sufficient workability to enable it to be well consolidated, to be worked in to the corners of the shuttering and around the reinforcement to give the specified surface finish, and to have the specified strength. Water cement ratio shall be maintained as per IS. 456-2000 and when a suitable amount of water has been determined, the resulting consistency shall be maintained through out the corresponding parts of
the work and tests shall be conducted to ensure the maintenance of this consistency. The max slump at the point of the discharge should not exceed 110mm max.

CONCRETE GRADES

Grade of concrete used in the works shall be shown on the drawings or as directed by the Engineer-in-charge. The minimum cement used for M-20 shall be 300 Kg. Per Cum, 350 Kgs for M-25 and 400 Kgs for M-30. The mentioned quantity of cement indicates cementious material i.e., cement including fly ash.

3.11.2. TRANSPORTING CONCRETE

Concrete shall be transported in agitating trucks without contamination, loss of ingredients or segregation. Not more than 4 hours are allowed between the wetting of mix and discharge of the concrete at site. The RMC vehicle should carry a computer-generated slip/challan showing weight of all the ingredients including cement used, date and time of mixing and quantum of concrete carried.

3.11.3. CONCRETE PLACEMENT

GENERAL

Concrete, when deposited, shall have a temperature of not less than 5°C (41°F) and not more than 32°C (90°F).

The concrete shall be placed in the positions and sequences indicated on the drawings, in this specification and/or as directed by the Engineer-in-charge.

Contractor shall give adequate notice to the Engineer-in-charge of his intention to concrete any section of the works.

Except where otherwise directed, concrete shall not be placed unless the representative of the Engineer-in-charge is present and has previously examined and approved the positioning, fixing and condition of the reinforcement or any other items to be embedded and the cleanliness, positioning and suitability of the concreting surface.

The concrete shall be deposited as nearly as possible in its final position. It shall be placed in such a manner as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall be brought up in horizontal layers not exceeding 450 mm in compacted thickness unless otherwise authorized or directed by Engineer-in-charge or his representative. Concrete shall not be placed simultaneously on each side of large horizontal specified or approved construction joints.

Shutters for walls or thin sections of considerable height shall be provided with openings or other devices that will facilitate the cleaning of the accumulation of hardened concrete on the shutters or on the metal reinforcement above the level of the concrete and the removal of concrete in the case of segregation’s.

PLACING CONCRETE IN COLD WEATHER

No concrete shall be mixed or placed while the ambient temperature is above 40°C on a rising thermometer or below 4°C on a falling thermometer. The contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position on the works. Aggregates that have been exposed to frost shall not be used until completely thawed. Concrete shall be maintained by approved means at a temperature of not less than 4°C during placing, and for a period of three days
thereafter. All concrete placed during cold weather or when a frost is predicated or is likely to occur or occurs contrary to expectation, shall be protected from freezing by approved means.

PLACING OF CONCRETE IN WET WEATHER

Concrete shall not be mixed and or placed in rainy weather or when there is likelihood of impending heavy showers. If it becomes necessary to place concrete during rainy weather, the contractor shall provide adequate protection by means of tarpaulin or similar other water proof material to immediately cover fresh concrete to prevent rain falling over it. This protection shall be left on the concrete for a period of 24 hours after placing of concrete.

3.11.4. QUALITY CONTROL

3.11.4.1. In order to ensure that the quality of materials and the mix proportions are suitable for the particular grade of concrete required are so maintained, sampling and testing shall be carried out regularly during the course or the works.

3.11.4.2. Workability testing shall be carried out in accordance with IS:456. The results shall lie within the range upon which the accepted mix design is based. Testing shall be carried out at such a frequency that the required workability is consistently achieved.

3.11.4.3. Not withstanding the foregoing, additional samples shall be taken by the contractor when directed by the Engineer-in-charge/ engineer-in-charge. The test cube procedure shall be in accordance with IS: 516 throughout.

3.11.5. SEVEN-DAY CUBE TESTS

Acceptance of concrete is based on the 28th day results. However, the contractor shall establish a relationship between 7 days and 28 days strengths by carrying out 7 days tests at the time of performing the laboratory testing and from subsequent quality control testing. This relationship shall be used in interpreting any further test results to predict the probable value of the corresponding 28 days cube strengths. The contractor shall without delay advise the Engineer-in-charge of any sample that appears likely to fail to meet the specification and the contractor shall take any necessary action to minimize the effect of such failure.

3.11.6. ACCEPTANCE CRITERIA

The general Acceptance Criteria of any and all of the concrete work shall be as per the relevant Clauses of IS. 456.

If any of the works tests are not up to the standard, the Engineer-in-charge/ engineer-in-charge shall have the power to stop the work until the reason is investigated and steps taken to prevent further low results. The contractor shall not be entitled to any claims on account of such delays. Any concrete carried out from the batch that is afterwards found to be faulty, will be liable for rejection and if so directed, the contractor shall at his own expenses dismantle and replace the defective work and any work built thereon or shall take such other measures as may be deemed necessary by the Engineer-in-charge. At the discretion of the Engineer-in-charge, the contractor may be allowed to prove by means of a load test to be carried out at his own expense, that the concrete is capable of safely withstanding the loads as specified in the test.

3.12. PILING WORKS

3.12.1. PARTICULAR SPECIFICATION FOR BORED CAST-IN-SITU PILES
Unless otherwise mentioned in the following paragraphs, stipulations of relevant section of I.S. 2911 shall be followed.

3.12.2. The layout and number of piles shown in the Tender Drawing are based on allowable carrying capacity on the pile section as given in the drawing.

3.12.3. Boring equipment and accessories shall generally conform to I.S. 2911. Boring may be done by auger method for 20m. In case of unstable soils the boring tools used should be such that suction effects are minimized. Stabilization of the sides of the bore hole, shall be done by the use of bentonite slurry and casing if necessary. The size of cutting tool shall not be less than diameter of the pile by more than 75 mm.

3.12.4. The drilling mud shall be used at least from the level of sub soil water or from the level of bottom of M.S. liner depending upon site conditions and the hole shall than be always kept full with the fluid which should preferably be kept in motion. The density and composition of the fluid shall be such as to suit the requirements of the ground conditions and to maintain the fine materials from the borings in suspension. A 5 percent bentonite suspension would be generally suitable and its quality shall conform to specification given in Appendix ‘A’ of I.S. 2911 (Part I/Sec-2).

3.12.5. The bottom of the hole shall be cleaned very carefully before concreting work is taken up. The cleaning of the hole shall be ensured by careful operation by air lifting process, unless otherwise allowed by the Engineer. To lift the mud at founding level before concreting, bore hole shall be agitated by jetting with relatively higher pressure than that used during boring through tremie pipe. While boring by use of drilling mud, the specific gravity of the mud suspension in the vicinity of the bottom of bore hole shall be determined by suitable slurry sampler in the first few piles and at suitable interval of piles and recorded. Consistency of the drilling mud suspension shall be controlled throughout the boring as well as concreting operation in order to keep the hole stabilized as well as to avoid concrete mixed up with thicker suspension of the mud.

3.12.6. In case of boring with casing, the casing should be used from the Ground level. The casing shall be kept ahead of boring in cases where there is danger of caving-in due to subsoil water entering into the bore hole or where the soil is loose.

While boring below sub soil water level, precaution shall be taken so that no boiling of the bottom of the hole occurs due to difference in hydrostatic head. Concreting of Bore holes shall start as soon as possible after its completion. Should a bore hole be left un-concreted for more than two hours it shall be cleaned thoroughly as directed by E-I-C before placing concrete.

3.12.7. Concreting shall be done in one operation. Concrete shall be placed by means of a tremie pipe the diameter of which shall be at least 8 times the size of the largest aggregate used in the concrete mix. The construction of and the method of handling the tremmie pipes shall be approved by the Engineer-in-charge. The pipes shall be waterproof and sufficiently strong to withstand severe handling conditions and any joints must be sealed with adequate gaskets. It shall, however be ensured that concrete entering the tremie pipe does not get mixed in with the slurry and 1/4 kg of granulated vermiculite shall be poured in the tremie pipe before pouring concrete as directed by the Engineer. At the commencement of tremmie work the bottom of the pipe shall be sealed before being lowered in to position. The seal shall only be broken by the concrete being placed. The concrete placed in contact with a horizontal construction joint shall have a lower proportion of coarse aggregate and a higher proportion of cement than the remainder of the concrete. The proportions of the mixes shall be agreed in accordance with the strength and workability required by the specification. To allow for losses an addition of 10% of cement shall be added to mixes of concrete scheduled to be placed under water.

3.12.8. The tremie pipes and funnel shall be filled and lifted just 15 cm above bottom before releasing the concrete column to facilitate flushing out the bottom. The concrete levels in the tremie shall be checked.
every few feet in order to note the difference, if any, between the theoretical quantity that should have been placed and actual quantity that has gone in. This is to locate the position of over cut during boring.

3.12.9. In addition to the normal precautions to be taken in tremie concreting as per relevant section of IS: 2911 the following specifications shall be particularly applicable for the use of tremie concrete pipes:

1. The concrete shall be coherent, rich in cement (not less than 400 kg/cum) and of slump not less than 160 mm.
2. The hopper and tremie shall be a closed system embedded in the placed concrete, through which water can not pass.
3. The tremie shall be large enough with due regard to the size of the aggregate. For 20 mm aggregate the tremie pipe shall be of diameter not less than 200 mm, aggregates more than 20 mm shall not be used.
4. The first charges of concrete shall be placed with a sliding plug pushed down the tube ahead of it or with a steel plate of adequate size to prevent mixing of concrete and water. However, the plug shall not be left in the concrete as a lump.
5. The tremie pipe shall always penetrate well into the concrete with an adequate margin of safety against withdrawal of the pipe is surged to discharge the concrete.
6. The pile shall be concreted wholly by tremie and the method of deposition shall not be changed part way up the pile, to prevent the laittance from being entrapped within the pile.
7. All tremie tubes shall be scrupulously cleaned after use.

3.12.10. Normally concreting of the piles shall be uninterrupted. In the exceptional case of interruption of concreting but which can be resumed within 1 to 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 be resumed by introducing a little richer concrete with a higher slump for easy displacement of the partly set concrete.

3.12.11. If the concreting cannot be resumed before final set of concrete already placed, the pile so cast may be rejected or accepted with modifications at the sole discretion of the Engineer.

3.12.12. 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 laittance of scum lying on the top of the concrete already deposited in the bore.

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

3.12.14. The top of concrete in a pile shall be brought 1 metre above the cut off level to permit removal of all laittance and weak concrete before capping and to ensure good concrete at the cut off level for proper embodiment into the pile cap. Remaining length of bore is to be filled by silver sand.

3.12.15. When concrete is placed by tremie method, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection or to a minimum of one meter above cut-off level. In the circumstances, where cut-off level is below ground level the need to maintain a pressure on the onset concrete equal to or greater than water pressure shall be observed and accordingly length of extra concrete above cut-off level shall be determined and allowed in works.

3.12.16. In case, defective piles are formed, they shall be removed or left in place whichever is convenient without affecting performance of the adjacent piles or the cap as a whole. Additional piles shall be provided at contractor’s cost to replace them as directed by the Engineer and in this regard Engineer’s decision shall be binding on the contractor.
3.12.17. 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. All such alterations shall be done at contractor’s cost.

3.12.18. Pile shall be installed accurately as possible as per the designs and drawings. Pile shall not deviate more than 75 mm or one-tenth of diameter whichever is more. In case of piles having diameter more than 600 mm it will not deviate more than 100 mm from their designed position. In case of single pile in a column, positional tolerance shall not be more than 50 mm.

3.12.19. In case of piles deviating beyond these limits and to such an extent that the resulting eccentricity cannot be taken care of by a redesign of the pile cap or pile ties, the piles shall be replaced or supplemented by one more additional piles by the contractor at his own cost along with any additional cost for pile cap being over size. The decision taken in this regard by the Engineer shall be final and binding on the contractor.

3.12.20. Manual chipping shall be permitted after three days of pile casting. Pneumatic chipping if permitted by the Engineer shall not be start before 7 days. In case, Portland Pozzalana Cement is used, chipping shall only be started as directed by the Engineer.

3.12.21. When working near existing structures care shall be taken to avoid any damage to such structures. In case of cased bored pile, care shall be taken to avoid effect due to loss of ground.

3.12.22. In case of deep excavations adjacent to piles, proper shoring or other suitable arrangement shall be done to guard against the lateral movement of soil stratum or releasing the confining soil stress.

3.12.23. Main longitudinal reinforcement in the length of the piles as well as links or spirals shall be provided as shown in the drawing. Longitudinal bars shall preferably be in one length. Reinforcing cage shall be handled and installed carefully without damaging its shape.

3.12.24. All other requirements or reinforcement bars i.e. quality, workmanship etc. shall be specified for reinforced concrete work in the relevant I.S. Codes.

3.12.25. During installation of pile the following data shall be recorded along with any other date as directed by the Engineer. These data shall be submitted to the Engineer in triplicate on completion of installation of each pile.

   a) Sequence of installation of piles in a group.
   b) Dimensions of the pile, including reinforcement details and mark of pile.
   c) Details of mild steel lines where provided along with stiffener.
   d) Depth bored and founding level along with a bore level indicating nature of stratum.
   e) Time taken for penetration of every 15 cm during last 2 m depth before founding level.
   f) Method of cleaning bottom of hole at founding level before concreting.
   g) Time taken for concreting.
h) Cut-off level/working level/RL of top of concrete.

i) Cement bag consumption, slump of concrete.

j) Any other relevant important observation

3.12.26. PILE TEST

The contractor shall quote separately for carrying out pile test for bored piles.

The test shall commence as per provision laid down in I.S. 2911 Part-IV 1979, latest revision.

Before any load test being performed, the proposed set-up and the kentledge (load frame) shall have to be approved by the Engineer-in-Charge.

The Engineer-in-Charge shall have the right to get test certificate regarding calibration of pressure gauge from the Govt. Laboratory, at the cost of contractor.

For each pile failing to conform to the specified requirements, the contractor shall at his expense, test further pile or piles as directed by the Engineer-in-Charge. The cost of all additional piles, and all other works necessitated due to failure of inadequacy of any test of pile to meet specified requirements shall be borne by the contractor.

The results of pile test shall be graphically represented to show the following relations:

i) Load vs. time

ii) Total settlement vs. time

iii) Load vs. total settlement (for loading and unloading).

iv) Load vs. net settlement.

3.12.27. PROCEDURE FOR ROUTINE LOAD TEST ON WORKING PILE

i) Load to be applied by means of hydraulic jack with a pressure gauge with a remote control pump, reacting against suitable load frame;

ii) The reaction to be made available for the test should be 25% more than final test load proposed to be applied;

iii) The test load shall be applied in increment of about 20% of assumed safe load carrying capacity.

iv) Settlement should be recorded with minimum three dial gauges of 0.02 mm sensitive for single pile and 4 gauges for pile groups. Each positioned at equal distance around the piles, and normally held by datum bars resting on immovable supports at least 5D away from the periphery of test pile where ‘D’ is the diameter of pile;

v) Each stage of loading shall be maintained till the rate of movement of pile top is not more than 0.10 mm per hour in case of clayey soil or a maximum period of 2 hours whichever is greater. For this purpose, the type of soil met at the pile top shall be considered. The estimated safe load carrying capacity may be maintained for 24 hours and settlement should be observed every hour during this period;
vi) For each increment, application of load shall be as smooth as possible. Settlement observation shall be made at about 15 minutes interval;

vii) The loading shall be continued up to twice the safe load carrying capacity or the load at which total displacement of pile top/cap equals the appropriate value specified below, whichever is earlier;

a) Safe load carrying capacity on single pile 2/3rd of the final load at which gross settlement is 12 mm.

b) 50% of the final load at which gross settlement comes to 10% of diameter of pile.

Safe load carrying capacity on group of piles

a) 2/3rd of the final load at which gross settlement come to 40 mm.

b) Final load at which gross settlement comes 25 mm.

viii) The load on the pile may be removed in one stage by releasing jack steadily after completion of the test and rebound observations should be made for at least 2 hours.

3.12.28. RECORDS

The contractor shall prepare in triplicate, a comprehensive record during the driving of piles, giving the following and other necessary data in a tabular form:

i) Serial No. of Pile Driven.

ii) Date and time at which pile is driven.

iii) Total depth of pile.

iv) Strata chart in case of bored piles only.

v) Any other data ordered by the Engineer-in-Charge.

vi) For cyclic test, loading record should be as per I.S. Code 2911 (Part IV), 1979 (latest revision).

Each of the three copies of such data prepared daily shall be signed by the contractor or his authorized representative as well as the Engineer-in-Charge. One copy shall be retained by the contractor and the other submitted to the Engineer-in-Charge for final record.

3.12.29. STANDARD OF ACCEPTANCE

The piles shall be accepted satisfactory only when the work has been executed in accordance with this specification and the standards stated hereinafter to the satisfaction of the Engineer-in-charge/Employer.

a) The pile shall not be out of plumb by more than 1.5%.

b) The toe of pile shall be at the approved bearing level in each case.

c) The total volume of concrete consumed for pile shall not be less than 10% and not more than 40% greater than the calculated volume. The calculated volume for this purpose shall be cross sectional area inside the casing multiplied by the length of pile.
The concrete shall show the specified strength as indicated by the cube test results.

d) The results of the load test carried out in accordance with the contract and with the specification for load testing shall be satisfactory.

3.12.30. BASIS OF MEASUREMENT OF PILES

The top eighty millimetres of each pile shall penetrate into the pile cap - the top of which shall be regarded as cut off level and reinforcement shall further project into the pile cap as specified.

The piles shall be measured in linear meter from the cut-off level to the bottom most point of the pile. The rate shall include the cost of driving the casing tube (if any), boring and placing in situ concrete including that in the portion inside pile cap. The rate shall also include for all labour and materials, if required, bailing out water from underground surface, withdrawing of the tube, breaking of boulders, old foundation etc met with before reaching the desired stratum, and everything necessary to have the pile in plumb and secure in position.

No payment will be made for piles driven out of plumb beyond the specific tolerance limits, or for imperfect or defective piles regarding which the judgment of the Engineer-in-Charge shall be final and binding on the contractor.

3.12.31. DEFECTIVE PILES

Any pile which is shown to be defective under load test shall not be accepted and the Engineer-in-charge/Employer will relate such failure to the acceptance of other piles in the area.

If an individual pile should fail to meet the requirements specified in Clause G as stated above, such pile shall be deemed to be defective and the Engineer-in-charge/Employer may order such investigation to be made which he considers appropriate.

When any pile is found defective the contractor shall replace the pile at his own cost. No extra time shall be allowed for such relocation of piles due to obstruction/failure during boring operation.

The contractor may carry out the piling work before excavation. In such an event, the portion of empty boring shall be filled with sand as per direction of Engineer-in-charge/Employer. The cost of such empty boring and sand filling shall be included in the contractor’s rate.

3.12.32. SETTING OUT

The positions of the piles are to be set out by the contractor from cardinal points which will be provided by the Engineer-in-Charge the contractor shall be responsible for all errors in setting out and shall rectify the same at his expense, to the satisfaction of the Engineer-in-Charge.

3.12.33. SAFETY OF EXISTING STRUCTURES:

The contractor shall take every precaution to avoid damage or subsidence or collapse of the existing structures and services in the vicinity as a result of pile driving. All claims arising on account of the damages caused to the existing structures and services in the vicinity as a result of pile driving and during the process of boring shall be duly covered by the contractor by Insurance or borne by the contractor.

The design prepared by the engineer-in-charge is on the following basis:

Cast-in-situ bored reinforced concrete piles.
The accompanying drawings and bill of quantities have been accordingly prepared.

3.12.34. DESIGN AND CONCRETE QUALITY:

The Grade of Concrete of all types of pile shall be minimum M-30 unless otherwise mentioned. The cement content of piling work shall be minimum 400 kg/cum with ordinary Portland Cement. Water cement ratio and slump shall be as per I.S. Specification for relevant piling work. Maximum size of coarse aggregate shall be 20 mm.

Grading and other requirement of coarse and fine aggregate, water and concrete shall be as specified for reinforced cement concrete work in the relevant I.S. Codes.

3.12.35. CONTRACTOR’S RATE SHOULD INCLUDE:

The rates of the contractor for providing and laying cement concrete in various grades or proportion in the Schedule of quantities shall, apart from any other factors specified elsewhere in the tender documents, include for the following :-

a. For all factors and method of work described in the specification.

b. For all materials, labour, tools and plants, scaffolding etc. mixing conveying and placing concrete in position, ramming, vibrating, trowelling, curing, providing necessary scaffolding and removing the same after the work is complete.

c. Unless otherwise specified in the Schedule of Quantities the cost for concrete items shall include for providing stays, struts, bolts, nuts and everything necessary to keep the form right, smoothening the surface to receive concrete as per detailed drawing, striking and stripping formwork after the concrete is cured, hacking the concrete surface, required to receiving plaster etc. Where shuttering is described as a separate item in the schedule of quantities the rate for shuttering shall be inclusive of all the works mentioned in this para apart from other factors mentioned in specification for form work and also elsewhere in this contract. Shuttering to curved structure will be measured and paid separately as detailed in Schedule of Quantities.

d. The reinforcement in case of reinforced concrete work be paid for separately unless otherwise stated in the particular items, but rate shall include for pouring concrete and packing around reinforcement.

e. Rates for concrete will be as per detailed drawings, shapes and size based on net structural sizes as drawing i.e. exclusive of plaster.

f. Rates for concrete items shall cover for any shape of a structural members like, columns, beams, facia, fins, louvers etc. and for cantilever beams, slabs etc. including curve structure.

g. Formation and treatment of construction joints, and expansion joints where water bars like copper strips, P.V.C. water bars or joints fillers like “Shalitex” are specified such materials shall be paid in separate rates.

h. Design of mixes where so required by specification in an approved government laboratory and on tests of materials and work required in the opinion of the Consulting Engineers and described in these specification.

i. Fixing all inserts and embeddings like pipes, plugs, forming roles etc. as per drawing to be paid separately.
j. Weigh-batching using a Mechanical Weigh batcher of a batching plant or where so specified for volumetric batching.

k. For taking out dowel bars, fan hooks, etc. through shuttering. However dowel bars, fan hooks etc. will be paid separately.

l. For forming drip moulds in chajja, sills, etc. where shown in the drawings or as directed.

m. For work at all levels.

n. In case where at the junctions of beams, columns, slabs, the composition of concrete mix of specified strength be different for columns, beams, and slab then in such cases only the richer concrete among those specified for in all these members shall be used at the junctions and rate quoted for columns, beams, and slabs, or any members entering such junctions shall allow for the same. Rate shall also cover for spill over of richer concrete in beams to natural angle of repose of wet concrete required from practical consideration while concreting the junctions.

4. FORMWORK

4.1. SCOPE OF WORK

The work covered by this section of the specifications, consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the supply and installation of form work for concreting, complete in strict accordance with this section of the specifications and subject to the terms and conditions of the Contract.

4.2. GENERAL CONSIDERATIONS

It shall be the responsibility of the Contractor to perform the work by well trained and experienced staff or by the Sub-Contractor who shall have enough number of well trained and experienced staff and coordinate with the other operations. However the Contractor shall be responsible for the quality of work performed by the Sub-Contractor as per the requirements of these specifications.

4.3. APPLICABLE CODES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tr>
<td>IS - 303</td>
<td>Specification for Plywood for general purposes</td>
</tr>
<tr>
<td>IS - 4990</td>
<td>Specification for plywood for concrete shuttering work</td>
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<tr>
<td>IS - 1629</td>
<td>Rules for grading of cut size of timber</td>
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<tr>
<td>IS - 2750</td>
<td>Specification for steel scaffoldings.</td>
</tr>
<tr>
<td>IS - 4014</td>
<td>Code of practice for steel tubular, scaffolding</td>
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4.4. MATERIAL SPECIFICATIONS

The Contractor shall use the following Form work materials for different purposes as stated below:

1. Timber.
   Form framing, sheathing, and shoring.

2. Plywood.
   From sheathing and panels.

3. Steel.
   - Heavy forms and falsework.
   - Column and joint forms.
- Permanent forms.
- Welding of Permanent forms.

4. Form Ties Anchors, and Hangers.
Principle Use: For securing formwork against placing loads and pressures.

5. Coatings.
Principle Use: Facilitate form removal.

Principle Use: Form work support.

7. Steel Frame Shoring.
Principle Use: Form work support and resisting side collapse.

Construction formwork with smooth faced plywood, steel or timber to produce smooth straight level and sharp profiles shall be used for the works. Panels to be in largest practicable sizes to reduce the number of joints.

Form material shall have strength adequate to withstand pressure of newly placed concrete without excessive and adjustable bow or deflection.

Factory fabricated adjustable length removable or snaps of metal forming ties, designed to prevent form deflection and to prevent spilling concrete surfaces on removal.

Ties shall be such that:

a) A portion remaining within the concrete shall be at least 38mm from the outer concrete surface.

b) That will not leave a hole larger than 25mm diameter on the concrete surface.

The form coating compound should not bond with, stain, not adversely effect concrete for required bond or adhesion and will not hamper the wetting of surface to be covered with water or curing compound.

All propping and centering shall be of adjustable steel supports (built-up sections of rolled steel) and tubular props to full height without joints, and with sufficient bracing to take into account the construction loads, namely full load of concrete with any live load and impact load likely to occur during concreting.

Steel shuttering used for concreting shall be sufficiently stiffened. The steel shuttering shall also be properly repaired before use and properly cleaned to avoid stains and defects in concreting.

4.5. DESIGN CRITERIA

4.5.1. Formwork system shall be executed and designed by a specialist qualified to the shapes, lines, forms and dimensions shown on drawings. The Contractor shall submit to the Engineer-in-charge/Client a method statement backed by design calculations. Required drawings and sketches shall be enclosed along with the statement for the proposed area to be taken up for working at a time. The number of repetitions expected, type of material used, etc shall be detailed therein.

4.5.2. Formwork shall start only after written approval from the Engineer-in-charge has been received. But this will not relieve the Contractor of its obligation to achieve its required line finish within accepted tolerance limits in terms of quality of works completed and safety. Neither will it diminish the Contractor’s responsibility for the satisfactory performance of formwork.

Basic points to be understood in designing of formwork are stated below:
i. Erected Formwork shall be watertight, shall conform to shape, lines, dimensions, verticality, rigid during placing, vibrating and configuring the concrete.

ii. Formwork system shall be of steel or timber or 12mm thick water resistant Ply board, and shall be continuous, straight and without any warping.

4.5.3. Design of formwork shall take into account:
1. Height of pour
2. Thickness of member
3. Rate of pour
4. Concrete slump
5. Texture of finish
6. Placing temperature
7. Concrete density
8. Construction joints
9. Wind load
10. Method of Discharge
11. Form work design shall have
12. Dimensional tolerance
13. De mountable without shock, disturbance or damage to concrete
14. All construction joints in beams and slabs shall be provided as shown in drawings.
15. Ties shall be provided where required
16. Cambers shall be provided where shown.
17. Props / supports of extra ceiling height shall be specially designed.

4.6. WORKMANSIP

4.6.1. Formwork shall be classified based on the ultimate finishes required of the concrete surface as

1. Textured or decorative finish
2. Fair-faced finish
3. Rough finish

4.6.2. The Contractor shall account for all material and labour to achieve the above finishes to the satisfaction of the Engineer-in-charge/ Client in his quoted price.

4.6.3. Guidelines for Good Workmanship

Following are a few points as guidelines for good workmanship in formwork and shall be accounted for in the contractor’s quoted price:

1. Erection of formwork may be from pre-moulded, pre-fabricated, pre-assembled plates or form reasonable enough to transport and erect at site to correct lines and levels as set at site.

2. Supports shall be firm and maintained in position by nails, cross bracing, tie-rods, locking bolts, nuts, etc. It shall be rigid and stiff so as to retain its shape during and after concreting.

3. Joints shall be water-tight and no cement slurry shall be allowed to pass out.

4. Pre-fabricated or site forms shall be assembled so as to deshutter without any jerk to the green concrete. For this double wedges shall be used. The wedges shall be nailed. The heads left with, allowing easy removal while deshuttering.

5. Pre-fabricated or site formwork shall be of sufficient thickness with supporting spans in both directions. These shall be standardized in size for easy replacement and universal use at site.
6. Props shall be of steel only. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be of proper steel plate or timber plank for equal distribution of load.

7. In case of multi-storied buildings, any upper floor shall be suitably supported on at least one floor below the same, or as approved by the Engineer-in-charge/Client.

8. Props shall be adequately cross-braced horizontally.

9. At the design and erection stage following additional points shall be considered and be incorporated into the setting
   a) Cleaning of openings prior to the start of concreting
   b) Pouring points shall avoid high drops and provide easy access to vibrating needles
   c) Surfaces shall be treated with suitable releasing oil or emulsion prior to the reinforcement laying. Such releasing oil shall be approved from the Engineer-in-charge/Client.
   d) Forms and adjacent surfaces should be thoroughly cleaned to receive concrete and should be free from debris.
   e) Construction joints should be located in a manner so as not to impair strength and appearance of structure.
   f) Without absolving the details on the above, the Contractor shall comply with instruction of the Engineer-in-charge/Client regarding designing, erection, execution, rotation, maintenance and reuse of formwork.

10. Following points shall be observed very carefully:
   a. Joints of formwork shall be watertight. It should be easy to check from the bottom and no light should be visible.
   b. Props shall be on solid base, plumbed, in straight line, braced horizontally and crosswise.
   c. Tie-bars, bracing and spacers in beams, walls and columns shall be at correct place/location and fully tight.
   d. Wedges shall be fully secured and nailed with heads left out for easy removal.
   e. All saw dust, dirt, shavings and any other unwanted material shall be cleaned and hosed out.
   f. Provision shall be made for watching formwork while concreting and any other platform needed for movement of workers without any disturbance to the reinforcement.
   g. Provision should be made for traffic on formwork and not to bear directly on reinforcing steel.
   h. Number of reuses shall be decided by the Engineer-in-charge/Client on examining the condition of formwork after each use. If during concreting any weakness develops or formwork shows any distress, the work shall be stopped and remedial action taken.

4.6.4. Finishing Formed Surfaces

The Contractor shall:
a. Smoothen concrete where fins and other projections have formed by moistening concrete surface within a day after forms have been removed and rubbing with carborundum stone until surface is of uniform color and texture within the projection limits.

b. If defects cannot be repaired to the satisfaction of the E-I-C, the defective concrete surface needs to be removed and repaired.

Surface defects includes colour and texture irregularities, cracks, spills, air bubbles, honeycombs, rock pockets, fins and other projection on the surface, stain and tie holes.

The contractor shall:

i. Undercut voids larger than 25mm diameter and fill with fresh concrete after thoroughly wetting concrete surfaces.

ii. Fill small holes and irregularities using 2:1 (Portland cement to fine sand by volume) grout mixed with approved bonding admixture according to manufacturer's specification.

iii. Blend standard Portland cement with white Portland cement if necessary so that final colour of dry grout matches adjacent surfaces.

iv. After applying grout to repair area, the same should be wiped with Hessian cloth to match adjacent texture and is to be kept within specified surface tolerances.

v. The concrete patch should be kept damp with fog spray for at least 36 hours.

4.7. MODES OF MEASUREMENTS

Formwork shall be measured as the area (in square metres) of shuttering in contact with the concrete including covers, angles, splays, mitres, bevels, etc. for which no special rate shall be allowed.

4.7.1. The quoted rate shall be applicable for all working conditions and at all heights and depths or lifts specified in the drawings. The rate shall include the cost of materials and labour for various operations involved, but not limited to the following:

4.7.2 Provision of formwork, its erection and treatment of the concrete surface immediately after removal of the formwork

4.7.3 Holes to be made in the formwork for inserting electrical conduits, piping for plumbing works, etc

4.7.4. Centering, bracing, tightening with bolts and nuts, staging, etc.

4.7.5. Splayed edges, notching, allowance for overlaps, centering, shuttering, strutting, bolting, nailing, welding, casing striking and removal.

4.7.6. Temporary openings in the forms for pouring concrete and removing rubbish.

4.7.7. Dressing with oil/approved emulsion to prevent adhesion of concrete with shuttering.

4.7.8. Raking or cutting.

4.7.9. Fixing inserts and openings at the correct line and level and at any stage to support the same at the directed height and place.

4.7.10. Platforms if any to check forms while concreting is in progress.

4.7.11. Filling and making joints watertight to the satisfaction of the Engineer-in-charge/ Client.

4.7.12. Cleaning of the shuttering.

4.7.13. Cleaning the complete floor immediately on deshuttering complete to enable the start of next activity.

4.7.14. Cleaning and washing of the complete floor during and after concreting to avoid any damage to finished surface. It will be responsibility of the contractor to protect and retain all finished surfaces.
Should there be any lattitude due to concreting of upper floors or other construction activities within the said floor the Contractor shall be responsible to do all that is required to bring the finish back to the original or as specified in the Technical Specification/ directed by the Engineer-in-charge/ Client.

No payment shall be made for temporary formwork used in concreting nor for formwork required for joints or buttheads, in floors or elsewhere where such joints are to be covered late with concrete or mastic or other material.

4.8. TOLERANCES

The following shall be the maximum permissible tolerance :-

a. On general setting out dimensions upto 4 M in length a tolerance upto 3mm will be allowed.

b. On lengths of more than 4 M tolerance of not more than 5mm will be allowed.

c. On the cross sectional dimensions of columns, beams, slabs, faces, chajja, mullions, grills, fins, louvers and such other members, tolerance of more than 1mm will not be allowed.

d. The top surface of concrete floor slab will be within 6mm of the level and line shown on the drawings.

e. Columns and walls and other vertical members shall not be more than 6mm out of plumb in their full height or 1 in 1000.

f. If work is not carried out within the tolerance set out above in (a) to (e), the cost of all rectification measures of dismantling and reconstructing as decided by the Owner/ Employer/ Consulting Engineers/ Consultant shall be borne by the contractor. In case of work dismantled, the same not be measured and paid for.

4.9. REMOVAL OF FORMWORK

Formwork shall not be struck until the concrete has reached strength at least twice the stress to which the concrete may be subjected at the time of removal of formwork.

1. Formwork shall be removed carefully without jarring the concrete and curing of the concrete shall commence immediately. Sudden shocks / vibrations during removal of wedges shall be avoided. Where finished edges have re-entrant angles, formwork should be removed as early as possible to avoid shrinkage cracks.

1. Concrete surfaces to be exposed shall where required by the Engineer-in-charge/ Client, be rubbed with carborundum stone to give a smooth and even finish.

2. Where concrete requires plastering or other finish later, the concrete surface shall be hacked as directed.

3. No extra charge will be allowed to the Contractor for such work.

4.10. MINIMUM TIME REQUIREMENTS

For precast moulds the stripping time shall be 24 hours.

Stripping time shall be in accordance to the provisions as laid in IS 456:2000.

Stripping of formwork within the time limits listed above is subject to successful crushing of cubes compressive strength results.
4.11. CLEANING AND OILING OF FORMS

The contractor shall ensure that the surface of the forms that will touch the concrete shall be free from encrustations of mortar, grout, or other foreign material. Temporary openings shall be left at the bottom of formwork to enable sawdust, shavings, wire off-cuts and other foreign material to be removed from the interior of the forms before the concrete is placed. Compressed air shall be used to clean the complete formwork and remove all traces of duct and debris before pouring of concrete. The temporary holes shall be closed thereafter.

The surface of the forms to be in contact with the concrete shall be coated with a reliable coating that will effectively prevent the adherence of concrete and will not stain the concrete surfaces. After each use, the surfaces of forms which have been in contact with concrete shall be cleaned of mortar and any other material sticking to them, then well wetted and treated with form oil approved by the Engineer-in-charge/Client.

The Contractor shall provide commercial form release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces.

4.12. OPENINGS / INSERTS

Contractor shall provide all required openings, pockets, inserts as detailed in drawings. The Contractor shall provide required material and labour for fixing and supporting during concreting. In its quoted price, it is imperative to consider that all openings and pockets shall be de-shuttered with care and all corners of openings shall be preserved, i.e shall be in correct line and level. After concreting the openings shall be secured against any accident by proper covering and guard rail, warning notice, lighting, etc for which no extra cost is payable to the Contractor.

5. REINFORCED STEEL WORK

5.1. SCOPE OF WORK

The work to be done under this section consists of furnishing, cutting, fabricating, bending, placing and tying steel reinforcement in concrete structures or else where as shown on the drawings or directed by the engineer-in-charge. The scope of this section of this section of specifications as laid down herein.

5.2. APPLICABLE STANDARDS

<table>
<thead>
<tr>
<th>Specification Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS-432</td>
<td>Specification for Mild steel and medium tensile bars and hard drawn steel wire.</td>
</tr>
<tr>
<td>IS-1139</td>
<td>Specification for hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement.</td>
</tr>
<tr>
<td>IS-1785</td>
<td>Specification for plain hard drawn steel wire for prestressed concrete.</td>
</tr>
<tr>
<td>IS-1786</td>
<td>Specification for cold twisted steel high strength deformed bars for concrete reinforcement.</td>
</tr>
<tr>
<td>IS-2080</td>
<td>Specification for high tensile steel bars used in prestressed concrete.</td>
</tr>
<tr>
<td>IS-2751</td>
<td>Code of practice for welding of mild steel structures are folded plates.</td>
</tr>
<tr>
<td>IS-2502</td>
<td>Code of practice for bending and fixing of bars for concrete reinforcement.</td>
</tr>
</tbody>
</table>
5.3. STEEL GRADES

Reinforcements for concrete may be from any of the “grades” of steel indicated below, conforming to the relevant Indian Standards and their latest amendments mentioned against each:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Conforming to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe 250</td>
<td>Mild Steel</td>
<td>IS 432 (Part I)</td>
</tr>
<tr>
<td>Fe 490</td>
<td>Hard drawn steel wire</td>
<td>IS 432 (Part II)</td>
</tr>
<tr>
<td>Fe 415</td>
<td>High strength deformed/ ribbed steel</td>
<td>IS 1786</td>
</tr>
<tr>
<td>Fe 500</td>
<td>High strength deformed / ribbed steel</td>
<td>IS 1786</td>
</tr>
<tr>
<td>Fe 550</td>
<td>High strength deformed / ribbed steel</td>
<td>IS 1786</td>
</tr>
</tbody>
</table>

Reinforcing steel may be any of the following types:

- Type I Plain round bars (PR)
- Type II Welded wire Fabrics (WWF)
- Type III Cold Twisted Deformed Bars/ Corrosion resistant bars. (CTD-R)
- Type IV Thermo-Mechanically Treated Ribbed bars (TMT)
- Type V Thermo-Mechanically Treated Ribbed Corrosion Resistant bars (Copper) Bearing (TMT-CR)

5.4. BIS CERTIFICATION

Material received at the Site shall have BIS Certification mark. Such bundle or coil containing the bars shall be suitably marked with BIS Certification mark. Bars shall also be marked to identify categories. This shall be done as per IS: 1387.

In case bars are without BIS Certification mark, the manufacturer shall give a certificate stating the process of manufacture, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark to which it applies, corresponding to the number or identification mark to be found on the material.

All reinforcements shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any other foreign deleterious material present on the surface. Cleaning should be done to the satisfaction of the Engineer-in-charge/ Client.

Each batch of steel brought to the Site shall be tested prior to use. Cost of all tests shall be borne by the Contractor.

Material acceptable as per IS Specifications will be allowed into the Project. All rejected material shall be removed from the Site by the Contractor within 30 days of its rejection. If the same is not done, the Engineer-in-charge/ Client can get work done by third party at the contractor’s risk and cost and shall impose a penalty of Rs 500 (Rupees Five Hundred only) per metric ton per day. This will be without any appeal.

5.5. STORAGE

Reinforcement bars received at the Site shall be stored on hard, concreted platform and clear of the ground to a minimum of 300 mm with the use of timber sleepers or any other means. Reinforcements shall be kept covered by tarpaulins or plastic to avoid excessive corrosion or any other contamination. It is advised to follow storage methods as described in IS: 4082. The Contractor shall comply with the instruction of the Engineer-in-charge/ Client on method of stacking of steel.

Reinforcement steel shall be stored in such a manner as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oily substance shall be used for removing the rust.
5.6. QUALITY ASSURANCE

5.6.1. Supervisory staff shall have qualification and experience in the above field.
5.6.2. Welders qualified and having approved certificates for welding shall be employed.

5.7. HANDLING

5.7.1. Bend test requirements shall conform to the following and shall be based on 1800 bends of full size bars around pins.

<table>
<thead>
<tr>
<th>Bar diameter (mm)</th>
<th>Pin diameter for test bend</th>
</tr>
</thead>
<tbody>
<tr>
<td>10, 12, 16</td>
<td>3.5 x bar dia</td>
</tr>
<tr>
<td>20, 22, 25</td>
<td>5.0 x bar dia</td>
</tr>
<tr>
<td>28, 30, 32</td>
<td>7.0 x bar dia</td>
</tr>
</tbody>
</table>

5.7.2. Spacers shall be of any of the following:

i. Wire
ii. Precast concrete
iii. Moulded plastic

Spacer material shall be of durable quality and shall not lead to corrosion of reinforcement or spilling of concrete.

Precast concrete spacers shall be of the same mix as that of surrounding concrete.

5.7.3. Tying wire shall be of 18G black annealed mild steel wire or other approved type double fold to tie the reinforcements.

5.7.4. Cover blocks shall be non-corrosive material such as plastic, but not wooden or broken bricks or stone. Specially made concrete blocks shall be used. Such cover blocks shall be cast from concrete and not from cement mortar; strength of these blocks shall be equal to the concrete in use.

5.7.5. Tying wire shall be of 18G black annealed mild steel wire or other approved type double fold to tie the reinforcements. It shall be face from rust, oil, paint, grease, loose mill seals or any other deleterious material undesirable for concrete or reinforcement or which may prevent adhesion of concrete to reinforcement.

5.8. UNIT WEIGHTS

Unit weights payable per meter shall be as follows:

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Unit Weight (kg/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 mm</td>
<td>0.22</td>
</tr>
<tr>
<td>8 mm</td>
<td>0.39</td>
</tr>
<tr>
<td>10 mm</td>
<td>0.62</td>
</tr>
<tr>
<td>12 mm</td>
<td>0.89</td>
</tr>
<tr>
<td>14 mm</td>
<td>1.21</td>
</tr>
<tr>
<td>16 mm</td>
<td>1.58</td>
</tr>
<tr>
<td>18 mm</td>
<td>2.00</td>
</tr>
<tr>
<td>20 mm</td>
<td>2.47</td>
</tr>
<tr>
<td>22 mm</td>
<td>2.98</td>
</tr>
<tr>
<td>25 mm</td>
<td>3.85</td>
</tr>
<tr>
<td>28 mm</td>
<td>4.83</td>
</tr>
<tr>
<td>32 mm</td>
<td>6.31</td>
</tr>
<tr>
<td>36 mm</td>
<td>7.99</td>
</tr>
<tr>
<td>40 mm</td>
<td>9.86</td>
</tr>
</tbody>
</table>
5.9. DETAILED METHODOLOGY

5.9.1. CUTTING AND BENDING

5.9.1.1. Flame cut and hot bending is absolutely forbidden.
5.9.1.2. Cutting and bending reinforcement to approved shop drawings and details shall be used.
5.9.1.3. Bars to be cold-bend, either mechanically or by hand, but to correct radius using proper tools, machine and platform and confirming to IS 2502-1963.
5.9.1.4. Rebending should not be done without approval. In case of re-bending, care shall be taken that the rating of bend is not less than 4 x bar dia at construction joints for plain steel bars and 6 x bar dia for high strength bars.
5.9.1.5. Reinforcement projecting from concrete shall not be bent without approval.
5.9.1.6. Bar bending schedule to be submitted for approval to the Engineer-in-charge/ Client prior to commencement of any cutting, bending and binding of steel at site.
5.9.1.7. Cracked end of bars shall not be used on this Project.
5.9.1.8. Bars should be inspected for visible defects such as cracks, brittleness, excessive rust, loose mills scale, etc.

5.9.2. WELDING

5.9.2.1. Reinforcement should not be welded unless authorized by the Engineer-in-charge/ Client and recommended by the manufacturers.
5.9.2.2. Site welding shall be done with suitable safeguards and techniques.
5.9.2.3. Welding, if approved, may be used for:
   i. Lapping reinforcement in position
   ii. Fixing reinforcement to other steel members.
5.9.2.4. The length of run deposited in a single pass shall not exceed 5 x bar diameters. If a longer welded length is required divide into sections with the space between runs not less than 5 x bar diameters.
5.9.2.5. Welded joints:
   i. Shall not be made at bends in reinforcement.
   ii. Stagger joints in parallel bars of principal reinforcement unless otherwise approved.
   iii. The distance between staggered joints shall not be less than the end anchorage length joints.

5.9.3. MECHANICAL SPLICING

5.9.3.2. Used as indicated in structural drawings.
5.9.3.3. Engineer-in-charge has to approve mechanical splices before using it at site.

5.9.4. INSPECTION

5.9.4.1. Reinforcement placing should be checked by Engineer-in-charge or his representative.
5.9.4.2. Ensure that the Formwork to receive the reinforcement should be clean and free from debris.
5.9.4.3. Cracked end of bars shall be cut out.

5.9.5. ANCHORING

Anchoring of bars and stirrups shall be provided exactly as detailed in the structural drawings or as directed by Engineer-in-charge.
In case of reinforcement steel in tension, deformed bars may be used without end anchorage provided the development length requirement is satisfied. Hooks shall normally be provided for plain bars in tension. Development length of the bars shall be determined as per relevant clauses of IS: 456 - 2000.
The anchorage length of straight bar in compression shall be equal to the Development length of the bars in compression as specified in relevant clause of IS: 456 - 2000.

5.9.6. LAPPING OF BARS

Laps shall be strictly as per the structural drawing or as directed by the Engineer-in-charge. For general guidance the following principles shall be followed as given in IS: 456 – 2000

5.9.6.1. As far as possible bars of the maximum length available shall be used.
5.9.6.2. Laps shown on drawings or otherwise specified by the engineer-in-charge will be based on the Contractor using bars of maximum length.
5.9.6.3. In case Contractor wishes to use bars of shorter length, laps shall be provided at the Contractor’s expense in the manner and the locations approved by the engineer-in-charge.
5.9.6.4. Splices shall be provided as far as possible away from the sections of maximum stress and shall be staggered.
5.9.6.5. Not more than half of the bars shall be spliced at a section
5.9.6.6. If more than half of the bars shall be spliced at a section, special case shall be ensured such as increasing length of lap or closer spacing of stirrups around the length of splice.
5.9.6.7. Lap splice shall not be used for bars having diameter larger than 36 mm. For larger diameters bars it may be welded. Lap length including anchorage value of hooks in flexural tension shall be La (as defined in Article 25.2.1 of IS: 456-2000) or 30 times the diameter of the bar whichever is greater and for direct tension 2La or 30 times the diameter of the bar whichever is greater.
5.9.6.8. Lap length in compression shall be equal to the development length in compression calculated as described in relevant clause of IS: 456-2000 or as specified in the structural drawing but not less than 24 times the diameter of the bar.
5.9.6.9. Overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or 1.25 times the maximum size of the coarse aggregate, whichever is greater.
5.9.6.10. When above is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the diameter of such bars with two strands of annealed binding wire of 0.90mm to 1.6mm diameter twisted together tightly.
5.9.6.11. As and when necessary welded laps shall be proved as specified by the engineer-in-charge.

5.9.8. CONCRETE COVER

5.9.7.1. Shall be in accordance with ISI: 456-2000 and as per the instructions in structural drawings. Sizes of cover blocks should be stipulated as follows:

- 50 mm
- 20 mm
- 20 mm
- 15 mm
- 40 mm
- 20 mm
- 40 mm
- 40mm

5.10. PRECAUTIONARY MEASURES

5.10.1. Do not insert bars into placed concrete.
5.10.2. Do not damage forms and form linings, if any when fixing reinforcement.
5.10.3 Necessary supports are to be provided to maintain reinforcement in its correct position.

5.11. ADJUSTMENT AND CLEANING

5.11.1. Reinforcement prior to and during placing concrete with particular attention to the top reinforcement in cantilever sections should be properly checked.

5.11.2. Reinforcement should be clean and free from corrosive pitting, loose rust, loose mill scale, oil and other substances, which may adversely affect reinforcement, concrete or the bond between the two.

5.11.3. The projecting reinforcement should be protected from weather where the rust staining of exposed concrete surfaces may occur.

6. STRUCTURAL STEEL WORKS

6.1. GENERAL DESCRIPTION

The contractor shall furnish all materials, labor operation, equipment, tools and plant and incidentals necessary and required for the completion of all metal work in connection items of metal work as called for in the drawings. The drawing and specifications cover the major requirements only. The supplying of additional fastenings, accessory features and other items not mentioned specifically herein but which are necessary to make a complete installation shall be a part of the contract.

6.2. APPLICABLE STANDARDS

IS-226-1975 - Structural Steel (standard quality)(fifth revision)
IS-456-1978 - Code of practice for plain and reinforced Concrete (third revision)
IS-696-1972 - Code of practice for general engineering drawings (second revision)
IS-786-1967- (supplement) SI supplement to Indian standard conversion factors and conversion tables (first revision)
IS-812-1957 - Glossary of terms relating to welding and cutting of Metals
IS-813-1961 - Scheme of symbols for welding
IS-814 - Covered electrodes for metal arc welding of structural steels: 814 (part -1)-1974 part-1 for welding products other than sheets (fourth revision)
IS-816-1969 - Code of practice for use of metal arc welding for general construction in mild steel (first revision)
IS-817-1966 - Code of practice for training and testing of metal arc welders (revision)
IS-819-1957 - Code of practice for resistance spot welding for light assemblies in mild steel
IS-875-1964 - Code of practice for structural safety of buildings: Loading standards (revision)
IS-919-1963 - Recommendations for limits and fits for engineering (revision)
IS-961-1975 - Structural steel (high tensile) (second revision)
IS-962-1967 - Code of practice for architectural and building drawings (first revision)
IS-1024-1979 - Code of practice for use of welding in bridges and structures subject to dynamic loading (first revision)
IS-1030-1982 - Carbon steel castings for general engineering purposes (second revision)
IS-1148-1973 - Hot-rolled steel rivet bars (up to 40 mm diameter) for structural purposes (second revision)
IS-1149-1982 - High tensile steel rivet bars for structural purposes
IS-1261-1959 - Code of practice for seam welding in mild steel
6.3. PRODUCTS

6.3.1. MATERIALS

1. Structural steel members.
2. Structural tubing.
3. Welding materials.
4. Primer.
5. Shear studs.

All metal materials shall be free from defects impairing strength, durability and appearance and they shall have structural properties that comply fully with the standards. All ferrous metal shall be free from rust, scale and other defects. All non-ferrous metal shall have uniform finished surfaces, machined and buffed, free from defects. All sections shall conform accurately to sizes and shapes required.

6.3.2. FABRICATION

6.3.2.1. Structural steel members should be fabricated in accordance with IS Specifications 800 section V and approved shop drawings.

6.3.2.2. Defective material used shall be replaced by the contractor.

6.3.2.3. Fabricated items delivered at site shall be suitably protected from any damages.
6.3.3. FINISH

Structural steel members should be cleaned, prepared and shopped and primed. Surfaces to be field welded or in contact with concrete should not be primed.

6.4. EXECUTION

6.4.1. Structural steel should in accordance with IS Specifications.
6.4.2. Provision for erection loads and for sufficient temporary bracing should be made to maintain the structure in proper plumb and in true alignment until completion of erection and installation of permanent bracing.
6.4.3. Structural members should not be field cut or altered without approval of engineer-in-charge.
6.4.4. Members shall be cut mechanically by saw or shear or by oxy acetylene flame and not by electric metal arc. Cut edges shall be ground as per IS 823. Cutting tolerances shall be:
   - Members connected at bolt ends: ±1 mm. and other members: ± 3 mm.
6.4.5. All bolt holes shall be drilled and to the sizes specified in drawings.
6.4.6. Tolerance for spacing between two holes: ±1 mm.
6.4.7. Tolerance between two perpendiculars of any oval holes: ± 1 mm.
6.4.8. Bolt holes for field joints shall be drilled in the shop to the required diameter and tested.

6.4. PREPARATION OF MEMBERS OF WELDING

6.5.1. Proper jigs and fixtures shall be used to ensure correct positioning of structural members during assembly.
6.5.2. Sharp edges, rusting of cutting edges, notches, irregularities, and fissures due to faulty cutting shall be chipped and ground.
6.5.3. Edge preparation for welding shall be done properly taking care of cleaning, providing dry surface, removing grease, dust or dirt, foreign matter, etc.
6.5.4. Finished dimensions of structure shall be ensured after taking into account the shrinkage and distortions during welding.

6.6. WELDING

PERSONNEL

Welders shall be fully trained, experienced and certified by the recognized welding institutes. Welders’ qualification tests shall be as per IS 823 and approved by engineer-in-charge.

EXECUTION

(a) Welding shall be done in accordance with IS 823.
(b) Welding parts shall be marked with welders' identification.
(c) The welded parts, electrode wires should be against wind and rain.
(d) Discontinued seams shall be melted before resuming welding operation.
(e) Welding seams shall be cooled slowly and not by any other quick methods.
(f) Before welding a second layer over the existing layer of weld, the layer shall be cleaned metal bright by light chipping and wire brushing.
(g) Execution shall proceed in strict compliance with section 2/7 safety procedures.

APPROVAL

(a) Welded parts shall not have any deformations.
(b) Welded joints should compensate for contraction due to welding.
(c) Defective welds must be rectified.
(d) Weld seams shall correspond to design shapes and dimensions.
(e) Weld seams shall not have cracks, fusion, under cuts, rough surfaces, burns, blowholes, and incomplete penetration.

6.7. BOLTING

6.7.1. MATERIAL
A) Bolts, nuts shall be in accordance with IS 1367 and tested as per IS 1608.
B) Washers shall be as per IS 2016.

6.7.2. PREPARATION
(a) Members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.
(b) All sharp edges, shavings, rust, dirt, etc. shall be removed before assembly.
(c) Before assembling the contacting surfaces of the members shall be cleaned and given a coat of primer.
(d) The assembling shall be done temporarily and checked for co-axiality of the holes after which the assembly shall be finally bolted.

6.7.3. EXECUTION
1. Bolts shall be fixed after all the defects have been rectified and approved by engineer-in-charge.
2. Bolts shall be tightened from the center of joint towards the edge.

6.7.4. IDENTIFICATION
1. Structural members prior to dispatch for erection shall be marked with a weather proof light colored paint. The size and thickness of members shall be so chosen as to facilitate easy identification.
2. Structural members small in size shall be bundled or crated and shall be marked with metal tags for bundles and painted on crates for identification with particulars of the bundle/crate size, weight, etc.

6.8. PAINTING

6.8.1. PREPARATION
(a) Surface to receive primer coat shall be sand blasted/ wire brushed, free of dust, oil, rust etc.
(b) Surfaces not accessible to painting shall be filled with approved type of oil and putty.
(c) Surface shall be completely dry.
(d) Surfaces where water or aggressive agents may accumulate during transportation, storage, erection and operation shall be filled with putty and provided with drainage holes.
(e) Structural steel members and welds need to be inspected and approved by E-I-C.
(f) After satisfying the above criteria the surfaces are to be provided with one coat of red oxide/zinc chromate primer to the satisfaction of engineer-in-charge before the material is dispatched for erection.

6.8.2. The following areas are not to be primed.
(a) Surfaces to receive weld at site.
(b) Surfaces bearing markings.
(c) Surfaces shall receive a coat of hot oil or any approved resistant lubricant only.
(d) To give a coat of cement wash for any members either embedded or in contact with concrete.
(e) To give a bituminous coat for members in contact with ground, gravel, brickwork and moistures.
(f) Contractor to give a further coat of red oxide paint after erection and placing in position of the assembly if called for by the engineer-in-charge.

6.8.3 FIELD ERECTION
(a) Approvals of foundation, column pedestals or other related structure on which the structural steel members are to be erected is a prior necessity.
(b) To get approvals of the members receiving structural steel members regarding their levels dimensions, alignments and verticality well in advance.
(c) To carry out any minor discrepancies at no additional cost.
(d) To get approvals of pockets, bolt locations, levels of base plates etc. before erection.
(e) Erection to commence after satisfying the above conditions.
(f) Erection to be done in an organized way so that any individual member is not subjected to instability during the erection time.
(g) Precautionary measures to be taken during erection of trusses, purlins and other steel members by providing proper bracing
(h) Faulty erections done without caring for safety of members and of personal shall be made good at no additional cost.
(i) Contractor is not relieved of his responsibilities, guarantees even after the engineer-in-charge approves the fabrication, erection, etc. at any stage of work.
(j) Contractor is solely responsible for the correctness accuracy and quality of the fabrication erection and final approvals to be obtained by the engineer-in-charge.

7. BRICK MASONRY
7.1. GENERAL.

Brick Masonry shall consist of all work required in connection with constructing brick masonry at locations shown on drawings including, but not limited to, furnishing brick, portland cement and sand for mortar and all other materials, and mixing, placing brick masonry as per bill of quantities.

7.2. MATERIALS.

i) All portland cement for mortar and plaster work shall be furnished by the Contractor and shall conform to the applicable requirements specified in the section- 3.5.1.

ii) All sand for mortar and plaster work shall be furnished by the Contractor and shall conform to the applicable requirements for sand specified in the section- 3.5.2.

iii) All water used in the manufacture of bricks and in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities, and will be tested and approved by the ENGINEER-IN-CHARGE as per the guidelines of IS: 456.

7.2.1. MORTAR.

i) MIX: Mortar for all brick masonry, expect where otherwise directed by the ENGINEER-IN-CHARGE, shall consist of one part cement to six parts of damp loose mortar sand by volume for brickwork 230mm and above. For brick piers, half brick walls, honey-combed brickwork and hollow (cavity) walls, the mortar mix shall consist of one part cement and four parts of sand. Quantity of water shall be just sufficient enough to produce proper consistency for the intended use. Where directed and approved by the ENGINEER-IN-CHARGE, hydrated lime putty, shall be added to the mortar for increased workability. The putty shall, however, not exceed 25% by volume of the dry cement.

ii) Methods and equipment used for mixing mortar shall be such as will accurately determine and control the amount of each separate ingredient entering into the mortar and shall be subject to the approval of the ENGINEER-IN-CHARGE. Mortar shall be mixed only in sufficient quantities for immediate use and all mortar not used within 30 minutes after addition of the water to the mix shall be wasted. Re-tampering of mortar will not be allowed. The mixers shall be thoroughly cleaned and washed at the end of each day's work.
7.2.2. BRICK.

i) All bricks shall be of first class quality made from good brick earth, free from saline deposits and shall be sand moulded. They shall be thoroughly burnt without being vitrified, shall be regular, uniform in shape and size with sharp and square edges parallel faces and of deep red or copper colour. First class bricks shall be homogeneous in texture and emit a clear ringing sound when struck, and shall be free from flaws, cracks, chips, stones and nodules of lime. First class brick in an oven dried condition shall not absorb more than 1/5 of its weight of water when immersed for one hour in water at 21 to 27 degrees centigrade and shall show no signs of efflorescence on subsequent drying. The average compressive strength of five representative first class bricks shall be 15 N/ sq. mm. and shall no result shall fall below 10 N/mm sq. The bricks in general shall conform to the requirements of IS:1077.

ii) All bricks shall be manufactured by the Trench Kiln method or other standard methods approved by the ENGINEER-IN-CHARGE. The earth used in manufacturing bricks shall be carefully selected and shall be free from objectionable quantities of lime, gravel coarse sand, roots, or other organic matter. Salts shall not exceed 0.3% and calcium carbonate shall not exceed 2.0%.

iii) The moulds used in the manufacture of bricks shall be thoroughly sanded before each use and shall be sufficiently larger than the size of the bricks being manufactured to allow for shrinkage in drying and burning. The size ready for use shall be 9" by 4 3/8" by 2 3/4" (229X 112X 70mm) and shall weigh between 3.2 to 4.2 Kilograms. All bricks shall have a "Frog" 1/4" deep on one face.

7.3. PLACING.

i) All bricks shall be immersed in water for 24 hours before being put into work. The contractor must make tanks of sufficient capacity (at his own cost) for the purpose of soaking. The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the brick nor delay the use of mixed mortar. Brick shall not be placed during rains sufficiently heavy or prolonged to wash the mortar from the brick. Mortar which becomes diluted by rain shall be removed and replaced before continuing with the work. All bricks to be used in brick masonry shall be moistened with water for three to four hours before they are used. The chosen method of wetting shall ensure that all bricks are thoroughly and uniformly wetted. All bricks shall be free from water adhering to their surface when they are placed in the brick masonry.

ii) Bricks shall be laid "Frog" upward with mortar joints and in English bond as shown on the drawings or as directed by the ENGINEER-IN-CHARGE. Both bed and vertical joints shall be 6mm in thickness completely filled with cement mortar as specified herein, and each brick shall be bedded by firmly tapping with the handle of the trowel. All horizontal joints shall be parallel and all vertical joints in alternate courses shall be directly over one another. Excess mortar at the outer edges shall be removed and joints drawn straight with the edge of a trowel and a straight edge. All anchors and similar work required to be embedded in the brick masonry shall be installed as the work progresses. At the completion of the work all holes or defective mortar joints shall be cut out and repointed.

iii) The exterior faces of the walls shall be finished by striking the joints as the work proceeds. The joints shall be struck by raking the green mortar after the brick work has been laid and finishing the joint with a pointing tool. Horizontal joints shall be struck to form a weathered joints and vertical joints shall be struck with a V notch. Care shall be taken that the striking tools do not develop a cutting edge as the object of striking the joint is to compress the mortar into the joints.

iv) REINFORCED BRICKWORK:
All half brickwork shall be reinforced with 2 no. 6. mm dia M.S. round bars or equivalent reinforcement at every fourth course. The reinforcement cleaned of rust and loose flakes with a wire brush, shall be embedded thoroughly in cement mortar at every fourth course. It shall be cast in or securely fixed to adjoining columns or walls, in a manner approved by the ENGINEER-IN-CHARGE.
v) EXPOSED BRICK WORK:

Where exposed brick work is specified the usual specification for 'Brick Work' as mentioned above will be applicable for 'Exposed Brick Work', but in addition specially selected brick shall be used for facing, ensuring regular and clean faces of uniform colour. No bricks which are broken, chipped, wrinkled or which have irregular edges of corners shall be used. Depending on the quality of bricks and if instructed by the Owner/ Employer/ Consulting Engineers the exposed faces of every bricks shall be rubbed before laying without extra charge. Wooden fillets 10 mm thick and 10 mm wide shall be placed at the edge of joints so that the mortar comes on the surface of the bricks and a regular thickness of joints is maintained. The surface shall be rubbed down with brush on bricks if necessary, and thoroughly washed. No mortar shall be allowed to stick to the surface, which shall be left clean to the Owner/ Employer's/ Consulting Engineers's satisfaction with all joints even and true to straight line. Double scaffolding shall be used for exposed brick work, if necessary.

7.4. CURING AND REPAIR.

i) All brick masonry shall be water cured and shall be kept wet for least seven days by an approved method which will keep all surfaces continuously wet. Water used for curing shall meet the requirements of these specifications for water used in the manufacture of bricks.

ii) If, after the completion of any brick masonry work, the brick is not in alignment or level, or does not conform to the lines and grades shown on the drawings, or shows a defective surface, it shall be removed and replaced by the Contractor at his expense unless the ENGINEER-IN-CHARGE grants permission, in writing to patch or replace the defective area.

7.5. SCAFFOLDING.

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expenses. Scaffolding which is unsafe in the opinion of the ENGINEER-IN-CHARGE shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate for masonry items.

Damaged, masonry from scaffolding or from any other objection shall be repaired by the Contractor at his own cost.

7.6. TOLERANCES.

The brick work shall be erected plumb and true to line at level with the maximum variation in any storey height of any length of wall being 1 mm in one meter. The maximum tolerance in the length, height or width of any single masonry unit shall be +/- 3mm.

7.7. MEASUREMENT.

Measurement of acceptable completed works of brick masonry will be made on the basis of cubic metres for 200mm thick brickwork or above and Square metres for 75mm upto 125mm thick brickwork provided and installed in position as shown on the drawing or as directed by the ENGINEER-IN-CHARGE.

7.8. RATES TO INCLUDE:

Apart from other factors mentioned elsewhere in this contract, the rates for items of brick work shall also include for the following:

a) All labour, materials, use of tools, equipment and other items, incidental to the satisfactory completion of brick masonry at all heights and levels.
b) Erecting and removing of all scaffolding, ladders and plant required for the execution of the work to the height and depths and shapes as shown on the plan or as ordered by the Owner/ Employer/ Consulting Engineers/ Consultant including extra labour and materials for using cut bricks in the construction of wall of varying thickness other than one brick, one and half brick, half brick and brick on edge walls as per drawings.

c) Constructing brick work to lines, levels, batters, pillars, curve, projection, cutting, toothing etc. in strict conformity with the drawings and to any position or shape, to any heights or levels including raking out joints and housing frames, fixtures etc.

d) Necessary charges of outside scaffolding work for construction of external brick work form outside to have fair-face on external surface.

e) Curing brick work.

f) Extra labour for bonding brick work to R.C. works as specified.

g) Removing of all stains and adhering mortar lumps on the brick work surface.

h) Cost of reinforcement in half brick walls and brick on edge walls.

i) Raking out joints for receiving plaster as specified.

8.0 PLASTERING

8.1 SCAFFOLDING
Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

8.2 PREPARATION OF SURFACE
All holes in brick work and junction between concrete & brick work shall be properly filled in advance. Joints in brick work shall be racked about 10mm and concrete surface hacked to provide the grip to the plaster. Projecting burns of mortar formed due to gaps at joints in shuttering shall be removed.

The surface shall be scrubbed clean with wire brush/ coir brush to remove dirt, dust etc. and the surface thoroughly washed with clean water to remove efflorescence grease and oil etc. and shall be kept wet for a minimum of six hours before application of plaster but there should not be any free standing water on the surface.

All plaster work shall be kept continuously wet for seven days.

8.3 ORDINARY CEMENT PLASTER
The preparation of surface shall be as stated above. The thickness and proportion of plaster shall be specified in the schedule of items.

The mortar shall be applied evenly with force on the surface to be plastered. The mortar surface shall be finished at once by rubbed over with a trowel till the cement appears on the surface, all corners. Angles and junctions shall be truly vertical & horizontal as the case may be 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 not be hollow sound when struck.
8.4 SAND FACED PLASTER

The surface shall be prepared as above. The cast of cement mortar in proportion of 1:4 or as specified in the schedule of works shall be applied uniformly all over the surface to the specified thickness and finished true to level and line and keys shall be formed on the surface.

The surface shall be kept moist till the finishing coat is applied. The finishing coat shall be applied a day or two after. The proportion of mortar for finishing coat shall be one part of cement and three parts of selected, well graded and washed sand & it shall be applied in a uniform thickness of 6 mm (1/4"). The surface shall be tapped to uniform grained texture by using sponge pads as directed. Curing shall start after 24 hours and the surface kept wet for seven days.

8.5 ROUGH CAST PLASTER

Except for the finishing coat, the surface shall have base coat of plaster applied, prepared finishing coat of mortar shall be in proportion of one part of cement and one part of specially selected and graded sand and one part of gravel of 3 to 6 mm size. It shall be flung upon the first coat with large trowel size to form an even and decorative coat. The work shall generally conform to clause 16.5 of I.S. 1661-1960 and the thickness of the coat shall be about 12 mm (11/2"). It shall be cured for seven days.

8.6 RATES TO INCLUDE:

Apart from other factors mentioned elsewhere in the contract rates for the item of plaster shall include for the following:

i) Erecting, dismantling and removing the scaffolding.

ii) Preparing the surface to receive the plaster.

iii) Providing cement plaster of the specified average thickness.

iii) All labour, materials, use of tools and equipment to complete the plastering as per specification.

iv) Curing for 7 days.

iv) Any moulding work if shown on the drawings or as specified unless separately provided in the tender.

9.0. WATER PROOFING

9.1 WATER PROOFING TREATMENT:

Waterproofing specifications given hereunder or in the BOQ are indicative only. Acceptance of any other alternative specifications will be subject to approval by the E-I-C/ Consultant. The tenderer further to note that a guarantee of 10 (ten) years for satisfactory performance on a Rs. 50.00 non-judicial stamp paper has to be furnished to the Owner/ Employer as per Proforma approved by the Consultant.

9.2 UNDERGROUND WATER TANK:

The entire inner surface of base slab and side walls (external and internal) of water tank shall be cleaned properly to be free from dust, oil, loose particles etc. 15mm thick cement sand plaster (1:3) should be added with water proofing compound @ 3% by weight of cement over which a layer of Tape crete is to be applied. The surface to which Tape crete should be allowed should
be kept moist before it's application. The Tape crete with cement slurry should be applied both horizontally on the surface with a 100mm wide brush. Application of one coat of Tape crete will be deemed to be completed when it is applied both horizontally and vertically. The same will be allowed to dry for 24 hours and the application of second coat will be made thereafter in a similar manner. 2 coats of application of Tape crete should be considered as application of one layer. This should be followed by 15 mm thick (1:3) cement plaster with water proofing compound @ 3% by weight of cement and finish it with neat cement punning. Neat cement punning will be done only on the inner walls and base slab.

9.3 ROOF TREATMENT

The roof waterproofing treatment comprises of addition of waterproof compound during casting of R.C.C. roof slab (above G+IV level), waterproof plastered surface and waterproof cement concrete (1:2:4) as laid in slope.

a) Preparation of sub-grade: The surface of the roof slab should be cleaned properly by chipping off any loose mortar and reasonably leveled. The surface should be cleaned, dust free and dry. Any pocket or honey comb in concrete surface must be filled properly with (1:1.5:3) concrete and if necessary pressure grouting to be done as per direction of the E.I.C. by the Agency at his own cost.

b) Plastering: After preparation of sub-grade apply 15mm thick cement plaster (1:3) mixed with waterproofing compound @ 3% by weight of cement.

c) Chemical Treatment (Tape crete): The chemical waterproofing treatment is in two operation. First one coat of tape crete is applied and after paint becomes dry then second coat of tape crete is to be applied.

d) Guarantee of the Chemical Treatment: The contractor must produce guarantee certification.

e) Cement concrete: When the Chemical paint becomes dry plain cement concrete (1:2:4) with graded stone chips (20 mm down) mixed with waterproofing compound @ 3% by weight of cement is to be laid in panels. The panels should not be more than 10 sqm. with maximum length 3.0 m. The concrete should be laid with every precautions, so that there is no damage to the waterproofing Tape crete paint. Cement concrete must be laid with proper scope as per roof drainage drawing, thoroughly beaten in both direction so that it is well compacted. The thickness of concrete should not be less than 35 mm at the minimum point. Dry cement is to be spread when the concrete is still green and finished smooth with trowel. The rate should include preparation of water channels, goondy, mouth of rain water pipe etc complete.

9.4 WATER PROOFING TREATMENT TO THE BASEMENT

All R.C.C castings of Basement walls, floor and Basement roof should be done with waterproof compound @3% by weight of cement.
a) HORIZONTAL SURFACE

i) Basement Floor: After laying of P.C.C, the waterproofing operation will be made sequentially as under:

After laying of 75mm thick P.C.C (1:4:8) over 600mm thick sand filling, a course of A.P.P. (Atactic Polypropylene Polymer) modified prefabricated fine layer, 3mm thick water proofing membrane is to be laid as per manufacturer's specification (as detailed in the schedule of work) followed by a layer of 15mm. thick Cement Plaster(1:3) using water proofing compound @ 3% by weight of cement before casting. The R.C.C. Slab should be casted with water proofing compound @ 3% by weight of cement. Over the R.C.C. Slab, sand filling to be done followed by one layer of P.C.C. and then a layer of Tape crete (2 coats) is to be applied on the P.C.C. followed by 35mm. thick artificial stone flooring having chequered finish and laid in panel.

ii) Basement roof: After casting of R.C.C slab, the waterproofing operation will commence. The stepwise sequence will be as under:

a) 1st course: Applying 10mm thick cement plaster (1:3) mixed with water proofing compound @ 3% by weight of cement.

b) 2nd course: Providing and laying A.P.P.(Atactic Polypropylene Polymer) modified prefabricated fine layer, 3mm thick water proofing membrane.

c) 3rd course: Applying 15mm thick cement plaster (1:3) mixed with water proofing compound @ 3% by weight of cement.

b) VERTICAL WALL OF BASEMENT:

a) External surface:

(i) After removal of shuttering, surface of the walls should be thoroughly scrubbed and cleaned. The wall surface is to be prepared for application of tape crete as per manufacturer’s specification. The surface should be properly saturated prior to the application of tape crete. A layer of 15mm cement plaster 1:3 containing integral waterproofing compound to be applied there after.

ii) Providing and laying A.P.P.(Atactic Polypropylene Polymer) modified prefabricated fine layer, 3mm thick water proofing membrane.

iii) Applying 15mm thick cement plaster (1:3) mixed with water proofing compound @ 3% by weight of cement.

b) Internal surface: After removal of shuttering, surface of the walls should be thoroughly scrubbed and cleaned for application of one layer of Tapecrete, over which a layer of 15mm thick cement plaster (1:3) containing integral waterproofing compound is to be applied.
9.5 WATER PROOFING TREATMENT TO SUNKEN FLOOR OF TOILET, KITCHEN AND PANTRY.

Providing and laying water proofing treatment to vertical and horizontal surface of depressed portion of WC, kitchen and the like consisting of:

(i) **1st course:** Applying cement slurry @ 4.4 kg/sqm mixed with water proofing compound conforming to IS 2645 in recommended proportion including rounding of junction of vertical and horizontal surface.

(ii) **2nd course:** Applying 20 mm cement plaster 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding of junction of vertical and horizontal surface.

(iii) **3rd course:** Applying blown or residual bitumen applied hot at 1.7 kg/sqm area.

(iv) **4th course:** Applying 400 micron thick PVC sheet (overlapped at joint of PVC sheet should be 100mm wide and pasted to each other with bitumen @ 1.7Kg / SQM).

9.6 WATER PROOFING TREATMENT TO OPEN TERRACE GARDEN AND PLANTERS

Water proofing treatment to open terrace gardens should be done in a similar manner like the Basement roof.

**N.B.:** The surfaces where water proofing treatment is required to be done, should become water tight in true sense after application of the water proofing treatment. Any defect in this regard will have to be rectified as per direction of E.I.C by the Agency at his own cost i.e. no claim for payment in this regard will be entertained.

Rectification by chemical injection grouting may be adopted as stated below subject to written approval of EIC/Consultant, solely to be done at the cost of the agency.

Chemical injection grouting is to be carried out by fixing nozzles and through mechanical pump at an optimum pressure of 3.0 to 4.0 Kg/sq cm. Grouting at defective zones shall be done with Acrylic based waterproofing chemical mixed with neat cement slurry. The viscosity of cement slurry is important - thinner the slurry, deeper the penetration into the fine capillaries. For honeycombed areas of finished concrete, thicker slurry is to be used. All construction joints, honey combs, cold joints, after casting shall be treated by hacking open the affected area to sound concrete, fixing nozzles and grouting the same, under pressure with cement slurry mixed with plasticizer, and non shrink additive.
10.0 FLOORING, SKIRTING & CLADDING WORK:

10.1 CEMENT CONCRETE FLOORING:

a) Cement concrete is to be composed of 1: 2: 4 (1 part cement : 2 parts coarse sand and 4 parts 12 mm down stone chips) for the bottom layer 20 mm and 30 mm for 25 mm and 35 mm finished flooring respectively. The topping is to be 6 mm thick in all cases and consist of neat cement paste of uniform colour.

b) In case of dado and skirting the total thickness is to be 20 mm of which the bottom layer is to be 15 mm and the topping 6 mm. In all cases, both the layers are to be laid simultaneously in one operation, but the mixing may be made in two lots.

c) Before laying concrete surfaces are to be chipped off, roughened and cleaned and thoroughly wetted and grouted in neat cement.

d) The floor shall be bounded and flooded with water for a period of two weeks after laying.

e) The treads and risers of staircase shall be finished as like the floors.

f) Specified polishing is to be done by expert trained labour only when the surface is matured, by rubbing with carborandum stone by machine, to the satisfaction of the authorities. The polishing shall not be done before proper maturing, which takes at least eight weeks.

g) Where desired all internal angles are to be coved.

h) Where coloured artificial stone is specified, the proportion of pigment shall be one part of pigment to three parts of “Portland” cement. The pigment must be of approved manufacture and tints to be uniform.

i) Any cracks, rust, disfiguration or discolouring of surfaces will have to be made good without extra charge to the satisfaction of the Consulting Engineers/ Consultant/ Owner/ E-I-C.

j) Flooring of specified thickness shall be laid in alternative panels as directed by the Consulting Engineers/ Consultant/ Owner/ E-I-C. The panels shall be of uniform size not exceeding 3 sqm. with a minimum length of 1800 mm and below in any direction with glass divisional strips penetrating the entire thickness of the surfacing. The rates quoted should include all the close operations including cost of glass strips.

10.2 ARTIFICIAL STONE FLOORING:

a) Grey and coloured stone is to be composed of two parts of fine stone chips, 6 mm down, washed and screened, to one part of cement for the bottom layer, which must have a minimum thickness of 16 mm and 26 mm for 25 mm and 35 mm finished flooring, respectively. The topping is to be 10 mm thick in all cases and to consist of clean and
fine stone dust and cement (2:1). Sufficient skin thickness is to be kept for polishing. The base course is to be covered with a thick layer of neat cement grout, well brushed in, to be laid, well tamped with screed bars lightly floated to the required level and slopes. As soon as initial set takes place the surface shall be trowelled to a smooth finish, or broom finish, as instructed. Sprinkling of dry cement or mixture of dry cement and sand, on the surface should be avoided.

b) In the case of dado and skirting, the total thickness is to be 20 mm of which the bottom layer is to be 14 mm and topping 8 mm. In all cases, both the layers are to laid simultaneously in one operation, but the mixing be made in two lots.

c) The floor shall be bounded and flooded with water for a period of two weeks after laying.

d) The treads and risers of staircase shall be finished as like the floors and with a wooden float and have a small quantity carborandum sprinkled evenly on the surface to provide anti-slip finish.

e) Where specified, polishing is to be done by expert trained labour, only when the surface is matured, by rubbing down with carborandum by machine, to the satisfaction of the Consulting Engineers/ Consultant/ Owner/ Employer. The polishing shall not be done before proper maturing, which takes at least eight weeks.

f) When desired, all internal angles are to be coved.

g) Where coloured artificial stone is specified, the proportion of pigment shall be one part of pigment to three parts of “Portland” cement. The pigment must be of approved manufacture and tints to be uniform.

h) Any cracks, rust, disfiguration or discoloring of surfaces will have to be made good without extra charge to the satisfaction of the Consulting Engineers/ Consultant/ Owner/ Employer.

i) When cast-in-situ, the flooring is to be carried out in panels not exceeding 7.0 sqm. with maximum length of 3 M, expansion joints separated by aluminium/ glass trips penetrating the entire thickness of the surfacing. Rates quoted are to be inclusive of the cost of dividing strips.

10.3 IRONITE HARDNER:

a) Where desired, ironite hardner is to be laid on top of cement concrete floor, the ironite topping must not be less than 12 mm thick.

b) This shall consist of 12 mm thick layer of mix 1:2 (1 part ironite mixture and 2 parts hard stone grit 6 mm ad sown gauge) by volume the ironite mixture is to be composed of 1 ironite : 4 cement by weight. Ironite shall be dry mixed thoroughly with cement on a
clean dry pucca platform and then stone grit added and mixed. The mix is prepared by adding water in the usual manner.

c) The mix is then laid to the desired thickness, when the initial set takes place, the surface is to be trowelled to a smooth finish with a steel trowel. The finished flooring is then kept wet for at least seven days by means of wet sacks or by other suitable materials to the approval of the Consulting Engineers/ Consultant/ Owner/ E-I-C. Sprinkling of neat cement over the flooring during the process of final trowelling is prohibited.

10.4 CAST-IN-SITU MOSAIC FLOORING, DADO AND SKIRTING

FLOORING:

a) Preparation of sub-grade:
The surface of the base slab shall be struck off reasonably true at a level (average 30 mm or other wise) required to suit the thickness of floor finish as mentioned in the schedule of quantities below the required finished level. Before laying floor concrete, the sub-grade shall be properly cleaned and trimmed to give required thickness of floor and neat cement slurry applied to give proper bond of floor with the sub-grade.

b) Flooring composition (In-situ):
This will consist of two layers, the bottom one called the ‘under coat’ and the top one called the ‘top coat’. The bottom coat shall be 26 mm thick (average) and the top coat shall be 9 mm thick (finished). The total finished thickness shall be 35 mm (average) unless otherwise stated in the Schedule of Quantities.

i) Undercoat: The concrete for the undercoat shall be mixed in the proportion of one part Portland cement 2 parts of sand to 4 parts of fine stone chips mixed with not less than 25 litres (5 – gallons) of water per bag of Portland cement.

ii) Glass Strips: While laying the undercoat, glass strips of about 3 mm thick and width to suit thickness as separators shall be provided from approved panels unless otherwise specified in Schedule of Quantities.

The area of each panel in the flooring shall not exceed 3 sqm. or as directed, the longest side of any panel not exceeding 1.5 metre. The cost of providing glass strips in the flooring shall be included in the rate quoted for mosaic flooring.

iii) Top Coat: The grading, proportion and colour of the marble chips shall be got approved from the Owner/ Employer/ Consulting Engineers after preparing a few
samples of cast-in-situ mosaic flooring. The proportion of cement to marble chips shall be 1:2. The thickness of top coat shall be as specified in relevant B.O.Q.

c) Workmanship:
Before laying cast in situ mosaic work, approval should be taken from the Owner/ Employer/ Consulting Engineers for samples of different types of marble chips (grade and shade) and which shall be kept in the office of the Owner/ Employer/ Consulting Engineers at site for reference. The sub-grade shall be chipped, thoroughly cleaned wetted and given a coat of cement grouting. Cement concrete (1: 2: 4) undercoat of stiff consistency shall be laid on the surface and proper key for the terrazzo mix shall be formed. After undercoat has fully set the surface shall be given a coat of cement grouting (coloured or grey as required) and the top coat shall immediately be laid, tamped and trowelled to an even surface. Terrazo topping including the base shall be carried out in alternate section not exceeding 3 sq.m. Glass strips penetrating through the full thickness of terrazzo and concrete base shall be used at joints to attain best quality of works. The top coat should have sufficient thickness so that after final polishing the thickness as mentioned in the Schedule of Quantities is maintained.

After striking off the finished level, the concrete top coat shall be rolled lengthwise and crosswise, so as to secure thorough compaction of marble chips and cement paste. Additional marble chips of the larger size shall be spread over the topping during rolling until 85% of finished surface shall be composed of marble chips. Immediately after rolling, the surface shall be floated and trowelled once. No attempt shall be made to remove trowel marks. After this the floor must be kept continuously moist for at least 10 days.

After the terrazzo concrete has hardened enough to prevent dislodgement of aggregate particles, it shall be ground down with an approved type of grinding machine set with free, rapid cutting carborundum stones to expose the coarse aggregate. All the materials ground off shall be removed by squeezing and flushing with water. Air holes, pits and other blemishes shall then be filled with a thin grant composed of neat cement. This grout shall be spread over the surface and worked into the pits. After all patch fillers have hardened for seven days, the floor surface shall receive a second and final grinding to remove the film of cement paste. The surface then shall be rubbed with oxalic acid powder mixed with water and when dry shall be finished by applying wax polish with felt pads.
All freshly placed concrete shall be protected from the elements and all defacement due to building operations. The contractors shall provide and use, with necessary tarpaulins to cover complete or enclose all freshly finished concrete.

All angles at bases and corners are to be covered without any extra charge.

iv) Rates also to include:
Apart from other factors mentioned elsewhere in this contract, the rates shall include for the following:

a) Providing and laying 1: 2: 4 cement concrete for undercoat in panels including cost for providing a coat of cement grouting on sub-grade and on undercoat as specified.
b) Mixing the ingredients or terrazo mix to white cement/ approved pigments and marble chips of approved quality, maximum size and graded down as required and laying it in the top coat.
c) Curing of concrete leveling course and top coat submerging in water for 7 days.
d) Machine polishing and finish as specified above.

v) Mode of Measurement:
The measurement shall be in sqm. for the actual cast in situ mosaic flooring provided.

DADO AND SKIRTING : (In-situ)
Dado and skirting shall be laid in two layers, the under coat being laid as (1: 2: 4) cement concrete and the top coat with marble chips in white cement as required.

a) Under Coat :- The under coat shall be in (1: 2: 4) cement concrete and shall be applied to the wall surface. The thickness of the undercoat shall be 16 mm over the proudest part for brick work & the concrete faces. The surface of the under coat shall be kept rough to form a key for the tap coat of the marble chips in white/ grey cement with pigment as required in different proportions. Total finished thickness shall be 25 mm (average) unless mentioned in the B.O.Q.

b) Top Coat :- This shall be 9 mm thick finished to 6 mm or thickness as mentioned in B.O.Q.

c) Polishing :- Same as that for flooring without machine polishing should be done.
d) **Rates also to include** :- Apart from other factors mentioned elsewhere in this contract, the rates shall include for the following :-

i) Applying under coat 1: 2: 4 cement concrete and roughening the surface including cost for providing a coat of cement grouting on sub-grade and an undercoat as specified.

ii) Mixing the ingredients of terrazzo mix as required and laying it in top coat.

iii) Curing.

iv) Polishing and finishing the dado and skirting.

**Mode of Measurement** :
Dado and skirting shall be measured in square metre for the actual area of the top coat provided.

**10.5 PLAIN OR COLOURED CEMENT TILES OR TERRAZO TILE FLOORING** :

i) **Tiles** :
Plain or coloured cement tiles and terrazzo tiles shall be manufactured as per I.S. 1237 of latest edition using grey or white cement and pigment and marble chips (white and coloured) or size as required. Tiles shall be of approved quality, colour, shade and make. The tiles shall be of approved size and the minimum thickness shall be 20 mm. A few samples of tiles to be used shall be deposited by the Contractor to the office of Owner/ Employer/ Consulting Engineers/E-I-C at site for reference.

ii) **Concrete Base and Mortar Bedding** :
The base of cement or lime concrete shall be laid and compacted to a reasonably true plain surface and to the required slopes and below the levels of the finished floor to the extent of the thickness of the tiles and mortar bedding. Lime surki mortar for bedding shall be prepared in a mortar mill.
Care shall be taken in preparing the mortar to ensure that there are not hard limps that would interfere with the even bedding of the tiles. Before spreading mortar, sub-floor or base shall be cleaned of all dirt, scum, laitance and all loose materials and then well wetted with out forming any pools of water on the surface. In case of R.C.C. floors, the top shall be left a little rough. All points of level for the finished paving surface shall be marked out. The mortar shall then evenly and smoothly spread over the base by the use of screed battens only over so much area as will be covered with tiles before the setting of the mortar. The thickness of the mortar bed shall not be less than 15 mm and not
more than 25 mm. Unless otherwise specified, the proportion of mortar bedding shall be composed of 1 cement and 3 medium sand by volume.

iii) Laying, Curing, Polishing & Cleaning:
Tiles shall be laid as per approved pattern on the mortar bed and floated in neat cement slurry. The joints of the tiles shall not be more than 1.5 mm wide and shall be filled with neat cement slurry or required colour to match the colour of the tiles. If required, the border tiles shall be cut to proper sizes and the rate quoted shall cover for the same. No border tile shall be less than 100 mm in width, unless otherwise approved by the Owner/Employer/Consulting Engineers.

Flooring shall be kept wet for 14 days.

iv) Polishing and cleaning of the whole floor will be done as per direction of E-I-C.

Rates to include:
Apart from other factors mentioned elsewhere in this contract, the contractor’s quoted rate shall include for the following:

a. Cleaning for the base and providing and laying bedding mortar and leveling.
b. Providing and fixing the tiles in neat cement float on the bedding mortar.
c. Filling of joints of tiles with neat cement slurry of required colour to match the colour of the tiles.
d. Polishing, finishing and cleaning. All labour, materials and use tools and carrying out the item as specified above.

vi) Mode of Measurement:
The tile shall in square metre for the actual area provide measurement for the tile flooring.

DADO AND SKIRTING:
a) Tiles shall be as specified above for flooring except that in the case of skirting the height of tiles may be less than the height of 1 full tile.

b) Mortar Backing:
The proportion of mortar for backing shall be 1.3 cement mortar.

c) Fixing dado – Skirting tiles:
Dado or skirting shall be fixed only after fixing tiles on the floor. The tiles shall be soaked in water before being used for dado or skirting work. The tiles shall be fixed when the backing mortar is still plastic and before it gets stiff. All the tiles shall be covered with an additional layer of neat cement base and tiles shall then be pressed in mortar and gently tapped against, the wall with wooden mallet. The fixing shall be done from the bottom of wall upward without any hollows in the beds or joints. Each tile shall be fixed as close as possible to the adjoining tile. The tile shall be jointed in neat cement slurry to match the color. Joint of the tiles should not exceed 1.5 mm in width and they shall be uniform. While fixing the tiles in skirting or in dado, care shall be taken to see that the joints to the adjoining flooring tiles below matches with the joints in the skirting or the dado tiles as the case may be or shall be staggered as directed.

d) **Polishing**:
Polishing may be done by hand with approved type of polishing stone. A smooth and even polished surface shall be obtained to match the finished surface of the flooring.

e) **Curing**: The dado or skirting shall be kept wet for 14 days.

### 10.6 Marble Slab Counters:
Granite/ Marble slab shall be of best Indian Granite/ Marble of white or any other approved colour as specified in the item. They shall be hard, dense uniform and homogeneous in texture and shall have even crystalline grain and free from defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and edges machine cut to true shape. The rear face shall be rough enough to provide a key for the mortar but when used for shelves all the faces shall be machine polished and perfectly plane. The size of the slab shall be as per requirement of the work and thickness should be uniform.

a) **Dressing and Rubbing**:

Each slab shall be cut to the required size and shape and fine chisel dressed at all the edges of the full depth. The sides thus dressed shall have a full contact if a straight edge is laid along. The sides shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edge of the slabs shall be true be square and free from chipping giving a plane surface.

Thickness shall be 25 mm as specified in the item.

b) **Bedding**:

Bedding for the Granite or Marble slabs shall be cement mortar as specified in the schedule of work of average thickness 20 mm as given in the description of the item. Minimum thickness at any place shall be not less than 10 mm.

b) **Laying**:
Sub-grade shall be cleaned, wetted and mopped. Mortar of the specified mix and thickness shall then be spread on an area sufficient to receive one slab. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped gently to bring it in level with the other slabs. It shall then be lifted and laid a side. Top surface of the mortar shall then be corrected by adding fresh mortar at hollows or depressions. The mortar is then allowed to harden a bit. Over this surface, cement slurry of honey like consistency at 4.4 kg. of cement per square metre. The edge of the slabs already paved shall be buttered with grey or white cement with or without pigment to match the shade of the granite stone slabs as given in the description of item. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slab. Surplus cement on the surface of the slab shall be removed. The slabs fixed in the floor adjoining the walls shall enter not less than 10 mm under the plaster, skirting or dado. The junction between the wall and floor shall be finished neatly. The finished surface shall be true to levels and slopes as directed by the E-I-C.

Rates shall include:

a) All labour, materials and equipment, cleaning the sub-base, laying mortar bed and cement grout and laying granite stone slabs as specified above and making up the joints with pigments / white cement etc.

b) Any cutting and waste if required,

c) Curing.

d) Cleaning the floor from all stains etc.

Mode of Measurement:

The measurement shall be in square metre for the actual granite stone flooring provided.

10.7 GRANITE WORKS

The granite stonework shall, in general, be carried out as per the PWD- SOR Specifications. The specifications for dressing, laying, curing, finishing, measurements, rate etc. for the granite stone flooring shall be same as that of works for the Marble flooring, skirting and risers of steps under Flooring Sub Head of the PWD-SOR Specifications. The wall lining / veneer work with granite stone shall be as per the PWD-SOR Specifications for Marble work Sub Head.

Granite stone tiles and slabs shall be pre polished (mirror polished), eggshell polished, flame finished or given any other surface treatment as specified, as per the Architectural drawings and as directed by the Engineer-in-Charge.
Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the Engineer-in-Charge may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost. Nothing extra shall be payable on this account.

Granite stone slabs shall be individually packed in cardboard paper. These shall be handled carefully to prevent any damage. The stone slab procured shall be free of any surface defect or any edge damage. The damaged stones shall not be allowed to be used in the work. So the Contractor shall procure additional such quantities, to cover such contingencies. However nothing extra shall be payable on this account. The stone slabs shall not be waxed or touched up with dyes / colours.

The granite stone slabs to be procured for the work shall match the samples shown to the Contractors. Before starting the work, the Contractor shall procure and submit the samples of granite stone slab (matching to the samples shown to the Contractors) for the approval of the Engineer-in-Charge. The samples shall be submitted along with the following details:

a) Three representative samples for each type of granite stone specified.

b) Details of physical characteristics such as dimensional tolerances (within the specified limits), water absorption, compressive strength, Mohs Hardness, Specific gravity with reference to IS or International standards.

c) Source of supply and confirmation of availability in full quantity and uniformity of colour, tone and textures.

d) Company profile of Suppliers.

e) Procedure for fixing including samples of fixtures such as cramps, pins, dowels etc.

The decision of the Engineer-in-Charge as regards the approval of the samples for the various types of the granite stones shall be final and binding on the Contractor. No claim of any kind whatsoever shall be entertained from the Contractor on this account. The Contractor shall then procure and get the mock up prepared at site of work for approval of quality of workmanship and the granite stone as specified. The mock up shall be prepared in lift lobby, toilet etc. on one of the floors. The size of the stones shall be as per the architectural drawings. If the quality of the workmanship and the material is as per the required standards, the mock up shall be allowed as part of the work and measured for payment and shall not be dismantled. Otherwise, it shall be dismantled by the contractor as directed by
the Engineer-in-Charge and taken away from the site of the work at his own cost. Nothing extra shall be payable on this account.

The entire supply for each type of granite stone slab shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one floor to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the Engineer-in-Charge, shall not be used in the work and shall be removed and replaced by the Contractor. Nothing extra shall be payable on these accounts. Also no claim of any kind shall be entertained from the Contractor on this account.

The stone work may be required to be carried out in patterns, design and/or in combination with granite stones of different colour and shade with or without borders and in combination of different stone slabs/ceramic tiles for which nothing extra shall be payable. The stones shall be provided in sizes and shapes as per the architectural drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account.

The following tolerances shall be allowed in the dimension of granite stone slab:

**Slabs: Tolerance**

a) Length ± 1mm  
b) Width ± 1mm  
c) Thickness ± 1mm  
d) Angularity at corners ± 0.25%

The stones (slab and tiles) not meeting the above tolerance limits shall be rejected and not permitted to be used in the work.

Stones slabs shall have uniform thicknesses with in the tolerance limits and linear items like treads, sills and jambs, coping, risers, urinal partitions, kitchen/wash basin platforms, vanity counters, facias and other similar locations etc. shall have calibrated thickness i.e. exposed edges shall have uniform thickness throughout the length of the work.

The flooring work shall be carried out as per the architectural drawings in design and pattern (geometric, abstract etc.) and in linear and/or curvilinear portions and in combination with stones of different colour and shade and ceramic tiles etc. For the flooring portions curved in plan, the stone slabs (at the edge) shall be cut to the required profile and shape as per the architectural drawings. Nothing extra shall be payable on this account and any consequent wastages and incidental charges on such accounts shall be deemed to be included in the cost of such items.

For the steps (risers and treads) in the linear profile, the granite stone shall be provided in single pieces up to 2.0m as per the architectural drawings, unless otherwise specifically permitted by the Engineer-in-Charge. Wherever required, the joints shall be provided as per the architectural drawings. Nothing extra shall be payable on this account.
For the granite stone work in treads and risers of steps at the entrance to the building from the ground to the plinth level shall be provided as per the architectural drawing, using tread stones and riser stones in the profiles of the steps shown in the architectural drawings. Based on the architectural drawings and the actual dimensions at site, the contractor shall first prepare shop drawings. However, the length of the granite stone slabs shall generally be not less than 1.2 metres unless otherwise approved by the Engineer-in-Charge specifically to match the architectural details.

The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the Engineer-in-Charge. Wherever stone slab other than in single piece is allowed to be fixed, the joints shall be provided as per the architectural drawings and as per the directions of the Engineer-in-Charge. In the cabin areas, the joints in sills shall preferably be provided in line with the partition wall. Depending on the number of joints, as far as possible, the stone slabs shall be procured and fixed in slabs of equal lengths as per the architectural drawings and as directed by Engineer-in-Charge / Consultant.

While fixing the granite slabs in sills, soffits and jambs of doors, windows, ventilators etc., rebates shall be made by overlapping the stones at the required places for fixing shutters for doors, windows and ventilators etc. as shown in the architectural drawings and as per the directions of the Engineer-in-Charge / Consultant. Epoxy based adhesives shall be used for fixing the granite stones to each other, as per the manufacturer’s recommendations. Any extra mortar thickness required due to the overlap arrangement shall be deemed to have been included in the item. Nothing extra shall be payable on this account. The cut exposed edges of the granite stones shall be polished / moulded as per the architectural drawing.

The granite stone slab shall be fixed for wash basin counters as shown in drawing. The stone shall have uniform thickness and shall be provided in sizes as per the architectural drawings. The stone slab shall have uniformly leveled surface after fixing. All the joints shall be finished smoothly. The necessary cutouts for fixing wash basins shall be provided in granite. The edge moulding / nosing / polishing to the cut exposed edges of the granite stone slab to be used in flooring, skirting, dado, sills, jambs, soffits, risers, treads etc. shall be provided in a workmanlike manner as per the architectural drawings.

The granite work shall be adequately protected by a layer of Plaster of Paris, which shall be maintained throughout and removed just before handing over of the works for which nothing extra shall be payable.

Wherever the granite stone slab dry cladding is provided exposed to environment, both the surfaces of the granite stone slabs shall be treated to make the surfaces hydrophobic by applying one or more coats of water repellant / hydrophobic clear coating of water soluble silconate based impregnating agent DC 777 of Dow Corning or equivalent brand. The formulation shall be prepared and applied as per the manufacturer’s recommendations. Before applying the formulation, the surface preparation shall be done as per the manufacturer’s recommendations. The stainless steel pins /
anchors / cramps shall be provided for fixing granite as shown on drawing. The surface shall be cleaned using water and the formulation shall be applied on the damp surface.

Mode of Measurement:

The measurement shall be in square metre for the actual granite stone flooring provided.

10.8 KOTA STONE FLOORING:

a) Stone slab: The stone slab shall be hard, even, sound and durable. The slabs shall be machine cut in a place parallel to the natural bed of the stone. They shall be of required colour, size and shape. Stones having yellowish strips shall not be used. The thickness of slabs shall be 25 mm to 30 mm and total thickness of floor finish including bedding mortar shall not exceed 50 mm.

b) Dressed stone flooring: The exposed faces shall be fine chisel dressed or rough tooled as directed. All angles and edges shall be true, straight and square.

c) Setting: Each slab shall be thoroughly wetted before being laid. It shall be laid in cement mortar 1:4 (1 cement : 4 sand) or lime mortar (1:2) and jointed with grey cement slurry mixed with pigment to match the shade of the slab and gently tapped down with a wooden mallet so that no hollows are left beneath the slabs. Where pointing is not required to be done, the joints shall be leveling flush with a trowel at the time of paying.

d) Joints: Shall be uniform and full of mortar. They shall be in line and shall not be more than 3 mm in width. They shall be rubbed and pointed after completion.

10.9 CERAMIC TILES OR SPARTEX OR REGENCY TILES IN FLOOR & WALL:

a) Tiles: White glazed tiles ceramic tiles including specials shall be of approved make and quality. Samples of tiles shall be got approved by the Owner/ Employer/ Consulting Engineers/E-I-C, who will keep them in his office for verification as to whether the materials brought, conforms to the approved samples. Tiles should be soaked in water for at least 2 hours before use and stacked neatly for draining out the dripping water.

b) Mortar backing/ Leveling course:

All joints in the brick work shall be racked out to depth equal to not less than the width of the joints or as directed by the Owner/ Employer/Consulting Engineers/E-I-C. Concrete surface shall be properly hacked, all dirt, soot, oil, or any other material which might interfere with satisfactory bond shall be removed. The surface shall be cleaned and scrubbed with fresh water and kept wet for hours prior to applying backing mortar. The tile work shall not be commenced unless the preparatory leveling course work is passed by the E-I-C. The proportion of mortar for leveling course shall be 1.4 cement mortar. Sand in mortar bedding shall be from approved source. The thickness of mortar backing
for leveling course shall not be less than 6 mm and not more than 10 mm. The leveling course should be properly cured for at least 7 days and dried before commencement of tile work.

c) **Fixing of tile:**
The work in wall/ dado shall be done only when the fixing of tiles in floor is completed. The glazed tiles/ ceramic tiles shall be soaked in water for at least 2 hours before being used. 5 No. of stone chips are to be fixed at the back of the tile with Araldite glue as key. A thin layer of cement mortar (1:4) is to be used as paste for fixing of tile as backing mortar. No hollow should be audible when the fixed tiles are tapped.

d) **Cleaning:**
After the tiles have been fixed the surplus materials that may have come out of the joints shall be cleaned off before it sets. After complete curing, the tile work shall be washed and thoroughly cleaned.

**Rates also to include :-**
Apart from other factors mentioned elsewhere in this contract, the rates for the item of dado or skirting shall include the following:

i) Backing Mortar/ Leveling course.

ii) Providing and fixing tiles including all specials like round edges, angles capping, cutting of tiles etc.

iii) Fixing, jointing of the tiles with the adhesive/ joint filler of approved shade, cutting necessary holes for pipe outlets.

iv) Curing.

v) Cleaning.

vi) All labour, materials, use of tools and equipment's for carrying out the items as specified above.

### 10.10 VITRIFIED TILE FLOORING & DADO WORKS:

Vitrified tiles of approved manufacture with nominal size of 600 x 600 mm of required colour and shade (pastel shades) shall be used in the work. The tiles shall conform to ISO 13006 or equivalent. However, the dimensional tolerance of the vitrified tiles shall be $0.10\%$ in length, $1.0\%$ in thickness, $0.1\%$ in rectangularity, $0.1\%$ in surface flatness.

The Contractor shall procure and submit the samples of the tiles, of required colour, shade, design & make, for the approval of the Engineer-in-charge prior to the execution of the item. The mock up, protection etc. shall be as specified above for the granite stone work.
The entire material shall be procured preferably, in one lot from one manufacturer to avoid any variation in the colour, shade and design of the tiles. Any tile with variation in the colour, shade and design, not acceptable to the Engineer-in-Charge, shall not be used in the work and shall be removed and replaced by the Contractor.

The Contractor shall obtain and submit to the Department the manufacturer’s certificate for compliance of the material as per the manufacturer’s specifications and also a copy of the manufacturer’s test report for the record. The tiles shall be transported to site well packed in boxes. These shall be handled carefully to prevent any damage. The tiles procured shall be free of any surface defect, edge damage and any other such defects. The defective / damaged tiles shall not be allowed to be used in the work. So the contractor shall procure additional quantity of tiles to cover such contingencies. However nothing extra shall be payable on this account. The work shall be carried out as per the architectural drawings and as per the directions of the Engineer-in-Charge / Consultant. The work may be carried out in design and pattern in linear as well as curvilinear portions of the building, as per the architectural drawings. Nothing extra shall be payable on account of any wastage, incidental costs etc.

The flooring / dado should be set out such that the perimeter/ corner tiles are in excess of half a tile so that the edge panels on both the sides are of equal sizes, as far as possible. The tiles shall be cut to required size and shape but with all precautions as per the manufacturer’s specifications.

The floor tiles shall be laid to required pattern with 3 mm space between the tiles using approved spacers as recommended by the manufacturers. After allowing 3 to 4 days wet curing, the joints shall be filled with polymer modified cementitious grout with polymer modified cementitious adhesive of BAL ENDURA or equivalent approved brand and with pigments of approved colour and shade as directed by the Engineer-in-charge.

The excess grout shall be wiped off with a damp sponge after fifteen minutes of application. Adequate care shall be taken before installation as well as afterwards till handing over the building for occupation. The flooring shall be free of any scratches, stains etc. at the time of handing over. Abrasive cleaners shall not be used to clean the marks.

The preparation of base surface, laying, frequency of testing shall in general be as that per PWD-SOR Specifications.

10.11 VINYLE FLOORING / SKIRTING

2 mm thick vinyle flooring / skirting of approved make and shade shall be laid in required pattern and design, laid in linear as well as curvilinear portion, all complete as per the drawing fixed using VC 3
Acrylic Glue of “Pidilite Industries Ltd.” or equivalent adhesive as per the manufacturers specifications on the existing I.P.S. floor. The work shall be carried out to the satisfaction of Engineer-In-Charge in all respect.

10.12 GLASS MOSAIC DADO WORK

The work shall be carried out as per the manufacturer’s specifications. The Contractor shall obtain and submit to the Department the manufacturer’s certificate for compliance of the material as per the manufacturer’s specifications and also a copy of the manufacturer’s test report for the record.

The Glass Mosaic tiles shall be S A Series of Italia or equivalent approved make, of approved colours and shades. The size of the glass mosaic tiles shall be generally 20mm x 20mm x 4mm, and joint width of about 1.80 mm, all as per the architectural drawings. The Contractor shall procure and submit the samples of the tiles for approval of the Engineer-in-charge before taking up the work. The work shall be carried out in patterns and designs in combination of tiles of different colours and shades, fixed in linear as well as curvilinear profile, as per the architectural drawings.

Before fixing the glass mosaic tiles on the surface, the surface shall be cleaned properly and cement mortar shall be applied as per the item description and shall be sponge finished without any scratches, in true plumb and level. Thereafter, the glass mosaic tiles shall be fixed with polymer modified cementitious adhesive (minimum 2 mm thick) with white star of BAL ENDURA adhesive or equivalent including grouting the joints with polymer modified grout of required colour and shade. The tiles in the required pattern shall be laid with random mix of tiles (in combination of tiles of different colours and shades) as per the architectural drawings and as per the directions of Engineer-in-Charge / Consultant.

Mode of Measurement:
Floor as well as dado shall be measured in square metres for the actual area provided.

10.13 WOODEN FLOORING

- **Seasoning and Preservation:**
  All timber used for timber floors shall be thoroughly seasoned in accordance with IS : 1141. After seasoning, the timber shall be treated with preservative in accordance with IS : 401. Seasoning and preservative treatment shall not be paid for separately and the rate quoted for the item shall be inclusive of the same.

- **Planks/ Boards:**
  It shall be of the class of timber and thickness specified in the description of the item. Only selected boards of uniform width shall be used. Unless otherwise specified or shown in the drawings, the width of boards selected shall not be less than 100 mm nor more than 150 mm. The same width of boards shall be maintained throughout except where the width of the room is not an exact multiple of the boards. In
the latter case, the difference shall be equally adjusted between the two end boards (adjacent to walls).
The length of the boards shall not exceed 3 metre anywhere.
Unless otherwise described in the item, the longitudinal joints of planks shall be tongued and grooved to a minimum depth of 12 mm.

- **Fixing:**
The planks should be placed over foam and the floor shall be truly levelled and should be plane. The joints shall be truly parallel and or perpendicular to the walls, unless otherwise specified. The floor shall be planed in both directions and made perfectly even, true and smooth.

**NOTE:** No wood of any kind shall be placed within 60 cm of any fire place or flue.

- **Finishing:**
The surface of the floor shall be bees waxed or finished otherwise as directed by the Engineer-in-charge.
The lower face shall be painted or treated with wood preservative as directed. The finishing shall be paid separately unless specifically included in description of the flooring item.

30. 6. Measurements: Length and breadth of superficial area of the finished work shall be measured correct to a cm. The area shall be calculated in sqm correct to two places of decimal. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm.

- **Rate:**
The rate shall include the cost of labour and materials involved in all the operations described above, with the exceptions noted in the relevant sub paras.

### 10.14 HARDONITE FOR IPS/ VACCUM DEWATERED FLOORING

Marking into bays: The complete floor should be marked off into bays. The application of Nitoflor Hardtop Standard or approved can begin when the base concrete has stiffed to the point when water evaporates from the surface.

Broadcasting of the material: The material need to be applied in two stages:
The first application is made by using 50%-70% of the total material & evenly broadcasting onto the concrete surface. When the material becomes uniformly dark by the absorption of moisture from concrete the concrete should be floated either by wooden floats or by power float for larger areas. Immediately after floating the remaining material is sprinkled evenly over the surface & floated as done previously.

Bay Edges: While applying the material at the edges extra precaution is taken by way of sprinkling more material & finishing it smoothly with a steel trowel.
11.0 PAINTING

11.1 WHITE WASHING WITH LIME

The wash shall be prepared from fresh stone lime (Narnaul/Satna or Dehradun quality). The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient to water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 4 Kgs of gum dissolved in hot water, shall be added to each Cum. of thin cream. The approximate quantity of water to be added in making cream will be 5 liters of water to 1 Kg. of lime.

Indigo (Neel) up to 3 gm. per Kg. of lime dissolved in water, shall then be added and wash stirred well. Water then shall be added at the rate of about 5 liters per Kg. of lime to produce a milky solution.

PREPARATION OF SURFACE

Before white washing is started, the surface shall be thoroughly brushed free from mortar droppings and foreign-matter. Any unevenness shall be made good by applying wall putty made of plaster of Paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it dries up.

APPLICATION

The white wash shall be applied with moon brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from top downwards, another from bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries up.

RATE

The rate shall include cost of all materials and labour involved in all the operations described above including scaffolding, protecting doors, windows, floor etc. from splashes and dropping.

11.2 WHITE WASHING WITH WHITING

Preparation of mix: Whiting (ground white chalk) shall be dissolved in sufficient quantity of warm water and thoroughly stirred to form thin slurry which shall then be screened through a clean coarse cloth. Two Kg. of gum and 0.4 Kg. of copper sulphate dissolved separately in hot water shall be added for every cum of the slurry which shall then be diluted with water to the consistency of milk also, so as to make a wash ready for use.

Other specifications described above shall be applied in this case also.

11.3 COLOUR WASHING

The mineral colours not affected by lime, shall be added to white wash. Indigo shall however, not be added. No colour wash shall be done until a sample of the colour wash of the required tint or shade has been got approved from the Engineer-in-charge.

A priming coat of white wash with lime or with whiting shall be applied. Two or more coats, shall then be applied on the entire surface till it represents a smooth and uniform finish.

Other specifications described in above shall apply in this case also.

11.4 DISTEMPERING

Dry distemper of required colour and (IS: 427 - 1965) of approved brand and manufacturer shall be used. The shade shall be got approved from the Engineer-in-charge before application of the distemper. The dry distemper colour as required shall be stirred slowly in clean water as specified by the
maker. Warm water shall preferably be used. It shall be allowed to stand for at least 30 minutes (or if practicable over night) before use. The mixture shall be well stirred before and during use to maintain an even consistency. Distemper shall not be mixed in larger quantity than is actually required for one day’s work.

PREPARATION OF SURFACE

Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth. Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

A priming coat of whiting shall be applied over the prepared surface. No white washing coat shall be used as a priming coat for distemper.

Application

The treatment shall consist of a priming coat of whiting followed by the application of two or more coats of distemper till the surface shows an even colour.

Other specifications described as above shall apply in this case also.

11.5 OIL EMULSION (OIL BOUND) DISTEMPERING

Material: Oil emulsion (oil bound) distemper (IS:428-1929) of approved brand and manufacturer shall be used. The primer used shall be cement primer or distemper primer. This shall be of the same manufacturer as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for days work shall be prepared. The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities, at a time for a fortnights’ work. The empty tins shall not be removed from the site of work, till this item of work has been completed and passed by the Engineer-in-charge.

Preparation of surface

Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth. Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular of distemper is applied.

A priming coat of whiting shall be applied over the prepared surface. No white washing coat shall be used as a priming coat for distemper.

Application

The priming coat shall be with distemper or cement primer, as required in the description of the item and as recommended by the manufacturer.

Note:

If the wall surface plaster has not dried completely cement primer shall be applied before distempering the walls. But if distempering is done after the wall surface is dried completely, distemper primer shall be applied.

Oil bound distemper is not recommended to be applied within six months of the completion of wall plaster.
After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rule out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (Water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitute one coat. The subsequent coats shall be applied in the same way.

For distemper 15 cm double bristled brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry.

The specifications in respect of scaffolding protective measures and rute shall be as described under.

**11.6 ACRYLIC EMULSION PAINT FOR EXTERIOR FINISH**

a) Where specified the exterior plaster is to be finished with ACRYLIC EMULSION PAINT of M/s ASIAN PAINTS or equivalent of approved shade and colour, as approved by the Consulting Engineers.

b) The surface is to be previously cleaned and rubbed down and all inequalities and defects properly rectified.

c) The material is to be obtained from approved sources and the work shall be carried out with proper supervision and under direct guidance and instructions of the manufacturers to achieve high grade finish.

d) The rates quoted must include necessary scaffolding including erection and removal.

**11.7 CEMENT PRIMER COAT**

Cement primer shall be used as lease on wall finish of cement lime or lime cement plaster or asbestos cement surface before oil distemper paints are applied on them. Only approved cement primer shall be used. Primer coat shall be preferably applied by brushing and not by spraying.

**PREPARATION OF SURFACE**

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface then be allow to dry for atleast 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

**APPLICATION**

Cement primer shall be applied with a brush. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. The entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil emulsion paint is applied.

Rate shall include cost of all material and labour involved in all the operations described above including scaffolding.

**11.8 CEMENT PAINT**

Cement paint shall be (conforming to IS:5410 - 1969) of approved brand and manufacture.
PREPARATION OF SURFACE

The surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, alga, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the cement paint is applied.

PREPARATION OF MIX

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish.

Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturers instructions shall be followed meticulously. The lid of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hydrophobic qualities.

APPLICATION

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application shall be as per manufacturer's specifications. The completed surface shall be watered after day's work.

Water cement paint shall not be applied on surface already treated with white wash, colour wash distemper dry or oil bound, varnishes, paints etc. It shall not be applied on gypsum, wood and metal surfaces.

Rate shall include cost of all material and labour involved in all the operations described above including scaffolding.

11.9 PLASTIC (ACRYLIC) EMULSION PAINT:

Plastic (acrylic) emulsion paints are not suitable for application on external surface and surface which are liable to have condensation and are to be used generally on internal surface. For plastered surface a cement priming coat is required before application of plastic emulsion paint of approved brand and manufacture and of the required shade shall be used. The paint will be applied in the usual manner with brush or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hardened the next coat can be applied. The time for drying varies from one hour on absorbent surface to 2 to 3 hours on non-absorbent surfaces. Thinning will be particularly required for the undercoat which is applied on the absorbent surface. The quantity of thinner to be added shall be as per manufacturer’s instructions. The surface on finishing shall present a flat, velvety, smooth finish.

If necessary more coats will be applied till the surface present a uniform appearance.

Precautions:

i) Brushes should be quickly washed in water, immediately after use and kept, immersed in water during break periods to prevent the paint from hardening on the brush.

ii) In the preparation of walls for plastic emulsion painting, an oil base putty shall be used in filling cracks, holes etc.
iii) Splashes in floors etc shall be cleaned out without delay as they will be difficult to remove after hardening.

ii) Washing of surface treated with emulsion paints shall not be done within 3 to 4 weeks of application or the time specified by manufacturer.

11.10. PAINTING PRIMING COAT OF WOOD SURFACE

Primer for wood work shall be as specified in the description of the item. Surface to be primed shall be dry and thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. knots, if any, shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate wood filler material with same shade as paint shall be used where so specified.

The surface treated for knotting shall be dry before primer is applied. After the primer is applied the holes and indentation on the surface shall be stopped with glaziers putty or wood putty. Stopping shall not be done before the priming coat.

11.11. PAINTING PRIMING COAT ON IRON & STEEL SURFACES

All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during raking which becomes loose by brushing, shall be removed. All dust and dirt shall be thoroughly wiped away from the surface.

11.12. ALLUMINIUM PAINT

Aluminium paint of approved brand and manufacture shall be used. The paint comes in compact dual containers with the paste and the medium separately. The two shall be mixed together to proper consistency before use. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted before the next coat is applied. The finished surface shall present an even and uniform appearance. As aluminium paint is likely to settle in the container, care shall be taken to frequently stir the paint during use.

11.13. TEXTURED PAINT

The textured finish to external surfaces of walls as per manufacturer's specification and approved by the engineer-in-charge including scaffolding etc. complete.

11.14. PAINTING PRIMING COAT ON PLASTERED SURFACE

The surface shall ordinarily not be painted shall be applied to get correct finish until it has dried completely. Before primer is applied, holes and undulations shall be filled up with plaster of Paris and rubbed smooth.

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. Painting shall be done by crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left the laying off is finished. The full process of crossing and laying off will constitute one coat.

The surface to be painted shall have received the approval of the Engineer-in-charge after inspection, before painting is commended.

APPLICATION

The number of coats including the under coat shall be stipulated in the item.
a) Under Coat
One coat of specified paint of shade suited to the shade of the top coat shall be applied and allowed to
dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth
and even surface, free from brush marks and all loose particles dusted off.

b) Top Coat
Tops coats of specified paint of desired shade shall be applied. Each coat shall be allowed to dry for not
less than 24 hours and lightly rubbed down smooth with finest wet abrasion paper to get an even glossy
surface. If, however, the surface is not satisfactory additional coats as required.

11.15 TOUCHWOOD FINISH

Touch wood polyurethane clear wood finish to be applied whenever specified in the bill of quantities as
per the following direction of use :-

Touch Wood Clear Matt is to be applied on filled wood surface, (Apcolite wood filler) which has been
smooth sanded along the grains with emery paper No. 320. Staining with Apcolite wood strainer is also
to be done. It is to be ensured that surface coated is free from all loose dust. TOUCHWOOD clear mat is
a single pack system. The contents should be well stirred and strained through a clean muslin cloth prior
to use. Two coat of touch wood to be applied by brush with thinner 101. The first coat of Touch Wood
Clear Mat should be allowed to dry for 6-8 hours prior to sanding and recoating. Containers should be
well capped after use.

11.16. INTUMESCENT PAINT

To provide anti-corrosive protection to the steelwork.
The intumescent coating is a coating that reacts to heat by swelling to produce a carbonaceous char,
which acts as a insulating layer to protect the steelwork. The dry film thickness of intumescent paint to be
applied to individual steel sections will depend on the size, configuration and period of protection
required. Thickness figures are available from International Protective Coatings.

Top coats, also known as sealer coats, protect intumescent paint from moisture, provide a decorative
cosmetic finish, and reduce dirt and dust retention. In certain circumstances and environments the top
can be omitted.

11.16.1. SURFACE PREPARATION AND PRIMING SYSTEMS

10.16.1.1. PRIMING SYSTEM
Intumescent paint must be applied over a priming system which provides the required anti-corrosive
protection to the steelwork and which will protect the steel from corrosion if intumescent paint is
damaged.

11.16.1.2. SURFACE PREPARATION – STEEL
The steelwork should be abrasive blast cleaned as per standard (ISO 8501- 1:1988 or SSPC-SP6)
followed by the application of the primer. The blast profile should be in accordance with the
recommendation for the particular primer.

11.16.1.3. SURFACE PREPARATION – PRIMER
Before application of the intumescent paint the primer surface should be of normal appearance, dry and
free from all contamination. Zinc primers must be free from zinc salts. If the zinc primer is exposed to
external conditions before application of intumescent paint a tie coat is recommended to prevent the
formation of salts. The primer must be a continuous film, any defects, mechanical damage etc must be
repaired prior to overcoating. Excessive thickness of primer must be avoided.

Recommended over coating intervals for the primer should be observed.
11.16.1.4. SURFACE PREPARATION – GALVANISED SURFACES
Due to the variability of galvanised surfaces the preferred option for preparation is to degrease and sweep blast followed by application of a suitable primer.

11.16.2. TOP COATS

Before application of top coat the applicator must ensure that the specified dry film thickness of intumescent paint has been achieved. Whenever possible the Interchar material should be allowed to harden sufficiently so that thickness readings can be taken. Indicative thickness readings can be taken on intumescent paint which is not fully hardened by measuring the dry film thickness over a shim.

If it is later found that the dry film thickness is low, certain top coats may need to be removed before more Intumescent paint can be applied.

The surface of the intumescent paint must be clean, dry and free from contamination before overcoating. Specific overcoating intervals for intumescent paint with the individual top coats, as given on the Technical Data Sheets, must be observed.

Depending on the choice of final colour of the top coat, two or more coats may be necessary to achieve full opacity. The thickness of top coat required to give a uniform finish will also be affected by the unevenness of the surface of the intumescent paint.

11.16.3. INTUMESCENT PAINT APPLICATION

MIXING
Intumescent paints are highly structured products which can build up a temporary false structure during the time it is stored in the pails or drums. Power stirring is essential to ensure that the coating is mixed to a uniform consistency to avoid cavitation at the spray pump and to ensure a steady flow. Hand held air driven mixers are the most common and are ideal for this purpose, preferably with a helical style shaft. 1 to 2 minutes of thorough mixing reaching all parts of a 20 litre pail will normally be sufficient. Manual mixing of intumescent paint is not recommended.

AIRLESS SPRAY APPLICATION EQUIPMENT
Airless spray pumps with a ratio of at least 56:1 are preferred. However, petrol and electrically driven airless pumps have also been found to be suitable by some applicators. For air driven airless spray pumps the following modifications to the normal set up are recommended:

- Remove any wet end extension hose and place the wet end directly into the coating.
- Place the pail or drum so that condensation from the pump does not run into the coating.
- All filters should be removed from the pump, lines and gun. A coarse filter (½- 1mm) can be fitted over the wet end to prevent contamination from external sources from entering the spray machine and causing blockages.
- Use the minimum length of 9mm bore fluid line. A 2 metre 6.5mm bore whip end with a swivel connection to the spray gun makes the fluid lines much easier to handle and more manoeuvrable.

11.16.3.1. FILM THICKNESS CONTROL AND MEASUREMENT

Marking of Steelwork for Identification and Traceability The dry film thickness of intumescent paint to be applied to individual steel sections will vary depending on the section size and its intended configuration as well as the number of sides to be coated, and for beams, the type of decking being supported. To ensure efficient working the applicator should be in possession of a full list of the specified dry film thicknesses and number of sides to be coated, etc and should mark the sections accordingly.

Marking with felt tip pen is a simple method but it is easily lost under coating or overspray and would not be visible when the dry film thickness is being checked. A more reliable method is to mark the details on a thin tinplate tag which can be folded to prevent obliteration by coating and then attached to the section by wire through a bolt hole.
Any method of marking must not interfere with the application or adhesion of the coatings.

11.16.3.2. WET FILM THICKNESS
During the application of intumescent paint frequent checks should be made on the coating using a wet film comb to ensure that the specified thickness is achieved. Wet film thickness readings are a guide to the applicator to enable application technique to be monitored. They should be taken as frequently as necessary to enable a “feel” for the coating, and the number of spray gun passes required, to be established.

On second and subsequent coats, wet film readings may be inaccurate due to the gauge sinking into the previous coat.

11.16.3.3. DRY FILM THICKNESS

MEASUREMENT OF DRY FILM THICKNESS
After sufficient drying time a survey of the dry film thickness should be carried out using a suitable calibrated gauge. An electromagnetic induction instrument with a statistical function to store readings and give an average is most useful.

Where dry film readings include a primer and/ or topcoat an allowance must be made for these coatings and subtracted from the total reading. The following is the recommended procedure for measuring dry film thickness and acceptance criteria.

Readings should be taken on every steel section as follows:

I sections
Webs: One reading per metre length on each face
Outer flanges: One reading per metre length on each face
Inner flanges: One reading per metre length on each face

Hollow sections: Four readings per metre length spread evenly around the section

No readings should be taken within 25mm of any edge or web/flange junction.

DRY FILM THICKNESS MEASUREMENTS OVER A SHIM
Indicative thickness readings can be taken on intumescent paint which is not fully hardened by taking the readings over a shim:
Place a rigid shim of known thickness on the surface.
Take readings over the shim.
Subtract the thickness of the shim, and the primer and top coat if applied, to give the thickness of intumescent paint.

DRY FILM THICKNESS ACCEPTANCE CRITERIA
The average thickness of each section should be equal to, or greater than, the specified thickness. Where any single thickness reading is found to be less than 80% of the specified thickness, a further three readings should be taken on the same face within a 300mm radius of the low reading. If one or more of the additional readings are also less than 80% of the specified thickness, further readings should be taken to establish the extent of the area of under thickness and the whole area should be brought up to the specified thickness.

Individual thickness readings of less than 50% of the specified thickness are not acceptable. The average measured dry film thickness of any member should not exceed by more than 10%, the maximum stated thickness for the particular steel shape and orientation as given in the loading charts.
11.16.3.4 CORRECTION PROCEDURE

Where the dry film thickness is found to be unacceptable because it is less than that required by the specification, remedial action will be necessary. The applicator must first establish the extent of the low thickness. Areas of low thickness may be random but frequently a pattern can be observed e.g. low thickness tending to occur on inner flanges.

Additional intumescent paint should be applied to ensure conformance with the acceptance criteria. The surface of the existing intumescent paint must be clean, dry and free from all contamination.

11.16.3.5 DRY FILM THICKNESS OF TOP COAT

The top coat dry film thickness is difficult to measure due to the variation in thickness of the underlying coats and its own relatively low thickness. It is, however, important that the top coat is applied at the specified thickness to ensure the longevity of the system without applying excessive thickness. Judging the thickness of the top coat is also made more difficult as an uneven surface will require more coating to achieve a uniform appearance.

As a guide, the number of spray gun passes to achieve the required wet film thickness can be determined by spraying on to a smooth surface. Monitoring of material usage will also give an indication of the applied thickness.

11.16.3.6 RESPONSIBILITY

It is the applicator's responsibility to ensure that all coatings are applied in accordance with these working procedures and that the specified dry film thickness is achieved.

11.16.4. REPAIR OF DAMAGED AREAS, ERECTION DAMAGE ETC

The repair method will depend on the extent of the damage. Repairs should be carried out at the earliest opportunity using the appropriate procedure from those given below.

11.16.4.1 DAMAGE WHICH EXPOSES BARE STEEL

Unsound, damaged coatings and corrosion products should be removed to a neat firm edge. The steel surface should be a bright metal surface without polishing the substrate. Coating edges should be feathered by abrading. The priming system should be reinstated. Overlap of primer onto surrounding intumescent paint should be avoided. The intumescent paint within the recommended overcoating limits of the repair primer should be reinstated. Top coats should be applied as appropriate.

11.16.4.2 DAMAGE NOT REQUIRING PRIMER REPAIR

Depending on severity of damage, damaged area should be either lightly abraded to a feathered edge, or cut out to a suitable area of intumescent paint and edges feathered out. During cutting out, the priming system should not be damaged. Intumescent paint should be reinstated to the required dry film thickness. After the appropriate overcoating interval, an approved topcoat in accordance with original specification is to be applied.

11.16.4.3 DAMAGE TO TOPCOAT ONLY

Loose or unsound coatings are to be removed to obtain a firm edge and the edges are to be feathered. All surfaces should be clean, dry, and free from all contamination. Top coat in accordance with original specification is to be reinstated.
12. Door, Window Frames and Shutters:

12.1 Wooden Section:
The specified timber which shall be used should be sawn in the direction of the grain and the sawing shall be truly straight and square. For door/ window frames scantling shall be chemically treated ( two coats of creosote oil/linseed oil over planed surface). There should be no patching or plugging and the frames should be simple, neat and strong. For joinery work rebates, rounding and moldings should be made before assembling. All doors, window frames must have plaster rabbit 12mm X 12mm and rabbit for receiving shutter at least 15mm deep. Wood work shall not be painted, oiled or otherwise treated before it has been approved by the Engineer-in-charge. All portion of timber abutting against or embedded in masonry or coal-tar, use of approved wood primer shall be permitted. In case of door frames without sills, the vertical members shall be buried in floor 40mm. deep. Where sills are provided, these sills shall be sunk in the floor to 40mm. depth and shall rest on damp-proof course. Sills shall be provided, where so directed. The door frames without sills while being placed in position, shall be provided with temporary wooden bracing or dry bricks well wedged between the styles at the sill level. These shall be retained to keep the frames from warping during construction, The frames shall also be protected from damages during construction. The shutters shall be so fixed that while closing, the left hand leaf of the shutter is closed first and the right hand leaf of shutter overlaps on the left hand leaf. The overlapping shall be minimum 20mm. Solid wood panels shall be made out of one or more pieces of timber of not less than 125mm. in width. In order to avoid warping, splitting and cracking, normally pieces not exceeding 200mm in width should be used. When made from more than one piece, the pieces shall be joined with continuous tongued and grooved joints glued together and reinforced with metal dowels. The grains of the solid panel shall run along the longer dimension of the panel. The corners and edges of panels shall be finished as shown in drawings and these shall be feather tongued into styles and rails. Sash bars shall have mitred joints with styles. In measuring the width and thickness of styles and rails, a tolerance can be allowed upto 1mm. Styles and rails shall be properly and accurately mortised and tenoned. Rails which are more than 180mm. in width shall have two tenons. Styles and end rails of shutters shall be made out of one piece only. Look and intermediate rails exceeding 200mm. in width may be made out of one or more pieces of timber, but the width of each piece shall not be less than 75mm. Where more than one piece of timber are used, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels at regular intervals not exceeding 200mm. Jointed pieces of timber shall belong to the same pieces. The cannons shall pass clear through styles. When assembling a leaf, styles shall be left projecting as a horn. The styles and rails shall have 12mm. grooves in paneled portion for the panel to feet in. The joinery work shall be assembled and passed by the Engineer-in-Charge and then the joints shall be pressed and secured by bamboo pins of about 6mm. diameter. The horns of styles shall be sawn off. Wood sued for making the doors must be chemically treated and machine seasoned. The veneering to cover the shutters should be either teak wood veneer or
commercial ply veneer. The glue used for manufacturing must be phenol formaldehyde and must be hot pressed. The outer framing of the shutter must suit for Mortice Lock and latches. Tolerance: The finished work with a tolerance of +/- 1mm in thickness and +/- 2mm in width of styles and rails shall be accepted.

Glass panes shall be fixed by wooden beading having mitred joints. A thin layer of putty shall be applied between glass panes and sash bars and also between glass panes and the beading. A fixing of glass panes with simple putty” and beads shall not be permitted. Putty shall be prepared by mixing one part white lead with three parts of finely powdered chalk and then adding boiled linseed oil to the mixture to from a stiff paste.

12.2 Aluminum Sections:

All works under this section should conform to the f BIS codes of latest edition as listed below.

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<thead>
<tr>
<th>Sl. No.</th>
<th>IS Code</th>
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<td>1</td>
<td>IS 733</td>
<td>Wrought Aluminium and Aluminium Alloys, Bars, Rods and Sections (For General Engineering Purposes) -Specification</td>
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<tr>
<td>2</td>
<td>IS 737</td>
<td>Wrought Aluminium and Aluminium alloy sheet and strip for general engineering purposes -Specification</td>
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<tr>
<td>3</td>
<td>IS 1285</td>
<td>Wrought Aluminium and Aluminium Alloy, Extruded Round Tube and Hollow sections (For General Engineering Purposes) -Specification</td>
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<td>Dimensions for wrought Aluminium and Aluminium Alloys bars, rods and sections.</td>
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Aluminium sections used for fixed/openable windows, ventilators, partitions, frame work & doors etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the Engineer-in-Charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AISI 304. The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/operation and appearance of door and windows.

Aluminium glazed doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminium work, with the approval of Engineer-in-Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing doors, windows, ventilators and partition etc. for the approval of the Engineer-in-Charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in-Charge and nothing extra shall be paid on this account.

12.2.1 Door, Window Clamps or Holdfasts:
(a) Unless otherwise specified the clamps shall be fixed to outer side of the frame with screws. For the purpose of receiving clamps a recess of at least 12mm. deep of suitable size shall be cut into the frame. After fixing the frame true to plumb with the clamps, the exposed face of the clamps shall be covered by a thin wooden covering fixed with screws.
(b) The side of the door, window frames which remains in contact with masonry shall invariably be painted with a protective coat of paint.

12.2.2 Schedule of Fittings:
Fittings shall be of iron, aluminium or as specified. All hinge pins shall be of steel and their riveted heads shall be wall framed.
Iron fittings shall be finished bright or black or copper oxidized. Brass fittings shall be finished bright (brass), oxidized or chromium-plated (electro-plated) and aluminium fittings shall be finished bright or anodized or as specified. Fittings shall be got approved by the Engineer-in-charge before fixing.

12.2.3 Performance Requirement for the finish
(i) Surface appearance: The finish on significant surfaces shall show no scratches when illuminated and is examined at an oblique angle, no blisters, craters; pinholes or scratches shall be visible from a distance of about 1 m. There shall not be any visible variation in the colour of finished surfaces of different sections and between the colours of different surfaces of same section.
(ii) Adhesion: When a coated test piece is tested using a spacing of 2 mm between each of the six parallel cuts (the cut is made through the full depth of powder coating so that metal surface is
visible) and a piece of adhesive tape, approximately 25 mm x 150 mm approved by the Engineer-in-Charge is applied firmly to the cut area and then removed rapidly by pulling at right angles to the test area, no pieces of the finish other than debris from the cutting operation shall be removed from the surface of the finish.

(iii) Protection of Powder Coated / Anodizing Finish: It is mandatory that all aluminium members shall be wrapped with self adhesive non-staining PVC tape, approved by Engineer-in-Charge.

12.2.4 FIRE DOORS
Fire doors should be of 2 hour fire rating and supplied from approved makes.

HOLLOW METAL SWINGING FIRE DOOR SELECTION GUIDE


- Labeling is not obligatory but recommended.
- According to IS / BS, a fire door can be tested without having leaf of an active latch bolt but with only a self-closing device.
- A fire door MUST be self-closing. Only the active door leaf of an access panel (service ducts) or cupboards, can however be installed without a closer but with a dead lock and a “Fire Door, Keep Shut” sign placed clear on the door face.
- Unless shown to be satisfactory when tested as part of a fire door assembly, the components of any hinge on which the door is hung should be made entirely from materials having a melting point of at least 8000°C.
- If a fire door is held open, it must be equipped with a tested, automatic release mechanism actuated by an automatic fire detection and alarm system, fusible link (not if door is fitted in an opening provided as means of escape), or a door-closed delay device.
- Two fire doors may be fitted in the same opening so that the total fire resistance is the sum of their individual fire resistances. Signs and other items of hardware containing plastic should not be fitted on the non-fire side of the metal door or frame.

12.2.4 Hardware Fittings
All fittings shall be of anodized aluminium as specified. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws. Screws used for fittings shall be of the same metal and finished as the fitting. However, chromium plates brass screws shall be used for fixing aluminium fittings. Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in-charge. These shall be truly vertical or horizontal as the case may be, screws shall be driven home with screwdriver and not by hammering. Recess shall be cut to the exact size and depth for the counter sinking of hinges.
a) Butt hinges shall be of extruded aluminium alloy type.

b) Aluminium sliding door bolts : - These shall be made of aluminium alloy and shall generally conform to I.S. 2681 – 1966. Aluminium sliding door bolts shall be anodized. All screw holes shall be counter sunk to suit the counter sunk head of wood screws of specified sizes. All edges and corners shall be finished smooth. In case of single leaf door when sliding door bolts can not be fixed, hole of suitable size shall be drilled in the door frame, cut to shape and shall be fixed at the face of the hole. The leading dimensions of the sliding door bolts are illustrated.

c) Tower bolts :- Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk head wood screws. All sharp edges and corners shall be removed and finished smooth.

d) Door Handles :- The door handles shall be well made and free from defects. These shall be finished correct to shape and dimensions. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handles shall be free from casting defects. Where the grip portion of the handle is joined with piece by mechanical means, the arrangement shall be such that the assembled handle shall have adequate strength comparable to that of integrally cast type handles.

e) Cast Aluminium Handles :- These shall be of aluminium of special size, and of shape and pattern as approved by the Engineer-in-charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size, and window handles of 75 mm size unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6. Aluminium handles, shall be anodized and the anodic coating shall not be less than grade AC – 15 IS : 1868 or as specified.

f) Floor door stopper :- This shall be made of cast brass of overall size as specified and shall have a rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-charge. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of floor stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the floor by means of wood screws. The body or housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be of casting or of sheet metal. The spring shall be fixed
firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shocks. All parts of the door stopper shall be of good workmanship and finish, and sharp edges removed. It shall be free from surface and casting defects. Aluminium stopper shall be anodized and anodic film shall not be less than grade AC-10 of IS : 1868 – 1968.

13.0 GRILLS / RAILINGS:

13.1 M. S. GRILLS / RAILINGS:

MATERIALS:
All structural steel shall conform to I.S. 226 sections for grills and shall be free from loose mill scales, rusts, pittings or any other defects affecting its strength and durability.

FABRICATION:
The grill shall be fabricated to the design and pattern shown in the drawings. All joints shall be made in workman like manner with slotting and welding as required to the specified size and shape. The edge of the M.S. flats shall be suitably mitred before welding to get the desired shape. The joints shall be filled to remove excess stay after welding. Screws, nuts, washers, bolts, rivets and any other miscellaneous fastenings, devices shall be of steel and shall be provided by the contractor. Manufactured M.S. grills should then be fixed in between the posts, balusters, M.S. frame work etc. to the correct alignment. Any undulations, bends etc. found shall be rectified by the contractor at his own cost. The complete assembly of grill/railing so fixed shall be firm and there shall not be any lateral movements.

SAMPLES:
Samples of grill and railings shall be submitted for approval of the Engineer-in-Charge and to be got approved before taking up for mass fabrication.

INSTALLATION:
The approved grills shall be fixed in position where specified and shown in drawings in masonry walls, teakwood frames, hand railings etc. Any damages to walls, frames etc. caused during fixing the grills shall be made good by grouting with cement mortar/packing/repairing properly at the contractors cost.

PAINTING:
Painting shall be done as per the specifications specified under painting.

MODE OF MEASUREMENT:
Actual area of m.s. grill manufactured and fixed in position shall only be measured in square metre for payment. All measurements shall be taken to two places of decimal of a metre and area shall be calculated to second place of decimals of a square metre. The rate is to include the cost of all materials, labour, transporting, fabricating, installing, scaffolding if necessary, grouting etc. complete.

FINISHING/PAINTING/POLISHING FOR RAILING:
Teak wood hand rail shall be polished with wax polish/ french polish/solignum with two or more coats over one coat of wood primer or painted with two coats of synthetic enamel paint/flat oil paint of approved make and shade
over one coat of approved primer. M.S. grills, balusters etc. also are to be painted as per specifications specified under painting/polishing.

**MODE OF MEASUREMENTS (HAND RAILS):**
Hand railing shall be measured for payment in running metre. The length shall be measured along the top centre line of the hand rail and shall be measured between ends of balusters, newels, posts as the case may be up to two places of decimals of a metre. Rate shall include fabrication, leaving suitable pockets, grouting the same, providing and fixing suitable teak wood plugs, fixing, all labour, materials, transport, painting/polishing, finishing and scaffolding if necessary.

### 13.2 STAINLESS STEEL RAILINGS

1. The scope of the work includes preparation of the shop drawings (based on the Architectural drawings), fabrication, supply, installation and protection of the Stainless steel railing till completion and handing over of the work.

2. The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-in-Charge.

3. The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work.

4. The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of Engineer-in-Charge / Consultant. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge / Consultant. The mock-up shall be dismantled and removed by the contractor as per the directions of the Engineer-in-Charge. Nothing extra shall be payable on this account.

5. The stainless steel shall be of grade 316 L with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

6. The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.

7. One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.

8. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned and polished using non abrasive approved cleaner for the material. Nothing extra shall be payable on this account.

9. The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T
& P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.

10) The railing shall be fixed in position using stainless steel pipes, stainless steel posts of grade 316 L of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc. The 900 mm high railing shall be provided with three horizontal pipes and hand railing with vertical supports. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-In-Charge.

14.0 FALSE CEILING

14.1 SCOPE OF WORK:
The work envisaged under these specifications refer to supplying and fixing in position false ceiling at any floor, any location and at any height.

14.2 MATERIAL:
The Fibre Cement Board or Gypsum Board shall be of the thickness as mentioned in the relevant items of the schedule of quantities and the size of panels and the arrangement of panels etc. for different area of the building shall be as indicated in drawings / as decided by the Engineer-in-Charge. Fibre Cement Board or Gypsum Board shall be of approved quality and shall be free from cracks, bends and other defects. Samples of materials to be used on the work shall first be furnished by the contractor and got approved by the Engineer-in-Charge. All materials which are used on the works shall strictly conform to the samples, otherwise the materials shall be summarily rejected.

The Fibre Cement Board or Gypsum Board shall be fixed to the frame work by means of suitable counter sunk brass self tapping screws not more than 200 mm. centre to centre or as directed, and all holes after fixing the screws be filled with approved filler. Necessary openings in the ceiling shall be left for trap doors, ducts etc.

14.3 ERECTION:
The Fibre Cement Board or Gypsum Board when brought to site shall be stacked carefully on floor over wooden sleeper supports. The boards shall be cut to required sizes either by sawing or by score and snap method. The edges shall be smoothened by wood rasp file or with emery paper. Wherever required the edges of each panel may require bevelling which also shall be done carefully to the correct line and dimensions.

The Fibre Cement Board or Gypsum Board shall be fixed to the frames either wooden or metallic or as mentioned in the Schedule of work. In case of metallic frame, the Fibre Cement Board or Gypsum Board are held to the frame by means of self tapping screws or by the ordinary machine screws and nuts, as directed by the Engineer-in-Charge.

Teak wood or aluminium beadings if required to be fixed shall be as mentioned in the item description and shall be carried out in best workman-like manner.
Any other treatment for finishing such as gluing of wall papers, cement or oil based paint etc. shall be as specified in the item description and shall be done as per relevant specifications.

14.4 MODE OF MEASUREMENT:
Fibre Cement Board or Gypsum Board false ceiling shall be measured in square metre as actually laid over the frame work.
The area being worked out correct to two places of decimal with length and breadth measured correct to a centimeter. The rates shall include the cost of all materials, frame work, labour, scaffolding etc. as mentioned above and in item description, unless otherwise specified.

14.5 Fibre cement board or gypsum board false ceiling and masking etc. with pressed steel frame work/anodized aluminium frame work:

14.5.1 GENERAL:
The work covered by these specifications shall consist of furnishing all labour, materials and equipment necessary for installation of the suspended false ceiling and vertical masking, with Fibre Cement Board or Gypsum Board on pressed steel frame work / Aluminium frame work interlocked and suspended by adjustable M.S. suspenders with necessary cut outs in the Fibre Cement Board or Gypsum Board for lighting fixtures, trap doors, A.C. grills etc., providing m.s. lighting troughs etc., erecting to proper line and level in the specified areas, floors and levels as indicated in the drawing and as directed by the Engineer-in-Charge.

14.5.2 MATERIALS:
All materials which are to be in-cooperated in work shall be got approved prior to bulk procurement.

14.5.2.1 Fabrication of Pressed Steel Frame:
The frame work for “snap grid” false ceiling shall be made out of tested special springs grade steel or approved cold rolled sheets of specified gauge as per schedule, accurately formed and die cuts with identical ends in automatic machine with precision tools. All workmanship shall be best quality as followed in a modern sheet metal shops equipped with all machines such as press, dies, spot welding machine, baking oven etc. and should be done in a manner that will not damage the materials. All work shall be accurately formed to the required dimensions, true to line, level and plane in all directions and properly sized to suit the exact dimension within permissible tolerances.

Twisted or bent sections shall not be permitted to be used on work. Main runners and cross tees shall be of sizes as specified in the schedule/shown in the drawing. The main runners shall be slotted for cross tees and punched for hangers/suspenders. Cross tees shall have identified die formed ends accurately cut for easy, correct and proper fit assembly. Shearing, cropping shall be clean, reasonably square and free from distortion. Surfaces and joints to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign materials. The surface shall be wire brushed vigorously. Welding sequence shall be followed to avoid needless distortion and minimise shrinkage stresses.
Holes to be made in pressed M.S. sheet shall not be made by flame cutting. The flame cut or unfair holes are not acceptable with regards to connection of supported members with clearance. Where for practical reasons greater clearance is necessary, suitable designed seating should be provided. Any damages done to the walls/ceiling shall be reinstated to the original condition. The contractor shall not be entitled for any extra cost on this account.

14.5.2.2 Suspended Aluminium Grid system:
Aluminium grid system shall be of BEST LOK/EEZI LOCK or equivalent approved standard suspended aluminium grid system. The suspended ceiling grid shall be of self interlocking anodised aluminium T bars for main runners and cross runners of specified section and pattern as required to suit the span and as specified in the work schedule.

14.5.2.3 Fibre Cement Board or Gypsum Board:
Fibre Cement Board or Gypsum Board shall be plain and of specified thickness, approved best quality and shall conform in all respect to the relevant Indian Standard Specifications. The sheets shall be free from cracks, chipped edges or corners, twist dents, rough patches and other damages etc.

14.5.2.4 M.S. Works:
All MS works shall conform to relevant specification mentioned under Structural Steel here-in-before.

14.5.2.5 Fastening:
All bolts, nuts, screws, fittings & fixtures shall be of best quality and of approved manufacture.

14.5.2.6 FIXING:
The contractor shall take all necessary field measurements before the commencement of the frame work to ensure proper fittings of the work to actual condition of work at site. Particular care should be taken to examine the positions of all recessed lighting, trap doors and other openings indicated on drawings or as directed by the Engineer-in-Charge. The correct panel sizes shall be decided to suit each location. The false ceiling levels shall then be marked on walls. The position of the runners should be marked to suit the span of the area. The wall angles are to be fixed up with approved metal fasteners and then levelled correctly. The position of suspender shall then be marked on the R.C. slab as per the sizes of the panels decided for each area with due consideration to location of air-conditioning ducts, grills etc. Suspenders of type and design fabricated as per drawing and approved by the Engineer-in-Charge, shall then be securely fixed at correct points with approved metal fasteners/expansion bolts of specified dia., as per manufacturer's specifications. It shall be ensured that the hanger/suspender shall remain perpendicular and not pulled by the suspension system to any side. The runners are to be fixed to the suspenders and locked up at the joints. The levelling should start from fixed points and proceed towards the other end. The cross tees are to be fixed up at every runner joint to have stability while levelling. Neoprene rubber gasket shall then be fixed all along the frame work with approved type of adhesive. Approved Fibre Cement Board or Gypsum Board cut to correct sizes shall then be placed on the runner, starting from the centre of the width towards sides. All cross tees are to be connected and put on the approved spring
hold down clip/pins as per drawing or as directed by Engineer-in-Charge. Holes if required to be provided in A.C. sheets shall be drilled and on no account holes shall be punched. The runner tees and tiles are to be locked with hold down clips/pins as required. Wherever grouting for frame work, suspenders etc. is required to be done in masonry walls columns/beams etc., the same shall be done after the entire frame work is properly levelled.

The contractor shall take into consideration all wastage in the Fibre Cement Board or Gypsum Board, aluminium grid system framework /pressed steel framework, M.S. suspenders, screws, nuts, bolts, washers etc. required for fixing Fibre Cement Board or Gypsum Board false ceiling and vertical masking while quoting his rates. Fibre Cement Board or Gypsum Board false ceiling and vertical masking shall be fixed to pressed steel frame or Aluminium grid system by means of spring clip (brass counter sunk machine screws in case of masking) of approved size, make and at approved spacing or as shown in drawing or as instructed by Engineer-in-Charge.

After fixing the Fibre Cement Board or Gypsum Board, all holes of screws etc. shall be filled with approved putty, levelled with the Fibre Cement Board or Gypsum Board and sand papered, so that no sign of screw is visible on the Fibre Cement Board or Gypsum Board.

For all the Fibre Cement Board or Gypsum Board false ceiling and vertical masking work, the Fibre Cement Board or Gypsum Board of required size and shape shall be cut as per approved panel size shown in drawing and fixed on pressed steel frame in the best workman like manner.

Trap doors/lighting recesses/troughs of approved size and shape with approved matching work, shall be provided in the false ceiling and vertical masking at the specified places.

Any damage done to the walls/columns/ceilings/plasters/floors etc. shall be made good to the original condition by the contractor at his own cost. The contractor shall not be entitled for any extra cost on this account. During the execution of this work, the contractor shall take all the precautions to prevent damage to the painted surface, plaster, floor tiles, doors etc. Contractor should specifically note that the area where the false ceiling is required to be provided will be in advance stage of completion with various finishing items such as painting, floor polishing etc. Any damage to these finishes will have to be made good by him at no extra cost to the Department.

14.5.3 SAFETY PRECAUTIONS:

No person other than workman employed by the false ceiling contractor shall be permitted access to any area over which the sheeting is being laid. The contractor should take protective measures during the progress of work. Cat ladders or roof boards, scaffolding etc. should invariably be used by men working on the roof/false ceiling/masking etc.

14.5.4 WORK TO INCLUDE:

Cost of all approved Fibre Cement Board or Gypsum Board with anodized aluminium/pressed steel frame work, adjustable M.S. suspenders, M.S. cleats, nuts, bolts, washers, screws, all labour, materials, tools, plants, approval scaffoldings, providing, M.S. cleats and fixing them with metal
fasteners/expansion bolts, nuts, washers, screws etc. to the concrete/wall surfaces and then fixing the adjustable suspenders in M.S. clamps, painting two coats of synthetic enamel paint on M.S. work as directed/as shown in drawing.

14.5.5 MODE OF MEASUREMENT:
Fibre Cement Board or Gypsum Board false ceiling with snap grid pressed steel/anodized aluminium internal grid system frame work completed and accepted as per above specifications shall be measured in square metre upto two places of decimals. The line measurements shall be taken upto two places of decimal of a metre. The width shall be measured, from wall angle to wall angle and length shall be measured as per actual. Areas of trap doors, lighting troughs, Air conditioning diffusers, Air conditioning grills and other openings shall be deducted and net areas of false ceiling so computed shall be paid for unless otherwise specified.

14.6 Fibre glass thermal insulation work at ceiling with T.W. battens frame work and covering with a.c. sheet:

14.6.1 SCOPE OF WORK:
The work envisaged under these specification covers providing and fixing fibre glass thermal insulation to ceiling at any floor, location and height as specified including T.W. battens frame work in required grid and insulation work covered with A.C. sheet/flexo board of specified thickness.

14.6.2 MATERIALS:
i) T.W. battens for frame: Battens required for frame work shall be as specified under chapter “Wood work in frames, shutters and panelling”.

ii) Thermal insulation media: The thermal insulation media shall be of fibre glass Crown 150 or equivalent approved make with K value of 0.0285 K. Cal/sqm. hr. 0°C, 50 mm. thick and density of 24 kg/cum. or as specified in the description of item/ in drawing. Sample of fibre glass to be used on the work shall first be furnished by the contractor and got approved from Engineer-in-Charge before mass procurement.

iii) Fibre Cement Board or Gypsum Board sheet covering: The plain Fibre Cement Board or Gypsum Board shall be as specified here-inbefore.

iv) Fire resisting paint: The fire resisting paint shall be of M/s. Garware Paints Ltd. or any other approved equivalent make and shall conform to I.S. 163. Sample of fire resisting paint to be used on work shall first be got approved from Engineer-in-Charge before bulk procurement. Ready mixed paint as received from the manufacturer without any admixture shall be used.

14.6.3 ERECTION / FIXING OF INSULATION:
i) Frame work:
The workmanship shall be of best quality. All wrought timber is to be sawn, drilled or otherwise machine worked to the correct sizes and shall be as indicated in drawing or as specified. All joinery
work shall fit truly and without wedging or filling. All necessary mortising, tenning, grooving, matching, tonguing, housing rebate and other necessary work for correct jointing shall be carried out in the best workmanship like manner. The frame work shall be made in required grid as specified in schedule item and in drawing. The frame work shall be rigidly screwed to the ceiling with 100 mm. long G.I. wood screws and rawl plugs @ 300 mm. centre to centre (or as specified) both ways by drilling holes in ceiling through frame work. The wood work shall be painted all over with fire resisting paint of M/s. Garware Paints Ltd. or any other approved equivalent make before erection of the same in position as per manufacturers specifications and as directed by Engineer-in-Charge. If after fixing the frame work in position, any shrinking or substandard material or bad workmanship is detected, the contractor shall forthwith remove them and replace the same at his own cost.

ii) Sticking of insulation material & fixing of Fibre Cement Board or Gypsum Board : After fixing of the frame work as above, a thick coat of bitumen of approved grade shall be applied as vapour barrier in the grids of frame work and then fibre glass of required thickness shall be stuck to ceiling and panel of grids as directed by the Engineer-in-Charge. The panels of fibre glass shall be cut exact to grid size and evenly pressed.

Approved Fibre Cement Board or Gypsum Board cut to correct sizes as specified in item description shall then be placed on the frame works starting from the centre of the width and work side-wards. Holes required in Fibre Cement Board or Gypsum Board shall be drilled and on no account holes shall be punched. Fibre Cement Board or Gypsum Board shall be fixed to wooden frame work with suitable size of C.P. brass screws @ 300 mm. c/c. 4 mm. wide groove or as shown in the drawing. They shall be kept to correct line, level and plane at the junctions of sheets.

Any damage done to the finishes and to walls, columns, ceilings, plasters, floors etc. shall be made good to the original condition by the contractor at his own cost. The contractor should take protective measures during the progress of work. Cat ladders or roof boards scaffolding should invariably be used by men working on the thermal insulation work.

14.6.4 MODE OF MEASUREMENT :
This work shall be measured on square metre basis. The length and width shall be measured between plastered surfaces of walls upto two places of decimal of a metre for working out the area.

14.6.5 RATES :
Rates quoted by the contractor for the work shall include cost of all materials and labour required to complete the work as per item description, as per above specifications and as shown in the drawing.
15. STRUCTURAL GLAZING SYSTEMS AND ALLUMINIUM CLADDING

15.1 SCOPE OF WORKS
The scope of works under this contract includes design, supply, installation, protection, guarantees, testing and maintenance up to the defects liability period for Structural Glazing, Curtain Wall, Aluminium Cladding, Stainless Steel Sheet Cladding, Sun shading device / Sun-breaker assembly, Doors, Sky-light, Windows, Louvres etc.

The work under this section includes all Labour, materials, equipment and services as required for the complete design, engineering, testing, fabrication, assembly, delivery, anchorage, installation, protection and waterproofing of the aluminium curtain wall / structural glazing system, cladding, aluminium doors, Sky-light, aluminium windows & louvres and all in accordance with the true intent and meaning of the specifications and drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings or described in the specification provided that the same can be reasonably inferred there from. Anchorage includes all primary and secondary anchor assemblies and supportive structural framing as required to secure aluminium structural glazing system, cladding, Sky-light and louvers to the building structure. Approval of certain components of works or change / modification in components or drawings should be reviewed and approved by the consultant for recommending to Engineer-in-Charge for final approval.

The detailed scope of works consists of:-
1. The aluminium structural glazing system, cladding, Sky-light, Sun shading device / Sun-breaker assembly, aluminium doors, aluminium windows & louvres described hereafter shall include but will not necessarily be limited to the following:-
   a. Frames, vision panels, spandrels, doors and ventilators.
   b. Openable panels where indicated, inclusive of all accessories, fittings etc.
   c. Copings, soffit trimmers, and external metal cladding panels for both the wall cladding and the curtain walling system.
   d. Aluminium doors, aluminium windows, aluminium fix glazing, louvres etc. wherever indicated.
   e. All caulking, sealing and flashing including sealing at junctions with roof waterproofing and exterior wall, flashing at doorway, raised kerbs and in window surrounds.
   f. Sealant within and around the perimeter of all work under this section.
   g. Separators, neoprene / EPDM / silicon gaskets, trims etc.
   h. All steel structural framing and beam supports, anchors and attachments as required for the complete installation of the whole system, wherever specified.
   i. Inserts in concrete, anchor fasteners etc. for the anchorage of all work under this section to the approval of Architect.
j. Isolation of all dissimilar metal surfaces as well as moving surfaces similar or dissimilar.

k. Fire-stops, Flashings, Sealing of all interfaces with buildings etc.

l. Protection during storage and construction until handing over.

m. Engineering proposals, drawings and data.

n. Shop drawings, engineering data and structural calculations of all systems including framing, fasteners and cladding.

o. Scheduling and monitoring of the work.

p. All samples, mock-ups and test units.

q. Co-ordination with work of Civil Works and other agencies / contractors employed on site.

r. All final exterior and interior cleaning of the aluminium structural glazing system, cladding, doors louvres and window etc.

s. Hoisting, staging, scaffolding and temporary services.

t. Specified tests, inclusive of necessary reports.

u. Maintenance manuals.

v. Design and Performance guarantees.

w. Periodic inspection, supervision and advice by Contractor’s Senior Personnel of the System Principal as well as guarantee in approved Proforma for the quality and performance of works.

x. Construction monitoring for regular quality control and technical inspection to ensure the work conforms to the shop drawing details (including any modification made during testing) and acceptable standards of quality

15.2 REFERENCES AND STANDARDS

15.2.1 The provisions not restricted to the latest Standards listed below and mentioned in subsequent Para’s.

- ANSI Z97.1.84 Safety Glazing materials used in Buildings
- ASTM C 1036-90 Specification for float glass
- ASTM C 1048-90 Specification for Heat treated Float Glass
- ASTM E 774 –88 Specification for sealed Insulating Glass Units
- ASTM C 1172- 91 Specification for Laminated Architectural Glass
- ASTM C 864 – 90 Specification for compression Seal Gaskets
- ASTM C 1115-89 Specification for Silicon Rubber Gaskets
- ASTM C 920-87 Specification for Sealants
- ASTM C 509-90 Specification for sealing material
- CPSC 16 CFR 1201 Specification for Safety of glass
- GTA Specification Specification for environment durability for heat
- NO 89-1-6 strengthened Spandrel Glass with Applied pacifiers.
- BSCP 118 Structural use of Aluminium
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ASTM E 283 Air Infiltration test
ASTM E 331 Static water penetration test
ASTM E330 Positive and negative Test
AAMA 501.1 Dynamic Water Penetration Test-600Pa equivalent wind speed by propeller engine.
AAMA 501.4 At 100% of the specified lateral displacement.
AS N25 4284 Seismic test
IS 875 1987 Part 3 Code of practice for design Loads (other than Earthquake) Wind Load

In general the Contractor may follow any International Standards subject to his satisfying the Architect/ Employer that these specifications are equivalent to latest specifications issued by ASTM, ISO, AAMA, BSS & SSIR.

Copies of all standards & codes are to be followed for design, materials, installation and testing.

15.2.2 Building Regulations
Design of the aluminium structural glazing system shall comply with all Government codes and regulations. For wind design, all calculations shall comply with the requirements of the relevant National Building Code and Indian Standard Code, unless specified otherwise.

15.3 GUARANTEE
The Contractor shall be fully responsible for and shall guarantee proper design and performance of his installed system for a period of 10 years from handing over of works. The design and installation shall conform to the best international standards. In addition specific 10 year guarantees (to be furnished in non-judicial stamp paper of value Rs.100/-) in approved Proforma shall be given for performance of glass, glazed units, anodizing, PVDF coating to cladding sheets and sealants. All the Guarantees shall be submitted before Final payment and shall not in any way limit any other rights to correction which the Employer may have under the Contract.

15.4 CONTRACTOR’S RESPONSIBILITIES
The Contractor’s responsibilities include but are not necessarily limited to the following items:
a) The Contractor shall provide and install all supplementary parts necessary to complete all items generally implied in the drawings and in the specifications though not specifically shown or mentioned. This shall include the design and sizing of all sections and anchor assemblies to meet the performance and design requirements, furnishing and installation of all inserts, fasteners, clips, bracing and framework as required for the proper anchorage of the structural glazing system elements to the structure. Alternate anchorage proposals will be considered, if, in the opinion of the Consultant, the general design and intent of the drawings and specifications are maintained. The Contractor’s system therefore must perform satisfactorily as a whole.
b) Drawings and specifications indicate the required basic dimensions, profiles and performance criteria. The Contractor shall have the option of modification and addition of details provided the visual concept
and performance requirements are fulfilled. Proposed modifications shall be clearly shown on shop
drawings as “Design Modifications” and acceptance of the same will not relieve the Contractor from sole
responsibility for performance of the aluminium structural glazing system and cladding. The Contractor
shall be solely and fully responsible for due performance of his installation based on his design and
details.
c) In-plant and job site inspection: The Contractor shall allow the Consultant / E-I-C or their authorised
agent full access to plants, shops and assembly points to view and inspect the processes and methods
employed in the fabrication, assembly and finishing of the aluminium structural glazing system and
cladding for this project. The Consultant / E-I-C will have the right to reject any and all aluminium
structural curtain wall / structural glazing system and cladding components and assemblies during
assembly and erection if the workmanship and intent are not in strict conformity with the approved shop
drawings, design, documentation, certifications, samples and mock-up.
d) Glass, sealants and other items or materials procured by purchase shall be back to back guaranteed
by the manufacturer.

15.5 SHOP DRAWINGS
15.5.1 The contractor shall prepare necessary shop drawings based on the preliminary drawings and two
(2) copies of all shop drawings shall be submitted to the Consultant for review and approval. The
Consultant’s review of all shop drawings will be limited to their conformity to the design concept &
specifications. Consultant’s approval of the shop drawings will not relieve the contractor from any of the
responsibilities and requirements as stated drawings and all other related submissions, documentation,
certifications, samples and the mock-up for that work have been reviewed and approved by the
Consultant. On approval of the drawings by Consultant, the Contractor shall submit six (6)copies of all
drawings to E-I-C for execution at site.

15.5.2 Shop drawings shall incorporate scaled and dimensioned plans, elevations, sections and full size
details for all work in this section. Shop drawings shall indicate the desired dimensional profiles and
modules, function, design and performance standards and, in general, delineate the scope of work. The
contractor shall verify and co-ordinate these items with all applicable and/or related trades, contract
drawings and specifications. Since the dimensions and modular references shown on the drawings are
for specific and/or typical detail, the shop drawings shall include a full complete layout of all modular and
referenced dimensions for all the aluminium structural glazing, cladding, doors, windows and louvres and
their related elements. All dimensions / modules, etc., shall be field checked as required.
The full size details shall show and specify all metal sections, types of finishes; areas to be sealed and
sealant materials; gaskets; direction and magnitude of thermal expansion; direction and magnitude of all
applicable construction including fasteners and welds; all anchorage assemblies and components; the
fabrication and erection tolerances for the work and applicable related works adjoining, attached to or in
some way related to the work covered by these specifications. The location of all static and dynamic anchor assemblies, the direction of thermal and other applicable building movements, coordination with concrete works and the sequence of installation shall be designated on the applicable plans, elevations and/or sections. All details shall be subject to Consultant’s approval.

15.5.3 Shop drawings shall indicate the desired profiles, dimensions, details of metal finish and in general delineate the scope of the work. Profile adjustments in the interest of economy, fabrication, erection, weather-ability or ability to satisfy the performance requirements may be made only with the written approval of the Consultant, provided that the general design and intent of the drawings and specifications are maintained.

15.6 STRUCTURAL CALCULATIONS

15.6.1 The Contractor shall guarantee that his design will ensure the structural safety and integrity of the curtain wall, cladding and glass panels against all natural forces, superimposed loads, environment and consequent movements. For that purpose the contractor shall employ a competent design engineer to design his systems and components. During the design stage, the Contractor shall interact actively with the Consultant concerning all aspects of design and shall obtain all the information from them concerning the structure, probable deflections and other building movements etc. The Contractor shall take full account of all possible building movements as well as the movements of his curtain wall and cladding systems in his design. The Contractor shall submit his detailed structural calculations for the systems and each of their components and shall guarantee that his design will ensure the structural safety and integrity of the curtain wall, cladding and glass panels against all natural forces, superimposed loads, and environment and consequent movements. The structure and functional design must be vetted and approved by the Consultant. The Contractor shall obtain the Consultant’s approval to his design calculations and to the provisions made in his design for all the building movements, and shall be responsible for the correctness of the fixing and interaction of the curtain wall with the structure so as to ensure that all the movements envisaged between the structure and the curtain wall area are fully taken care of. The Contractor shall be responsible for the workmanship of fabrication and installation and shall indemnify the Employer against all claims due to defects or non-performance during the specified 10 year Guarantee period. The provisions of this clause shall not in any way limit the Employer’s rights under other clauses of the Contract.

15.6.2 The R.C.C. in the building structure is Grade M 30. The Contractor shall design anchorages for this grade of concrete with adequate safety factor.

15.6.3 Three (3) sets of approved design calculations which is compatible with R.C.C. and steel structure shall have to be submitted to Consultant.

15.7.0 DOCUMENTATION AND CERTIFICATION

15.7.1 Glass and Glazing Documentation:
The applicable glass manufacturer(s) shall submit written certification for Consultant’s review and approval stating that all glass and glazing requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and/or design parameters, compatibility to adjacent materials and in conformity with all requirements as detailed and specified in the Contract Documents. Certification shall further state that the proposed glass and glazing materials are most appropriately suited for the use or uses intended and recommended for the specific use or the selection of the glass and the glazing materials include, but are not limited to, gaskets, setting blocks, sealant, the design and dimensional parameters of the glass pockets and the compatibility of materials. Test Certificate from approved laboratories for U-values and shading factor as claimed by the Manufacturer shall have to be submitted.

15.7.2 Sealants Documents:

All sealant applications must be clearly designated on the applicable shop drawing details and referenced to a master sealant schedule specifying materials, special instructions and application procedures. The applicable sealant manufacturer(s) shall submit in writing that all sealant requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and/or design intent, compatibility to adjacent materials and in conformity with all the requirements as detailed and specified in the contract documents. The manufacturer’s certification shall specify the optimum life expectancy, in years, for the proposed sealant materials as detailed and specified on the shop drawings and/or master sealant schedule and shall further state that the proposed materials are most appropriately suited for the use or uses intended and recommended for the specific use or uses.

15.7.3 Quality Control Documentation:

In-plant and job site quality control procedures shall be documented in writing for Consultant’s review and approval to ensure the design integrity and performance of the as built product. Documentation shall include schedule, details, isometric and/or schematic explanatory sketches cross-references to the shop drawings, data sheets, etc., all as required to intelligently witness and assess methods and materials; and to ensure that both the fabrication and installation are in accordance with the contract documents. The Employer/Consultant shall, if required, be given free access to the plant to inspect fabrication procedures. No fabrication or assembly of job site materials shall commence until the first production unit is inspected and approved by Consultant/E-I-C.

a) The in-plant quality control procedures shall include but not necessarily be limited to the following items:
Fabrication : Tolerances, Joinery, Sleeves, etc.
Finish Match : Approved finish controls required for matching the exposed surfaces.
Assembly : Welds, fastener, sealants, gaskets, separators, glazing etc.
Protection : Handling, protection, shipping etc.
b) The job site quality control procedures shall include, but not necessarily be limited to the following items:

**Anchorage:** Lines, grades and related building tolerances

**Installation:** Tolerances, finish, match, joinery, sleeves, flashing, welds, fasteners, sealants, etc.

**Sealing:** As recommended by the applicable sealant manufacturer(s)

**Protection & Cleaning:** As recommended by the applicable sealant manufacturer(s)

15.8 SAMPLES AND MANUALS:

15.8.1 The following samples of actual job site materials together with detailed technical data / catalogues shall be submitted in duplicate, unless otherwise noted, and in the sizes noted, for Consultant’s review and approval. Any omission of an item, or items which require the Contractor’s compliance with these documents does not relieve him from such responsibility.

(a) Aluminium sheet panel: Each type and thickness; 600 x 600 mm of the specified thickness.

(b) Aluminium extrusions; one only of each section; 300 mm long of specified thickness.

(c) Glass; Each type and kind, 300 x 250 mm of specified thickness and including frame.

(d) Glazing gaskets, tapes, separators, glass setting blocks, etc. each section or unit, 300 mm long or unit.

(e) Fasteners and connections devices: Each type and size.

(f) Window and door accessories, as applicable.

(g) Flashings and finish samples.

(h) Cladding.

(i) Samples submitted should also include assembly of various components forming a typical fixing and details complete with flat sheets, glazing, extrusion, fastener, sealants etc.

15.8.2 Mock - Up

Before the fabrication and site installation is taken up, the Contractor shall put up a mockup of his proposed curtain wall / structural glazing system & aluminium cladding system at least 4.00 m high and 3 modules wide incorporating all types of in-fill panels, fire-stop, flashing, shadowbox, bracket, hardware and fixtures. A mock-up of 4 panels of cladding shall also be put up. The mock-up are essential for final approval of all materials and installation details by the Consultant.

The Contractor shall submit samples and catalogues of door / window elements for approval, as applicable.

15.8.3 Maintenance Manual:

Submit Maintenance Manuals approved by Consultant in three (3) copies each indicating the detailed procedures for the periodical inspection maintenance and cleaning of all the structural glazing, cladding, doors, windows and louver elements, finishes etc.
15.9 INSPECTION OF COMPONENTS:
15.9.1 The Contractor shall submit fortnightly report on the results of the inspection of the components, in a format approved by the Consultant.
15.9.2 The Contractor shall submit a description of the procedure of delivery, hoisting, storage, handling, fixing, scaffolding, temporary working stage or gondola, protection and cleaning.

15.10 STORAGE, PROTECTION AND PROGRAMME
15.10.1 The Contractor shall submit a schedule on the procedure for inspection during installation so as to maintain quality control on the job site.
15.10.2 The Contractor shall submit a detailed method statement for the protection of the surface of the aluminium structural glazing & cladding members during delivery and erection, with description as to when the protection can be removed.
15.10.3 The Contractor shall submit weekly reports on the inspection of erection and installation as direction by the PMC.
15.10.4 Delivery and Storage of Materials: All materials delivered to site shall be stored in allocated spaces where the stored materials will not be exposed to rainwater, moisture or damage, and shall permit easy access to and handling of the materials. Materials shall be stored neatly and properly stacked.
   a) Aluminium wall cladding / Factory made structural glazing units and / or their components shall be transported, handled and stored in a manner to prevent damage of any nature.
   b) Accessory materials, required for erection at the site shall be delivered to the site in labeled containers by the manufacturer.
   c) All units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation should be replaced.

15.11 PERFORMANCE REQUIREMENTS
All components, assemblies and completed work included in or permit to the work of this section shall conform to or exceed the following performance standards and comply with all applicable and governing building codes and regulations.
15.11.1 Thermal Movement: Provide for noiseless contraction and expansion of component materials for an ambient temperature range of +10°C to 70°C and a material temperature range of 100°C without buckling, opening joints, glass breakage, undue stress on fasteners, or other detrimental effects. There should be allowance for vertical and horizontal expansion. For fabrication, assembly and erection, procedures shall take into account the ambient temperature range at the time of respective operations.
15.11.2 Building Movement and Related Building tolerance. The design and installation of the structural glazing system shall accommodate all inherent building movements and/ or deflections and the fabrication and installation tolerances of all related work not involved in this section without the loss of, or
any detrimental effect to, the performance requirements herein specified. The Contractor shall verify and co-ordinate all such movements and / or tolerances with the Consultant so that movements and deflections in the structure do not at any time affect the integrity and safety of curtain wall and aluminium cladding and vice versa.

15.11.3 Thermal property:
All insulation materials, fire-stops and smoke seals shall comply with the current requirements of WBF&ES (West Bengal Fire and Emergency Services).

15.11.4 Structural Properties:
a) The design of curtain wall / structural glazing system and aluminium cladding and all related components shall comply with the requirements of National Building Code I.S.875 and Indian Standard Code I.S.456.
b) No curtain wall / structural glazing system and aluminium cladding elements including sealants and sealed joints shall sustain permanent deformation or failure under loading equivalent to 1.5 times the specified design wind pressure.
c) Deflections: The specified deflections must be reduced if they are in any way detrimental to the aluminium structural glazing and cladding elements and sealants.

15.11.5 General
1) All braces, supports and connections for the aluminium curtain wall / structural glazing and cladding shall be designed, provided and installed complete as required.
2) Anchors for curtain wall shall be located within a maximum distance of 500 mm above or below the R.C.C. floor slab unless specifically approved otherwise by the Consultant.
3) Variations from schematic layouts indicated on the drawings may be permitted but only if a proposed revision does not, in the Consultant’s opinion, deviate from the design intent, cause excessive stress in the structure, cause excessive deflection, inhibit thermal and building movement or conflict with other requirements.
4) Member shapes and / or profiles if schematically shown on the Consultant’s drawings are not necessarily the exact shapes required or best suited for the particular condition. Final shapes and locations shall be as designed by the contractor and are subject to the Consultant’s review and approval.
5) The height-from the finished floor level to the top of the window sill shall not be less than as shown in the drawing. The horizontal or lateral load on such transom / railing (where not backed by an R.C.C. parapet) shall be designed in accordance with the following criteria i.e. a horizontal UDL at 0.74 KN/m run, UDL supplied to the infill of 1.0 KN/m2 and a point load applied to part of the infill at 0.5 KN.
6) No holes shall be burned, filed or drilled in any structural steel members unless approved by the Consultant in writing.
7) The contractor shall provide detailed layouts, alignment jigs etc. for the proper and exact placement of all welded anchor studs, anchorage components, embedded anchor assemblies etc.
8) All metal structural glazing and cladding elements and their applicable anchorage assemblies shall be designed to accommodate all thermal and building movements without any harmful effect to the structural glazing and cladding.

9) No field forming, cutting and/or alterations of primary wall elements will be allowed. All framing members shall be shop fabricated and finish coated. No unfinished surfaces will be permitted on exposed surfaces.

15.11.6 Concrete Tolerances:

a) The contractor shall take into account tolerance in concrete and masonry surfaces to which the structural and glazing framework is fixed.

b) In general, the construction tolerances in the building shall be as follows.

- Surface level of floor slab, sills and lintels -10 mm
- Plumb in a storey height -10 mm
- Plumb in full height of building -14 mm
- Cross – diagonal distortion between columns -14 mm
- Max. displacement of any point on External Facia from its true location -14 mm

15.11.7 Lightning protection

The whole of the curtain wall when having insufficient clearance from the lightning protection system shall be bonded as directly as possible to the lightning protection system. At each end of each continuous length of curtain wall, cladding or louvers, provision shall be made at top and bottom for bonding for electrical works. The exact locations and details of the bonding points shall be as determined by the Consultant.

15.11.8 Fire-stop and Interface with building.

Joints in the curtain wall / structural glazing system between successive floors shall have the required fire resistance of at least 2 hours and shall comply with requirements of WBF&ES. A fire-stop-cum-smoke seal shall be provided at each window-head level. In addition the Contractor shall provide aluminium flashing to approved design at the window sill level and on 2 sides of vision panels. All interfaces with building structure, and other elements shall be sealed / flashed / provided with expandable gaskets to Consultant’s approval.

15.11.9 Sound Control

Provisions shall be made (e.g. capping of all ends of mullions) to prevent sound transmission through the system. Provisions shall also be made to prevent metal to metal rubbing noise due to thermal changes and wind pressure. Desired sound levels should be 35 - 45 dB and shall not be more than 45 dB.
MATERIALS

15.12 GENERAL:

15.12.1. Materials and components used shall be of the best quality and suitable for the purpose to Consultant’s approval and shall have been tried and tested in similar environments.

15.12.2. Aluminium panels shall be of a minimum thickness of 2 mm and of max. 3 mm for solid sheets, and 4 mm for insulated composite units.

15.12.3. All materials shall be free from any defect that may impair the strength, functioning or appearance of the glazing and cladding system or adjacent construction.

15.12.4. Testing by independent testing laboratories or review of data by the Consultant shall not relieve the Contractor’s responsibility to verify for himself that the work conforms to the intent of the contract documents.

15.13 METALS

15.13.1. In general, metals shall comply with relevant Indian and International Standards.

15.13.2. Aluminium Wall Cladding

The aluminium cladding shall be fabricated with a minimum of 4 mm thick aluminium composite panel of approved make comprising of a thermoplastic resin core sandwiched between two skins of aluminium alloy. The panels shall be PVDF coated to minimum 35 micron thickness in approved metallic colour. The resin content of the PVDF shall be minimum 75%. The back of the panel shall be chromatised minimum 3 micron thick or otherwise protected as per Consultant’s approval. The insulation in-fill of the composite panel shall be non-toxic on burning.

15.13.3. Fasteners: The type, size, alloy, quantity and spacing of all fasteners and / or anchorage devices shall be as required for the specified performance standards.

a) Bolts, anchors and other fastening devices shall be of approved types as required for the strength of the connections, shall be self-locking, unless otherwise noted, shall be suitable for the conditions encountered, and shall be torque tightened, where required, to achieve the maximum torque tension relationship in the fasteners. Washers, nuts and all accessory items shall be of the same material as fasteners.

b) Fastening devices between aluminium and aluminium shall be Grade 304 of AISI nonmagnetic stainless steel unless otherwise approved.

c) Fastening devices between aluminium and dissimilar materials shall be Grade 304 of AISI non-magnetic stainless steel unless otherwise approved.

d) Exposed fasteners are subject to Consultant’s approval and shall be M.S. epoxy coated.

e) Self-locking fasteners shall be stainless steel of grade 304 with nylon inserts or patches.
15.13.4. Extrusions:
All aluminium extrusions shall conform to the system principal’s specification for tolerances which shall, in any case, be better than DIN standards. Any section not to the tolerances shall be rejected. In general aluminium alloy for extrusions shall be 6063 T5 or T6 as per B.S.1474. However, the grade and tempering specifications shall be as recommended by the supplier for each application and shall be approved by the system principal. All aluminium sections shall be either anodised in approved colour to a minimum thickness of 35 microns or coated with PVDF except for sections concealed from view behind cladding which may be mill-finished. All surfaces abutting the parent sections and designed to receive sealants shall have adequate sealant contact and adhesion. They shall be finished to match parent sections.

15.13.5. Aluminium Flashing
Flashings concealed from view shall be made from mill-finished aluminium sheets 1.5 mm thick. Visible flashings (e.g. on periphery of vision panels) shall be 2 mm thick aluminium sheets anodised in approved colour.

15.13.6. Capping
Top capping shall be from 3 mm stretch-levelled aluminium sheets coated with 35 micron PVDF in approved colour.

15.13.7. Soffits and Suspended Ceiling System
Soffits and suspended ceiling system if required shall be of similar metal of the aluminium wall cladding with a similar finish. Colour and shape shall be approved by the Consultant.

15.13.8. Fire stops – cum – smoke seals shall be provided at successive floor levels, and shall be two hour fire resistant. Metals sections shall be in galvanised steel sections minimum 1.5 mm thick. All details shall be approved by the Architect.

15.13.9. Protection:
Materials used as permanent or temporary protection for metals shall conform with relevant Indian / International Standards.

15.13.10 Brackets:
Brackets shall be of chromotised Aluminium of grade 6161-T6 or 6005-T6 conforming to ASTM 6511/A and approved by Consultant. Slots in brackets shall be pre-drilled / punched and not flame-cut.

15.13.11 Hardware and Fittings:
All hardware and fittings such as patch fittings, handles, locks, stay-arms, floor springs etc. for doors windows and openable panels shall be stainless steel to best International standards and approved by Consultant. Hinges for openable panel shall be stainless steel friction hinges / stays selected for specified wind load and dead loads or specifically extruded in-built hinges.
14.0 SEALANTS & GASKETS

15.14.1 All sealant applications must be clearly designated on the applicable shop drawings details and reference to a master sealant schedule specifying materials, special instructions and application procedures.

15.14.2 The compatibility and sequence of installation for all sealants must be carefully considered in all proposals in order to ensure the required cure and optimum performance. Sealants must not degrade and / or fail under all design conditions including, but not limited to thermal movement, water, ultraviolet exposure and / or other adverse environmental conditions. The designation of sealant types noted on the drawings is intended for general design guidance. Final selection by the contractor for the sealant types shall be based on their conformity with the Performance Requirements herein specified and subject to Consultant’s approval. Maximum precautions shall be taken to prevent failure of sealant.

15.14.3 Structural sealant:
Structural sealant shall be Dow Corning Silicone sealant 995, GE ultraglaze 4000, or equivalent recommended by manufacturer. All exposed and concealed metal to metal (including tight or butt type metal to metal assembly prior to assembly), perimeter, metal to concrete joints shall be silicone base sealant, preferably 2 component, in approved colour, conforming to the manufacturer’s recommendations for the specific uses and performance criteria. The manufacturer shall conduct laboratory test for adhesion for each lot of aluminium sections and glass. Laboratory reports shall be submitted to the Engineer-in-Charge.

15.14.4 Weather Sealant:
The grades of sealants for concealed metal to metal and metal to concrete joints such as embedment and lapping of flashings elements to be installed or embedded in a full bed sealant shall be the best recommended by the manufacturer for the application. (Dow Corning, GE or equivalent).

15.14.5 Joint fillers and back-up materials shall be non-gaseous polyethylene foam, sponge neoprene as per written recommendations from the applicable sealant manufacturers for each specific application. Shape, size, hardness, compatibility and bond breaking requirements are all factors to be considered.

15.14.6 All sealant must be non-staining and compatible with adjoining sealants, backup materials, substrate materials and their respective finishes and / or applied colour coatings.

15.14.7 Exposed assembly sealant will not be permitted at any wall area.

15.14.8 All sealants shall be given 10 years Guarantee for materials, workmanship and performance from the date of completion of Contract.

15.14.9 Caulking compound: Dow Corning 991 or approved equivalent, one part gun grade consistency, colour to match adjacent material or approved by Consultant for use around frame or between frame and floor slab.

15.14.10 GASKETS:
A) SILICON GASKET: All Gaskets and seals shall be SILICON of approved quality, compatible with substrates, finishes and other components they are in contact with.
15.15 SEPARATORS
Separators between steel and aluminium members and wherever required shall be rigid type, high impact, smooth both side Teflon with a minimum thickness of 0.8 mm or other non-conducting materials as approved by the Consultant.

15.16 GLASS
15.16.1 All glass and glazing materials shall be verified and co-ordinated with the applicable performance requirements.
15.16.2 Glass and glazing work shall be finished and installed as indicated on the drawings and as specified herein. All glass shall be cut to required sizes and should be made ready for glazing. Any pane which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the Contractor’s expense. All glass shall be of accurate sizes with clear undamaged edges and surfaces which are not disfigured.
15.16.3 Glass shall conform to the quality, thickness and dimensional requirements specified in US Federal specification DD-G 0451 C.
15.16.4 Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm within 260 mm of leading or trailing edge, or 0.076 mm in centre. Direction of ripples shall be consistent and extent shall be acceptable to Consultant. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be unidirectional. Surface compression stress of heat strengthened glass shall be within 320 – 450 Kg/cm².
15.16.5 Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by the Consultant. All glass shall be delivered to site with the manufacturer’s label of identification attached.
15.16.6 A complete list of materials to be used should be submitted for approval by Consultant including the sealants proposed and such samples as may be required. All glass and glazing methods and materials including the design and profile dimensions of glazing pockets shall be as approved and recommended in writing by the applicable glass and sealant manufacturers. A sealant substrate test report shall be submitted for each type of sealant for adhesion and compatibility.
15.16.7 Sealants in factory-glazed panels shall be fully cured prior to shipment to projects site and installation.
15.16.8 All glass breakage caused by the Contractor or his sub-contractor because of the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.
15.16.9 The Contractor shall be responsible to deliver to the Employer without any charge, replacement for any unit of glass and glazing that fails within the Guarantee period of Ten (10) years from date of completion of Contract.
15.16.10 The glass glazed panels / structural glazing frames for the structural glazing system shall be capable to withstand lateral imposed loads and comply with requirements of local building codes.  
15.16.11 Glass thickness should be selected in accordance with AS 1228 – 1989 “Glass in Buildings Selection and Installation” to satisfy design performance requirements and local design codes. 
15.16.12 Glass shall be free from defects or impurities detrimental to its performance. Defects such as bubbles, waves, spots, scratches, spalls, discoloration, visibly imperfect coating, chipping, and bubbles or delamination of opacifier film shall be limited in accordance with the Manufacturer’s / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass shall be consistent in colour. 
15.16.13 Manufacturer’s glazing instructions regarding installation, clearance, dimensional tolerance, bite edge clearance etc. shall be followed. 
15.16.14 All solar control glass panels shall be stored with particular care and protected against abrasion, sun and moisture prior to installation. 
15.16.15 Precautions specified by glass manufacturers to minimise thermal stress must be followed. A thermal stress analysis shall be obtained from glass manufacturer prior to fabrication and their recommendations shall be followed. Allowance shall be made for thermal movements due to an air temperature range of 60°C (+10°C-70°C) and a material temperature range of 100°C. 
15.16.16 Glass panels shall be selected / rejected on the basis of product quality standards specified by the manufacturer concerning scratches, pinholes, clusters, distortion, colour variations, flaws in coating and other defects. 
15.16.17 Each type of glass shall be obtained from only one manufacturer and one lot. Adequate spare quantity shall be ordered to cover for breakage and for replacement during maintenance period. 
15.16.18 Setting blocks for glass shall be extruded neoprene with minimum 80 durometer hardness. 
15.17 GLAZING COMPOUNDS; 

15.17.1 All neoprene materials shall be extruded high quality ozone resistant, cured, elastomeric, virgin neoprene compounds with durometer hardness, profiles and design parameters, lengths and locations all as required and recommended in writing by the applicable glass manufacturer (s). All neoprene glazing materials shall have smooth neat exposed surfaces, all flashings and burrs removed and in profiles, including integral locking projections to engage into the parent drawings. Furnish certified test reports to establish conformity with the specified standards. 
15.17.2 Setting blocks used to support the dead load of the glass shall be extruded in silicone material conforming to the design criteria, all as recommended by the glass manufacture. 
15.17.3 Jamb shims used to centre and station the glass shall be extruded in silicone material conforming to the design 
15.17.4 Fixed compression and roll-in glazing gaskets shall be extruded in silicone material as recommended by the glass manufacturer. Gaskets for any one light shall be one piece with injection moulded corners free of all flashings and burrs.
15.18 METAL COATINGS:
15.18.1 All Aluminium extrusions shall be PVDF (Powder Coating) coated to minimum 35 microns of shade approved by the Architect.
15.18.2 Coatings to aluminium sections and cladding where specified shall be fluoropolymer formulated and will consist of a 3 coat system comprising primer, colour coat and clear anti abrasion top coat. The coating system shall meet or exceed all the requirements of AAMA 605 - Voluntary specification for high performance organic coatings on Architectural extrusions and panels. The total dry film thickness shall be 35 microns.
15.18.3 After selection of colour by the Architect, the Contractor shall prepare two (2) sets of two (2) samples of each which shall define the colour and gloss range and submit them for approval.
15.18.4 All samples shall be identified and have a full laboratory report attached.
15.18.5 The coating system, including materials and application shall conform to the requirements and recommendations of the paint manufacturer.
15.18.6 Testing and Sampling Procedures
In-process testing shall be performed on test specimens of equal metal thickness pretreated and finished along with the production metal and in addition to running in-process tests to assure high quality production, additional finished extrusions or panels are to be submitted to the coating manufacturer’s laboratory for extended exposure testing.
All test samples shall be properly identified with date, batch number and shift indicated. The following tests shall be conducted at least once per production shift and submitted to the Employer when required.
(i) Dry Film Thickness – evaluated with a Permascope, Isoscope or Dermatron instruction.
(ii) Film Hardness.
(iii) Dry Cross batch Adhesion
(iv) Boiling Water Adhesion Test.
(v) Gloss Measurement
(vi) Colour Examination Against Standard
(vii) General Appearance – Smoothness, free of blisters, sags, pinholes and other surface imperfections.
Testing reports shall be certified by the testing agency, manufacturer and the Contractor

Performance Requirements:
Salt Spray resistance – withstand a minimum of 3000 hours exposure to 5% salt solution at 95% R.H., 37.5 degrees C with no more than 1.25 mm creepage or loss of adhesion from scribed line or cut edges.
Humidity Resistance – Withstand a minimum of 3000 hours exposure to 100% R.H. 37.5 degrees C with no more than a few blisters, size No. 8 (ASTM D 714 – 56).
Abrasion Resistance – Withstand abrasion of sand with an abrasion coefficient value of 65 minimum when evaluated as per ASTM D 968-51 test method.
Mortar Resistance – Withstand wet mortar, 24 hour part test at 100% RH without gaining adhesion or any visual effect on the painted surface of solid colours.

Detergent Resistance – Withstand immersion in 3% synthetic detergent solution for 72 hours at 37.5 degrees C with no loss of adhesion no blistering and no visible change.

Colour Retention – Withstand maximum chalk rating of No. 8 for colours and No. 6 for white per test method ASTM D659-44 (1970).

Field Touch-up and Repair – The contractor and coating manufacturer shall supply materials for air dry touch up for spray or brush application as per instruction of manufacturer. Touch up shall be held to an absolute minimum subject to Consultant’s approval. The contractor shall furnish to the owner a written guarantee warranting all work in connection with organic coating system to be free from defects in materials and workmanship for a period of Ten (10) years from date of completion and to correct promptly any defect free of cost. The following are considered as defects without being limited thereto:

i) Peeling

ii) Cracking

iii) Checking

iv) Blistering

v) Chalking in excess #8 Chalk rating when measured in accordance with ASTM D659-44 (1965).

vi) Fading or colour change in excess of 5 NBS unit when calculated from measurement on a spectrophotometer or colour meter capable of colour measurement by reflectance reading in accordance with ASTM D244-68.

15.19 ALLUMINIUM STRUCTURAL GLAZING AND CLADDING SYSTEMS

15.19.1 The method of assembly, reinforcing and anchorage of the aluminium structural glazing / cladding system, where indicated, is schematic. Locations and method of providing same shall be the Contractor’s responsibility, who shall design the assembly, reinforcing and anchorage to suit each specified conditions in an acceptable manner complying with the requirements specified herein after.

15.19.2 Visible joints shall be as shown in the Architect’s drawings.

15.19.3 All parts shall be secured by concealed means wherever possible and where exposed to view, screw positions are to be indicated on the preliminary drawings. Exposed screws shall be of the countersunk type coloured in same finish as of aluminium or non magnetic stainless steel and shall be evenly and neatly located in an approved manner.

15.19.4 All components shall be assembled, secured anchored, reinforced, sealed and made Weather-tight in a manner not restricting thermal or wind movements of the structural glazing. Sealants shall be concealed wherever possible.

15.19.5 All fastening into or through aluminium shall be SS-306 as approved by Architect.

15.19.6 Free and noiseless movement of all the components of the Curtain Walling system due to thermal effect, structural effect, wind pressure, seismic forces, erection or dead loads, shall be achieved
without strain to the glass, without buckling of any components and without excessive stress to any members or assemblies.

15.19.7 Aluminium surfaces in contact with mortar, concrete, plaster, masonry, wet application of fire-proofing and absorptive materials shall be coated with an anti-galvanic, moisture barrier material.

15.19.8 Waterproofing:
   a) A complete drainage system must be incorporated into the structural glazing framework. Water leakage and condensation shall be drained or discharged to exterior face of the wall and all internal spaces vented by acceptable means to ensure air pressure equalization wherever possible.
   b) Drainage system will be sealed off at every floor to prevent infiltrated water from leaking to lower floors.
   c) Movement of water behind and on exposed surfaces must be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to avoid the potential for algae and fungus growth as a result of standing or trapped water.
   d) The junction of bracket connecting S.S.Screen with reflector system & structural Glazing system shall be fully protected against ingress of water by providing suitable water proofing systems as approved by Consultant.

15.19.9 Anchorage System and Building Frame
   Each glazed unit shall be fixed to the structural slab at each floor level. All fasteners shall be SS-304 of AISI. The contractor shall also make necessary modifications to the anchor fasteners to suit existing site conditions of steel reinforcement without additional charge.

15.19.10 Mullions and Transoms
   a) The sections of mullions and transoms shall be designed to restrict deflection under wind pressure as specified and shall be rigid enough to support and retain the glass spandrel under all conditions. The mullions shall be designed if required, to act as guide tracks for gondolas to permit its free movement in vertical direction for window washing and to sustain concentrated loading by the gondola cage. The mullions & transoms should cater for the loading of S.S Screen with reflector.
   b) Reinforcing members, where used, shall be completely enclosed and if fabricated from steel shall be galvanised and protected with primer and two coats of zinc chromate.

15.19.11 Window units (Vision Panels)
   All windows shall be glazed from inside where possible. All cladding as well as internal glazing beads, if any (unless otherwise specified) shall be in anodised aluminium.

15.19.12 Spandrel Units
   a) Spandrel shall be of glass having equal colour matching with vision areas with opacifier coating.
   b) Structural spandrel beam, structural glazing fasteners and other construction shall not be seen through the glass from the exterior and shall be fully concealed behind shadow box.
c) A shadow box shall be provided a distance behind the spandrel glass panel. It shall consist of 50 mm semi-rigid fibre glass insulation of minimum density of 48 Kg/cum., and 0.8 mm galvanised sheet steel tray natural finished. The periphery shall be properly sealed. Surface #1 shall be adequately protected against damage until spandrel glazing is done.

d) Two hour rating fire stops–cum–smoke seals shall be constructed continuously at the spandrel to the approval of the Chief Fire Officer and other authorities.

15.19.13 Ventilators, Openable Windows and Doors

a) Ventilators, windows and doors shall be provided at positions as shown on the drawings. The ventilators when in closed position shall remain watertight under all weather conditions and pass the water tightness tests as specified.

b) All hardware and accessories shall be supplied by the contractor and when exposed shall be of stainless steel or approved aluminium alloys in approved finish.

c) Minimum aggregate openable area of the ventilator shall be as given in the Architect's drawings.

d) The detailed system of the ventilators and doors must be proposed by the tenderer keeping the position as shown on the drawings.

15.19.14 Coping and Soffit Trimmer

a) All coping and soffit panels shall have suitably designed frame reinforcement and be fixed rigidly to the structure.

b) All joints between coping / soffit panels and between coping / soffit panels to structural glazing frame and other sections of the work shall be tightly sealed up. Effective drainage system shall be provided to drain out the water that may penetrate through the joints.

15.19.15 CLADDING (Aluminium Composite panels)

Cladding shall be non-toxic composite aluminium panels of adequate strength with approved aluminium details. The panels shall be 4 mm thick composite units finished with PVDF coating minimum 35 micron thick of approved metallic colour. The resin content of the PVDF coating shall be minimum 75%. The back of the panel shall be chromatised minimum 3 micron thick, compatible with adhesives for stiffeners if any or given a polymer coating. The insulation fill of the composite panel shall be non-toxic on burning. The fabrication and installation of the cladding systems shall be carried out as per manufacturer's instructions with invisible / concealed fastenings, aluminium sub-structure, silicon sealants properly tooled etc. All cladding panels of one kind shall be obtained in one lot from the manufacturers. Each panel shall be guaranteed for a minimum flatness of ±1 mm from the true face after installation under no-wind conditions.
Deviations from the true alignment of adjoining panels shall not be cumulative. Full load deflections shall be kept to the minimum possible. Each panel shall be capable of withstanding wind pressure without any permanent deformation. The cladding system shall be adequately ventilated. The air gap between the cladding panels and the concrete / block wall shall be at least 50 mm to allow proper ventilation of the rainscreen system. The cavity shall be closed by a perforated bird / vermin-proof closer at bottom and by a flashing at top. The fabrication processes including cutting, grooving, benching, folding, joining, rout-in as well as installation shall be performed as per manufacturer’s instructions. The panels shall be backed by approved aluminium supporting framework, fixed to walls with aluminium brackets.

LOUVERED PANELS
15.20.1 Louvered panels shall be provided at positions as shown on the drawings (preferably at ducts and ventilation shafts).
15.20.2 Louvres shall be of 35 micron PVDF coated of approved shade aluminium fins of Aerofoil shaped blades of Min 1.5 mm thickness with an assumed efficiency of 50% unless otherwise specified and shall be complete with stainless steel bird-proof wire mesh (18 gauge) fixed internally.
15.20.3 All hardware and accessories shall be, when exposed, of non-magnetic stainless steel and / or coloured aluminium to match that of structural glazing / cladding wherever possible.

15.21 FABRICATION
15.21.1 General: All assemblies shall be fabricated and assembled in accordance with the drawings and the requirements of these specifications. Deviations of any nature, without approval of the Consultant shall not be permitted.
15.21.2 Tolerances: A schedule of fabrication tolerances for all major wall cladding components shall be furnished. In addition to the fabrication tolerances, there should be provision for thermal movement including assembly and installation tolerances for all major and/or applicable wall cladding components and/or assemblies.
15.21.3 Workmanship
1) All work shall be performed by skilled workmen, specially trained and experienced in the applicable trades and in full conformity with the applicable provisions of the listed References and Standards and/or otherwise noted on the drawings or as specified herein.
2) All work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, fabrication and installation tolerances and design criteria.
3) All forming and welding operations shall be done prior to finishing, unless otherwise noted.
4) All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, waves or flaws of any nature impairing strength or appearances; fitted with proper joints and intersections and with specified finishes.
5) All work shall be erected true to plumb, level, square to line, securely anchored, in proper alignment and relationship to work of other trades and free from waves, sags or other defects.

15.21.4 Joints in Metal Work
1) All exposed work shall be carefully matched to produce continuity of line, design and finish. Joints in exposed work, unless otherwise shown or required for thermal movement, shall be accurately fitted, rigidly secured with hairline contacts and sealed watertight.
2) Where two or more sections or metals are used in building up members, the surface in contact shall be brought to a smooth, true and even surface and secured together so that the joints shall be absolutely tight without the use of any point materials. Extrusions shall be finished to eliminate any edge projection or misalignment at joints.
3) Physical samples of all joinery elements should be furnished for comparative appraisal and approval of the production materials. Physical samples of all typical wall intersection assemblies shall be colour coded on surfaces and/or areas to receive sealants.

15.21.5 Shop Assembly
As far as practicable, all fitting and assembly of the work shall be done in the shop. Work that cannot be permanently shop assembled shall be temporarily assembled in the shop and marked with the approval of Consultant, before disassembling to ensure proper assembly later in the building.

15.21.6 Sleeves
Unless otherwise noted, all aluminum sleeves shall be extruded sections designed to accurately interlock with adjacent sections and incorporate serrated surfaces for the secure bedding of sealant between the parent metal and the sleeve.

15.21.7 Fasteners
1) All fasteners shall be of SS-304 of AISI stainless steel with self locking devices, unless otherwise specified, and of sufficient size and strength to withstand the applicable design materials. The spacing and quantities of fasteners shall be as required to develop the maximum strength of the member they secure or support. Washers and/or other accessory items shall be of the same material as the fastener.
2) All fasteners shall be concealed unless otherwise shown or approved. The head style for all exposed fasteners shall be countersunk oval head unless otherwise specified on the drawings. Exposed fasteners shall be finished to match surrounding metal finish.
3) All fasteners including washers and accessory items shall be scheduled and designated on the shop drawings so that anyone can witness and assess the assembled units to ensure that all fasteners conform to the designated and approved type, size, material, spacing, etc. When certain items are not readily apparent, such as material and alloy or torque tightening requirements, special instructions for the identification and appraisal of such items shall be issued.

15.21.8 Protection of Metals
1) Protection against galvanic action shall be provided wherever dissimilar metals are in contact.
2) Aluminium which is to be in contact with cured concrete, mortar or plaster shall have the contact surfaces protected wherever crevices between the contact surfaces may entrap moisture and corrosive elements. All metals, except stainless steel, which are to be in contact with fresh concrete, mortar or plaster, shall have the contact surfaces protected with epoxy paint.

3) A schedule of all protective coatings and related items including the designation of area and/or specific locations, materials used, special instruction, specification data sheets, etc. should be furnished to Engineer-in-Charge.

15.21.9 Welding

1) All welding in aluminum work shall be done by the inert gas shielded arc or fluxless resistant techniques and with electrodes and/or by methods recommended by the suppliers of the metals being welded. Type, size and spacing of welds, shall be as shown on approved shop drawings.

2) Welds in galvanized metal shall be touched up with zinc rich paint.

3) Welds behind finished aluminum surfaces shall be so done as to eliminate distortion and/or discolouration on the finished side. When required, weld spatter and welding oxides on finished surfaces shall be removed by de-scaling and / or grinding. Low heat filled welds are to be provided using chill bar on finished side to eliminate dimpling, distortion and / or discolouration on the finished or exposed surface. Plug, puddle or spotwelding are not permitted. If weld beads are shown on exposed finished surfaces, the surfaces shall be ground and polished to match and blend with finish on adjacent parent metal.

4) Structural welds shall be made by certified welders and shall conform to the general recommendations and regulations of AWS Specification D1.0-46.

a) Dirt grease, lubricant, or other organic material shall be removed by vapour degreasing or suitable solvent.

b) Joints rejected because of welding defects may be repaired only by rewelding. Defective welds shall be removed by chipping or machining.

Flame cutting shall not be used.

5) Wherever welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.

6) All welds shall be scheduled and designated on the shop drawings so that anyone can witness and assess the assembled units to ensure that all welds conform to the designated type, size, spacing etc.

15.21.10 Soldering

All soldering and/or brazing shall be done as recommended by the suppliers of the metals involved.

15.21.11 Shop painting of Carbon Steel

Item of carbon steel, unless galvanised or scheduled for other finish, shall be thoroughly cleaned of all loose scale, filings, dirt and other foreign matter and shall be painted with zinc chromate primer.

15.21.12 Factory Application
As much work as possible shall be carried out in the factory. All glazing shall be done in the factory. Gaskets shall be pre-positioned and welded in the factory as far as possible. Site work shall be kept to a minimum.

15.22 GENERAL EXECUTION

15.22.1 The drawings supplied by the Consultant shall be considered essentially schematic, except of profiles of exposed surfaces which shall be as indicated. If, in the opinion of the contractor, a change of profile is required in order to meet the specifications, he shall consult the Consultant for a review of the conditions.

15.22.2 The method of assembling, reinforcing and anchorage of the aluminum structural cladding system, as indicated is schematic. Location and method of providing the same shall be the Contractor's responsibility, who shall design, assemble, reinforce and anchor to suit each specified condition in an acceptable manner complying with main building structure. Site work shall be coordinated with the overall programme.

15.22.3 All visible joints shall be as shown on the Consultant's drawings.

15.22.4 All parts shall be secured by concealed means and screws exposed to view shall not be allowed.

15.22.5 All components shall be assembled, secured, anchored, reinforced, sealed and made weather tight in a manner not restricting thermal or wind movement of the metal wall cladding /curtain walling system. Where possible, sealants shall be concealed.

15.22.6 Free and noiseless movement of all components of aluminum structural glazing and cladding system due to thermal, structural, wind pressure, or dead loads shall be achieved without strain to glass, without buckling of any components and without excessive stress to any members or assemblies.

15.22.7 The entire aluminum structural glazing and cladding system shall be assembled and installed so that all leakage and condensation shall be drained and discharged to the exterior face of the wall.

15.22.8 Movement of water behind and on exposed surfaces shall be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungus growth as a result of standing or trapping water.

15.22.9 Measurements:
The measurements given on Consultant's drawings shall not be used by the Contractor for preparing his shop drawings and for executing the work. All dimensions shall be actually measured at site and in case of any discrepancy between measurements on site and in drawings, modules shall be decided in consultation with the Consultant and Engineer-in-Charge.
15.23 PRE-CONSTRUCTION LABORATORY PERFORMANCE TESTING.

15.23.1 General
Specification 24.1 to 24.7 shall apply and the Contractor is required to carry out performance tests in laboratory condition at one of the approved test laboratories at his own cost. The performance mock-up are full-size representative portion of the proposed exterior wall system built to study construction details, test for the whole system meeting the performance specification for weather, structural load and movements.

The Contractor shall carry out on site water penetration test at locations as specified in clause 24.8 at his own cost. The contractor shall produce Mock-up Elevation, construction detail drawings etc. for the structural glazed curtain wall mock-up test units and submit to Engineer-in-Charge for the final approval. The Contractor shall forward the copies of approved mockup elevation and shop drawings and test parameters to the Test Laboratory prior to installation of the test units. These drawings shall include:

- Test elevation and sections showing bracket spanning.
- Full scale typical details of unitized panels (intersections of members).
- Typical support details and spanning.
- Extent & type of sealants: weather and structural sealants.
- Pressure equalization and Drainage system in each panel with size.
- Blanking off details and spandrel panel pressure release.
- Openable vent details with multipoint locking positions.
- Method of installation.

Any deviations from the drawings shall agreed upon before commencement and recorded in the final test report. Contractor shall install the mock-up in line with the approved drawings and with the same supervision and installation work force.

15.23.2 Test Units
1) The test units shall comprise of components and full size representative portion of the proposed exterior wall system under examination. The width of the test sample shall be not less than three typical elements / units. The height of the test sample shall be not less than 2 storey high and must contain full height modules of the proposed structural glazing system. Vertical and horizontal movement joints shall be included in the test sample.

2) Critical details of the building facade which differ from those in the representative test sample, such critical inward and outward building corners, overhangs, copping seal at roof level and similar, supplementary on site test for water tightness shall be performed on such part of the facade.

3) The materials and components of the test sample (glass thickness, size and strength, aluminum profiles, bracket spanning, sealant, gaskets, accessories etc.) shall be of the same, type and size and have the same details, methods of construction, flashing and anchorage as that of proposed on the building facade.

4) The cost of entire testing shall be borne by the Contractor.
5) The test sample shall be mounted and sealed into a simulated building frame in the manner and by
the same fixing which are intended to attach the facade to the building structure. The support frame if not
same but shall be of equivalent stiffness to that supporting the building to prevent unrealistic deflection of
the prototype sample.
6) Simulated floor slabs and spandrel shall be to actual depth as of site condition with the air seal
connected to the slab. The air seal of the test sample shall be continued to the air seal of the test
chamber.
7) All Unitized mock-up panels in the facade shall be sealed at the test chamber boundaries. This is to
minimize the effects that the surrounding construction will have on the test performance of the sample.
All pressure equalization and drainage slots or holes in the test sample shall be left open.
8) Transparent viewing panels shall be provided so that the performance of the façade in areas that are
not readily seen can be determined.

15.23.3 Inspection of test units
1) The Contractor shall allow for the Consultant’s / Employer’s representative to inspect the test sample
during erection. At this stage the adequacy and stiffness of the support structure shall be assessed.
When the installation of the test sample is complete, the Consultant’s / Engineer-in-charge
representative shall inspect the test sample and if satisfied, shall approve its completeness in writing.
2) Testing shall commence only after obtaining the written approval as referred above.
3) Full time supervision of the contractor shall be provided for the erection of the test
unit and all thru testing of the test units.

15.23.4 TEST SEQUENCE- TEST PRESSURES
Prior to testing operable windows and doors need to be unlocked, fully opened, closed in the mockup for
minimum of 5 cycles. If any repairs or corrections are made, the above cycle should be repeated for 5
times.
1) Air Infiltration Test (ASTM E-283)
Method :
The test shall be conducted at 300 Pa pressure.
The test chamber leakages shall be calculated by attaching air tight seal of polythene sheet to the face of
the curtain wall with the tape and seal all around and applying Positive, negative pressures of 300 Pa to
measure the air infiltration rate through the test apparatus by calibrated flow meter placed in the test
chamber air line. Now sealing film or tape shall be removed from the test sample and the total air
infiltration through the test sample and the chamber shall be recorded. The difference between the total
leakages and the chamber leakage shall be the leakage of test sample.
Evaluation : Permissible air leakage shall be: 0.25 m3/hr/m2 for fix area and 1.0 m3/hr/mtr crack length
of operable panel.
2) Test Water tightness (Static pressure)
Method:
The differential air pressure for the test shall be 600 Pa. Water shall be sprinkled on the test unit at 3.4 L/m2-Min. The air pressure differential need to be applied within 15 seconds - negative pressure of 600 Pa shall be maintained continuously for 15 minutes before the pressure is turned to zero and the water spray should be stopped.
Observation:
All water leakage and drainage system at the joints and ventilators of the Curtain Walling System shall be observed from the inside of the chamber.
Evaluation: If water observed in the operable vent drainage path and the same is drained through drain slots after the spray is stopped it shall be considered as pass. Any uncontrolled water in excess of 15 ml or more on the top surface of any exposed interior shall be considered as leakage. In case of leakage the remedy needs to be carried out and the retest shall be conducted.
3) Test of Water tightness (Dynamic pressure)
Method:
This test shall be performed upon completion of the test for water penetration by static pressure.
The Dynamic water penetration test should not commence within thirty (30) minutes of the static water penetration test. Maintaining the wind flow with the help of wind generating device, wind speed shall be adjusted to 31.28 m/sec, water shall be sprayed on the complete face of the test specimen at the rate of 3.4 Ltr/m2-Min. The spray shall be maintained for a period of not less than 15 min.
Observation:
Observation of the internal face of the facade shall be carried out during the water spray operation and for five (5) minutes after the water spray has stopped and there is zero air pressure difference on the facade. Any water appearing on the inside face of the facade shall be recorded, with the extent and, if possible, the source of leakage indicated.
Evaluation:
There shall be no leaks at the peak pressure equal to 600 Pa static positive pressure. A leak is considered to occur when:
a) Water appears on the inside face of the facade and is visible from an occupied space in excess of 15 ml of water or
b) Uncontrolled water appears on the inside face of the facade and is likely to damage insulation or other Architectural fixtures.
c) Uncontrolled water is defined as any leakage that is not contained and drained away within the test duration (including the five (5) minutes observation period) in excess of 15 ml of water.
4) Test of Wind Resistance under static pressure
Method:
The equivalent load for wind pressure or wind suction shall be given to the test unit as increasing and
decreasing the inside pressure of the “Pressure Chamber” at which the test unit is fixed. Static Wind
Pressure: The static pressure shall be increased to a maximum of +215 Kg/sq.m. in steps.
Observation: Deflection on each observational point of the test unit shall be observed and recorded
under the static pressure as described above.
Evaluation: No damage or harmful permanent deformation on any parts shall be found at the maximum
design wind pressure, as defined in item 24.4. The deflection of the main structural members in this
condition shall be as follows:
a) Mullions less than L/175 in case of single glass and L/240 in case of double glass (L = length between
support) or less than 15 mm whichever is less.
b) Transoms Less than L/300 (L = length between support) or less than 15 mm whichever is less. No
damage or harmful permanent deformation of any parts except sealing materials shall be found at the
maximum testing pressure. The maximum deflection/span ratio of glass shall not exceed 1:90. The
residual displacement of a member shall not exceed L/1000. The slippage at supports and fixing shall not
exceed 1.0 mm.

5) Seismic Racking test
Method: The floor beam shall be subjected to 3 cycles of Lateral Displacement up to the value of 0.4%
of floor height with no time restrictions. First the beam will be jacked To one direction to the maximum
limit of the Displacement and released to allow the system to come Back to its original position. The
beam is than jacked to other direction to the maximum limit and released. Like Wise 3 cycles are
repeated.
Observation:
The observation team is placed inside and outside The specimen is to be observed for any sudden
effects of Jacking.
Evaluation:
No glass breakage or fall out is allowed. Any damage shall be easily repairable without any part
replacements required. No wall component fallout is allowed.

6) Repeat Air test:
Same as described under air infiltration test with static pressure.

7) Repeat Water test static: Repeat the water penetration test under static pressure.

8) Proof test
Method: The test sample shall be subjected to proof tests. The applied positive and negative pressure
shall be 1.5 times the designed wind pressure. Each proof test pressure shall be maintained on the test
sample for a period of 10 seconds at peak pressure and released to zero.
Evaluation: Under proof test there shall be no collapse shall mean any one or any combination of the followings:

a) Dislodgment of any glass.
b) Dislodgment of any frame, panel or any thereof
c) Failure of any fixings that connect the façade to the building structure, such that the test sample is unstable.
d) Failure of any stop, locking device, fastener or support which would allow an opening light to come open.
e) The permanent deformation in framing members in excess of L/1000 is not permissible and considered as failure.

15.23.5 Form of Report
Details of the test sample (including an outline of the simulated building frame) and the test apparatus, instrumentation and method shall be clearly given in a report.
The report shall include the following:
a) An identification and general description of the facade and Certificate of Identity from the contractor.
b) Drawings of the actual test sample showing modifications, if any.
c) Test sequence with pressure used in all tests.
d) Location of all transducers for the structural performance test.
e) Displacements, span/deflection ratios and air infiltration rates.
f) Other pertinent observations.

15.23.6 Record Drawings
1) The testing laboratory shall keep a copy of approved test unit, shop drawings and calculations at testing laboratory accurately and neatly recorded on the above mentioned shop drawings with all changes, revisions, modifications, etc. made to test unit, which shall become the record drawings.
2) On completion of testing and after approval of test reports, the testing laboratory shall submit the marked up record drawings to the Project Consultant.

15.23.7 Cost of Performance Testing
The cost of testing at the approved lab shall be payable by the contractor as per relevant item as indicated in the Bill /Schedule of Quantities. Testing shall include for the test chamber, support structure for the test, cost of fabrication, erection, corrections to and the demolition of the test unit. If the test unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the test unit and shall have the Test unit re-tested by the Testing laboratory until it passes the test. The rate shall also include for cost of correction to the test unit and cost of re-testing and no additional cost shall be payable in this regard.
15.23.8 Site Tests
The Contractor shall carry out site tests at his own cost to determine resistance to water leakage as per recommendations given in AAMA 501.2-94 and relevant Bureau of Indian standards for “Field Check of Metal Storefronts, Curtain Walls and Sloped Glazing Systems for Water Leakage”. The test areas shall be selected by the Consultant, one for every 600 sq.m. approx. of installed curtain wall and glazing system. Testing will normally be ordered on Lower floors but the Consultant may at his discretion order tests to be carried out on any upper floor. In case of any test failing, the Consultant shall order more tests to be conducted at the Contractor’s cost.
Each test area shall be:
a) 10 sqm. minimum or
b) 25 m. Run of perimeter of vision and spandrel units
c) 4 entire panels of standard types, whichever is the least.

15.24 INSTALLATION
15.24.1 Qualification of workmanship
All work shall be performed by skilled workmen, especially trained and experienced in the applicable trades employed and in full conformity with applicable provisions of the listed References and Standards. The qualification of the Contractor’s installation workmen shall first be filled with and approved by the Consultant.

15.24.2 Setting out
Bench marks for elevations and building line offset marks for alignment shall be established on each floor level by the contractor. Should any error be found in their location, the Contractor shall notify the Consultant in writing and installation work shall not proceed in the affected area until the errors have been corrected.
The Contractor shall submit the structural glazing anchorage plan for endorsement by the Consultant. The Contractor shall co-ordinate his system of anchorage according to site conditions.

15.24.3 Prior Inspection of the Structure
After the setting out has been established and before beginning installation in any area, the Contractor shall examine all parts of the structure on which the curtain walling system/metal wall cladding are to be placed in that area. Should any conditions be found which, in his opinion, will prevent the proper execution of his work or endanger its permanency, he shall report such conditions in writing to the Consultant and Engineer-in-Charge. Installation work shall not proceed in that area until such conditions are corrected or adjusted to the satisfaction of the Consultant and Engineer-in-Charge.

15.24.4 Workmanship
All parts of the aluminum structural glazing and cladding system shall be erected true to plumb and in proper alignment and relation to established setting out, as shown on approved shop drawings.
15.24.5 Erection Tolerances
The installed metal wall cladding/curtain walling system components shall conform to the following erection tolerances under no-wind conditions:

a) Amount of total deviation and/or misalignment in any direction for vertical members:
   3 mm maximum in a height of 4 m (non-cumulative) and maximum 7 mm in full-height of cladding/curtain walling.

b) Amount of total deviation and/or misalignment in any direction for horizontal members: 3 mm max. in a length of 7 m. 5 mm in full length

c) Maximum offset from true alignment between two butting members shall be 1 mm. No edge projection or misalignment will be permitted.

d) Maximum joints, gaps or openings between removable glazing stop and adjacent member shall be 1 mm and/or a maximum 1 mm cumulative opening at both ends of removable members (0.5 mm each end).

e) Deviation in spacing of brackets + 3 mm.

f) Allowances for the cumulative effect of all tolerances (fabrication, assembly, thermal and erection) must be made to ensure a workmanlike installation. The documentation and distribution of this information to all applicable installation and inspection personnel is essential in order to ensure the standard of quality and workmanship required.

15.24.6 Installation within and/or adjacent to concrete: Where work is to be installed within and/or adjacent to concrete, no aluminum structural glazing and cladding system components other than built-in anchor devices shall be put in place until the concrete work is completed, including the removal of all forms, shoring, etc.

15.24.7 Anchorage: See clause 12.5 (2) and 20.9.

a) Anchorage of the aluminum structural glazing and cladding system to the structure shall be by approved methods and in strict accordance with approved shop drawings. After the aluminum structural glazing and cladding system are properly positioned, all connections so designated on approved shop drawings shall be rigidly fixed by welding or other positive means.

b) All anchorage assemblies and their related components shall be thoroughly scheduled and described on the shop drawings so that anyone can evaluate an installation and ensure its compliance with the contract documents. Descriptive items shall include the access removal movement and tolerances of related building and the aluminum structural glazing and cladding system, direction and magnitude of thermal expansion, materials, sizes, quantities and any special instruction as may be required. All primary aluminum structural glazing and cladding, anchorage assemblies inclusive of frame/structural mullion shall receive a 100% inspection.

15.24.8 Welding
All welding shall be done by skilled mechanics qualified or licensed in accordance with local building regulations. Welds and adjoining burnt area in prime coated surfaces shall be thoroughly cleaned and
painted with one coat of primer. Welds in galvanised steel shall be coated with one coat of zinc rich paint. Special care shall be taken to protect glass and other furnished surfaces from damage and to prevent causing fires.

15.24.9 Use of sealing materials

a) Sealing materials shall be used in strict accordance with the Manufacturer’s printed instructions and shall be applied only by workmen specially trained or experienced in their use. Before applying sealant, all mortar, dirt, dust, moisture and other foreign matter shall be completely removed from surfaces it will be in contact with. Adjoining surfaces shall be masked when required to maintain a clean and neat appearance. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

b) The manufacturer(s) of the applicable materials shall, when required render technical assistance prior to the application of any sealant and witness the first applications as well as periodic site inspections thereafter. The contractor shall witness and document all inspections performed by the sealant manufacturer and provide close supervision of all workmen used to apply the sealant.

15.24.10 Coping and soffit trimmer

Installation of coping and soffit panels and field sealing between the copings and other trades shall be performed by the Contractor.

15.24.11 Tensioning of Bolts

All bolts shall be correctly tensioned. The tension shall be specified on shop drawings. At least 10% of bolts shall be mechanically checked for corrected tension.

15.24.12 Sequence of Installation

If so directed by the Consultant or Engineer-in-Charge, installation of the aluminum structural glazing and cladding shall be postponed in areas as designated by the Consultant or Engineer-in-Charge for a specified period of time so as to facilitate moving materials/equipment into and out of the building and installation of M&E (Mechanical & Electrical) fittings during construction. The Contractor’s work is to proceed along guidelines and schedule as directed by the Engineer-in-Charge.

15.24.13 Removal of Debris

All debris caused by or incidental to the installation work shall be promptly removed from the job site as the work progresses. Weep holes and drainage channels shall be unobstructed and free of dirt, rubbish and sealant.

15.24.14 Protection and Cleaning

a) The Contractor shall adequately protect all aluminum sections, glazing, cladding sheets, components and accessories from damage during shipment, storage, erection and after completion of the work by use of protective film/foil of approved non-staining quality,

b) At such time as may be directed by the Consultant, the Contractor shall remove all protective coverings and/or coatings and clean surfaces free of all soil and discoloration. Only those cleaning agents that are acceptable to the applicable aluminum, glass and coating manufacturers shall be used and where doubt exists, spot tests shall be made to satisfy the Consultant and Engineer-in-Charge.
16.0 INTERIOR WORKS

16.1 GENERAL
This Specification is for work to be done, items to be supplied and materials to be used in the works as shown in the schedule of work and defined on the drawings and described herein, all under supervision and upto the satisfaction of the client. The specification given under is General Specifications and shall be applicable to relevant items specified in the tender schedule. In case of brought out items where the model number is mentioned the manufacturer’s specifications shall be valid.

The workmanship is to be the best available and of high standards in all aspects of the work.

The materials and items to be provided by the Contractor shall be approved by the client in accordance with any samples which will be submitted for approval by Contractor and generally in accordance with the Specifications. Also if products are specified in the Specification and/or bill of brand, trade name or catalogue reference, the Contractor will be required to obtain the approval of the client before using the materials. The Contractor shall produce all invoices, vouchers or receipts for any material if called upon to do so by the client.

Samples of all materials are to be submitted to the client for approval before the Contractor orders or deliver the materials at site. Samples together with their packing are to be provided free of charge by the Contractor and should any materials be rejected, they shall be removed from the site at the Contractor’s expense. All samples will be retained by the client for comparison with materials which will be delivered at the site. Also, the Contractor will be required to submit specimen finishes of colours, fabrics etc. for the approval of the client before proceeding with the work.

The contractor shall be responsible for providing and maintaining and boxing or other temporary coverage’s required for the protection of dresses or finished work. He is also required to clean out all shelving, out ends and other waste from all pairs of the works before coverings or in-fillings are constructed.

Templates, boxes and moulds shall be accurately set out and rigidly constructed so as to remain accurate during the time they are in use. All unexposed surface of timber e.g. false ceiling, backing fillets, backs of door frames, cupboard framing, grounds, etc. are to be treated with two coats of approved timber preservative before fixing or converging. Only first class workmanship will be accepted. Contractor shall maintain uniform quality and consistency in workmanship throughout.

16.2 JOINERY
16. 2.1 Joinery is to be prepared immediately after the placing and framing, and then subsequently bonded and wedged up. Any portions that are warped or found with other defects are to be replaced before wedging up. The whole of the work is to be framed and finished in a manner in accordance with
the detailed drawings and whenever required, fitted with all necessary metal ties, straps, belts, screws, glue etc. Running beaded joints are to be cross tongued with teak tongues. Joinery work is generally to be finished with fine sand/glass paper.

16.2.2 JOINTS
All joints shall be standard mortise and tenon, dowel, dovetail, and cross halved. Nailed or glued butt joints will not be permitted. Where there are screws on a finished surface, the same will be sunk and the whole assembly being plugged with wood plug of the same wood and grain of the finished surface and the hole filled with wood filler to match the colour.

In event of joints opening in joiner's work open, or other defects arising, such defective joinery shall be taken down, and refilled, redecorated and/or replaced if necessary and any work disturbed shall be made good at the Contractor's expense. Nails, spikes and bolts shall be of lengths and weights approved by the client. Nails shall comply with IS 1959-1960. Brass headed nails are to comply with B.S.1210. Wire staples shall comply with B.S.1494 or equivalent.
The contact surface of dowels, tendons, wedges etc., shall be glued with an approved adhesive. Where joinery and carpentry works are likely to come into contact with moisture, the glue shall be of waterproof grade.

16.3 HARDWARE AND METALS
The hardware throughout shall be of approved manufacture or supplier; should be well made and equal in every respect to the samples to be deposited with the client. The Contractor may be required to produce and provide samples from many different sources before the client takes decision.
Fittings generally shall be brass polished & lacquered, unless otherwise specified and shall be suitable for their intended purpose. In any case, it will have to be approved by client before the Contractor procures it at site of work.

Screws are to match the finish of the article to be fixed, and to be round or flat headed or counter sunk as required. The contractor should cover up and protect the brass and bronze surfaces with thick grease or other suitable productive material, renew as necessary and subsequently clean off the same on completion.
Aluminium and stainless steel shall be of approved manufacture and suitable for its particular application. Generally the surface of aluminium shall have an anodized finish and both shall comply with the samples approved by the client. All stainless steel sheets shall be 304 SS Japan or equivalent with gauge as specified but not thinner than 16 G.
All steel, brass, bronze, aluminium and stainless steel articles shall be subjected to a reasonable test for strength, if so, required by the client at the Contractor's expense. All brazing and welds are to be executed in a clean and smooth manner rubbed down and left in the flattest and tidiest way, particularly
where exposed. Chromium plating shall be in accordance with I.S. Standard or as per approved specification for normal outdoor conditions and shall be on a base material of copper or brass.

16.4 GLAZIER

All glass to be of approved manufacturer complying with I.S. 3548-1966 as per approved quality and sample to be of the selective qualities specified and free from bubbles, smoke, air holes and other defects. Polished plate glass shall be "glazing glass" (G.G.) conforming to IS 3438-1965 or as per approved sample and quality. The compound for glazing to metal is to be a special non hardening compound manufactured for the purpose and of a brand and quality approved by the client.

While cutting glass, proper allowance shall be made for expansion. Each square of glazing should be in one whole sheet. On completion of work clean all glass should be cleaned inside and out, all cracked, scratched and broken panes to be replaced.

16.5 PAINTS & POLISHES

All material required for the works shall be of specified and approved manufacturer, delivered to the site in the manufacturer's containers with the seals etc., unbroken and clearly marked with the manufacturer's name or trade mark with a description of the contents and colour. All materials are to be stored on the site of the work.

Spray painting with approved machines will be permitted only if written approval has been obtained from the client prior to painting. The buzzle and pressure to be so operated as to give an even coating throughout to the satisfaction of the client. The paint used for spraying is to comply generally with the specification concerned and is to be specially prepared by the manufacturer for spraying. Thinning of paint made for brushing will not be allowed.

Impregnating wood preservative shall be Bison or equivalent and approved impregnating wood preservative and all concealed wood work shall be treated with wood preservative. All brushes, tools, pots, kettles etc. used in carrying out the work shall be clean and free from foreign matter and are to be thoroughly cleaned out before being used for a different type of class of materials.

All iron or steel surfaces shall be thoroughly scraped and rubbed with wire brushes and shall be entirely free from rust, mill scale etc. before applying the priming coat. Surfaces of new wood work which to be painted are to be rubbed down, cleaned, up to the satisfaction of the client.

Surfaces of previously painted woodwork are to be cleaned down with soap and water, detergent solution or approved solvent to remove dirt, grease etc. While wet, the surfaces shall be flattened down with a suitable abrasive and then rinsed down and allowed to dry. Minor areas of defective paint shall be removed by scraping back to a firm edge and the exposed surface touched in with primer as described and stopped with putty.

16.6 POLISH

16.6.1 FRENCH POLISH

The basic material shall be shellac dissolved in methylated spirit.
Preparation:- The timber must be sanded and cleaned and the grain filled with a grain filler. Any staining must be done before applying the polish.

Equipment :- The polishing shall consist of a pad of cotton wool, which acts as a reservoir for the polish, and a cover of soft white linen or cotton fabric, similar to a well-worn handkerchief which acts as a fitter, the rubber must never be dipped into the polish; it should be changed by pouring the polish on to the pad with the cover removed.

Application:- Work evenly over the surface until the timber is coated with a thin layer of polish. The objective is to apply a series of thin coats, allowing only a few minutes for drying between the coats. When a level and even-boiled surface is obtained the work is ready for the second stage i.e. spiriting off. Allow the work to stand for at least eight hours then take a fresh rubber with a double thickness of cover material and charge it with methylated spirit. Work in the direction of the grain and continue until the surface is free from smears and rubber marks then leave to harden off.

16.6.2 WAX POLISH

Preparation:- Wax polish shall contain silicones and driers. A good silicon wax is to be used. The timber shall be sealed first with another finish such as Ronseal, before applying the wax.

Application:- Apply a light coat of the sealer by brush or cloth direct to the unfilled timber, working it well and finishing evenly with the grain. Allow to dry thoroughly and then sand lightly with fine abrasive paper. Apply a heavy coat of wax by cloth or on flat surfaces, with a stiff brush. Work it well into timber and finish off by stroking with the grain before leaving to harden. Leave for several hours before rubbing up with a soft brush. Finally; buff the grain with a soft cloth. Transparent Colored Polyurethane (Melamine) shall be applied where natural grain of the wood is required. Polyurethane produces as tough surface which resist chipping, scratching and boiling water.

Clean off all grease and wax with an abrasive and white spirit. This should not be applied in humid conditions. Apply the first coat, preferably of clear hard glaze with a cloth pad. Leave this to dry for at least six hours, and then apply further coats with a paint brush. If you wait for longer than 24 hours between coats, rub down the previous coat with fine glass paper or a medium grade of steel wool. Obtain a Matt finish, if required by giving a final coat of clear Ronseal Matt coat.

16.7 TIMBER

Only seasoned New Burma Teak Wood or Sal Wood to be used. All the wood shall be properly seasoned, natural growth and shall be free from worm holes, loose or dead knots or other defects, saw die square and shall not suffer warping, ting or other defects. The moisture content shall not exceed 12%

All internal frame work shall be treated with approved wood preservative. All wood brought to site should be clean and shall not have any preservative. All rejected decayed, bad quality wood shall be immediately removed from site. All wood brought to site must be stacked-stored properly as per instructions.
16.8 PLYWOOD

Plywood/medium density fiber board/teak particle board/ Veneered board etc., as specified in the approved list of manufacturers shall only be used. Only Fire retardant type exterior grade Phenol formaldehyde bonded, hot pressed ply generally conforming to I.S.I. 5509 of approved make only to be used. Marine plywood shall generally conform to I.S. 710-1980 and also to Defense/ Navy specification bonded, with phenol formaldehyde, treated with wood preservative.

16.9 CARPENTRY WORK

Providing and fixing in position Wood frame work for partitions up to true ceiling height, panelling, boxing, soffit with vertical members at not more than 600 mm centres and horizontal members not more than 600 mm centres complete including necessary additional supports, bracing runner etc. complete as per drawing and directions. Items are to be completed in all respects as per drawings & instructions from client. Rate to include applying of approved wood preservative on the finished frame work.

16.10 PANELLING / BOXING

The item of work consists of providing and fixing in position 12mm thick Fire-Retardant Plywood and to be completed in all respects as per drawing / instructions of EIC. The actual executed area is to be measured. The item also includes providing and fixing 8mm thick Glass in partition of approved make, of appropriate size as per drawings and design with necessary wooden mouldings / biddings to hold the glass in position. All exposed wooden surfaces has to be finished with 2/3 coats of melamine polish.

IMPORTANT NOTE: Actual executed area will be measured on one side of partition. Rate of this item shall include cost of providing fixing wooden facia, if any, matching laminate in approved pattern, skirting, Cornice Moulding at both door level and false ceiling level, Top Cap moulding in case of Low Height Partition etc. as per details and finished in melamine polish of wooden and veneered surfaces for which no extra payment shall be made but shall be measured along with the partition dimensions. The finishing material shall be fixed in required divisions/ panels/ pattern with proper grooves etc. as per drawings & directions. Item are to be completed in all respects as per drawings & instructions from Consultant.

17.0 LANDSCAPING & HORTICULTURE WORKS

17.1 SCOPE

The landscape contractor shall from the date of commencement of contract, furnish all materials, labor, and related items necessary to complete the work indicated and specified herein.

The scope of work for the above mentioned work shall include the following and shall be carried out as per BOQ, Specification & Landscaping Layout drawings.

The landscape contractor will be generally responsible for the entire site but in particular to works listed below. Along with site management, the responsibilities will include landscaping works and arboriculture works and maintaining the same.

After planting, all planted areas that have exposed soil will have to be mulched with straw or hay. Mulching will be evenly spread to cover any exposed soil.
In addition, the contractor will also be responsible for filling gaps, thinning and transplanting, or replanting where plants may need to be replaced. Along with other planting, the contractor will also be responsible for improving soil conditions for planting. This may include import/export of sand/soil to/from site. The contractor will also clear vacant area from existing grasses, keep the site clean and maintain the already planted areas free of weeds, pests or insects that cause diseases. All weeds, unwanted grasses and plant material will be cleared up to 1000mm from the edge of planting of newly created and already existing horticultural works (such as boundary trees). The contractor will also be responsible for protection of the plants from salt spray that may occur during the monsoons.

17.2 STORAGE SHED
No storage area will be provided at site by the Employer. As mentioned in General Conditions of Contract, security of materials at site will be the responsibility of the contractor. Any temporary sheds or structures may be built as working space at the area shown at site and on the approval of the Site Engineer.

17.3 WATERING
Water will be made available at only one source at site. If the water on site is insufficient or saline or unacceptable, then the contractor shall be responsible for importing water in water tankers for the general upkeep of the plants. No plants shall be allowed to wither or die due to lack of proper watering.

17.4 PLANT REQUIREMENTS
Plants and shrubs shall be sourced by the contractor from available nurseries, unless otherwise specified. Seeds shall be acquired from reputed organizations and hybrid seeds will be used where possible – particularly for flower varieties. No plant material shall be changed without the consent of the Consultant.

17.5 RESPONSIBILITY
a) The contractor’s work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. Any damage by the landscape contractor’s team to such utilities will be penalized and contractor shall be responsible for cost for such damages.

b) The contractor shall abide by the Security rules / procedures of the Employer, and shall obtain gate pass, issue I.D. badges to all their employees on site, etc. as prescribed by the Employer.

17.6 MATERIALS & LABOUR
All the materials which are required for the progress of the Landscaping works shall be supplied by the contractor. The required numbers of Labour are to be provided by the contractor.

17.7 PLANTING
Whenever planting, the following specifications will be followed by the contractor. Wherever sand is to be removed, the following specifications shall be followed after refilling the area with good soil.

17.7.1 DIGGING OF PITS
Tree pits of 600mm x 600 mm x 600 mm (approx. 2’x2’x2’) shall be dug a minimum of two weeks prior to back filling. The pits for shrubs shall be 600 mm in depth and 300mm diameter. For ground cover, the land will be prepared by digging up to 300 mm (1’) and soil loosened. While digging the pits the top soil may be kept aside, and mixed with the rest of the soil as specified.

If the soil quality is poor, it shall be replaced with soil mixture acceptable to the Consultant. If the soil quality is satisfactory, then it shall be mixed with manure and river sand. The soil condition will have to be approved by the Consultant. Pest/termite prevention chemicals or any other approved chemical to be applied into the soil before planting as per supplier’s specification. When planting is in more than one row, then pits will be dug in a zig-zag fashion ensuring a diagonal planting in each row.
17.7.2 PLANTING MIXTURE:
The topsoil will be mixed with 15% farm yard manure or coco-peat, 40% red soil, 20% river sand and 20%
excavated earth (topsoil). This mixture will be filled in pits before and after planting.

17.7.3 BACK FILLING:
The soil is back filled, watered thoroughly and gently pressed down a day previous to planting, to make
sure that it may not further settle down after planting.

17.7.4 PLANTING:
No tree pits shall be dug until a final tree position has been pegged out for approval. Care shall be taken
that the plant sapling when planted is not buried beyond the level of the pot containing it. Planting should
not be carried out in waterlogged soil.

17.7.5 STAKING:
If necessary, a single vertical stake 1 meter (approx. 3 ft) longer than the clear stem of the plant, driven
300 mm to 450 mm (approx.1ft to 1'6") into the soil shall be used. Each plant should be secured to the
stake so as to prevent excess movement.

17.7.6 WATERING:
The landscape contractor shall allow for the adequate watering of all newly planted trees, shrubs and
groundcover immediately after planting and during the following growing season, shall keep the plant
material well watered.

17.7.7 MULCHING:
All planted areas including around trees which have open soil that is exposed will have to be mulched
with straw or hay. Rates indicated in the Bill of Quantities shall include such mulching costs. No separate
compensation will be paid for mulching.

17.7.8 PROTECTION:
The contractor will be responsible and should take measures to protect the planted saplings from cattle,
salt spray and high wind pressure. Rates indicated in the Bill of Quantities shall include such costs of
protecting the plants including any physical construction such as walls, tree guards, etc. that may be
required for the same.

17.8 LAWN

17.8.1 PREPARATION:
During period prior to planting the lawn, the area shall be maintained free from weeds, whatever the
nature of soil, complete surface shall be trenched over to a depth of 300 – 450 mm. Grading and final
levelling of the lawn shall be completed at least 2 weeks prior to the actual sowing.

17.8.2 SOIL
The soil itself shall be ensured to the satisfaction of Consultant to be a good fibrous loam, rich in humus.
Pest/termite prevention chemicals to be mixed if required. Top soil shall be mixed with farm yard manure
or coco-peat and mixed with river sand in ratio of 15% manure, 25% river sand, 35% red soil and 25%
excavated earth and leveled to maintain positive drainage or specified slopes.

17.8.3 EXECUTION
Nodes of specified grass shall be dibbled not more than 50mm apart on above mentioned soil conditions.
Wherever specified, carpet lawn will used. The carpets will be laid next to each other in an even pattern
to ensure that all lawn area is covered. After laying of carpet, it should be lightly pressed into the ground
to ensure that it is does not shift, and to ascertain that the roots are in soil. Positive slopes will be
maintained to ensure that there will be no low lying areas in center where water logging or pools are
created.
17.8.4 MAINTENANCE
In the absence of rain, lawn shall be watered daily - heavily, soaking the soil thoroughly to a depth of at least 150 mm.

17.8.5 CUTTING
The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine.

17.8.6 EDGINGS
These shall be kept neat and must be cut regularly with the edging shears.

17.8.7 FERTILIZING
The lawn shall be fed once a month with liquid fertilizer by dissolving 45 gms of Ammonium Sulphate in 5 litres of water.

17.8.8 WEEDING
Prior to regular mowing, the contractor shall carefully remove unsightly weeds.

17.9 MAINTENANCE
Tenderer shall have to carry out annual maintenance for a period of 1 (one) year during 'Defects Liability period' Maintenance of all items as per BOQ should be for a period of 1 (One) year .

17.10 MEASUREMENT
The measurement for payment to the contractor will be item wise as mentioned in the schedule of works.

18.0 PAVER BLOCKS FOR PATHWAY
The compressive strength requirement of concrete paver block shall be minimum 47.2 MPa (N/sqmm) for 28 days (Testing as per IS-15658) after applying the correction factor as per IS-15658:2006. Testing certificate is to be submitted by the agency.

18.1. Paver Block Dimensions

<table>
<thead>
<tr>
<th>Thickness</th>
<th>80mm/60mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td>Regular (Uniform shape with no Hollow or Cracks)</td>
</tr>
<tr>
<td>Chamfer</td>
<td>5 mm to 7 mm along top edges</td>
</tr>
<tr>
<td>Thickness of Wearing Layer</td>
<td>Minimum 6 mm (The thickness of the wearing surface shall be measured at several points along the periphery of paver blocks. The arithmetic mean of the lowest two values shall be the minimum thickness of the wearing layer)</td>
</tr>
<tr>
<td>Colour</td>
<td>Natural cement Grey colour without use of any pigment OR colour as specified</td>
</tr>
<tr>
<td>Dimensional Tolerance</td>
<td>Tolerances as per IS-15658:2006</td>
</tr>
</tbody>
</table>

Note: All other visual/physical & dimensional acceptance on parameters like aspect ratio, squareness etc to be as per IS-15658:2006
18.2. Testing of Paver Blocks
i) FOR 80MM PAVER TILES

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>TEST</th>
<th>SPECIFICATION Average Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28 day Compressive Strength</td>
<td>Minimum 47.2 MPa (N/Sqmm) (for 80mm)</td>
</tr>
<tr>
<td>2</td>
<td>Abrasion Resistance</td>
<td>Maximum 2 mm [i.e. 10 units of 1000 mm3 per 5000 mm2 reported as per E-5 of Annex E of IS-15658:2000]</td>
</tr>
<tr>
<td>3</td>
<td>Water Absorption</td>
<td>Avg. of 3 units - Maximum 6% by mass (restricted to 7% in individual test units)</td>
</tr>
</tbody>
</table>

ii) FOR 60MM GRASS PAVER TILES

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>TEST</th>
<th>SPECIFICATION Average Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28 day Compressive Strength</td>
<td>Minimum 37.1 MPa (N/Sqmm) (restricted to 31.5 MPa in individual test units)</td>
</tr>
<tr>
<td>2</td>
<td>Abrasion Resistance</td>
<td>Maximum 3 mm [i.e. 15 units of 1000 mm3 per 5000 mm2 reported as per E-5 of Annex E of IS-15658:2000]</td>
</tr>
<tr>
<td>3</td>
<td>Water Absorption</td>
<td>Avg. of 3 units - Maximum 6% by mass (restricted to 7% in individual test units)</td>
</tr>
</tbody>
</table>

Sampling and Testing Procedure strictly As Per IS – 15658; 2006.

18.3. Laying of Paver Blocks

18.3.1 PRIMING
The contractor is required to verify the existing WBM driveway surface and ascertain the CBR value. Accordingly the total subgrade thickness required for achieving the desired CBR value shall be advised to NKDA within seven days of receipt of call-up. NKDA shall, through regular agencies arrange to carry out such WBM, wherever required. Before taking over the site, the contractor is required to verify the stabilization of the surface with CBR values. It will be the responsibility of the contractor to ensure that the Manholes / Pipeline / Cable trenches / circular drainage system etc. is raised to driveway level using the requisite materials as per instruction of EIC. The areas of potholes / deep depressions at the isolated locations shall be filled up and properly compacted before laying the paver blocks. No extra payment will be made for this purpose. The area of raised manholes shall be included in the measurement of overall area of paver blocks for the purpose of payment.

18.3.2 BEDDING SAND COURSE
The bedding sand shall consist of naturally occurring, clean, well graded sand passing through 4.75mm sieve and suitable to concrete manufacture. The bedding should be from either a single source or blended to achieve the following grading:

<table>
<thead>
<tr>
<th>IS SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.52mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75mm</td>
<td>95-100</td>
</tr>
<tr>
<td>2.36mm</td>
<td>80-100</td>
</tr>
<tr>
<td>1.18mm</td>
<td>50-100</td>
</tr>
</tbody>
</table>
Contractor shall be responsible to ensure that single-sized, gap-graded sands or sands containing an excessive amount of fines or plastic fines are not used. The sand particles should preferably be sharp, not rounded. The sand used for bedding shall be free of any deleterious soluble salts or other contaminants likely to cause efflorescence. The sand shall be of uniform moisture content, which shall be within 4% - 8%, at the time of spreading and shall be protected against rain when stockpiled prior to spreading. Saturated sand shall not be used. The bedding sand shall be spread loose in a uniform layer as per drawing. The compacted uniform thickness shall be as specified in the schedule and within 5mm. Thickness variation shall not be used to correct irregularities in the base course surface. The spread sand shall be carefully maintained in a loose dry condition and protected against pre-compaction both prior to and following spreading. Any pre-compacted sand left overnight shall be loosened before further laying of paver blocks takes place. Sand shall be slightly spread in a loose condition to the predetermined depth only slightly ahead of the laying of the paver block. Any depressions in the spread sand exceeding 5mm shall be loosened, raked and re-spread before laying of paver block.

18.3.3 LAYING OF INTERLOCKING PAVER BLOCK:

Paver block shall be laid in pattern as specified in drawing throughout the pavement. Once the laying pattern has been established, it shall continue without interruption over the entire pavement surface. Cutting of blocks, the use of infill concrete or discontinuities in laying pattern is not to be permitted in other than approved locations. Paving units shall be placed on the uncompacted sand bed to the nominated laying pattern and care shall be taken to maintain the specified bond throughout the job. The first row shall be located next to an edge restraint. Specially manufactured edge paving units are permitted or edge units may be cut using a power saw, a mechanical or hydraulic guillotine, bolster or other approved cutting machine. No haphazardly broken pavers shall be used. Paver block shall be placed with the help of spacers to achieve gaps nominally 2 to 3mm wide between adjacent paving joints. No joint shall be less than 2mm nor more than 4mm. **However it is mandatory to use 3.0mm wide spacer while laying paver tiles so as to ensure uniform 3.0mm gap between adjacent pavers.**

Frequent use of string lines shall be used to check alignment. In this regard, the “laying face” shall be checked at least every two metre as the face proceeds. Should the face become out of alignment, it must be corrected prior to initial compaction and before further laying job is proceeded with. In each row, all full units shall be laid first. Closure units shall be cut and fitted subsequently. Such closure units shall consist of not less than 25% of a full unit. To fill spaces between 25mm and 50mm wide, concrete having minimum 1:1:2 cement : sand : coarse aggregate mix and a strength of 40 N/Sqmm shall be used. Within such mix the nominal aggregate size shall not exceed one third the smallest dimension of the infill space. For smaller spaces dry packed mortar shall be used.
Except where it is necessary to correct any minor variation occurring in the laying bond, the paver block shall not be hammered into position. Where adjustment of position is necessary.

18.3.4 INITIAL COMPACTION
After laying the paver block, they shall be compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than two (2) passes of a suitable plate compactor. The compactor shall be a high-frequency, low amplitude mechanical flat plate vibrator having plate area sufficient to cover a minimum of twelve paving units. Prior to compaction all debris shall be removed from the surface. Compaction shall proceed as closely as possible following laying and prior to any traffic. Compaction shall not, however, be attempted within one meter of the laying face. Compaction shall continue until lipping has been eliminated between adjoining units. Joints shall then be filled and recompacted as described in Clause 6.5

All work further than one meter from the laying face shall be left fully compacted at the completion of each day’s laying. Any blocks that are structurally damaged prior to or during compaction shall be immediately removed and replaced. Sufficient plate compactors shall be available at the paving site for both bedding compaction and joint filling.

18.3.5 JOINT FILLING AND FINAL COMPACTION
As soon as practical after compaction and in any case prior to the termination of work on that day and prior to the acceptance of any traffic, sand for joint filling shall be spread over the pavement. Joint sand shall pass a 2.36mm (No. 8) sieve and shall be free of soluble salts or contaminants likely to cause efflorescence. The same shall comply with the following grading limits:

<table>
<thead>
<tr>
<th>IS SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.36mm</td>
<td>100</td>
</tr>
<tr>
<td>1.8mm</td>
<td>90-100</td>
</tr>
<tr>
<td>600mm</td>
<td>60-90</td>
</tr>
<tr>
<td>300 microns</td>
<td>30-60</td>
</tr>
<tr>
<td>150 microns</td>
<td>15-30</td>
</tr>
<tr>
<td>75 microns</td>
<td>10-20</td>
</tr>
</tbody>
</table>

The Contractor shall supply a sample of the jointing sand to be used in the contract prior to delivering any such material to site for incorporation into the works. Certificates of test results issued by a recognised testing laboratory confirming that the sand sample conforms to the requirements of this specification shall be submitted prior to supply of total volume required. The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the jointing sand shall be compacted with not less than one (1) pass of the plate vibrator and joints refilled with sand to full depth. This procedure shall be repeated until all joints are completely filled with sand. No traffic shall be permitted to use the pavement until all joints have been completely filled with sand and compacted. Both the sand and paver block shall be dry when sand is spread and broomed into the joints to prevent premature setting of the sand.
The difference in level (lipping) between adjacent units shall not exceed 3mm with not more than 1% in any 3m X 3m area exceeding 2mm. Pavement portions which are deformed beyond above limits after final compaction, shall be taken out and relaid to the satisfaction of the Engineer in charge.

18.3.6 EDGE RESTRAINT USING KERB BLOCK

Edge restraints shall be done using the kerb blocks. They should be fixed properly to withstand overriding by the anticipated traffic, thermal expansion and to prevent loss of the laying course material from beneath the surface course. The edge restraint should present a vertical face down to the level of the underside of the laying course. The surface course should not be vibrated until the edge restraint, together with any bedding or concrete haunching, has gained sufficient strength. It is essential that edge restraints are adequately secured.

18.3.7 UNIFORM INTERLOCKING SPACES

The pavers should have uniform interlocking space of 2mm to 3mm to ensure compacted sand filling after vibration on the paver surface.

18.3.8 SKILLED LABOUR

Skilled labour should be employed for laying blocks to ensure line and level of pavers, desired shape of the surface and adequate compaction of the sand in the joints. The laying pattern should follow the drawings provided by employer.

Executive Engineer-I
New Town Kolkata Development Authority
<table>
<thead>
<tr>
<th>SI No.</th>
<th>Material</th>
<th>Approved supplier &amp; Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CEMENT</td>
<td>ULTRATECH/AMBUJA/ACC/LAFARGE</td>
</tr>
<tr>
<td>2</td>
<td>STEEL/REINFORCEMENT</td>
<td>TATA/SAIL/TISCO/ SRMB/ELEGANT</td>
</tr>
<tr>
<td>3</td>
<td>VITRIFIED TILES</td>
<td>SOMANY/KAJARIA PLUS</td>
</tr>
<tr>
<td>4</td>
<td>CERAMIC TILES</td>
<td>SOMANY/KAJARIA /JHONSON</td>
</tr>
<tr>
<td>5</td>
<td>CEMENT CONCRETE TILES</td>
<td>ULTRA / EUROCON</td>
</tr>
<tr>
<td>6</td>
<td>WATER PROOFING COMPOUND</td>
<td>SIKÁ / PLASTOCRETE / CICO SUPAPLAST</td>
</tr>
<tr>
<td>7</td>
<td>GLASS</td>
<td>MODIFLOAT/SAINTOBAIN /PILKINGTON</td>
</tr>
<tr>
<td>8</td>
<td>PLASTER OF PARIS / PUTTY</td>
<td>BIRLA/JK</td>
</tr>
<tr>
<td>9</td>
<td>ALUMINIUM SECTIONS</td>
<td>JINDAL/INDAL/ BECO</td>
</tr>
<tr>
<td>10</td>
<td>FALSE CEILING</td>
<td>ARMSTRONG/EVEREST</td>
</tr>
<tr>
<td>11</td>
<td>ADHESIVE</td>
<td>FEVICOL/PIDILITE</td>
</tr>
<tr>
<td>12</td>
<td>BLINDS</td>
<td>VISTA LEVLR/MAC</td>
</tr>
<tr>
<td>13</td>
<td>FLUSH DOOR</td>
<td>GREEN/ CENTURY</td>
</tr>
<tr>
<td>14</td>
<td>BLOCK BOARD &amp; PLYWOOD</td>
<td>GREEN/ CENTURY</td>
</tr>
<tr>
<td>15</td>
<td>LAMINATES &amp; VENEER</td>
<td>GREEN/ CENTURY</td>
</tr>
<tr>
<td>16</td>
<td>LOCKS</td>
<td>GODREJ</td>
</tr>
<tr>
<td>17</td>
<td>HARDWARES</td>
<td>EARLBIHARI/DORMA/HAFELLE/GEZE</td>
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<tr>
<td>18</td>
<td>CEMENT CONCRETE PIPES</td>
<td>INDIAN HUME PIPE/MM METAL &amp; CO</td>
</tr>
<tr>
<td>19</td>
<td>DOOR CLOSER</td>
<td>DORMA/HAFELLE/HARDWYN</td>
</tr>
<tr>
<td>20</td>
<td>PVC DOOR</td>
<td>SIINTEX / DURO PLAST</td>
</tr>
<tr>
<td>21</td>
<td>ALUMINIUM WINDOW</td>
<td>WINTEK/FENESTA</td>
</tr>
<tr>
<td>22</td>
<td>STEEL SECTION</td>
<td>TATA/JINDAL/SAIL</td>
</tr>
<tr>
<td>23</td>
<td>ACP CLADDING</td>
<td>ALSTONE/ALUDECOR/ALSTRONG</td>
</tr>
<tr>
<td>24</td>
<td>PAVER BLOCK</td>
<td>TUFFSTONE</td>
</tr>
<tr>
<td>25</td>
<td>GALVANİUM SHEET</td>
<td>G.E PLASTICS / TATA BLUESCOPE</td>
</tr>
<tr>
<td>26</td>
<td>WALL PAPER</td>
<td>MARSHALL</td>
</tr>
<tr>
<td>27</td>
<td>PVC DRAIN CELL</td>
<td>DUPOINT</td>
</tr>
<tr>
<td>28</td>
<td>STAINLESS STEEL HANdRAIL</td>
<td>KITCH / SHYAM STEEL / NEKI INDIA</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Brand/Manufacturer</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------</td>
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</tr>
<tr>
<td>29</td>
<td>TOILET MODULAR PARTITION</td>
<td>BESCO MERINO</td>
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<tr>
<td>30</td>
<td>FLOOR CARPET</td>
<td>SHAW CARPET / AHUJA CARPET / SKIPPER</td>
</tr>
<tr>
<td>31</td>
<td>POLYCARBONATE SHEET</td>
<td>GE lexan /TATA Bluescope</td>
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<tr>
<td>32</td>
<td>MODULAR FURNITURE</td>
<td>GODREJ / PHOENIX MACHINE</td>
</tr>
<tr>
<td>33</td>
<td>ANCHOR FASTENER, DUCT SEAL</td>
<td>HILTI</td>
</tr>
<tr>
<td>34</td>
<td>FIRE RATED DOOR</td>
<td>KHEMKAA TIMBER / S &amp; T ENTERPRISE / PROMATE</td>
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<tr>
<td>35</td>
<td>RUST REMOVING AGENT</td>
<td>SIKA RUST OFF</td>
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<tr>
<td>36</td>
<td>BONDING AGENT</td>
<td>SIKA HIGH BOND / CICO BOND EPO</td>
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<tr>
<td>37</td>
<td>PARTICLE BOARD</td>
<td>CENTURY / ALISHAN</td>
</tr>
<tr>
<td>38</td>
<td>EPOXY GROUT FOR FILLING TILE JOINT</td>
<td>SIKA TILOGROUT / LATAPOXY SP-100</td>
</tr>
<tr>
<td>39</td>
<td>ACOUSTIC PANELS &amp; BOARD</td>
<td>AMSTRONG / ANUTONE</td>
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<tr>
<td>40</td>
<td>MEDIUM DENSITY FIBRE BOARD</td>
<td>CENTURY / NU WOOD</td>
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<tr>
<td>41</td>
<td>PAINT (SYNTHETIC ENAMEL)</td>
<td>DULUX GLOSS / LUXOL/ SUPERLAC HIGH GLOSS/ APCOLITE</td>
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<td>42</td>
<td>INTERIOR ACRYLIC EMULSION LUXERY</td>
<td>ICI VELVET TOUCH/ BERGER SILK/ ROYAL LUXURY EMULSION</td>
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<tr>
<td>43</td>
<td>EXTERIOR ACRYLIC EMULSION 100% Acrylic</td>
<td>WEATHER SHILD MAX / APEX ULTIMA</td>
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<tr>
<td>44</td>
<td>EPDM</td>
<td>AMEE Rubber industries Pvt. Ltd, Bohra Rubber</td>
</tr>
<tr>
<td>45</td>
<td>FIBRE GLASS WOOL</td>
<td>U.P. Twiga Fibreglass Limited, Lloyd Industries (India) Ltd.</td>
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<tr>
<td>46</td>
<td>ROCK WOOL</td>
<td>Vetrotex Industries India Private Limited. Lloyd Insulations (India) Limited</td>
</tr>
<tr>
<td>47</td>
<td>SILICON SEALANT</td>
<td>Dow Corning, GE</td>
</tr>
</tbody>
</table>

Executive Engineer-I
New Town Kolkata Development Authority
# SECTION –C

## SPECIFICATION WATER SUPPLY, SANITARY AND DRAINAGE SYSTEM

### I. GENERAL:

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practice given below as amended up to the date of submission of Tender. All equipment and material being supplied shall meet the requirements of BIS and other relevant standard and codes.

### Plumbing Works:

<table>
<thead>
<tr>
<th>Item</th>
<th>IS Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitreous Chinaware</td>
<td>IS: 2556 - 1974 (Part - I)</td>
</tr>
<tr>
<td></td>
<td>IS: 2556 - 1981 (Part - II)</td>
</tr>
<tr>
<td></td>
<td>IS: 2556 - 2556 (Part - III)</td>
</tr>
<tr>
<td>Ball Valve</td>
<td>IS: 1703 - 1977</td>
</tr>
<tr>
<td>Cistern Brackets</td>
<td>IS: 775 - 1970</td>
</tr>
<tr>
<td>Toilet Seat Cover</td>
<td>IS: 2548 - 1983</td>
</tr>
<tr>
<td>Vitreous China Cistern</td>
<td>IS: 2326 - 1987</td>
</tr>
<tr>
<td>Sand Cast Iron Pipes and Fittings</td>
<td>IS: 1729 - 1979</td>
</tr>
<tr>
<td>Spun Cast Iron Pipes and Fittings</td>
<td>IS: 3989 - 1984</td>
</tr>
<tr>
<td>GI Pipes</td>
<td>IS: 1239 - 1979</td>
</tr>
<tr>
<td>Galvanizing for GI Pipes</td>
<td>IS: 4736 - 1986</td>
</tr>
<tr>
<td>Pipe Threads</td>
<td>IS: 554 - 1985</td>
</tr>
<tr>
<td>Malleable Iron Fittings</td>
<td>IS: 1879 - 1987</td>
</tr>
<tr>
<td>Cast Iron Sluice Valves</td>
<td>IS: 780 - 1984</td>
</tr>
<tr>
<td>Full Way Valves</td>
<td>IS: 778 - 1984</td>
</tr>
<tr>
<td>Brass Ferrule</td>
<td>IS: 2692 - 1978</td>
</tr>
<tr>
<td>Stone Ware Gully Trap</td>
<td>IS: 651 - 1980</td>
</tr>
<tr>
<td>RCC Pipes</td>
<td>IS: 458 - 1971</td>
</tr>
<tr>
<td>Cast Iron Class LA Pipes</td>
<td>IS: 1536 - 1989</td>
</tr>
</tbody>
</table>
Cast (Spun) Iron Fittings - IS: 1538 - 1976
Pig Lead - IS: 782 - 1966
Induction Motors - IS: 4691
Code for Measurements - IS: 1200
UPVC Pipes and Fittings - IS: 13592 & IS 15328; Fittings -IS-14735
Specification for Caulking Lead - IS: 782
Code of Practice for laying of concrete - IS: 783

1. The Contractor shall arrange with local Municipal Authorities for getting the water and Sewerage connections. The actual connection charges to be paid to the local bodies shall be borne by the Contractors.

2. No payment will be made to the Contractor for submission of plans to the statutory authorities / Local bodies etc. and obtaining sanction of the same. The rates quoted by the Contractor shall be considered and deemed to have been inclusive of all these charges that might have been incurred by the Contractor.

3. The rates are of complete items as fixed in position and over all costs- e.g. cutting of holes, chases, etc., and also for provision of fixing arrangement viz., clamps, brackets, wooden blocks, priming, painting etc. the rates shall also include restoration to original condition of all damages to walls, floors etc., during the process of fixing sanitary installations, water supply and drainage. All debris of plumbers excavation, etc., shall be removed without any extra charge. The plumbing work/or the building work effected by the plumber work shall be left thoroughly cleaned to the satisfaction of NKDA.

4. Unless specified, all material should conform to ISI specification and be of best quality and make as approved by the E.I.C. Testing shall be undertaken for various materials samples, pipe lines etc. and as may be directed by the E.I.C. at the risk & cost of the Contractor.

5. All G.I pipes (except concealed pipes and underground pipes) and brackets and fixtures and manhole covers shall be painted with 2 coats of synthetic enamel paints of approved brand over a coat of Red-oxide Primer/Red lead primer, as directed.

6. All concealed and underground G.I pipes and specials shall be painted with 2 coats of Bituminous paint of approved brand as directed by the E.I.C.

7. All priming and painting work shall be carried out to the satisfaction of the E.I.C. and cost thereof shall be covered in the rates of all the respective items.
8. The Plumbers shall obtain the drainage completion certificate and the certificate of adequate water supply from the Local statutory body / Municipality and shall abide by the rules and regulations prescribed by them or other authorities concerned, wherever necessary.

9. In case of concealed G.I pipe work, the chases in floors and walls shall be made as approved by E.I.C. The pipes shall be secured tightly to the walls with clamps. The chases shall be filled with cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate of 20mm nominal size). Payment shall be made for cutting chases and filling in the cement concrete and making them good as per relative item in the Bill of quantity for renewal items as per State P.W.D. specifications.

10. The cast iron pipes shall be laid exposed on wall with M.S. holder butt clamps made from 32mm thick. M.S. flats of approved design and required size. A clear minimum gap of 25mm between the wall and the pipe shall be left. All the clamps shall be embedded in cement concrete blocks sized 20cm x 20 x 10 cms. in 1:2:4 mix (1 cement :2 coarse sand : 4 graded stone aggregate - 20mm. nominal size). The holes in walls and RCC work shall be made at point approved by E.I.C, and shall be made by the Contractors. Payment shall be made as per relative item in the Bill of Quantity complying with State P.W.D. specifications.

11. All plumbing and sanitary fixtures, pipes and pipe fittings, traps etc., which are to be embedded into the concrete or masonry work or other building work shall be placed in position and embedded for concealed at the time of casting of concrete during the work of construction. In case where chasing or cutting of concrete, masonry, or other structural or constructional work is unavoidable, the location of such fittings, pipe lines and traps etc., shall be chalked out at the various places and the cutting, chasing or disturbing of the construction work shall be proceeded only after the due approval of E.I.C.

12. All cuttings, chasing and fixing work shall be completed before commencement of any plastering, tiling or finishing work. Any rectification required shall be done at the risk & cost of the Contractor to the entire satisfaction of E.I.C.

13. Galvanized iron pipes of “TATA” or equivalent make, of “Medium” quality, E.R.W. as per IS – 1239, P-I; and Pipe Fittings shall be of “Heavy” quality, as per IS – 1239, P-II, of Galvanized Malleable Cast Iron, with Material code conforming to IS-1879 of “HB”, or “NB”, “Zoloto”, Leader, “JSI” or equivalent Brand. Test certificates from the manufacturer shall be submitted by the Contractors. Over & above the submission of test certificates, E.I.C. may also ask to the Contractor for further testing of samples in Govt. laboratories/test houses at the risk & cost of the Contractor.

14. **Samples:**

In all cases, samples of the materials proposed to be used shall be submitted for approval of the NKDA, before taking up the work in hand and the samples shall be well preserved at site by Contractor at his own risk & cost.
15. **Materials, Workmanship & Samples:**

All the materials and workmanship are to be of the best possible description and to the entire satisfaction of NKDA and the Contractors shall immediately remove from the site any materials and/or workmanship which, in the opinion of NKDA, is defective or unsuitable and shall substitute proper materials and/or workmanship forthwith at Contractor’s risk & cost.

16. The Contractors shall, if required by the E.I.C., arrange to test material and/or portions of the works at his own cost in order to prove their soundness and efficiency, physical & chemical properties from Govt. laboratories/test houses. If after any such test, the work or portion of works is found in the opinion of the E.I.C., to be defective or unsound, the Contractor shall pull down and re-execute the same at his own cost. Defective materials shall be removed from the site within 7 days from receipt of such order at his risk & cost. No extra claim whatsoever shall be entertained by the E.I.C.

17. Wherever reference has been made to Indian Standard or CPWD specifications or any other specifications, the same shall mean to refer to the latest specifications irrespective of any particular edition of such specifications being mentioned in the specifications or schedule of quantities. **In case of any dispute, the decision of the E.I.C. shall be final & binding on the Contractor.**

18. The rates quoted shall be for all heights and depths.

19. **Bidders should note that the quantities in the Bill of quantities are approximate and are subject to variation upto any extent.**

20. This Technical specification shall be read in conjunction with other part/specification of the contract, viz. GCC etc.

21. The E.I.C. shall have the right to modify/change the working drawing even after issue to the Contractor.

**II. MATERIALS:**

**General:**

a) All materials shall be of best of their kind and shall conform to the latest Indian Standard specifications.

b) A set of specification samples of all approved materials shall be kept well preserved at site, cost of which is to be borne by the Contractor.

**1.0 SANITARY WARES:**

All sanitary wares and fittings shall be of first class quality white vitreous China as manufactured by **Hardware**, or Parryware or Cera or equivalent brand approved by E.I.C. prior to the procurement by the Contractor.
Stainless steel sinks and draining board shall be of best quality stainless steel of “Imagine” SS Sink from “Hindware”/ “Nirali” /“Parryware”/, or “Hafele” with sample and brand approved by the E.I.C. prior to the procurement by the Contractor.

2.0 SOIL & WASTE PIPE & fittings:

All soil pipes shall be of Spun pipe of standard make. The thickness and specification shall conform to Indian Standard specifications IS: 3989-1984.

Pipes and fittings shall be true to shape smooth cylindrical, their inner and outer surfaces being as nearly as practicable concentric.

Pipe when tested for soundness by striking with a light hand- hammer shall emit a clear ringing sound. The pipes shall be free from cracks, laps, pinholes or other imperfection and shall be neatly dressed and carefully felted.

The fittings shall be of easy clean type. The access door fittings shall be designed so as to avoid dead spaces in which filth may accumulate. Door shall be provided with (3mm) rubber insertion packing and when closed and bolted, these shall be water tight.

Pipes and fittings shall be supplied without ears. Each pipe fittings shall have the trade mark of the Manufacturer and nominal size suitably marked on it.

M.S. stays and clamps shall be made from minimum 1.6mm thick M.S. flat of minimum 30mm width bent to the required shape and size to fit tightly on the socket, when tightened with screw bolts. Lead to be used for the jointing of the pipes shall be refined lead of best quality.

Floor traps shall be of approved make, ‘P’ type with minimum of 2” (50mm) water seal. At the top of each of these Floor Traps there shall be provided with 5” dia. (125mm) CP brass circular Grating of approved make.

Approval of Sample of specified brand / make shall be done by the E.I.C. prior to procurement by the Contractor. E.I.C. at its discretion may ask the Contractor for sample testing through Govt. test house / laboratories at the risk and cost of the Contractor.

2.1 Lead Caulked Joints:

The annular space between the socket and spigot will be first well packed in with spun yarn leaving 25 mm.(1") from the lip of the socket for lead. the joint may be leaded by using proper leading rings or if they are not available, by wrapping a ring of hemp rope covered with clay round the pipe. The lead shall be rendered thoroughly fluid and each joint filled in one pouring. Before caulking, the projecting lead shall be removed by flat chiesel and the joint caulked round with proper caulking tools and a hammer of 1 to 1.1/2 kg (2 to 3 pounds) in weight in such a manner so as to make the joint sound. After being well set, the joint is to be flush, neat and even the sockets. The specifications etc., shall comply to the relevant IS & West Bengal P.W.D. specifications.

The approximate depth and weight of pig lead for various diameters of C.I pipes and specials shall be as given below (as a guide-line):
LEAD FOR DIFFERENT SIZES OF PIPES

<table>
<thead>
<tr>
<th>Nominal Size of Pipe (mm)</th>
<th>Lead/Joint (Kg.)</th>
<th>Depth of lead Joint (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>1.8</td>
<td>45</td>
</tr>
<tr>
<td>100</td>
<td>2.2</td>
<td>45</td>
</tr>
<tr>
<td>125</td>
<td>2.6</td>
<td>45</td>
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<tr>
<td>150</td>
<td>3.4</td>
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<td>250</td>
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<td>300</td>
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<td>19.0</td>
<td>60</td>
</tr>
<tr>
<td>700</td>
<td>22.0</td>
<td>60</td>
</tr>
<tr>
<td>750</td>
<td>25.0</td>
<td>60</td>
</tr>
</tbody>
</table>

Note:

The quantity of lead given in the table are provisional and a variation of 20 percent is permissible, at the discretion of the E.I.C.

The approximate depth and weight of pig lead for various diameters of C.I. pipes and specials shall be as per relevant IS & West Bengal P.W.D. specifications.

2.2 Smoke Testing:

All CI Sewer & Waste pipes and fittings including joints will be tested by a smoke test and left in working order after completion. The smoke test shall be carried out as stated under. No extra payment will be made for the tests. Smoke shall be pumped into the brains at the lowest end from a smoke machine which consists of a blow and burner. The materials usually burnt are greasy cotton waste which form clear pungent smoke which is easily detectable by sight as well as smell if leaking at any point of drain. The Contractor will have to rectify all defects traced in such tests at his own expense to the complete satisfaction of the E.I.C. The test along with all equipments and accessories shall be carried out at the risk & cost of the Contractor at Site, in presence of E.I.C. or his representative complying to the relevant IS & West Bengal P.W.D. specifications.

2.3 Testing of Materials and works:

As and when required by the E.I.C. the Contractor shall arrange to test materials and/or portions of works at his own cost to prove their soundness and efficiency. if after tests, any materials, work or any portions of work are considered defective or unsound by the E.I.C., the Contractor shall remove the same from the site forthwith at his own risk & cost. No extra claim
for this or for any rectification / modification shall be entertained by the E.I.C. All testing shall be guided by relevant IS & West Bengal P.W.D. specifications at the risk & cost of the Contractor.

3.0 G.I PIPES AND FITTINGS:

All pipes shall be of galvanized iron “Medium” quality (as per IS-1239, P-I) of “TATA” make unless otherwise specified or separately / specifically approved / allowed by NKDA. All fittings shall be of ‘HB’, ‘NB’, ‘Zoloto’, ‘Leader’, ‘JSI’ brand or other equivalent make bearing ISI certification mark. The pipes shall be seamless screwed of socketted conforming to the requirement of IS : 1239-1985. These shall be of the diameter (nominal bore) specified. The pipes and sockets shall be cleanly finished, well galvanized in and other defects. All screw threads shall be clean and well cut. the ends shall be cut cleanly and square with the axis of the tube. Sample tests for physical & chemical properties may be asked for by the E.I.C. at the risk & cost of the Contractor from Govt. laboratories / Test houses over & above submission of Manufacturer’s Test certificates.

4.0 (FULL WAY) GATE VALVES:

These shall be of Bronze / Gun metal (PN-10) or (PN-16) quality of “ZOLOTO” “SANT” or ‘SBM’, ‘Leader’ conforming to the relevant IS specifications and tested to 21 kg. per sq. cm. for 2 minutes. Necessary Test certificates shall be submitted by the Contractor with warranty from the manufacturer as asked for by the E.I.C.

5.0 C.P. TOILET FITTINGS:

5.1 C.P. Brass Bib Cocks, Two-way Bib Taps, Stop cocks, Angle Stop cocks, Pillar cocks:

These shall be of Chromium plated Brass ‘heavy’ quality, threaded to BSPT (F) of ‘Marc’ / ‘Jaquar’, /’Hardware’ /’Essco’ makes (as per the B.O.Q) conforming to IS specification as per IS-8931. Sample approval shall be taken by the Contractor from the E.I.C. prior to procurement in bulk quantities with samples well preserved at Site at the risk & cost of the Contractor.

5.2 C.P. Brass Pillar Cock -(with Control Box) : [for Wash Basins]

This shall be of ‘Marc’ / ‘Jaquar’, /’Hardware’ /’Essco’ model with wall mounted Control Box below the Wash Basins, threaded to BSPT (F) and conforming to IS-8931. Sample approval shall be taken by the Contractor from the E.I.C. prior to procurement with samples well preserved at Site at the risk & cost of the Contractor.

5.3 Health Faucets:

This shall be of ‘Marc’ / ‘Jaquar’, “Allied” model, /”Hardware” to be fitted with the Two-way Bib Taps inside each W.C.s (except Driver’s Toil), threaded to BSPT (F) and conforming to IS-8931. Sample approval shall be taken by the Contractor from E.I.C. prior to procurement with samples well preserved at Site at the risk & cost of the Contractor.
6.0 BALL FLOAT VALVE:

The Ball Float valves shall be of Brass body of high pressure or of Pressure as specified. The Ball valve shall be of brass and the float of PVC of high pressure withstanding capacity. The minimum gauge of PVC Ball Float, the body of the ball valve shall be capable of withstanding a pressure of 200 lbs. per sq.m.(14 kg. per sq.m.). the ball valve shall conform to IS specification No. 3708-1962. Necessary test certificates with warranty shall be submitted from manufacturers by the Contractor to the E.I.C. when asked for.

7.0 DOMESTIC WATER FEED PUMPS TO TOILETS/KITCHEN/TERRACE TANK FROM RAIN HARVESTING TANK/UNDERGROUND DOMESTIC WATER TANK-AT BASEMENT:

<table>
<thead>
<tr>
<th>(A) WATER FEED PUMP from Rain Harvesting tank to Gardening use &amp; Toilet Flushing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Supply, Carriage, Installation &amp; Commissioning)</strong></td>
</tr>
<tr>
<td>It shall be of Hydro-pneumatic type Pumps in a single Skid with (2-working + 1-standby) for transfer of water from Rain Harvested Water Tank to directly to individual Toilets for Flushing &amp; for Gardening Points etc, with an extra provision to connect with the terrace Domestic tank to store the water suitable to suit the water quality required for Flushing &amp; Gardening use (as per IS-10500).</td>
</tr>
<tr>
<td>(Pumps should be with C.I. Impeller, integrally coupled with 3 – phase 2900 R.P.M., 415 Volts, A.C. Motor, capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, including Pump Control Panel with &quot;Auto&quot; Start / Stop 3nos. &quot;Indfoss' make Pressure switch with each sets of Pump and one set of Pressure Gauge connected with a Ball Valve of 15mm dia to the Delivery Header. .</td>
</tr>
<tr>
<td>Pump of Maximum capacity – <strong>333.0 LPM</strong> (i.e., 20 cum/hr.) @ <strong>50.0 M</strong> head with maximum <strong>4.4 KW</strong> (Working), 6.6 KW (Total Connected) - Motor input, 3 phase integrally coupled Motor, including Pump Control Panel, 100 Ltrs. capacity Air charged Diaphragm Tank (Pressure Vessel), Mounting Base, Baseframe, Pressure Switches, Panel to Pump Cabling, etc, including all necessary accessories.</td>
</tr>
<tr>
<td>(To be located near the Rain Harvested Water Tank in a Pump room)</td>
</tr>
<tr>
<td>Make = &quot;GRUNDFOS&quot;, Model :- 'MPC F 4 CR 10-6', &quot;Willo&quot; / &quot;SAMLSON&quot;).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(B) DRINKING &amp; HAND-WASH WATER FEED PUMP from u/g Domestic Water Reservoir to different Toilets Wash Basins &amp; Ablution Taps, Kitchen Sinks, Drinking Water Units.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Supply, Carriage, Installation &amp; Commissioning)</strong></td>
</tr>
<tr>
<td>It shall be of Hydro-pneumatic type Pumps in a single Skid with (3-working + 1-standby) for transfer of water from the U/G Domestic Water Reservoir to directly to individual Toilets &amp; Kitchen for Handwash &amp; Drinking use etc, with an extra provision to connect with the terrace Domestic tank to store the water suitable to suit the water quality required Drinking use (as per IS-10500).</td>
</tr>
</tbody>
</table>
Pumps should be with C.I. Impeller, integrally coupled with 3 – phase 2900 R.P.M., 415 Volts, A.C. Motor, capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, including Pump Control Panel with "Auto" Start / Stop 3nos. 'Indfoss' make Pressure switch with each sets of Pump and one set of Pressure Gauge connected with a Ball Valve of 15mm dia to the Delivery Header, also including with one 100 Ltrs. capacity Air charged Diaphragm tank.

Pump of Maximum capacity – **500.0 LPM** (i.e., 30 cum/hr.) @ **50.0 M** head with maximum **6.6 KW** (Working), 8.8 KW (Total Connected) - Motor input, 3 phase integrally coupled Motor, including Pump Control Panel, 100 Ltrs. capacity Air charged Diaphragm Tank (Pressure Vessel), Mounting Base, Base frame, Pressure Switches, Panel to Pump Cabling, etc, including all necessary accessories.

(To be located inside the Pump room of near the near the Basement Domestic Water Reservoir)

Make = "GRUNDFOS", Model : 'MPC F 4 CR 10-6', /"Willo" / "SAMLSON")

(Necessary test certificates with “warranty” from manufacturers as asked for by the E.I.C. shall have to be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of E.I.C. or his representative.

(Necessary test certificates with “warranty” from manufacturers as asked for by the E.I.C. shall have to be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of the E.I.C. or his representative.

(C) BASEMENT DE-WATERING PUMPS:

Basement "De-watering Pump" shall be of Vertical Pump integrally coupled with motor, with matching Motor Control Panel of Mono-set fully submersible Vertical mounting type reservoir pumps for transfer of logged water from Basement to the adjacent outside building Yard Gully Chamber / Storm water Manhole.

Pump should be with CI 'Mixed Flow' / 'Radial Flow' type Impellers, integrally coupled with submersible type 3 – phase 2900 RPM 415volts, AC motor capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, but excluding pump control panel.

Pump of capacity – approximate - 200.0 LPM @ 8.0 M to 10.0 M head with **KW (HP)** Motor input, 3 phase integrally coupled "Submersible" type Motor.

(To be located inside the BASEMENT)

[1-working + 1-Standy]

Make = MBH, / "SEHRA"- Polder Pump / "DARLING" / "JALRANI").
8.0 **GLOBE VALVE:**

<table>
<thead>
<tr>
<th>Bronze / Gun-metal Globe valve, rising / non-rising Spindle type (IS-778), screwed in Bonnet, provision of repacking under pressure, Teflon Gland packing, Class-I, with ‘OPEN’ / ‘SHUT’ indicator and locking device, and also with C.I. Wheel of approved quality (screwed end)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Make :: Zoloto, code- 1033 / &quot;Sant&quot; /&quot;SBM&quot; / “Leader”)</td>
</tr>
</tbody>
</table>

It shall be of Bronze body **Globe Valve** with C.I. Wheel, screwed-in Bonnet, rising Spindle, Lubricated Gland Packing, conforming to IS-778, class-I, Bronze Disc & Disc nut, Brass Stem, with Asbestos Gland packing, and valve of approved quality (screwed end- female threaded). Necessary test certificates with warranty from manufacturers as asked for by the E.I.C. shall be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of E.I.C. or his representative.

9.0 **PRESSURE REDUCING VALVE :** (At Inlet Main to every individual toilets and Kitchen / Canteen – except the Top floor)

It shall be of 50mm and 32mm nominal diameter of **Rubber Diaphragm type Pressure Reducing Valve** of Bronze Body / Bottom Cover & Lock-nut (as per IS- 318 LTB 2), Spring loaded, screwed (female) end as per B.S.-21 class with reduced Set pressure range (Up-stream - to - Down-stream) of 3.5 Kg. / sq. cm. - to - 1.0 Kg. / sq. cm., with C.I. Camber & Bonnet, Seat Ring & Stem of S.S. (AISI 410), Bolt/nut & Tommy Bar of M.S., C.I. Spring Disc & Carbon Steel Spring, & EPDM Diaphragm, C.A.F. Gaskets (IS- 2732, Gr.-C), and the Valve with a Test Pressure (Hydraulic) of 35 Kg. / sq. cm. & with S.S. Screw / bolts / washers etc., and also with Teflon Thread Seal etc., all complete.

(Make - ZOLOTO- Product Catalogue no.-1040)

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

10.0 **NON-RETURN VALVE (N.R.V.) :**

Bronze body "VERTICAL -LIFT" type Non-Return ("Check") valve with S.S. (AISI-410) body Seat Ring, two-piece design, S.S.(AISI-410) Disc, Screwed to BSPT-female (BS-21), with necessary 'Teflon' Thread Seal, including accessories.

(Make - ZOLOTO- Product Catalogue no.-1045 / Leader)

(At Submersible Raw water Supply Pump Discharge pipe at the U/G Reservoir).

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.
11.0 GATE VALVE (BRONZE BODY) :-

It shall be of 40mm nominal diameter of Gate Valve of Bronze Body, hand wheel operated, screwed (female) end as per B.S.-21 class with Non-Rising Spindle, Screwed in Bonnet, and Lubricated Gland packing, & with a provision of re-packing, Valve conforming to IS-778, Class-I, outer body with Bronze conforming to IS-318 LT B 2, Bonnet, Stuffing Box & Gland of Bronze/ forged Brass conforming to IS-318 LT B 2 / or IS-6912 FLB, Brass Stem, Bronze or Brass Gland nut, with C.I. Hand wheel conforming to IS-210 Gr.- FG 200, & with S.S. Screw / bolts / washers etc., and Valve Test pressure of 1.0 M Pa, and also with Teflon Thread Seal etc., all complete. (Make - ZOLOTO- Product Catalogue no.-1035 / Leader)

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

12.0 NON-RETURN VALVE (N.R.V) : C.I. BODY :-
(At Hydro-pneumatic Pump Discharge pipe)

| These should be of C.I. Body, Check valve, Horizontal “Lift” – type with PN – 10 rating, with M.S. “Slip-on” type matching Flanges, along with CAF gaskets and appropriate M.S. Bolts, nuts, plain round Washers etc, all complete |
| (Make: - "Zoloto", code- 1067) |

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

13.0 AIR-RELEASE VALVE : BRONZE/GUN METAL BODY: -
(At Water Supply Line top to different Blocks & to Kitchen pipe Riser top)

| It shall be of Bronze / Gun metal body “Parallel Slide” – “Blow-off”valve with BS-10 Table-H / E Flanged ends, sliding action Discs, spring loaded, rack-pinion arrangement., S.S Discs, Body Seat Ring of S.S., Granite Asbestos packing, M.S. Key, with Hyd. Test pressure of 500 p.s.i.g, with adjustable ‘OPEN’ / ‘SHUT’ arragt. of approved quality (Flanged end) |
| (Make: - “Zoloto”, code- 1052) |

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C.. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

14.0 “BLOW-OFF” VALVE : BRONZE / GUN METAL BODY :-
(At Water Supply delivery Main Line Hydro-pneumatic system for blow-off due Extra pressure in Main back to the U/G treated tank)

| It shall be of Bronze / Gun metal body “Parallel Slide” – “Blow-off” valve with BS-10 Table-H / E Flanged ends, sliding action Discs, spring loaded, rack-pinion arragt., S.S Discs, Body Seat Ring of S.S., Grahite Asbestos packing, M.S. Key, with Hyd. Test pressure of 500 p.s.i.g, with adjustable ‘OPEN’ / ‘SHUT’ arragt. of approved quality (Flanged end) |

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Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C.. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

15.0 DRAINAGE- STONE WARE PIPES :

All pipes shall be of best salt glazed variety conforming to IS specification. The pipes shall be free from visible defects such as fire cracks or hair cracks. The glaze of the pipe shall be free from blisters. The pipes shall conform to IS: 651-1965.

16.0 SANITARY INSTALLATION :

Sample approved shall be done prior to bringing in bulk quantities at site by the Contractor.

16.1 The W.C. Pans shall be of white Vitreous China Wall mounted Pattern with C.I. Chair Bracket of fitted with ‘P’ or ‘S’ trap (with a conversion bend) of vitreous China with effective 2” seal and 2” vent as per IS : 771-1963 & IS: 2556 (Part II & VII), 1967.

16.2 Fixing:

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with water proofing compound and made leak proof.

16.3 Flushing by PVC ‘Low Level’ Cistern : (manually)

The flushing of W.C. pan shall be done by “Hind ware” / Parryware / Cera make, PVC ‘Low Level’ Cistern- manually operated. with push lever.

16.4 Brackets : (for Wall mounted W.C.- fixing)

The fixing bracket of Wall mounted W.C.’s should be of C.I. ‘Chair‘ Brackets to remain fully concealed & embedded in wall and partially in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanized fixing Bolts, Nuts, and Washers etc, to the satisfaction of the Engineer- in charge.

16.5 Flush Pipe :

The outlet of flush pipe from the cistern shall be of 32 mm rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the Inlet port of the ‘Wall hung’ W.C.’s, and that shall be connected with the W.C. pan by means of an approved type of joint.
16.6 **Seat & Lid:**

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard ‘Hind ware’ or ‘Parryware’ makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

17.0 **URINALS:**

The urinal basin shall be flat back of white vitreous China of specified size. It shall be fixed in position by using wooden plugs and screws at a height such that the outside bottom of Urinal Basin remains at 600 mm. from the finished floor level. The Urinal Basin shall be of “Flat-back-Large” type. Standard height of the Urinal Basins shall be as per the respective Manufacturer’s standard. At least 200mm is to be given for fixing the “Jaquar” Sensor Installation Box from the top of the urinal (where the CP Spreader inlet Hole). Each urinal shall have 32 mm. dia. CP Bottle Trap with connected CP Waste Pipes, CP Waste Couplings etc, (as per the drawings).

17.1 **Waste Pipes-concealed & Traps:**

Each concealed Waste pipes (in proper slope) from the Urinals shall have 32 mm. dia. Rigid PVC (ASTM D 1785, schdl.-40) and this shall be further connected to 40 mm. lead of PVC waste pipe conforming to ASTM D 1785, complete with G.I. unions, elbows, tees (equal or unequal) (as per IS-1879) of approved make as specified in the schedule of quantities, including wiped plumber joint complete with unions shall be terminated upto the mouth of respective extension pieces of the 100mm dia C.I. ‘P’ traps (below floor finish).

The main and distribution pipes fittings and clamps shall be of C.P brass unless otherwise specified in the schedule of quantities, distribution pipes shall feed the urinals with C.P. brass spreaders of approved make.

17.2 **Painting:**

In case of cast iron flushing cisterns, painting shall be done as specified in the Bill of quantity.

18.0 **KITCHEN SINK:**

The above item shall be of **Salem Stainless Steel Kitchen Sink - (AISI-304, conforming to IS-13983), Single Bowl**, built with superior steel, with **Bowl size not less than- 560 x 410mm and with Bowl depth of 205mm to 215mm; and total overall size - 1145 x 510mm, or of approved size, with or without provision of a Drain-board,** also including with 40mm Salem Stainless Steel Unique Waste Coupler and Coupler knob with C.I. / MS fixing Brackets, and C.P. screws/washers etc.

(Make - 'Hind ware' - / Parryware / Hefele / Nirali)

18.1 **Fittings:**

Each Sink shall have single pillar tap (Sink Cock with swinging lever of “Jaquar”, model-Clarion). It’s a special tap for the type of the sink specified and other fittings as specified, of
‘Jaquar’/ ‘Essco’ make 40 mm C.P. brass waste (CP). C.P. brass angle valve with inlet connection of C.P. brass chain and rubber plug.

18.2 Waste Connection:

Waste pipe shall be of 1.1/2” (32 mm.) rigid P.V.C. (concealed) pipe of approved make (as per ASTM D 1785), complete with unions. This shall discharge into a Floor trap.

18.3 Fitting:

Sinks shall be provided with 1/2” (15 mm C.P. brass valve) mixing fitting of ‘Jaquar’, or ‘ESSCO’ make complete with swinging spout.

18.4 Waste Connection:

The waste pipe shall be of PVC 1.1/2” (32 mm.) dia. As per ASTM D 1785, discharging upto the Floor trap. The rates shall include the cost of all materials and labour involved in all the operations described above.

19.0 TOILET REQUISITES:

Approval of Sample of specified brand/make shall have to be done by the Contractor prior to procurement.

19.1 Mirror:

Mirrors shall be of 6.0 mm. thick plate glass ‘Saint Gobain’ or ‘Modi-guard’ or “Ashai” make or approved equivalent make. The glass shall be uniformly silver plated at the back. Silvering shall have a uniform protective coating of red lead paint. The mirror shall have Plastic moulded frame of approved quality and colour. The mirror and its 6mm thick hard backing shall be fixed on the wall face to wooden cleats with C.P. brass screws and washers.

Toilet paper holder shall be of Chromium plated as specified in the schedule of quantities of “Jaquar” – Continental or "ESSCO".

19.2 CP Robe Hooks (with double/ single Forks):

Theses should be of CP Robe Hooks with double / or single forks, of “Hind ware” / “Jaquar”- Continental supported on anodized chromium plated Base, fixed with 40mm long screws, rawl plugs etc., all complete.

20.0 WATER CLOSETS:

Samples shall have to be got approval from E.I.C. prior to procurement at site by the Contractor.
20.1 European type water Closets (EWC): “Floor mounted type”.
(Hind ware / Parryware)

The W.C. Pans shall be of white Vitreous China Wall mounted Pattern with C.I. Chair Bracket of fitted with ‘P’ or ‘S’ trap (with a conversion bend) of vitreous China with effective 2” seal and 2” vent as per IS : 771-1963 & IS:2556 (Part II & VII), 1967.

20.2 Fixing:

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with waterproofing compound and made leak proof.

21.0 FLUSHING BY PVC FLUSHING CISTERN: (MANUALLY)

21.1 Brackets: (for Wall mounted W.C.- fixing)

The fixing bracket of Wall mounted W.C.’s should be of C.I. ‘Chair’ Brackets to remain fully concealed & embedded in wall and partially in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanized fixing Bolts, Nuts, and Washers etc, to the satisfaction of the E.I.C.

21.2 Flush Pipe:

The outlet of flush pipe from the cistern shall be of 32 mm rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the Inlet port of the ‘Wall hung’ W.C.’s, and that shall be connected with the W.C. pan by means of an approved type of joint.

21.3 Seat & Lid:

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard ‘Hind ware’ or ‘Parryware’ makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

The W.C. Pans shall be of white Vitreous China Wall mounted Pattern with C.I. Chair Bracket of fitted with ‘P’ or ‘S’ trap (with a conversion bend) of vitreous China with effective 2” seal and 2” vent as per IS : 771-1963 & IS:2556.

21.4 Fixing:

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the....
concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with water proofing compound and made leak proof.

21.5 **Flushing by Flush valve : (manually)**

The flushing of W.C. pan shall be done by “Jaquar” make, CP Flush valve with 32mm dia CP Control cock (Wall mounted), with push lever.

21.6 **Brackets : (for Wall mounted W.C.- fixing)**

The fixing bracket of Wall mounted W.C.’s should be of C.I. ‘Chair’ Brackets to remain fully concealed & embedded in wall and partially in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanized fixing Bolts, Nuts, and Washers etc, to the satisfaction of the E.I.C.

21.7 **Flush Pipe :**

The outlet of flush pipe from the cistern shall be of 32 mm rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the Inlet port of the ‘Wall hung’ W.C.’s, and that shall be connected with the W.C. pan by means of an approved type of joint.

21.8 **Seat & Lid :**

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard ‘Hind ware’ or ‘Parryware’ makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

22.0 **RAIN WATER PIPES OF C.I. (IS-3989 OR IS-1729) & CI PIPE FITTINGS (IS-3989 OR IS-1729) :**

All Rain water pipes shall be of spun pipe and shall conform to Indian Standard specifications IS:3989- 1984.

Pipes and pipe Fittings shall be true to shape smooth cylindrical, their inner and outer surfaces being as nearly as practicable concentric.

Pipe when tested for soundness by striking with a light hand-hammer shall emit a clear ringing sound. The pipes shall be free from cracks, laps, pinholes or other imperfection and shall be neatly dressed and carefully felted.

The Fittings shall be of easy clean type. The access door fittings shall be designed so as to avoid dead spaces in which filth may accumulate. Door shall be provided with( 3mm) rubber insertion packing and when closed and bolted, these shall be water tight. Pipes and fittings shall be supplied without ears. Each pipe fittings shall have the trade mark of the Manufacturer and nominal size suitably marked on it.
M.S. stays and clamps shall be made from minimum 1.6mm thick M.S. flat of minimum 30mm width bent to the required shape and size to fit tightly on the socket, when tightened with screw bolts. Lead to be used for the jointing of the pipes shall be refined lead of best quality.

Sample and brand / make approval shall be done by the E.I.C. prior to procurement in bulk quantities by the Contractor. E.I.C. at its discretion may ask the Contractor for sample testing through Govt. test house / laboratories at the risk and cost of the Contractor.

**22.1 Lead Caulked Joints for Rain water Pipes:**

The annular space between the socket and spigot will be first well packed in with spun yarn leaving 25 mm. from the lip of the socket for lead. the joint may be leaded by using proper leading rings or if they are not available, by wrapping a ring of hemp rope covered with clay round the pipe. The lead shall be rendered thoroughly fluid and each joint filled in one pouring. Before caulking, the projecting lead shall be removed by flat chiesel and the joint caulked round with proper caulking tools and a hammer of 1 to 1.1/2 kg in weight in such a manner as to make the joint quite sound. After being well set, the joint is to be flush, neat and even the sockets. The specifications etc, shall comply to the relevant IS & West Bengal P.W.D. specifications.

The approximate depth and weight of pig lead for various diameters of spun pipes and specials shall be as given below (as a guide-line):

<table>
<thead>
<tr>
<th>Nominal Size of Pipe (mm)</th>
<th>Lead/Joint (Kg.)</th>
<th>Depth of lead Joint (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>1.8</td>
<td>45</td>
</tr>
<tr>
<td>100</td>
<td>2.2</td>
<td>45</td>
</tr>
<tr>
<td>125</td>
<td>2.6</td>
<td>45</td>
</tr>
<tr>
<td>150</td>
<td>3.4</td>
<td>50</td>
</tr>
<tr>
<td>200</td>
<td>5.0</td>
<td>50</td>
</tr>
<tr>
<td>250</td>
<td>6.1</td>
<td>50</td>
</tr>
<tr>
<td>300</td>
<td>7.2</td>
<td>55</td>
</tr>
<tr>
<td>350</td>
<td>8.4</td>
<td>55</td>
</tr>
<tr>
<td>400</td>
<td>9.5</td>
<td>55</td>
</tr>
<tr>
<td>450</td>
<td>14.0</td>
<td>55</td>
</tr>
<tr>
<td>500</td>
<td>15.0</td>
<td>60</td>
</tr>
<tr>
<td>600</td>
<td>19.0</td>
<td>60</td>
</tr>
<tr>
<td>700</td>
<td>22.0</td>
<td>60</td>
</tr>
<tr>
<td>750</td>
<td>25.0</td>
<td>60</td>
</tr>
</tbody>
</table>

**Note:**

The quantity of lead given in the table are provisional and a variation of 20 percent is permissible, at the discretion of E.I.C.
The approximate depth and weight of pig lead for various diameters of spun pipes and specials shall be as per relevant IS & West Bengal P.W.D. specifications.

22.2 **Smoke Testing of Rain Pipes:**

All CI Sewer & Waste pipes and fittings including joints will be tested by a smoke test and left in working order after completion. The smoke test shall be carried out as stated under. No extra payment will be made for the tests. Smoke shall be pumped into the brains at the lowest end from a smoke machine which consists of a blow and burner. The materials usually burnt are greasy cotton waste which form clear pungent smoke which is easily detectable by sight as well as smell if leaking at any point of drain. the Contractor will have to rectify all defects traced in such tests at his own expense to the complete satisfaction of the NKDA. The test along with all equipments and accessories shall be carried out at the risk & cost of the Contractor at Site, in presence of NKDA complying to the relevant IS & West Bengal P.W.D. specifications.

22.3 **Testing of Materials and works:**

As and when required by the E.I.C., the Contractor shall arrange to test materials and /or portions of works at his own cost to prove their soundness and efficiency. If after tests, any materials, work or any portions of work are considered defective or unsound by the E.I.C., the Contractor shall remove the same from the site forthwith at his own risk & cost. No extra claim for this or for any rectification / modification shall be entertained by E.I.C. All testing shall be guided by relevant IS & West Bengal P.W.D. specifications at the risk & cost of the Contractor.

All Rain Water pipes and fittings shall be spun pipes, conforming to the latest Indian standard specifications for Rain pipes. The pipes shall have spigot and socket ends, with bead on spigot and shall be with ears. Instead MS Holder Bat Clamps may be used for proper clamping on the wall.

These shall be free from cracks and other flaws. The interior of pipes and fittings shall be clean and smooth and the Pipes & Fittings are to be painted outside with Paints matching with the colour of the building outside wall paints.

The access door fittings shall be of proper locations and in no circumstances less than as shown in the drawings. Doors shall be provided with 3 mm. rubber insertion packing and when closed and bolted they shall be fully water tight.

22.4 **Joints of Pipes & Fittings:**

The annular space between the socket and spigot will be **Lead jointed by caulking tools** between the pipes & Pipe Fittings. This shall be done with 100% Leak-proof under Hydro-static Pressure **Test under 4.0 Kg-f / cm² (g)** pressure with a minimum Holding time of 1.0 hour and those joints after found tested OK shall be preserved and care is to be taken in such a manner so that there should be no undue load / impact / hammerage on those tested joints so as to make the joint quite sound. After being well set, the joint is to be flushed, neat and even the sockets.

The Pipes shall be of “SWR” class.
22.5 C.I. Roof Outlets:
   The traps shall be of self cleaning design provided with a minimum 50 mm Water seal at the Trap to arrest Foul smell there stopping it to enter into the building inside from the respective Stacks. Further more every Floor Trap will associated with a S.S. “Chilly” make cockroach arrestor trap with SS Circular Grating.

23.0 Waste Connections:
   Waste from Wash Basins, floor traps, Sinks, Ablution Traps inside wcs etc, shall separately discharged into the Waste Stacks that terminated & fed to the Gully Traps on the building outside ground level / Plinth protection level and shall be separately connected to (IP) Inspection Pits that leads to the Septic tank.

24.0 Anti-Syphonage (Vent) Pipes: 50mm dia C.I (sand cast as per IS-1729)
   Anti-syphonage Vent pipe shall be HCl pipes of sand cast (as per IS-1729) with lead caulked joints and to be remained connected at a point with the Sewer Stack above every Junction Branches (keeping a gap of at least 450mm above the top-most Junction Branches per floor from the Stack and finally that 50mm dia Vent Stack after running parallel with Sewer Stack joined again with the Sewer Stack by 100 x 100x 50 mm dia Inverted unequal junction (IS-1729) above the top most finish floor level at a point above all the other horizontal junction points.

   In every floor with the main anti-syphonage pipe junction Tees shall be 50 mm. internal diameter or as specified.

25.0 Painting:
   All the exposed Spun Stacks / Pipes and fittings shall be painted with two coats of synthetic enamel paint over one coat of primer of approved quality, manufacture, colour and shade to match the surroundings. The cost of such painting should be included in the Contractor’s rates for pipe work.

   The surface of pipes and fittings to be painted shall be cleaned thoroughly. Red lead or other primer shall be painted as specified and allowed to dry. the finishing shall be done by painting 2 or more coats with paint in an approved colour and shade.

26.0 WATER SUPPLY:
   Sample and brand / make shall be got approved by the E.I.C. prior to bringing at site by the Contractor. Necessary test certificates shall have to be submitted from the manufacturer. Over & above the submission of test certificates, E.I.C. may ask the Contractor for further test from Govt. test house / laboratories at the risk & cost of the Contractor.

26.1 G.I. Pipes and Fittings:
   The pipes shall be of galvanised steel, ERW, (IS-1239, P-I) ‘Medium’, screwed and socketed and shall conform to latest Indian Standard specifications for medium quality.
The pipes shall be tested to a pressure of 50 kg/sq m. these shall have threads and the sockets, paralleled threads complying to the relevant IS & West Bengal P.W.D. specifications.

26.2 Laying & Fixing:

Where pipes have to be cut or re-threaded, ends shall be carefully filled out so that no obstruction to bore is offered.

In jointing the pipes, the inside of the sockets and the screwed end of the pipe shall rubbed over with white lead and few turns of hemp yarn wrapped round the screwed end of the pipe which shall then be screwed home in the socket with a pipe wrench. Care must be taken that all pipes and fittings are kept at all times free from dust and dirt during fixing.

26.3 Internal Work:

For internal work, G.I pipes and fittings inside and outside the walls shall be fixed either visible (not in chase) by means of standard pattern holder bat clamps keeping the pipe 12 mm clear of the wall every where or concealed as specified in Bill of Quantity. When it is imperative to fix the pipe in front of house or in any conspicuous position where it looks unsightly chasing may be adopted.

All pipes and fittings shall be fixed truly vertical and horizontals or as directed by the E.I.C.

26.4 External Work:

For external work G.I pipes and fittings shall be laid in trenches. the width of the trench shall be the minimum width required for working the pipes laid underground level. they shall not be less than 60 CMS from the ground level, and wrapped with gunny cloth dipped in hot bitumen. The work of excavation and refilling shall be done in accordance with the instruction of the E.I.C.

26.5 Painting:

All internal G.I pipes and fittings shall be painted with two coats of synthetic enamel paint over one coat of red lead primer of approved quality manufacture, colour and shade as directed by the E.I.C. The cost of such painting shall be included in the Contractor’s rates.

26.6 Testing:

All G.I pipes and fittings shall be tested to a pressure of 7 kg. per sqm. as specified in the relevant IS & West Bengal P.W.D. specifications to ensure that pipes have proper threads and that proper materials (such as white lead and hemp) have been in jointing. All leaky joints must be made leak-proof by tightening at Contractor’s expense. E.I.C. may ask the Contractor to submit the necessary test certificates in this regard.
27.0 **BRASS WATER FITTINGS**:

All water fittings shall be of standard manufacture as approved by the E.I.C. and shall be in all respects comply with the latest Indian Standard Specifications. The brass fittings shall be fixed in the pipe line in a workmanship like manner. Care shall be taken to see that joints between fittings and pipes are made leak proof. The fittings and joints shall be tested to pressure of 21 kg per sqm. unless otherwise specified. The defective fittings and the joints shall be repaired or replaced.

28.0 **SPECIFICATION OF WATER SUPPLY MATERIALS**

(As per Specifications Pages attached Annexure as a guideline to the Contractor)

**General:**

a) All materials shall be of best of their kind and shall conform to the latest Indian Standard specification.

b) A set of specification samples of all approved materials shall be kept & well preserved at site by the Contractor for ready reference, cost of which is to be borne by the Contractor.

c) Over & above the list of specifications, NKDA reserves the right to ask the Contractor for fixing of materials / fittings of equivalent quality other than mentioned in the list.

29.0 **DRAINAGE**:

29.1 **Stone Ware Pipe**:

**Pipes**: All pipes must be new and perfectly sound, free from fire cracks and imperfection of glazing, cylindrical straight and of standard nominal diameter, length and depth of socket. They shall be hard burnt stoneware of dark grey colour and thoroughly salt glazed inside and outside. They should conform **IS: 651-1980**.

29.2 **Trenches for S.W. Pipe Drains**:

**Excavation**: The trenches for the pipes shall be excavated to lines and levels as directed. The bed of the trench shall be truly and evenly dressed throughout from one change of grade to the next.

The gradient is to be set out by means of bending rods and should the required depth be exceeded at any point the trench shall be refilled by means of cement concrete of the specification of the bed concrete, at the Contractor’s own expense. The bed of the trench if in soft or made up earth shall be well watered and rammed and depressions thus formed filled with sand or other suitable materials as directed by WBSEDCL before laying the bed concrete.

If rock is met with, it shall be removed to 15 cms. below the level of the pipe and the trench will be refilled with concrete, sand or other suitable material as directed by WBSEDCL to bring it to
required bed level. The excavated materials shall be kept away from the edge of the trench at a
distance equal to 1 Metre or equal to half the depth of the trench which ever is greater.

The trench shall be kept free from water. Shoring and timbering shall be provided wherever
required.

The trench width shall be the nominal diameter of the pipe plus 36 cms. but it shall not be less
than 52 cms. in case of all kinds of soils excluding rock and not less than 92 cms in case of rock.

Wherever the drain runs deeper, the width of the trench in the upper reaches may be
increased as per the directions of the E.I.C.

30.0 ROAD CROSSINGS:

All road crossings shall be excavated half at a time, the second half being commenced, after
the pipes have been laid in the first half and the trench refilled. The trench at the existing road
crossings shall be filled in with mud concrete for the full depth except for the 15 cms layer,
which shall be filled with cement concrete 1:2:4 or as directed.

31.0 PROTECTION OF EXISTING SERVICES:

All pipes, water mains, cables etc., met within the course of excavation shall be carefully
protected and supported. Such mains will be hung from timbers placed across the trench. Care
shall be taken not to disturb the electrical and communication cables, removal of which if
necessary may be arranged by E.I.C.

32.0 LIGHTING AND WATCH:

The open trenches shall be provided with requisite fencing and watchman to guard against
accidents. Red flags during day and red light during night shall be provided at the ends and at
intervals along the sides of the trenches.

Sign boards with necessary wording such as “SLOW, ROAD CLOSED” etc. shall be provided at
least 30 metres ahead of road crossing where the work is in progress. The precautions will be
continued till the surface is restored.
Temporary bridges or planks shall be provided over the trenches for keeping open the access
to private or public property.

33.0 REFILLING:

Refilling in trenches for pipes shall be commenced as soon as the joints and concrete have
been passed. The refilling on the top and around the drain shall be done with great care and in
such a manner as will obtain the greatest amount of compactness and solidity possible. For
this purpose the earth shall be laid in regular layers of 15 cms watered and rammed at each
layers. All surplus earth shall be disposed off as directed by the E.I.C.
34.0 CONCRETING:

All S.W. pipes shall be laid on a bed of 15 cms. thick cement concrete as specified with projection on each side of the pipe to the full width of the trench and surrounding the pipes all-round with 1:4:8 concrete mix.

All NP-3 RCC pipes below Road crossing / Car Parking areas shall be laid on a bed of 15 cms. thick cement concrete as specified with projection on each side of the pipe to the full width of the trench with 1:4:8 concrete mix.

The pipes with their crown level at 1.20 Metre depth and less from ground shall be covered with 15 Cms. thick concrete above the crown of the pipe and slipped off to give a minimum thickness of 15 Cms. allround the pipe or as per construction drawing.

Pipes deeper than these shall be concreted upto haunches level with the top of the pipe.

35.0 LAYING AND JOINTING S.W. PIPES:

35.1 Laying:

The pipes shall be carefully laid to the levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc., from entering the pipes. The pipes between two manholes shall be laid in straight line without vertical or horizontal undulations.

The pipes will be laid “socket up” the gradient. The body of the pipe shall for its entire length rest on an even bed.

35.2 Jointing:

The cement mortar joints shall be cured at least for seven days.

35.3 Testing:

All joints shall be tested to a head of 60 Cms of water above the top of the highest pipe between two manholes.

The lowest end of the pipe shall be plugged watertight. Water shall then be filled in manhole at the upper end of the line. The depth of water in the manhole shall be 60 cms. plus the diameter of the pipe. The joints shall then be examined. Any joint found leaking or sweating shall be remade or embedded into 15 Cms. layer of cement concrete (1:2:4) in length and section re-tested, at the Contractor’s expense until satisfactory results are obtained.

36.0 GENERAL:

36.1 Under-ground Storm Water Drain Pipes:

NP-3 R.C.C. pipes are used for storm water drainage, on a concreting at pipe bed with 1:4:8 mix. The cement mortar for jointing with the Pipes and Collars will be 1:2 or that as specified in the Schedule of Quantities. Testing of joints also, will be
required under a Hydro-static Pressure Test under $1.5 \text{ Kg-f/ cm}^2 (g)$ pressure with
a minimum Holding time of 1.0 hour and those joints after found tested OK shall be tagged
"Tested OK" for those portion of the tested pipe and shall be preserved and
care is to be taken during back-filling in such a manner so that there should be no
undue load / impact / hammerrage on those tested joints so as to make the joint
quite sound.

36.2 Precaution:

To avoid logging of drains, both ends shall be kept plugged until the construction of manholes
is completed in every respect. On completion, care shall be taken that
each plug is removed and the face of the drain made smooth.

36.3 Measurements:

The measurements for providing, laying and jointing R.C.C. pipes shall be recorded
for the finished length of the pipe line i.e., from inside of one manhole to the inside of other
manhole.

37.0 S.W. GULLY TRAPS:

This must be new, perfectly sound free from fire cracks and other imperfections of glazing of
standard nominal diameter and other dimensions. It shall be made of hard burnt stoneware of
dark grey colour and thoroughly salt glazed inside and outside.

Each gully traps shall have a C.I. piping $15 \times 15$ Cms. and one water tight C.I. cover with frame
$30 \times 30$ Cms. (inside dimensions) with machine seating faces or as specified.

37.1 Excavation:

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans
or as directed by the Engineer-in-Charge.

37.2 Fixing:

The gully trap shall be fixed on cement concrete foundation $70$ Cms. square and not less than
$10$ Cms. thick. The mix for the concrete will be $1 : 3 : 6$ (1 Cement : 3 Sand : 6 Stone ballast) $40$ mm gauge or
as specified. The jointing of gully outlet to the branch drain shall be done similar to jointing of
S.W. pipes.

37.3 Masonry Chamber:

After fixing and testing the gully and branch drain, a brick masonry Chamber $30 \times 22.50$ Cms
(inside in first class brick in cement mortar $1:5$ shall be built with $11$ Cms. thick around the gully
trap from the top of the bed concrete upto ground level. The space between the Chamber
walls and the trap being filled in with cement concrete of the specifications of bed concrete.
The upper portion of the Chamber i.e. above the top level of the trap shall be plastered inside
with cement mortar 1:3 (1 cement : 3 sand) finished with floating coat of neat cement. The corners and bottom of the Chamber shall be rounded off so as to slope towards the grating.

37.4 C.I. Cover:

C.I. cover with frame 30 x 22.50 Cms. or as specified with mechanical seating faces shall then be fixed on the top of the brick masonry with cement concrete 1 : 2 : 4 and rendered smooth. The finished top of cover shall be left 15 Cms. above the adjoining ground level so as to exclude the surface water from entering the gully trap.

38.0 MANHOLEs, INSPECTION PITS, GULLY CHAMBER ETC.:

38.1 Manholes: (The size of Manholes): The size specified shall be in the internal size of the manhole. The work shall be done strictly as per drawings and specifications. The following specifications shall be adopted.

38.2 Excavation: The manhole shall be excavated true to dimensions and levels, shown on the plan or as directed by the E.I.C.

38.3 Brick Work: The brick work shall be with best quality brick in cement mortar 1:4, brick work in arches shall be with 1st class brick in cement mortar 1:4, brick masonry round the pipes shall also be with 1st class brick in cement mortar 1:4, the joints shall be made thoroughly leak proof.

38.4 Bed Concrete: The manhole shall be built on a bed of 15 Cms. thick cement concrete (1 : 3 : 6) over a layer of brick flat soling.

38.5 Plaster:

Inside of the walls be plastered with 12 mm. thick cement plaster 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement.

In wet ground, 12 mm. thick cement plaster of the above specifications shall be done on the outside surface of the walls also. This plaster shall be done with waterproofing admixture as approved by the E.I.C. The plastering shall be done upto 30 cms. above the wet soil line. Extra shall be paid for plastering the outside surface wherever directed.

38.6 Pointing:

Pointing shall be done with cement mortar 1:2.

38.7 Benching:

The channels and benching shall be done in cement concrete 1:2:4 and rendered smooth with neat cement.

The following sizes of the channels shall be adopted for the benching:
<table>
<thead>
<tr>
<th>Size of the Drain</th>
<th>Depth at the Centre</th>
<th>Depth at sides i.e., at walls</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mm. (4&quot;)</td>
<td>15 Cms (6&quot;)</td>
<td>20 Cms</td>
</tr>
<tr>
<td>150 mm. (6&quot;)</td>
<td>20 Cms (8&quot;)</td>
<td>30 Cms</td>
</tr>
<tr>
<td>250 mm. (10&quot;)</td>
<td>30 Cms (11&quot;)</td>
<td>40 Cms</td>
</tr>
<tr>
<td>300 mm. (12&quot;)</td>
<td>35 Cms (14&quot;)</td>
<td>45 Cms</td>
</tr>
</tbody>
</table>

39.0 **R.C.C. WORK:**

R.C.C. work for slabs or lintels shall be in cement concrete 1:1 1/2:3 with steel reinforcement as per details. Plain concrete, if used for fixing manhole covers, shall be of (1:2:4) proportion, unless otherwise mentioned specifically in the BOQ / drawings etc.

40.0 **FOOT RESTS:**

These shall be of C.I. standard / or by M. S square rod 22 mm. or as specified and shall be galvanized or painted with coal tar. These shall be embedded in masonry in cement mortar at least 22.5 Cms. while the brick work is in progress. These shall be fixed 30 Cms. apart vertically and staggered laterally and shall not project more than 11 Cms., from the wall.

41.0 **C.I. MANHOLE COVERS:**

The C.I covers shall be of tough homogeneous cast iron of ‘heavy’ or ‘Medium’ type as specified in the Bill of quantities, are the clear internal dimensions. The approximate weights of the various types of manhole covers with frames and their internal size will be as per specification in schedule of quantities & conform to IS : 1726-1966. Variations in weight ton the extent of 6 percent on either sides shall be permissible. the covers used in manhole on sewer lines shall invariably bear the work ‘SEWER’ on the top and those used for storm water drains shall bear the word ‘S.W.D.’. These markings shall be done during casting of the covers.

The frame of manhole cover shall be embedded firmly in the R.C.C slab or plain concrete as the case may be on the top of the masonry.

After the completion of the work, manhole covers shall be sealed by means of thick mortar greased. All exposed surfaces of the frames and covers shall be painted with coal tar. The cost of such paintings should be included in the Contractor’s rates for the manhole cover.

42.0 **PLAIN MANHOLE (TYPE A):**

As per drawing or 60 cms. x 45 cms. when not mentioned / shown specifically. This type of manhole is minimum generally constructed within compounds for house drainage only. Due to shallowness and narrowness the manhole is provided with cover with bigger opening to facilitate cleaning and repairs. Cover of size 90 Cms. x 45 Cms shall be used.
43.0 **PLAIN MANHOLE (TYPE B):**

As per drawing or 1.2 X 0.9 M when not mentioned / shown specifically. This type of manhole is constructed for main drainage work for depth less than 2.4 Meters.

When the manhole is built on the footpath ,this shall be provided with 45 Cms. internal diameter light type C.I cover , when it is built within the width of the road under traffic, it shall be provided with 53 Cms. internal diameter heavy type C.I cover.

44.0 **LEVELS OF INVERT OF INSPECTION PITS AND STORM WATER MANHOLES:**

All Invert levels as specified in the drawing to be maintained strictly as minimum requirement. All Invert levels (I.L.) given in the drawings are with respect to the (+) 0.00 level as specified in the drawings.

Unless some acute problem as per the Site conditions the Invert levels as mentioned in the drawing shall have to be maintained.

For any alterations in Invert levels as per the Site conditions (if any) shall have to be approved by the E.I.C. before executing the job.

The invert of the smaller sewer at its junction with main shall be at least 2/3rd dia. of the main above the invert of the main . The branch sewer should deliver sewage in the manhole in the direction of main flow and the junction must be made with ease so that flow in the main is not impeded.

45.0 **MEASUREMENTS:**

The depth of the manhole wall be reckoned from the invert level of the channel to the top level as to the C.I cover . The depth shall be measured correct to nearest 25 mm.

46.0 **HOUSE CONNECTIONS:**

No drain from house fittings e.g. gully trap or soil pipe etc., to manhole shall exceed a length of 6 Meters unless it is unavoidable.

47.0 **DROP CONNECTIONS (DROP MANHOLES) – IF ANY:**

In case where branch pipe sewer enters the manholes on main pipe sewer at a higher level than the main sewer, a drop connection should be provided.

C.I. Inspection bend shall be fixed in position at right angle to the drop pipe at the level of the inlet branch drain. The plain C.I. shoe at the bottom shall be fixed in the benching cement concrete 1:2:4 (1 cement : 2 sand : 4 stone ballast ¾” size) so as to discharge into the channel (the joints be lead caulked as per specification for the cast iron pipes for water supply).
48.0 C.I. PIPE DRAINAGE:

48.1 C.I. Drainage:

C.I. pipe drainage shall be adopted (IS-3989 or IS-1729) in the case mentioned below:-

a) When the drain passes under a structure.

b) When the drain passes under a road which is subject to heavy traffic and where the covering cushion is not considered sufficient.

c) When the drain passes through a place where it is subjected to vibrations.

d) In hilly places where the slopes are very steep.

e) When drainage lines run on the surface or above ground.

48.2 Trenches:
Specifications for trenches for stoneware pipe drains will apply in this case.

48.3 Pipes:
The pipes used shall conform to the Indian Standard specifications for class “A” pipes.

48.4 Fittings:
C.I. trap with hopper, C.I. inspection bends C.I. inspection Chambers etc., shall conform to Indian Standard specifications for C.I fittings.

48.5 Laying:
For laying C.I. pipes and fittings, specifications for C.I. water mains will apply.

The joints for pipes and fittings shall be lead caulked joints under water supply. the joints shall be leak proof.

All inspection doors etc., shall be provided with felt washers and strong brass bolts and nuts.

48.6 Testing:
Testing of joints for C.I. pipes and fittings shall be done by smoke test as specified under C.I. pipes and fittings.

48.7 Masonry Chamber:
C.I. inspection chambers and bends for underground shall be enclosed in masonry chambers.

NOTE:
In case of non-availability of any particular brand of material as specified in the Bill of Quantities, bidder, Consultant or E-I-C may propose any other equivalent brand or material or equipment conforming to the latest I.S specifications. The approval of E.I.C in this regard will be final and binding.

**List Of Approved Specifications, Makes & Brands of Manufacturer for PHE work:**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of Approved Material</th>
<th>Approved Brand / Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Internal Water Supply:</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>G.I. Pipes - medium class (As per 15-1239, P - I)</td>
<td>TATA/ Jindal / Utkarsh / Nezone.</td>
</tr>
<tr>
<td>2</td>
<td>G.I. Pipe fittings (as perIS-1239, P - II) ; of material with Galvanized Cast Iron Fillings, with material code conforming to IS- 1879</td>
<td>HB’/ &quot;NB’/ “ZOLOTO”/Leader / - &quot;JSI” fittings ISI approved Heavy</td>
</tr>
<tr>
<td>3.0</td>
<td><strong>C.P. on brass fittings</strong></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>CP Bib cock</td>
<td>JAQUAR-Continental /ESSCO-'Delux' or 'sumthing special’/ “Marc”/ “Hindware” or as approved by ENGINEER-IN-CHARGE</td>
</tr>
<tr>
<td>3.3</td>
<td>CP Angle valve</td>
<td>- Do -</td>
</tr>
<tr>
<td>3.4</td>
<td>CP 'Concealed' Stop cock 'Heavy' type with adjustable CP wall Flange</td>
<td>- Do -</td>
</tr>
<tr>
<td>3.5</td>
<td>CP Shower Rose</td>
<td>- Do -</td>
</tr>
<tr>
<td>4</td>
<td>Gun metal body Ball Float valve with PVC (High pressure) Ball Float</td>
<td>Merck / Leader”/ “Sant” / “Neta</td>
</tr>
<tr>
<td>5</td>
<td>15 mm dia. PVC Connector pipe with Symet nuts at both ends. - ( for Wash Basin Pillar tap &amp; W.C. &amp; Urinal -Cistern connections)</td>
<td>PRAYAG or as approved by ENGINEER-IN-CHARGE</td>
</tr>
<tr>
<td>6</td>
<td>Wall Outlet Connection Flexible Pipe - 15mm dia</td>
<td>“Jaquar” / “Essco”/ “Hindware”</td>
</tr>
<tr>
<td>7</td>
<td>Bronze / Gun metal-body Gate valve with threaded screwed ends, &quot;Non-rising Spindle&quot; type (PN-1.0) or (PN-1.6) class</td>
<td>Sant / “Leader” /“Merck”/ “Zoloto”-for Bronze body / ‘Neta” / SBM – “Peglar” type</td>
</tr>
<tr>
<td>8</td>
<td>Bronze -body Globe valve with ‘BSPT(F), threaded screwed ends, &quot;Non-rising Spindle&quot; type (PN-1.0) (PN-1.6) class</td>
<td>Valves of 'Zoloto', or ‘Sant’ or as approved by ENGINEER-IN-CHARGE.</td>
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<tr>
<td>9</td>
<td>CI body Gate / Sluice valve with flanged ends rising Spindle&quot; type (PN-1.0) / or (PN-1.6) class</td>
<td>‘Sant’ / ‘Zoloto’/Leader / ‘Hawa’</td>
</tr>
<tr>
<td>11</td>
<td>CP Urinal Spreader-15mm (for Urinals only)</td>
<td>for all Toilets :- Hindware /&quot;Crabtree”/&quot;Parryware&quot; or as approved by ENGINEER-IN-CHARGE.</td>
</tr>
<tr>
<td>12</td>
<td>Soil, waste &amp; vent pipes / and Pipe Fittings &amp; Specials :- C.I. Centri cast (as per 15-3989)</td>
<td>'NECO’ / 'HEPCO’/ 'KAPILANSH DHATU UDYOG (P) L TD.’ / &quot;BIC”</td>
</tr>
<tr>
<td>13</td>
<td>Sanitarywares (Vitreous chinaware) :- W.C. - (European type) – with ‘S’ / 'P' -Trap - Floor mounted type, without PVC Flushing Cistern, ii) Wash Basins - &quot;Flat-back&quot; type rectangular pattern (size-550mm x 400mm) with “Essco” CP Pillar Tap / or “Swan neck” type Mixer, iii) Urinal - Flat back “Small” with CP Spreader, CP Waste coupling, CP Bottle Traps with waste pipes &amp; also with &quot;Jaquar’ Sensors with installation box.</td>
<td>1st quality White Vitreous China-ware of ‘Hindware’/ ‘Parryware’ or ‘Cera’ :- for Vitreous chinaware W.C.:- Floor mounted &quot;Pedestal&quot; type- W.C. - of 'Hindware’- &quot;Popular” without PVC Cistern but with PVC Seat &amp; Lid of 'Hindware’, / 'Parryware' or 'Cera’, CP Flush Pipe of approved standard make.</td>
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<td></td>
<td>Wash Basin :- 'Hindware' - &quot;OVAL&quot; type or Parryware-equivalent / 'Cera' equivalent Wash Basin Pillar tap equivalent as approved by ENGINEER-IN-CHARGE for Wash Basins.</td>
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<td></td>
<td>For WC flushing :- PVC 'Low-level' &quot;Dual- Flush&quot; Cistern of 'Hindware&quot; &quot;SLEEK” or equivalent Parryware or 'Cera' Model. / or through “Jaquar” make CP Flush valve.</td>
<td></td>
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<tr>
<td></td>
<td>Urinals: - Hindware - &quot;Flat Back 'Large’- / or Parryware / or 'Cera’ – equivalent.</td>
<td></td>
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<td>&amp; for Urinals :- 'Jaquar', &quot;PRESSMATIC&quot;</td>
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<td>14</td>
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<td>6mm thick ‘Modiguard’ / 'Ashai’ / or equivalent as approved by ENGINEER-IN-</td>
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<td>JAQUAR/ESSCO Delux'/Marc /Hindware /or as approved by ENGINEER-IN-CHARGE</td>
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<td>CP Towel Ring</td>
<td>- Do -</td>
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<td>- Do -</td>
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<td>15.5</td>
<td>CP Bottle Trap with CP wall connection Pipe</td>
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<td>- Do -</td>
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<td>- Do -</td>
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<td>Rigid PVC (Concealed) Waste pipe, [Schdl.-40], (as per ASTM D 1785)- (concealed or exposed)</td>
<td>Supreme / Oriplast / Finolex/ Utkarsh</td>
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<td>Rain Water Pipes :: C.I. – Sand cast &quot;SWR&quot; class, 'as per (IS: 1792)</td>
<td>NECO'/HEPCO'/KAPILANSH DHATU UDYO (P) LTD./ &quot;BIC&quot;</td>
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<td>Rain Water Pipe Fittings :: ‘Sand cast Iron’ - &quot;SWR&quot; class, as per (IS: 1792)</td>
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<td>Salem Stainless Steel Sink as per AISI 304 (18/8) conforming to I.S.- 13983</td>
<td>&quot;Hindware&quot; “Hafele” ”Nirali”, 'Parryware' / “IMAGINE” Brand from Saraswati Steel</td>
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<td>21</td>
<td>C. I. Manhole Cover (I.S. - 1726) - &quot;Medium&quot; or &quot;Heavy&quot; Grade' (Light duty only on Oil/Grease Trap Chamber)</td>
<td>NECO'/ 'HEPCO' /Swastika // &quot;BIC&quot;.</td>
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<td><strong>NP-2</strong> class R.C.C. Pipes and Pipe Fittings (i.e., RCC Collars etc.)</td>
<td>Eastern Spuncrete / ‘West Bengal Concrete Industries (P) Ltd. / ‘HINDUSTAN’ / ‘SUR’.</td>
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<td>Sonali / GINNI / NIRALI / Hind</td>
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<td>24</td>
<td>C. I. Grating- (Over Catch Pit / Yard Gully Chamber), (I.S. - 1726) - &quot;Medium&quot; or “Heavy” Grade</td>
<td>NECO’/ 'HEPCO' / ‘BIC’/”Kapilansh Dhatu Udyog”</td>
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<td><strong>STP- cum/day</strong> : As per the Detailed Specifications</td>
<td>“THERMAX” / “Ion-Exchange” / or equivalent.</td>
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<tr>
<td>No.</td>
<td>Description</td>
<td>Brand/Make</td>
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<td>26</td>
<td>&quot;Enclosed&quot; Analogue type <strong>Water Meter</strong> (&quot;Bulk Type&quot;), conforming to IS- 2373 with Calibration Certificate, including all necessary accessories</td>
<td>&quot;Dashmesh&quot;/&quot;Kaycee&quot;/&quot;Capstan&quot;/&quot;Kent&quot;.</td>
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<td>Bronze body &quot;Parallel Slide&quot; &quot;Blow-off valve (&quot;Spring loaded, blow-off pressure sellable&quot; type), with flanged ends, also with matching Flanges (PN-1.0) / or (PN-1.6) class</td>
<td>'Zoloto'/Sant –make / Leader/ MERCK</td>
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<td>28</td>
<td>Bronze body &quot;Parallel Slide&quot; 'Blow-off valve (&quot;Spring loaded, blow-off pressure sellable&quot; type), with flanged ends, also with matching Flanges (PN-1.0) / or (PN-1.6) class</td>
<td>Zoloto'/Sant –make / Leader / MERCK</td>
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<td>29</td>
<td>Bronze / Gun metal -body Ball valve with 'BSPT(F), threaded screwed ends, &quot;quarter turn Lever operated&quot; type (PN-1) / or (pN-1.6) class</td>
<td>Valves of Bronze body :- 'Leader', 'Zoloto' – Metal only:- Sant make / Leader</td>
</tr>
<tr>
<td>30</td>
<td>Gaskets-CAF 'Full face' conforming to IS-2712, Gr.- C; (3mm thick)</td>
<td>&quot;Klinger&quot;/&quot;Permanite&quot;/&quot;Champion&quot;.</td>
</tr>
</tbody>
</table>

**Executive Engineer-I**

**New Town Kolkata Development Authority**
Construction of First Phase (B+G+IV) of Administrative Building of New Town Kolkata Development Authority
At
Plot no. DG / 13, Premises No. 04-3333, Action Area – ID, New Town, Kolkata.

TECHNICAL SPECIFICATION FOR ELECTRO – MECHANICAL, HVAC FIRE – FIGHTING AND ELECTRIFICATION WORKS.
## TECHNICAL SPECIFICATIONS

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TECHNICAL SPECIFICATIONS

1.0 GENERAL SCOPE OF WORK:

The scope of work shall cover internal and external electrical works for NEW TOWN KOLKATA DEVELOPMENT AUTHORITY, KOLKATA. The scope of work covers major electrical equipments as per BOQ. Also, supply, installation, testing and commissioning of electrical works of the project including the following main items / systems:

i. H.T. Sub-station including VCB panel, Transformers, HT cables etc

ii. Main LT, Capacitor panels (APFC), Rising mains, MV Panels.

iii. DG sets including AMF panels etc.

iv. MCB Distribution Boards.

v. Internal electrification through concealed PVC conduit and provide light Points, fan points, socket outlets etc. including supplying, installation, testing and commissioning of light fixtures, fans etc.

vi. Conduiting and wiring for telephone points including Main Telephone Distribution Boards (Tag Blocks), telephone outlets etc. complete with telephone cabling from tag blocks to telephone outlets including EPABX, telephone instruments etc.

vii. Addressable Fire Detection & Alarm System consisting of Main Fire Control & Indicator Panel, Smoke & Heat Detectors, Manual Call Point Hooter etc. including conduiting/wiring & cabling complete.

viii. Conduiting and wiring for Cable TV system

ix. Conduiting for computer networking

x. Lightning protection system consisting of lightning arrester, finial, horizontal and vertical strips, test joints, earth electrodes etc.

xi. Lifts
Xii. LT Cabling.

xiii. Earthing, safety equipments and misc items required for electrical installation complete in all respect.

xiv. Outdoor lighting

xv. Testing and commissioning of all electrical installations

xvi. Any other items/ works required for the completion of electrical works.

xvii. Enhancement/Sanctioning Electrical Load from State Electricity Board.

xviii. Submission of GA drawings of electrical equipments and getting approvals from Client/ Owner before manufacturing/fabrication.

xix. Obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority, Telecom Department, and any other statutory Authorities for the complete scope.

xx. Proper approval for Diesel tank and pollution control for DG set.
    Contractor shall submit equipment drawing from manufacturer along with The layout etc. and working drawings for approval from NKDA Electrical Engineer before manufacture / commencement of work at site.

xxi. Contractor has to submit the working drawing of internal as well as external electrification based on our tender drawings for the approval of NKDA Electrical Engineer before commencement of work.

xxii. Contractor has to take the approval of DB schedule/drawing of each DB from NKDA.

xxiii. Incase, details of any electrical item/ system are left out, then kindly refer the CPWD specifications & approval from Engineer.

1.01 REGULATIONS AND STANDARDS:

All equipments their installation, testing and commissioning shall conform latest CPWD/ IS specifications in all respects.
Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian electricity Rules and the Regulations, National Electric Code, National Building Code, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall conform to the Indian Standards specifications and code. Mode of all measurement will be as per latest CPWD norms/ specifications
Some of the applicable codes / standards are as under:

a) CPWD General specifications for electrical works Part-I (Internal)- 2005
b) CPWD General specifications for electrical works Part-II (External)-1995
c) CPWD General specifications for electrical works Part-III (Lifts & Escalators)-2003
d) CPWD General specifications for electrical works Part-IV (Substation)-2007
e) CPWD General specifications for electrical works Part VII (DG Sets)
f) CPWD Specification/norms for measurement Latest revision
g) Guide for marking of insulated conductors IS 5578
h) Guide for uniform system of marking and identification of conductor and apparatus terminals. IS 11353
i) Low voltage switchgear and control gear assemblies S 8623 Part-1 to 3
j) Specification for low voltage switchgear and control gear IS 13947
k) Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V AC and 1200 V DC IS 2675
l) Code of practice for selection, Installation and maintenance of switchgear and control gear. ISI 10118 Part – 1 - 4
j) Low-voltage fuses for voltages not exceeding 1000V AC or 1500V DC ISI13703 Part-1&2
k) PVC insulated (heavy duty) electric cables IS 1554

l) PVC insulated cables for working voltages upto and including 1100V.
   IS 694

m) Conduit for electrical installations IS 9537

n) Accessories for rigid steel conduits for electrical wiring IS 3837

o) Boxes for the enclosure of electrical accessories IS 14772

p) General and safety requirements for luminaries IS 1913

q) Code of practice for earthing IS 3043

r) Electrical accessories – circuit breakers for over current protection for
   household and similar installations. IS 8828

Specification for factory built assemblies of switch gear and control gear for
voltage up to and including 1000V AC and 1200VDC IS 8623

s) Low voltage switchgear and control gear IS 13947 part 1 – 5

t) Residual current operated circuit breakers IS 12640

u) Current Transformers IS 2705 & relay IS 3231

v) Voltage Transformers IS 3156

w) Direct acting indicating analogue electrical measuring instruments and
   their accessories IS 1248 part – 1 to 9

A1) Control Switches (switching device for control and auxiliary circuits
    including contactor relays) for voltages upto and including 1000V ac and
    1200V DC. IS 13947 & IS 1336

A2) Indicating instruments IS 1248 & Integrating Instruments IS 722.

A3) Control switches & push button IS 6875.
A4) AC motor starters of voltage not exceeding 1000V IS 1822

In case of contradiction in specification the priority of the documents shall be as follows:
CPWD/ IS specification, BOQ, drawings, Technical specifications.

2.00 DESIGN BASIS & SITE CONDITIONS:

All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.

2.01 SITE CONDITIONS
Location : Kolkata  Site altitude : 50 M above mean sea level

Ambient Temperature Relative Humidity
Maximum : 40 Deg C Maximum : 71.6 %
Minimum : 12 – 14 Deg C Minimum : 37 %
Design : 50 Deg C Design : 90% at 45 Deg C

Ground Temperature: 35 Deg C Rainfall : 1582 mm/year

Seismic factor: Zone III as per IS : 1893

Environmental: Tropical / humid / corrosive conditions

3.00 H.T. SUBSTATION(11 KV VACUUM CIRCUIT BREAKER PANEL  BOARD

3.1.1 GENERAL:

Power supply for Equipment
Voltage: 11KV +/- 15% Frequency: 50Hz +/- 3%
Permissible combined Voltage & Frequency variation: +/- 6%
System design fault level (Symmetrical) : 50 KA for 1 sec. Max.
Grounding : solidly earth

**DESIGN CRITERIA**
The switchgear shall be capable of continuous operation of specified rating under the following condition:

Voltage variation : +/- 10%
Frequency variation : +3%, -6%
Combined voltage & frequency variation : 10%

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified.

VCB’s shall conform to IEC 298 and 694 IS 3427, BS 5227 and VDE 0670, part 6 as well as the regulations mentioned therein. VCB’s shall be suitable for operation on 11kV, 3 phase, 50Hz, AC supply.

**3.1.2 TYPE AND CONSTRUCTION:**

The metal clad panel shall be fully extensible and compartmentalized to give.

a. Circuit Breaker Compartment 
b. Busbar Compartment 
c. CT and Cable Compartment

**3.1.2.1** The compartments shall be safe to touch and compartments thus formed shall be dust proof & vermin proof. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall be provided.

**3.1.2.2** The VCB shall consist of three air insulated poles incorporating mechanism of interrupters. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalised aluminum oxide. The contacts shall be of chromium copper and butt shaped.

**3.1.2.3** Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. In case of truck mechanism, the breaker shall be on a trolley while in a carriage mechanism, shall be separate door and it shall be possible to perform all operations with front door closed. The draw out carriage shall have two positions for the circuit breaker viz isolated/test & service position. Bus bars shall be insulated type made of high conductivity copper supported on cast epoxy monobloc designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.
3.1.2.4 It shall be horizontal isolation, horizontal draw out type, fully interlocked, with dust and vermin proof construction, suitable for indoor installation. The panel shall be supplied with the manufacturer’s test certificates.

3.1.2.5 Certificates with date of manufacture and shall be complete in all respects as per details in the schedule of quantities. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphate process and shall then be given power coating (Electrostatic) paint of manufacturer’s standard shade.

3.1.2.6 The switchgear constructions shall be such that breaker operation and Internal explosions do not endanger the operating personnel, and the front of the panel shall be specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, bus bar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of at least 2.0mm thickness. It shall have a rigid, smooth, leveled, flawless finish.

3.1.2.7 Voltage transformer of burden not less than 100 VA and a proper ratio as specified shall be provided in the incoming panel. The accuracy class for the VT shall be 0.5 as per IS 3156 parts I to III for incomers and class 1 for outgoing panels. The transformer shall be of cast epoxy resin construction. It shall be fixed/ withdrawable type. HRC fuses/ MCBs shall be provided on both HV and LV side.

3.1.2.8 The making contact arms (upper & lower) of the circuit breaker shall be encased in polypropylene tubes. Penetration type bushings shall be provided in the busbars & cable compartment for the fixed contacts.

3.1.2.9 Safety shutters shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the carriage is moved to isolated disconnected position. The shutters shall move automatically with the movement of the draw out carriage. It shall, however, be possible to open the shutters of busbars side and cable side individually.

3.1.2.10 Mechanically operated circuit breaker auxiliary switches of minimum 5 NO + 5 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by 1.5 sq. mm; 1.1kV grade
stranded copper PVC insulated cable. All control fuses shall be HRC link type.

3.1.2.11 Terminal blocks shall be clamp type suitable for connection of only 2 wires per terminal and shall be 650 V grade. The L.T. control circuit shall be routine tested to withstand 1.5kV for one minute.

3.1.2.12 Busbar compartment shall be provided at the rear. Electrolytic copper busbars shall be of rectangular cross section and insulated. Busbars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Busbars shall be provided with necessary color coding for phases indication. The busbars shall be designed to withstand a temperature rise of 60deg. C above and ambient temperature of 45 deg. C

3.1.3 BUSBAR AND REGULATORS
3.1.3.1 All busbars and jumper connections shall be of electrolytic copper conforming to relevant IS standards. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Busbar cross section shall be uniform throughout the length of switch board.

3.1.3.2 Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance.

3.1.3.3 Busbar insulators shall be of track-resistance, high strength, and non-hygroscopic, non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Busbar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the busbars and all other equipments, when carrying the rated of relevant Indian Standards, duly considering the specified ambient temperature.

3.1.4 EARTHING AND PROTECTIVE EARTHING
3.1.4.1 Copper earthing bus shall be provided. It shall be bolted/ welded to the framework of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable
temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting. Earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of busbars & feeder circuit.

### 3.1.5 METERING AND PROTECTION

#### 3.1.5.1

The VCB Panel Board shall be provided with epoxy resin current transformers for metering and protection. The protection CTs shall be of accuracy class 5 P 10 of IS 2705- Part-III-1992. The metering CTs shall confirm to the metering ratio and accuracy class 0.5 of IS 2705-1992 for incomer and class 1 for outgoing feeders. Ammeter and voltmeter to be installed on panel shall be of moving iron type or as specified in the BOQ. All meters shall be 96mm square pattern, flush mounting type with necessary selector switches. Necessary indicating lamps of low voltage type with built in resistors shall be provided (maximum wattage 2.5W).

### 3.1.6 OPERATING MECHANISM:

#### 3.1.6.1

Vacuum Circuit Breaker shall be equipped with motorized spring charge. These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty.

#### 3.1.6.2

Interlocking and Safety Arrangement.

#### 3.1.6.3

Vacuum Circuit Breaker shall be provided with the following safety and Interlocking arrangements:

i. The draw out carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is ‘On’.

ii. The circuit breaker cannot be switched ‘ON’ when the carriage is in any position between test & service position.

iii. The front door of the panel cannot be opened when the breaker is in service position or in an intermediated position.

iv. The low voltage plug & socket cannot be disconnected in any position except test/isolated position.
v. The door cannot be closed unless the LV plug has been fitted.

vi. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed.

vii. Individual explosion vents shall be provided for breaker, busbar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel.

viii. Circuit Breaker & sheet metal enclosure shall be fully earthed.

ix. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the draw out carriage mechanism.

3.1.7 Rating:

3.1.7.1 The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breaker shall be 350 MVA (18.37 KA RMS) at 11 kV. The rated making capacity shall be as per the relevant standards.

3.1.8 Accessories:

3.1.8.1 Circuit Breakers shall be provided with the following accessories.
   i. Auxiliary Switch with minimum 5 NO+ 5 NC auxiliary contacts.
   ii. Tripping Coil
   iii. Mechanical Operation Counter
   iv. Spring Charging Handle

3.1.9 Additional Accessories

3.1.9.1 The loose items to be supplied with the 11kV VCB Panel Board shall comprise of the following:
   a. Instruction Book.
   c. Reaching in/out handle.
   d. Handle for spring charging mechanism.
   e. Foundation bolts.
f. Busbar Earthing & Circuit Earthing Trolley.

3.1.10 Mounting:

3.1.10.1 Vacuum Circuit Breakers shall be mounted as per manufacturer’s standard practice.

3.1.11 Auxiliary Supply:

a. The tripping shall be at 24 Volt D.C. through a power pack unit.

b. Space heater indication & other auxiliary supply requirement shall be at 230 V AC. Necessary termination arrangements complete with isolating switch, control fuse & link shall be provided at one place in the panel for receiving the purchaser’s cable.

3.1.12 CURRENT TRANSFORMER:

Current transformers shall be primary, cast resign type. All secondary connections shall be brought out terminal blocks where Y or D connection will be made.
2. Class 5P20 for other relaying.
3. Class 1.0 and ISF < 5 for metering.

The current transformer shall be capable of safety withstanding the short circuit, stresses corresponding to the fault level as indicated & shall be able to meet the short-time requirement specified.

All CT secondary shall be earthed through separate switch link on terminal block. The secondary terminals of the CTs shall have the provision of shorting and disconnecting facilities by links.

CT terminals & their polarities shall be clearly marked.

3.1.13 VOLTAGE TRANSFORMER:

Voltage Transformer shall be cast-resin, draw out type and shall have an accuracy class of 2.0, 3P. Voltage Transformer mounted on breaker carriage is not acceptable.
High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.

Low voltage fuses, sized to prevent overload, shall be installed in all undergrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.

The connections from main circuit to PT shall be capable of withstanding short circuit stresses.

3.1.14 RELAY
Protective relay shall be numerical type.
Relays shall be of draw out design with built-in site testing facilities. Small auxiliary relays may be in non-draw out execution and mounted within the cubicle.
Relays shall be rated for operation on 24VDC secondary voltages and 5A secondary current. Number and rating of relay contacts shall suit the job requirements.

3.1.15 TESTS:

3.1.15.1 Factory Tests
The circuit breakers panel shall be subjected to routine tests at manufacturer’s Works in accordance with the details specified in the relevant IS specifications. These shall however necessarily comprise of the following.

a. Power frequency voltage test on the main power circuit.
b. Verification of the correct wiring/Functional Test.
c. Dielectric test at 1.5kV on the control circuit. Apart from above, the vendor shall submit the routine test certificates for the following equipment.
   i. Circuit Breakers
   ii. Current Transformers
   iii. Voltage Transformers

The vendor shall submit the type test certificate for following along with the offer.

a. Temperature rise test.
b. Impulse & power frequency voltage test

c. Short time current test on circuit breaker.

3.1.16 Site Test:

3.1.16.1 General:

1. Verification for completion of equipment, physical damage/deformities.
2. Alignment of panel, interconnection of busbars & tightness of bolts & connection etc.
3. Interconnection of panel earth busbar with plant earthing grid.
4. Inter panel wiring between transport sections.
5. Cleanliness of insulators and general Cleanliness of panel to remove traces of dust, water etc.

3.1.17 Circuit Breaker & Panel:

1. Check for free movement of circuit breaker, lubrication of moving part & other parts as per manufacturers manual.
3. Meggar before the Hi Pot test.
4. H.T. Test - Hi Pot test (Power frequency withstand test for one minute at 28kV RMS). At site Hi Pot test is carried out at 80% of 28kV RMS value.
5. Meggar after the Hi Pot test.
6. CT/PT ratio/polarity primary injection test.
7. Secondary injection test on relays to practical characteristics.

3.2 HT CABLES:

3.2.1 Construction:

All H.T cables shall be of 11kv grade XLPE earthed insulated & PVC sheathed Flat steel wires (strips) armored electrical purity aluminum conductor cables shall Be manufactured & tested in accordance with IS Specification.

3.2.2 TERMINATION JOINTS:

Terminal joints shall be carried out as per IS specifications. Heat shrink cable termination kit shall be used for terminations.
3.2.3 INSTALLATION OF CABLES:

Cable laying shall be carried out as per CPWD specifications.

3.5 CABLE TRAY:

Cable tray is manufactured at Indian Standard Specification. Laying is done as per IS & CPWD specification.

3.6 EARTHING:

Earthing specified in BOQ is done as per IS & CPWD specification.

3.7 TRANSFORMERS:

GENERAL FEATURE
Installation : outdoor
Service    : continous
Type of Cooling :ONAN
Position : Plingth mounted

3.7.1 ELECTRICAL DATA
Earthing on LV side : solid
Nos. of winding : Two
Voltage Ratio : 11/0.433 V
Vector Group : Dyn11
Termination on H.V side : Disconnecting type cable box
Size 1 No. 3C x 240 Sqmm AL HT XLPE(E)
CABLE
L.V side : as per drawing.

TAP CHANGER
Tappings : HV circuit
Tap changer : LINK type Off load tap changer
Tapping range : -7.5% to +7.5% (750KVA)
No. of steps : in steps of 2.5%

a)  HV test, if directed by owner in accordance with IS:2026-1962.
b)  Insulation resistance to earth of each winding to earth in accordance with (IS:2026-1962).
c) Ratio Polarity and phasing check (IS-1886).

d) Oil Test (IS-335:1953) should withstand 40 KV/cm

e) Buchholz relay operation and test (by compressed air or other suitable means approved by owner)

f) Operation of all other accessories including OTI, WTI, oil level gauge. No load test for 8 hours prior to throwing load progressively on the transformer.

4.0 L.T. PANELS AND:

4.1 M.V. PANELS:

4.2 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.

4.3 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 2100 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 mm  
ii. Between phases and neutral - 26 mm  
iii. Between phases and earth - 26 mm  
iv. Between neutral and earth - 26 mm  

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions. Creepage distances shall comply with those specified in relevant standards. All insulating material used in the construction of the equipment shall be of nonhygroscopic 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.

4.4 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.
4.5 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 50 kA 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.

4.6 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.

4.7 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.

4.8 TEST AT MANUFACTURES WORK:
All routine tests specified in IS: 8623-1977 shall be carried out and test Certificates submitted.

4.9 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.

5.00 L.T. SWITCHGEARS:

5.01 AIR CIRCUIT BREAKERS;

5.01.1 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.

5.01.2 Technical Specifications:
The Air circuit breakers shall conform to the requirements of IS13947-2 and IEC 60947-2 & their latest amendments and should be type tested & certified for compliance to Indian standards from–CPRI/ERDA. Manufacturer shall submit testreport for combined sequence tests from CPRI/ERDA. The breakers shall besuitable for isolation and should be clearly indicated on the front facia. The Aircircuit breakers shall be suitable for following system conditions:
1) The ACBs shall have $I_{cs} = I_{cu} = I_{cw}$ for 1 sec for short circuit breaking capacity of not less than 50 KA rms at 415 Volts 50Hz AC.

2) Rated Operational Voltage (V) & Frequency: 415 Volts, 3 phase, 4wire 50 Hz.

3) Rated insulation voltage ($U_i$): 1000 volts AC

4) Ambient temperature: designed at 40 degree C ambient temperature. ACB shall be fully rated at inside panel temperature of 50 deg C.

5) Rated impulse voltage 8 KV for Main circuit.

7) Utilization Category: B

All ACBs shall be of electrically operated and draw out type (EDO) unless Otherwise stated. The circuit breakers shall be 3/4 pole (as specified in BOQ) with Quick make/break, trip free operating mechanism. All current carrying parts shall be silver plated and suitable arcing contacts with proper arc chutes shall be provided to protect the main contacts. The ACBs shall be fitted with detachable arc chutes on each pole designed to permit rapid dispersion, cooling and extinction of the arc. It should be possible to remove arc chutes without using any tool & without removing the breaker from the panel. The ACBs shall have minimum mechanical life of 20000 operations for ratings up to 2500A & 5000 operations for higher ratings. It should be possible to extend electrical life of the ACB to mechanical life by replacing the arcing contacts at site. It shall be possible to directly terminate Aluminum links / bus bars as specified in IS13947-2. All 4 Pole ACBs should have fully neutral Pole. Auxiliary switches directly operated by the breaker operating mechanism and having 6NO and 6NC contacts, shall be provided on each breaker. The auxiliary switch contacts shall have a minimum rated thermal current of 10 Amps at 230V ac.

All the ACB ratings shall have a uniform panel door cut-out, on left or right side of the panel for allowing maximum utilization of panel space. The ACB with Panel should meet IP53 protection on breaker front.

Cradle:
The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. Draw out ACBs shall have 4 distinct and separate positions wrt cradle i.e. Service Position, Test Position, Isolated Position and Maintenance. ACB should have facilities for carrying out maintenance without physically removing the breaker from panels. For ease of maintenance, it should be possible to replace jaw contacts without disturbing the busbar links for draw-out type ACBs.
Protection Release:
The protection release of **Incomer level ACBs (except APFC Panels)** should be microprocessor based release having inbuilt adjustable protections against overload, short circuit, instantaneous and earth fault protection with adjustable time delay settings for all protections except instantaneous zone. The release should have separate indication by LEDs for Power ON, Overload, Short Circuit, Instantaneous and Earth Fault, Trip & Alarm. The release should provide following additional protection with necessary modules apart from basic protections:

- Undercurrent
- Current Unbalance
- Reverse power
- Under and over voltage
- Under and over frequency.
- Phase sequence
- Maximum demand exceed

The parameterization should be possible through communication and menu. The release must provide a password protection to access the protection configurations. The release shall meet the EMI / EMC requirements. The release should have high-resolution LCD for comprehensive metering with the following parameters:

- Phase and Neutral currents (running, avg & max), percentage loading etc
- Phase voltages (P-P & P-N) (running, avg & max)
- Energy & power parameters (active, reactive and apparent)
- Maximum demand in KW
- Power Factor
- System Frequency
- Harmonic- Voltage & current

5.01.2 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 draw out type unless otherwise specified) with horizontal draw out 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. Inter phase barriers shall be provided to prevent flashover between phases.

5.01.3 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 energized. 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.

5.01.4 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.

5.01.05 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 specified at 415 volts. The rated making capacity shall be as per the relevant standard.

5.01.06 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.

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

5.01.08 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.

5.02 MOULDED CASE CIRCUIT BREAKERS:

5.02.01 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/0.8 In to 1.0 In. as per BOQ.

5.02.02 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 25KA / 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. 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. 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.

5.02.02 FRAME SIZES:

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

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

5.02.03 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.

5.02.04 BREAKING CAPACITY:

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

5.03 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.

5.03.1 MINIATURE CIRCUIT BREAKERS:

Miniature Circuit breakers shall be current limiting type conformed with British Standard BS: 3871 (Part I) 1965 and IS: 8825. The housing of MCBs shall not be less than 9000 A at 230 V. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical ‘ON’ and ‘OFF’ indications.

The Circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit.

The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.

5.03.2 FUSE:

Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS: 2000-1962 and having high rupturing capacity of not
less than 35 MVA at 415 V. The backup fuse rating for each motor/equipment shall be so chosen that the fuse does not operate on starting of motors / equipment. HRC fuses shall be of the make as specified in Make of material.

5.04 MEASURING INSTRUMENTS, METERING & PROTECTION:

5.04.01 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 voltimeters 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.

5.04.02 AMMETERS:

Ammeters shall be moving iron or moving coil type. The moving part assembly shall be with jewel bearing. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks, the ammeters shall be manufactured and 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.

5.04.03 VOLTMETERS:

Voltmeter shall be of moving iron or moving coil type. The range for 415 volts, 3 phase voltmeters 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.

5.04.04 CURRENT TRANSFORMERS:

Current transformers shall be in conformity with IS: 2705 - 1964(Part I, II & III) in all respects as amended upto date. 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.

5.05 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.

Colour shade for the indicating lamps shall be as below – the LED shall be 22.5 mm and self coloured:

ON indicating lamp : Red
OFF indicating lamp : Green
TRIP indicating lamp : Amber
PHASE indicating lamp : Red, Yellow, and Blue

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. The contacts shall be of silver alloy and rated at 10 Amps. Continuous current rating.

**5.06 DRAWING & INFORMATION:**

Prior to fabrication of the panels the supplier/contractor shall submit for consultant’s approval the shop / vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, busbar size, internal wiring size, panels dimension, colour, mounting details etc. The contractor shall submit manufacturer’s catalogues of the electrical components installed in the panels.

**INSPECTION & TESTING:**

At all reasonable times during production and prior to transport of the panels to site, the supplier/contractor shall arrange and provide all the facilities at their plant for inspection.

Testing of panels shall be carried out at factory and at site as specified in Indian standards in the presence of consultant / client. The results shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate to the consultant for approvals.
**METHOD OF MEASUREMENT:**
All the items will be measured as mentioned in Bill of Quantity.

**6.00 INTERNAL ELECTRIFICATION OF BUILDING:**

**6.1 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 – 2005 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.

**6.2 DISTRIBUTION BOARDS:**
As a general practice only pre-wired MCB type double door DB shall be used. Prewired DB shall have following features:

i) Recess/ surface type with integral loose wire box.

ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.

iii) DIN channel for mounting MCBs.

iv) Arrangement for mounting incomer MCB/RCCB/MCCB as required.

v) Copper bus bar.

vi) Earthing terminals.

vii) Wiring from MCBs to terminal block.

viii) Interconnection between terminal block/ incoming switch/ bus bar/ neutral/terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
ix) Termination block should be suitable for termination of conductor/cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.
x) Terminal block shall be made of flame retardant polymide material.
xi) Coloured terminal blocks and FRLS wires for easy identification of RYB phases, Neutral and Earth.
xii) Pre-wired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.
xiii) The pre-wired DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.
xiv) Detachable plate with knock out holes shall be provided at the top/bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from 1.6mm sheet steel, properly pretreated, phosphotized with powder coated finish.
xv) DB shall be of double door construction provided with hinged cover in the front. 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 10 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. Residual Current Circuit
Breaker shall be current operated type and of 100mA sensitivity unless otherwise specified.
Distribution Boards shall be ready for connections and shall be inspected in the factory by NKDA Electrical Engineer before dispatch. Before procurement of Distribution Boards, MCB’s, RCCB’s (incomer and Outgoings) etc., the contractor has to take approval of the DB Schedule /Drawings of each DB from the NKDA Electrical Engineer. The whole unit i.e. Distribution Board, MCB’s, RCCB’s etc. shall come from the manufactures premises/workshop. After inspection and clearance from the NTKDA Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as RCCB 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 NTKDA Electrical Engineer.

6.3 PVC CONDUIT WIRING SYSTEM.

6.3.1 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.

6.3.2 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 13mm 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.

6.3.3 PROTECTION AGAINST CONDENSATION:
The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

6.3.4 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 anticorrosive preservative or covered with approved plastic compound.

6.3.5 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.

6.3.6 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. In case 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 burying 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.

6.3.7 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.

6.3.8 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 NKDA 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.

6.3.9 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 5 pin type and 15 Amp socket shall be 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.

6.3.10 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.

6.3.11 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.

6.4 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

6.5 Bunching of Cables:
Conductors of different circuits / different phases / different voltages shall be bunched in separate conduits. The number of insulated cables that may be drawn into single conduit is given in the following table with maximum space factor of 40%.

<table>
<thead>
<tr>
<th>Nominal section mm²</th>
<th>Cross area</th>
<th>Number and diameter in mm of wires</th>
<th>Size of Conduit (mm) outside diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>19/20 25 32 40 50</td>
<td>1/0 S/B S/B S/B S/B</td>
</tr>
<tr>
<td>1.5</td>
<td>1/ 1.4</td>
<td>7/5 12/10 20/14 ---</td>
<td>---</td>
</tr>
<tr>
<td>2.5</td>
<td>1/ 1.8</td>
<td>6/5 10/8 18/12 ---</td>
<td>---</td>
</tr>
<tr>
<td>4.0</td>
<td>1/ 2.24</td>
<td>4/3 7/6 12/10 ---</td>
<td>---</td>
</tr>
<tr>
<td>6</td>
<td>1/ 2.8</td>
<td>3/2 6/5 10/8 ---</td>
<td>---</td>
</tr>
<tr>
<td>10</td>
<td>1/ 3.55</td>
<td>2/0 5/4 8/7 ---</td>
<td>---</td>
</tr>
<tr>
<td>16</td>
<td>7/ 1.7</td>
<td>--- 2/0 4/3 7/6 ---</td>
<td>---</td>
</tr>
<tr>
<td>25</td>
<td>7/ 2.24</td>
<td>--- --- 3/2 5/4 8/6</td>
<td>---</td>
</tr>
<tr>
<td>35</td>
<td>7/ 2.5</td>
<td>--- --- 2/0 4/3 7/5</td>
<td>---</td>
</tr>
<tr>
<td>50</td>
<td>7/ 3</td>
<td>--- --- --- 2/0 5/4</td>
<td>---</td>
</tr>
</tbody>
</table>

The above table shows maximum capacity of conduits for the simultaneous drawing of cables. Supply to runs of conduit which has distance not exceeding 4.25M between drawn in boxes and which do not deflect from the straight run by an angle more than 15°. The B applies to runs of conduit which deflect from the straight run by an angle more than 15°.

6.5.1 JOINTS:
All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits and junction boxes. Conductors shall be continuous from outlet to outlet.
6.5.2 LOAD BALANCING:
Balancing of circuits in three-phase installation shall be planned before
the commencement of wiring and shall be strictly adhered to.

6.5.3 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 incase of insulated earth wire.

6.5.4 CLASSIFICATION OF POINTS:
6.5.4.1 General:
Classification and measurement of Point wiring shall be as per CPWD

6.5.4.2 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/MB. 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.
(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).
   b) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not pre-wired).
   c) Back Plate (in the case of stiff pendants).
   d) MS Fan Boxes with MS hook (as per CPWD specifications) for the erection of Ceiling Fans

**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.
6.5.5. Circuit and Sub main Wiring:

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

Sub main Wiring:
Sub main wiring shall mean the wiring from one main/distribution switchboard to another.

Measurement of circuit wiring and sub main wiring:

(i) Circuit and sub main 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 sub main 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 sub main wiring.

6.5.6 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 PVC Conduit (including supplying and fixing PVC 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 number basis.
from Switch board/15A power point to 5A point. Conduit of point wiring/power point wiring can also be used for 5A point wiring, but both phase and neutral wires shall come directly from switchboard/power point. Looping of neutral shall not be done.

15A Power Plug Wiring:

Wiring for all 15 A Socket Outlets point shall be done with 2X4 sq.mm. PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing PVC Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board or from one power point 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 point wiring shall be done on number basis under following two subheads:
  i) Directly from MCB-Distribution Board to the Socket Outlets  
  ii) From One power point/computer power point to another (looping)

6.5.7 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 - 1.5Sq.mm  
  iii. Call Bell Point - 1.5Sq.mm  
  iv. Plug Point (5 A Outlet) - 1.5Sq.mm  
  v. Circuit Wiring - 1.5Sq.mm & 2.5sqmm.  
  vi. General Power Point - 4Sq.mm

6.5.8 LIGHTING FIXTURE AND FANS:

6.5.8.1 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.

6.5.9 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.

6.5.10 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.

6.5.11 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.

6.5.12 FIXTURE SAMPLES:

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

6.5.13 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.

6.5.14 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
6.5.15 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.

7.00 TELEPHONE SYSTEM:

7.01 Telephone point wiring:

(a) The point wiring shall be carried out with Five pair telephone wire/cable, unarmored, PVC insulated, 0.5 mm dia annealed tinned copper conductor (IS:2532-1965)in suitable size conduit (one pair always remaining spare for one point) Minimum Dia of Conduit for Internal/External Telephone Wiring - 20mm. If more than one telephone point has to be provided at one point, multicore, unarmored telephone cable shall be used (pairs required are equal to 2 nos. of points) in suitable size of conduit.

(b) The point shall commence from the main telephone tag box/sub tag box and would terminate at outlet box of point. Connection at both ends included in point wiring.

(c) Fixing of conduit, conduit accessories draw out boxes and outlet box etc. in concealed/surface conduit works as that of wiring for light fixtures shall be applicable for telephone wiring conduit system also.

(d) Joint in telephone wiring (between main tag box/sub tag box and outlet box of point) shall not be allowed and the contractor should bear the wastages of wire if resulted due to this special requirement of telephone system.

(e) External/Internal telephone and intercom wiring can be drawn in the same conduit, provided after drawing wires, 50% of conduit cross sectional area is free. However, independent PVC insulated telephone wire of suitable pairs shall be used for external, internal and intercom.

(f) To identify each pair of multipair telephone wire/cable, PVC indication numbers shall be put on both ends of pair just before termination.
7.02 Telephone Tag Boxes:

These shall be of MS sheet 2 mm thick with connector suitable for telephone connection (as approved by ITI). It shall have hinged MS sheet cover.

8.00 ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM:

8.01 GENERAL:

The Contractor shall supply and install the Addressable Fire Detection & Alarm System as per schedule of quantities are as herein specified. The system shall include Addressable Main Fire Alarm Control Panel with microprocessor based, software complying with BS5839 Part 4(1995) & CE mark, battery charger, batteries, addressable heat detectors, addressable smoke detectors, manual fire alarm station, fire alarm bells/hooters, response indicators, conduiting, wiring and all necessary accessories required to complete fire alarm system installation as per IS: 2189-1988. Equipment like control panel, smoke detector, heat detectors etc shall be EN-54/ UL approved.

8.02 FEATURES:

The system shall be general alarm electrically supervised type activation of manual fire alarm station or any of the automatic alarm initiating devices shall sound the general alarm bells on all floors and shall give indication on the control panel. The signal shall be continuous unit the station from which it is originated is restored to normal and a reset button on the control unit is operated.

The system shall be electrically supervised against open and ground on both the stations and signal device wiring. Open and ground in the system shall cause a trouble bell to ring at the fire alarm control panel and a trouble lamp to light. It shall be possible to silence the bell but the lamp shall remain lit until the fault is rectified. Incase of power failure the system shall automatically changeover to the battery standby.
8.03 CONDUITING & WIRING:

Conducting & Wiring for FDA system shall be carried out in PVC Conduit with copper conductor PVC insulated wires.

8.04 CONTROL PANEL:

The fire control panel has to be addressable type. The Main Fire Control Panel shall be constructed to sheet steel of red colour, and provided with windows for the alarm and trouble lights. All components shall be of the plug in type, for simple replacement and extension in the future. Control panel shall be wall mounting type conforming to IS 513-1986. The number of loops is mentioned in B.O.Q. Each loop shall be able to support at least 128 any device addressable analog/digital (as the case may be) sensors and control module etc. The control panel shall have alphanumeric display. The Main Fire control panel shall be provided with all necessary relays, resistors, fuses, transformers, rectifiers and all other components to assure full and proper functioning of the system. All relays shall conform to the relevant IS Standards. Control panel shall include power include power on lamps, system trouble lamps, audible trouble signal, trouble silence switch with ring back, alarm silence push button with repeat alarm capability, low battery indicator with reset, ground detection indicator, alarm reset, milli ammeter, supervised alarm lamps, zone "Open" test pushbutton, zone alarm test push button, end of line resistors etc. Each zone shall be equipped with an auxiliary contact for control of a remote annunciation. Main control panel shall include a power supply model to provide a filtered and regulated source of power to provide additional power wherever supplementary power is required within the system. It shall include an output fuse, key reset switch, provision for automatic transfer to standby power upon primary power failure. Main control panel shall in addition have audible signal and lamp to indicate as failure of the charge of battery. Two stages general Alarm shall be provided in which a continuous evacuation alarm is immediately given in zone of fire and its adjoining zones. In other zone intermittent alarm signal shall be provided as per IS 2189-1988. Repeater Panel shall be of same specification as main control panel and shall have fire/fault indication with audio device.
8.05 CHARGER AND BATTERY:

Unit shall comprise a ventilated cabinet supplied complete with charger, meters, high rate charge switch and lock and key in a sheet metal enclosure.

8.06 ELECTRONIC HOOTERS:

Hooter shall be electronic solid-state speaker type having tone for fire, which shall be wailing. Hooter should be loop powered having an output of approximately 6 watt. The audible range shall be around 100m under normal condition. Cable for this in our system shall be 2 cores. The switching shall be provided on the control panel. The outer enclosure of the speaker shall be of MS sheet and shall be suitably oven baked and painted. The speaker shall be 4" heavy magnet type. All hooters shall be on one or more circuits.

8.07 MANUAL ALARM CALL POINT FOR SURROUNDINGS (ADDRESSABLE)

The manual call point shall be electrically compatible with the standard range of automatic detectors so that it can be connected directly into a supervised two-wire zone of the manufacturer's standard range of control units. The manual call point shall be of pleasant, streamlined and flat appearance permitting its use as flush and surface mounted unit. The manual call point shall consist of base plate, insert and cover. The push button shall have minimum one normally closed plus one normally open contacts. The push button shall not be shrouded and the same shall be projected out from the surface of the MS Box. The whole assembly of push button shall be enclosed in the 16 SWG MS Box except from the front side. The front side shall be sealed with breakable glass covering neoprene or equivalent gasket. The glass cover shall be fixed in such a way that the actuating push button is kept depressed (with NC contact open) so long as the glass cover is in contact. In case of fire, when the glass cover is broken to give the fire warning the push button shall be released due the spring action hence giving remote fire alarm through the NC contact. The breaking of the glass must release an alarm. All inscriptions, texts and marks must be on the manual call point front plate, not on the glass, so that the glass can easily be replaced anywhere. The alarm contacts shall be of self-cleaning design to prevent
failure after a prolonged period of inactivity in unclean environments. It shall be possible to test the call point without destroying the seal or removing the cover. The manual call point shall be equipped with a self-holding device to maintain the alarm condition until reset by an authorized person. The complete unit and the push button shall be painted signal Red. The internal surface of the MS enclosure of the box shall painted white colour. The external painting shall be of synthetic enameled paint. Aluminium hammer shall be suspended on a hook fixed to the external MS enclosure by means of a non-corrodible easy breaking of the glass cover. Manual alarm call point located on the outer walls of the building and/or exposed to weather conditions shall be weather proof type and satisfying the requirement of APB. The manual call point shall be capable of being remotely tested from control panel.

8.08 OPTICAL (PHOTOELECTRIC) TYPE SMOKE DETECTORS (ADDRESSABLE TYPE):

The optical type smoke detectors shall be based on light attenuation by smoke/ or light scattering by smoke particles. Smoke detectors shall have an inherently stable sensor with built-in automatic compensation for changes in ambient conditions. All electronic circuits must be solid-state devices and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. The response sensitivity of each detector shall be factory set. A built-in barrier shall prevent entry of insects into the sensor. The detector shall be designed for fast and simple laboratory cleaning. The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The manufacturer shall produce and provide test equipment allowing to test and exchange smoke detectors upto 7m (23ft) above floor level. The detector shall connect to the control unit via a fully supervised two-wire circuit. The detector shall be capable of being remotely tested from control panel.
8.09 HEAT DETECTOR (ADDRESSABLE TYPE):

Heat detector shall be combined rate of rise and fixed temperature type. Heat detectors shall consist of two independent thermistors, designed to automatically compensate virtually hermetically sealed to prevent their operation from being impaired by dust, dirt of humidity. All circuitry must be protected against usual electrical transients and protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. It shall be possible to test the detector in the field. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness. The detector shall be installed into the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The detector shall connect to the control unit via a fully supervised two-wire circuit. The manufacturer shall produce and provide test equipment allowing to test and exchange rate-of rise/fixed temperature heat detectors up to 7m (23ft) above floor level. The detector shall be capable of being remotely tested from control panel.

8.10 PLUG-IN BASES:

The smoke & heat detectors shall fit into a common type of standard base. Once a bases has been installed, it shall be possible to insert, remove and exchange different types of detectors by a simple push-twist movement. The standard base shall be equipped with crewels wiring terminals capable of securing wire sizes up to formation and weakening of contact pressure. The standard base shall be supplied with a sealing plate, preventing dirt, dust, condensation or water from the conduit reaching the wire terminals or the detector contact points. All standard bases shall be supplied with a removable dust cover to protect the contact area during installation and construction phase of the building. It must allow the check out and certification of the zone wiring before insertion of any detectors. The standard base shall feature a built-in mechanism, which allows mechanical locking of as installed detector head, thus preventing unauthorized removal or tempering while maintaining. The detector contact points shall be designed to retain the detector safely and to ensure uninterrupted
contact also when exposed to continuous severe vibration. All electronic components of base and modules must be solid state and virtually hermetically sealed to prevent their operation from being impaired by but, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The standard base shall allow snap-on insertion of an (optional) electronic module, it shall be possible to turn a standard base part into an individually addressable detector base with its own unique identification address at the control unit. The standard base shall have a built in alarm indicator which is repeatable by connecting a simple 2 core wire to the base. No changes in the zone wiring shall be required to operate the additional alarm indicator. Removal and insertion of dust covers or detectors shall be feasible by a simple push twist movement, even if the locking device has been activates. Special base assemblies shall be available for use in air ducts and aspiration air-sampling system wherever required. Contractor is required to submit samples and get approved from NKDA Electrical Engineer of all above mentioned items including Response Indicators, Hooters, manual call points.

9.00 GENERAL TECHNICAL SPECIFICATION OF ELEVATOR

9.1.0 GENERAL
This specification covers the minimum requirements for the design, engineering, Manufacture, inspection, testing, supply and installation of Passenger cum Freight Elevator. This Elevator shall be provided for transportation of goods and passengers from grade to the highest platform with number of intermediate landings as described in the Architectural drawings. All elevations, number of landings shall be reviewed post order stage for compliance with operational requirements of the plant.

9.2.0 SCOPE OF SUPPLY AND SERVICES

9.2.1 Scope of supply:
The Contractor shall supply one (1) no. Passengers cum Freight Elevator of 1.5T complete with, but not be limited to, the following:
- Complete Car body with door, Fan on top, Operating device(s), Car Guide etc. with all other accessories.
- Counterweight and its guide rails with suitable fixtures.
- Drive mechanism with rope & sheaves - located in machine room.
- Accessories such as limit switches, landing stop switches, door contacts, alarm bell, car buffers, counterweight buffer and all other necessary accessories for ensuring safe operation of lift.
- Operating device at landing with necessary indicating devices.
- Landing door with necessary contacts.
- Landing door with emergency unlocking facility.
- Over speed safety mechanism
- Pit ladder.
- Lighting in the car.
- Lighting in hoist way and pit
- CP Block of adequate capacity in machine room for maintenance purpose.
- All Electrical equipments as per attached data sheets and Electrical specification.
- Supply of Lubricants.
- Commissioning spares.
- Special tools and tackles for maintenance.

9.2.2 Scope of services:

The scope of services shall include, but not be limited to, the following.
- Design, Engineering, Manufacture, Testing, Painting and Supply of the complete equipment at site.
- Erection of Passenger cum Freight Elevator equipment complete including cutting holes, welding supports, brackets and counterweight rail brackets.
- Properly framed and enclosed hoist way including its extension (machine room) above the roof. All civil & foundation works.
- Passenger cum Freight Elevator pit of proper depth below the lowest landing.
- Continuous sill bearing area for each hoist way entrance of proper construction so as to achieve anchorage and support for each sill, if & wherever required.
- Monorail beam in the machine room and rolled steel sections with bearing plates for support of the machine with metal grating, buffer support channels in the pit.
- All safety norms as per statutory regulations shall be complied by Elevator Package vendor.
- Elevator over weight safety shall be considered by elevator package vendor.
- In case of power failure the lift should travel to the nearest floor and stop with gate wide open till power resumed.
- Contractor shall arrange inspection and initial certification of Elevator installation at site by statutory authorities. All inspection/certification expenses shall be borne by contractor. However, statutory fees shall be paid by the Purchaser.
- Contractor / Vendor's free maintenance shall be available on the Passenger cum Freight Elevator for a period of one year after the Passenger cum Freight Elevator equipment is commissioned and handed over to the purchaser. During free maintenance period, Contractor / Vendor shall carry out load testing and safety checks once in six month to meet the statutory requirement.
- After free maintenance period, the Elevator Vendor's AMC services shall also be available for regular maintenance of Elevator on chargeable basis, for which Elevator Vendor shall quote AMC charges separately on yearly basis to Client. Elevator Vendor shall be obliged to provide AMC (renewable every year) for lifetime of equipment.
- Maintenance (Free as well as AMC) shall be for routine inspection of Elevator, checking of clearances, necessary adjustment, lubrication etc. The replacement of damaged parts shall be by Elevator Vendor within AMC.
- Attending breakdowns of Elevator within short notices shall also be part of maintenance work.

9.3.0 CODES AND STANDARDS:
Following codes and standards (latest edition) shall be followed for design, fabrication, testing etc.
The installation and testing shall be carried out as required by the local codes and as per normal practice prevalent in the Lift Industry, Lift Act & Rules. All electrical equipment / works in connection with electric Passenger cum Freight Elevator shall be in accordance with the latest provisions of Indian Electricity Act 1910 and Indian Electricity Rules.
9.4.0 TECHNICAL REQUIREMENTS:

The Passenger cum Freight Elevator shall generally be endowed with following minimum features. Additional features required as per Elevator Vendor’s standard design shall also be provided.

9.4.1 Drive Unit:

The Drive Unit shall be of the single wrap traction type, and shall include a motor, electro-mechanical brake, reduction gear, sheave, shaft, all compactly mounted on a single base plate. The worm shaft and sheave shaft shall be provided with suitable bearings. The bearings shall be selected for minimum 40,000 hrs life. The driving sheave shall be grooved to ensure sufficient traction and minimise rope wear. Adequate means of lubrication shall be provided for all bearings and gearbox.

9.4.2 Base Plate:
A properly machined drive unit base plate of steel construction shall be supplied.

9.4.3 Foundation:

The machine shall be placed directly above the hoist way in machine room on suitable steel structure and RSJ sections with suitable anti vibration pads in between machine base plate and its support to reduce vibration.

9.4.4 Brake:

The direct current brake shall be spring applied and electrically released and designed to provide smooth stops under variable loads.

9.4.5 Controller:

An automatic controller shall be provided which shall control all the operations starting/ stopping, application of brake in case of power failure etc. An automatic rescue device shall be provided, that will move lift to the nearest upward and downward landing (subject to load) in the event of power failure.
9.4.6 Ropes:

The Passenger cum Freight Elevator shall be provided with traction steel hoist ropes (galvanized).

9.4.7 Car Frame:

The car frame consisting of car enclosure and the floor shall be fabricated out of rolled sheet sections. Suitable guides shall be provided for smooth up/down movement of the car. The car safety device shall be located underneath the car frame. Floor plate shall be chequered type. The car frame shall be robust enough to withstand occasional impact loading by a forklift or platform truck.

9.4.8 Operating Devices:

These shall be furnished as flush type finished metal panel containing buttons marked to correspond with landings served. An emergency stop switch and an alarm button connected to a bell shall serve as an emergency signal. It shall be possible to operate the Passenger cum Freight Elevator both from inside the car and from various landing floors.

9.4.9 Door Open & Emergency Bell:

A bell, furnished and installed in the car, shall ring while a landing button is pressed and the car gate or hoist way door is open. Emergency call bell shall be provided at ground floor. Contractor shall also make provision to extend the alarm to nearby control room.

9.4.10 Car Gate Contact:

An electric contact shall be provided for the car door or gate. The contact shall be designed to prevent movement of the car away from a landing unless the door or gate is in properly closed position. For starting the lift, the door shall be closed manually and a button shall be pressed.

9.4.11 Car operation:

The car shall not start unless the car gate is in the closed position and all hoistway doors are locked in the closed position. Momentary pressure of car or hallway button shall send the car to the landing selected where
the car will automatically stop. Car operation shall be of “simplex full collective up and down” type. Momentary pressure of a landing button shall bring the car to the desired landing. Car position shall be indicated at all the floors and also inside the car.

9.4.12 Guides:

Contractor shall furnish steel Tee guides with necessary brackets for car and

9.4.13 Hoist way Door and Car Door:

The hoist way door as well as the car door shall be of sliding shutter collapsible type (vertical bi- parting) of steel construction and shall be suitable for manual operation. Each hoist way door shall be provided with an interlock, which shall prevent movement of car away from the landing unless all the doors are closed and locked. The interlocks shall also prevent opening of the doors except at the landing where the car is stopping or has stopped.

9.4.14 Hoist way Landing:

Suitable Push button shall be provided at each landing. It shall be possible to load the Passenger cum Freight Elevator at any floor and send unmanned to any floor.

9.4.14 Counter Weight:

For economical operation of the Passenger cum Freight Elevator suitable counter weight arrangement, moving in guided structural steel frame, shall be provided.

9.4.15 Over speed Safety:

An over speed safety device to stop the car whenever the car achieves runaway speed limit resulting from high speed descending of the car, shall be provided. The device shall be operated by a centrifugal governor, which continuously and automatically senses the car speed. The actuation of the safety device shall cut off the power supply to the motor and apply the brake immediately. An alarm shall be activated.
Afterwards it shall be possible to bring the car safely to the nearest landing to rescue men and materials.

**9.4.16 Terminal and Final Limits:**

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landing. To arrest movement of car beyond the terminal landings, final limit switches shall be provided which on operation shall cut off the power and apply the brake immediately. Inching device shall be provided for accurate positioning of the car with the landings.

**9.4.18 Terminal Buffers:**

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 provided by purchaser, placed between both the car and counterweight guide rails.

**9.4.19 Indications:**

Following signals shall be provided:
1. Hall buttons with Up/Down arrows at all floors
2. Car position indication with arrow in the car.
3. Car position indication with arrow in hall on all floors.

**9.4.20 Following details shall be displayed inside car:**

1. Name plate indicating capacity of lift.
2. Operating instructions in English and Hindi language.

**9.4.21 Emergency rescue procedure shall be displayed in machine room.**

**9.4.22 Electrical Equipment:**

One point power supply of 415V, 3 Phase, 4 Wire + 10% and 50Hz + 3% shall be provided to the package unit Power Distribution Board (PDB) / Panel in machine room, further distribution shall be by vendor. electrical works for the Elevator shall be in Elevator Vendor’s scope and shall be as
per enclosed Electrical specification. Electrical equipments as listed below but not limited to following shall be in package vendor's scope.
- Motors.
- Power distribution board(Package unit panel)
- VVVF drive.(As required for Vendor design)
- Power and control cables along with accessories i.e. cable gland (brass/Nickel cadmium ,double compression) and lugs including hardware.

Cable specification shall be as follows,
MV Power cables shall be with stranded Aluminium conductor,XLPE insulation,PVC inner sheath,armoured and overall FRLS PVC outer sheath. All Control cables shall be copper conductor ,XLPE insulation,PVC inner sheath,armoured and overall FRLS PVC outer sheath.
Cable type shall be selected to meet the Statutory requirements.
- Lighting panel ,Lighting fixtures,Emergency light fixtures(With 2 hour battery backup) and receptacles for maintenance along with cables, Cable gland, Lugs and junction boxes including hardware etc. for Lighting inside Car(Elevator), hoist way, Pit and machine room etc.
- Earthing material including hardware and accessories for all equipments under Elevator package. Package Earthing shall be connected to nearest main earth grid.
- Paging handset , speaker, Power and Signal cables upto Junction box (at ground floor near staircase) with all accessories including hardware.
- Push buttons switches,Selector switches and Alarms bell etc.required for package.
- Junction boxes as required.
- Miscellaneous items for completing Electrical works in all respect.

9.4.23: Provision shall be made in Elevator control panel to hook-up Signal for Emergency operation from Fire alarm System.

9.4.24: Make of major Equipments shall be as below.
Motor : Bharat Bijlee/ Crompton geaves/ Siemens/Marathon Electric/Kirloskar.
VVVF drive : Rockwell / L & T / Siemens / ABB / Hitachi / Toshiba / Fuji.
Switchgear components : L & T / Siemens / Schneider.
Power and control cables : Nicco / Polycab / RPG / Universal cables.
Lighting Fixtures : Bajaj / Crompton / Philips.
Cable glands and Junction boxes : Baliga / FCG flameproof / FCG Power / Flexpro Electrical.

9.4.23: Access to elevator door should not be less than the width of the car.

9.4.24 Also, forklift access to the grade level landings shall be ensured while making layout. If there is not enough space for the fork lift access, suitable double door arrangement on the other side of the lift shall be provided with proper approach the ground floor.

9.5.0 INSPECTION AND TESTING:

All equipment shall be subjected to stage wise expediting, inspection and testing at vendor’s/sub-vendor’s works by purchaser/ authorized inspection agency. Contractor shall submit Quality Assurance (QA) procedure before commencement of fabrication for review. Approved QA procedure shall from the basis for equipment inspection. Contractor shall carry out the tests as required by the local code and as per normal practice of the lift industry. Over-load testing will be done as per IS Code for Freight Elevator.

APPROVAL OF ELEVATOR INSTALLATION:

Contractor / Elevator Vendor shall comply with the requirement of local laws and statutory authorities. Lift inspection etc. and getting the requisite certification for operation of lift at site is included in Contractor’s scope of services. All inspection / certification expenses shall be borne by Contractor.

9.6.0 GUARANTEE:
The Contractor shall stand guarantee specifically for the following performance.
- Rated capacity of the Elevator.
- Speed of the Elevator.
- Accurate positioning of the Elevator at all landings.
The above shall be proved at site during Performance Guarantee Run.
9.7.0 LIST OF SUGGESTED VENDOR FOR ELEVATOR:

1. M/s OTIS, INDIA
2. M/s KONE, INDIA
3. M/s MITSHUBISHI INDIA.
4. Johnson Lifts Ltd., India

10.00 LT CABLES:

10.1 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.

10.2 MATERIAL:

The L.T. power cable shall be 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-I) with up to date amendments.

10.3 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 NKDA Electrical Engineer. Cable laying shall be carried out as per CPWD specifications.

10.4 INSPECTION:

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

10.5 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.

10.6 LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING:

Cable shall be laid on perforated GI. 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 GI clamps/saddles. Care shall be taken to avoid crossing of cable.

10.6.1 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.

10.7 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.

11.00 CABLE TRAY:

11.2 Perforated Type Cable Tray:

The cable tray shall be fabricated out of slotted/perforated GI. Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. These shall be galvanized or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with cross-bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing. 2mm thick GI perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

11.3 Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

11.4 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

11.5 The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

11.6 The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 300mm.
11.7 Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II -1994). The radius of bend, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

11.8 The cable tray shall be suspended from the ceiling slab with the help of 10mm dia GI rounds or 25mm x 5mm flats at specified spacing as per CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 300mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the NKDA /Consultant to take the weight of the cable tray with the cables.

11.9 The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

11.10 The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.

11.11 The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross-joints, etc, and paid for accordingly.

12.00 EARTHING:

12.01 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.

12.02 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 galvanized GI strip.

Minimum distance of 2 mtr. Shall be maintained between other electric conductor, earthing conductor and the conductor laid for the lightning protection system.

The earthing met conductors, risers, earthing cables, etc. passing through walls shall be covered with galvanized iron sleeves for the passage through wall.
Water stop sleeves shall also be provided wherever the earthing conductor enters the building from outside.

12.03 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.

12.04 GI pipe shall be of medium class 50mm dia and 3.04 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
2 metres 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.

12.05 PLATE EARTH ELECTRODE:

Earthing shall be provided with either GI plate electrode or copper plate electrode of following minimum dimensions.

i. Copper Plate Electrode : 600mm x 600mm x 3.12 mm 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 cast 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.

12.06 RESISTANCE TO EARTH:

The resistance of earthing system shall not exceed 5 ohm.

13.00 SAFETY EQUIPMENTS:

13.01 DANGER NOTICES:

Danger notices shall be affixed permanently in a conspicuous position in Hindi or English and the local language of the district with sign of skull and bones at every overhead lines, transformer, electrical equipments motors, etc.

13.02 FIRST AID BOX:

Standard first aid box with all standard contents shall be supplied.
13.03 FIRE BUCKETS:

The fire bucket unit shall consist of our galvanised iron baskets, which shall be with round bottom, and of 13 liters capacity. They shall be filled with dry sand. Arrangement shall be made to hang them on GI pipe stand comprising of at least 2 vertical and one horizontal members of 50 mm GI pipe. The stands shall have hooks and locking chain arrangement. The buckets and stand shall be painted with epoxy red paint.

13.04 FIRE EXTINGUISHER:

Foam type Fire extinguishers of 9 Kg. capacity and Dry Chemical type Fire Extinguishers of 10 Kg capacity shall be of approved make. It shall be filled with carbon tetrachloride. It shall have horns. Extinguishers shall be fixed on walls/columns with necessary clamps made out of 50 mm x 6mm MS flat and coated bolts and nuts grouted in wall/column.

13.05 RUBBER MAT:

Corrugated rubber insulating matting shall be provided in front of all power & motor control centers, push button station and distribution board in the electrical rooms. The width of matting shall be one meter. It shall be as ISI mark.

13.06 INSTRUCTION CHART:

Printed instruction chart both in English and Hindi and duly framed with front glass, prescribing treatment to be given to persons having Electric shock, shall be supplied.

14.0 DIESEL GENERATOR SETS:

14.1 INTENT OF SPECIFICATION:

14.1.1 This specification covers the design, manufacture, assembly, packing, dispatch, transportation supply, erection, testing, commissioning, performance and guarantee testing of Diesel Gen-sets with Acoustic Enclosure, complete in all respects with all equipment,
fitting and accessories for efficient and trouble free operation as specified hereunder.

14.2 SCOPE OF WORK:

14.2.1 Scope of Supply & Services:

General Scope of work shall include, supply, erection, testing and commissioning of the following:

a) Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/rigid coupling complete with all accessories for starting, regulation and control, including base frame etc. interconnecting piping and accessories, power and control cable glands and lugs.

b) Diesel Local/Remote control panel including cables between bidders local equipment and special cables if any.

c) Equipment necessary for engine cooling system, radiators, pumps, valves, interconnecting pipes etc.

d) Equipment necessary for fuel storing and distribution, day oil tank (990 Lt.), piping, pumps, valves, level indicators etc.

e) Flexible connections and residential type silencer of exhaust system, including thermal lagging.

f) Batteries with iron battery stand and battery charging equipment, including their connections as necessary along with tools & accessories for battery maintenance.

g) Anti Vibration Mountings etc.

h) Preparing all related shop drawings for approval from client/consultant and statutory bodies.

i) Obtaining approval of the installation of Diesel Generators by the Electrical Inspectorate and Pollution Control bodies and any other statutory bodies.

j) Minor civil works like chasing, grouting etc. for execution of jobs.

k) Carrying out performance and guarantee test at site available load but not more than the capacity of D.G. Set.

l) Acoustic enclosure as per CPCB norms and type approved.

14.2.2 Specific Exclusions:
Following items of works are excluded from the scope of works under this specification:

a) All civil works relating to DG foundation etc.
b) All cables between contractors and owners equipment other than special cables external to the equipment.

14.3.2 The installation work shall conform to Indian Electricity act and Indian Electricity Rules as amended up to the date of installation.

The fuel oil installation shall meet all statutory requirements of Govt. of India as amended up to the date of installation. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the contractor of these responsibilities.

14.3.3 Equipment conforming to any other National/International Standard which ensures equal or better quality may be accepted. In such case the bidder shall furnish copies of the standards in English along with his bid and shall clearly bring out the salient features of comparison with corresponding listed standards.

14.3.4 The equipment furnished under this specification has to operate in a tropical climate and shall be given tropical and fungicidal treatment as per relevant specification.

14.3.5 Period of Operation/Duty Cycle:

The sets are intended to supply power only during an emergency for essential services and may be idle for long periods except for periodic routine tests once in a week. When there is a total failure of main power supply, the sets shall be required to operate continuously at full load for a period which at times may exceed even 24 hours.

14.4 Engine Type:

The diesel engine shall be of stationary type four stroke/two stroke with vertical in line or (V) type cylinder arrangement, Turbo-charged, cooled with radiators.

14.4.2 Rating:
a) Prime power BHP rating of the engine shall be such that the DG set deliver the specified net electrical output while supplying power/driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft at specified site conditions and ambient temperature of 50OC. The bidder shall submit the deration calculations if the engine is not designed for 50deg C. ambient temperature.

b) It shall also be capable of satisfactorily driving the alternator at 10% over load at the rated speed for one hour in any period of 12 hours of continuous running.

The bidder shall have to furnish copy of duration chart from the original manual of the engine manufacturer and supporting calculations to arrive at diesel engine rating.

14.4.3 Speed and Vibration Levels:

a) Speed shall be 1500 revolutions per minute. Speed governor/over speed protection shall be provided. At due running conditions, speed shall be stabilized at plus or minus 2% nominal speed, regardless of load. At transient condition, engine speed shall vary not more than 10% plus or minus. Governor class shall be A1 (4% drop) for normal application unless otherwise specified.

b) The engine vibration level shall not exceed 100 microns.

14.4.4 Lubrications:

a) The engine shall have a closed cycle forced & splash lubricating system with positive oil pressure and a crank chamber for collection/storage of the lubricating oil during circulation.

b) A lubricating oil filter shall be provided for operation under normal conditions for a period of 300 hours without the necessity of its replacement or cleaning.

c) In case lubricating oil coolers are required it shall be supplied as an integral part of the Diesel Generator Set.

d) Necessary temperature and pressure gauges and other instruments shall be supplied and fitted on the lubrication system.

e) A lubricating oil level dipstick suitably graduated shall be provided and located in the accessible position.

14.4.5 Fuel System:
a) The engine shall be capable of running on all types of diesel fuel oil normally available in India.
b) The fuel consumption of the engine at full, three quarters and half of its rated power output shall be indicated by the Contractor in the bid.
c) A fuel service tank of 990 litres capacity with each D.G. Set shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints should be brazed/welded.

14.4.6 Air Intake System:

The diesel engine shall be provided with special dry type air filters having low resistance to air passage, high dust retaining efficiency and provision for easy cleaning. Filters shall be suitable for achieving satisfactory engine operation and ensuring the engine life under tropical humid conditions, with sulphur dioxide fumes, abrasive dust and coal particles of 5 to 100 microns present in the atmosphere. The minimum efficiency of filters shall be 90% down to 5 micron size.

14.4.7 Cooling:

The diesel engine should be water cooled with radiator heat exchanger system. The cooling system should include temperature gauge with high temp., alarm/trip corrosion resistor etc.

14.4.8 Engine Governor:

The governor shall be Electronic ISO-Chronous type to maintain zero speed rate or regulation and shall be Al type as per BS:5514 in order to take care of heavy motor starting. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit. The governor shall be suitable for operation without external power supply.

14.4.9 Turbo Charger:
It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

14.4.10 Quietness of Operation:

a) The engine shall be designed to achieve maximum quietness of operation.

b) Efficient residential silencer shall be provided as per engine manufacturer’s approved make only for the exhaust.

c) Noise level of the set shall not exceed 115-120dbA at one meter distance of the engine.

14.4.11 Engine Starting:

a) Engine starting shall be by electric starting motor complete with manual/automatic starting arrangement. The starter motor shall conform to IS:4722 and shall be of adequate power for its duty and be of inertia or preengaged type. The pinion shall positively disengage when the engine starts up or when the motor is de-energized. The engine cranking shall be only from the panel both for AMF & DG sets (Manual) and any engine starting devices etc. that are given as original fitment on the engine by engine manufacturers shall be either removed or padlocking arrangement given for this so that all normal start/stop operations could be done only from panel whether the set is AMF or manual. The engine wiring shall be appropriately modified, ferruled to totally match with schematic drawings of the panel.

b) Time for Run-up to Speed: From the initial operation of the starting device, the engine shall start, run up to normal speed and be capable of accepting 60% of full load within a maximum time of 20 seconds, and full load within a further 20 second.

14.4.12 Starter Battery:

a) The battery shall conform to the requirement of IS:1651. Starting battery each of 12 V, heavy duty high performance approved
make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery set shall be capable of performing at least (5) five normal starts without recharging.

b) The battery shall be provided with good quality teakwood stand painted with acid proof black paint with min 3mm thick rubber mat below the battery.

c) Batteries shall be of load container type only and not with PVC moulded sealed container so that each individual cells are available for individual monitoring during its life span. Each cell shall be provided with electrolyte filling cap with level floats for easy monitoring of electrolytic level.

d) The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.

e) The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.

f) The batteries Set shall be supplied fully filled and first charged ready to use.

14.4.13 Battery Charging System:

a) Float rate charging and quick rate charging system shall be provided at the generator panel with appropriate bridge charger system, LC network, rate selector switch and generously rated charging transformer and silicon one rectifier bridge, so that the cranking battery system can be kept fully charged at all times from E.B. supply network with quick charging rate limited to 0.8 times rated discharge current with provision in control transformer and Si rectifier present to enable boost charging the battery at 2 times rated discharge current in case of emergencies. To this and in the mode selector switch boost charge position shall be present which however shall be kept disconnected at mode selector switch normally.

b) DC ammeters to clearly indicate float charging current and quick/boost charging current shall be provided.
c) Dropper resistor network on the load side of battery charger system shall be provided so that higher charger voltages in quick or boost conditions does not get impressed on the I/L and Contactor coils, which voltage shall remain well within +10% of rated voltage.

d) Battery charging subsystem shall be designed for continuous operation at cubicle ambient of 50OC corresponding to 45OC ambient outside and should be designed to operate at 1.5 times rated maximum current corresponding to boost charge current which can reach in practice as high as 2.5 times or 3 times rated discharge current.

e) Any charger dynamo and dynamo charging current network present on the set shall be made in operative so that both for AMF and manual application the cranking battery system is kept charged from the charger at the panels at all times during or shut down periods of the set.

f) To the above and in case of manual DG sets, the input to charger subsystem viz.,240 V AC is foreseen to be provided from customer network from the portion that is normally supplied by manual DG Set during DG operation or being fed by E.B. System.

14.4.14 Engine Fitments:

The engine shall be provided with but not limited to following essential basic fitments:
Crank case breather - Dry type element.
Air Cleaner - Dry type mounted.
Corrosion resistor - to control acidity and impurities from coolant.
Lubricating Oil Cooler -
Filters - Lub oil & fuel oil, paper element type.
Coolant Pump - Gear Driven.
Fuel Pumps - Priming & Transfer
Governor - Electronic Class A1.
Turbo Charger - Exhaust gas driven in case of turbo
charged engines.
Flywheel with flywheel housing - SAE Type
Vibration dampers - One Set
Exhaust/Intake manifolds -
Oil Sump (crank case) with dip stick
Engine Supports
Residential type silencer in exhaust system
Electrical starter 12 V or 24 V
Safety controls & instruments

14.4.15 Engine Instrumentation:

The following instruments mounted on instrument panel shall be essentially present as minimum:
- Engine speed tachometer with service hour counter
- Lub oil pressure gauge
- Coolant water temperature gauge
The instrument panel shall be mounted on engine using rubber dampers for vibration isolation.
The gauges shall have clear red marking to identify the limiting dangerous levels, ‘Zone Markings’ on the scale to indicate the normal healthy & abnormal operating zones for the parameters concerned. The metering could be either normal electro-mechanical analogue type or electronic digital type, latter being preferred as manufacturers fitment only. The engine control panel must be supplied by the engine manufacturer only.

14.5 ALTERNATOR:

14.5.1 The alternator shall have brushless type with rotating field and static excitation circuit controlled by field control unit suitably compounded for voltage and load current for a self excited self regulated system.
14.5.2 The alternator shall be in SP-DP enclosure, foot mounted with ball and roller bearings on end shields.
14.5.3 The alternator shall conform to IS:4722/BS:2613 and shall be suitable for tropical conditions.
14.5.4 The alternator shall comply with the following specifications:
Rating - As per BOQ.
(Shall be capable of 10 % over loading at the rated speed for one hour of 12 hours continuous running).
Voltage - 415 V
Speed - 1500 RPM
Frequency - 50 Hz.
P.F. - 0.8 lag
Enclosure - IP:23
Insulation - H
Execution -Self excited, self regulated with brushless system and static voltage control unit suitably compounded for voltage and current to maintain terminal voltage constant at ± 5% at all load for p.f. not less than 0.8. lag.
Terminal Box - As per BOQ.
Earthing Studs - 2 Nos. in each DG

14.5.5 Neutral Point:

The winding of the alternator shall be star-connected.

14.5.6 Terminal Box and Connection:

The alternator output terminals shall be enclosed in a terminal box mounted in an accessible position on the alternator frame. As far as possible, connections between the exciter and alternator shall be contained within the machine frame and connections carrying A.C. and D.C. shall be segregated from each other. The terminal box shall be of sufficient size to conveniently terminate the size and number of the Owner’s cables, which shall be intimated during detailed engineering. Suitable tinned copper pads shall be provided for power cable termination along with all necessary hardware and cable lugs. Glands and lugs shall be provided for control cables also. For single phase cables, gland plate shall be of non-magnetic material. Gland plate shall be removable type.

14.5.7 The generating set shall be so designed that it is capable of reaching its full voltage and frequency and shall be ready to take full load within 30 seconds of a remote starting impulse being received.

14.5.8 Acoustic Enclosure:
**Thickness of Sheet – 14-G:**

High Class sheet metal fabricated enclosure for reducing the noise level of DG Set and also acts as weather proof housing. Genset will be an integral part of acoustic enclosure and whole construction will be on multi-fold sheet channels and ISMC sections. Enclosure construction is fully bolted keeping in view the major service requirements all doors are provided with specially designed hinges and lockable handles, battery, fuel tank is housed inside the enclosure.

**Acoustic Materials:**

Rock wool in the form of slabs of 75 – 100 mm thickness and 48 KG/Metric cube density (Specification of Rock wool conforms to IS: 8183. Further to increase the life of Acoustic material resin coated fiber glass cloth is provided on exposed surface of Rock wool slabs and the panels are supported by perforated sheets.

**Ventilation:**

Acoustic enclosure is designed in such a way that there are no hot pockets around engine and it is provided with suitable designed engine radiator/or additional axial flow fan and does not allow the temperature to rise more than 70C. To achieve optimal output and minimum sound level from the DG Set, suitable openings with acoustic hoods are provide for increasing the inflow of air required for combustion and forced ventilation. Air intake system as per the recommendations and engine requirement are provided.

- Acoustic hoods with noise splitters provided to block and reduce the sound
- Leakage.
- The sound control system designed to suppress the sound level to 75 db  
  Maximum at 1 meters distance in open environment.

**Silencer:**

Specially designed low noise silencer is provided. Silencer & engine exhaust outlet, connected with flexible SS below.
Vibration Isolation:

- To avoid transfer of vibration from Genet to enclosure & surrounding specially
- Designed vibration isolators are used.

14.6 AMF PANEL:

14.6.1 General:

a) The control panel shall be sheet steel enclosed and shall be dust and vermin proof providing a degree of protection of IP-42. Sheet steel used shall be cold rolled and at least 2.0mm thick and properly braced and stiffened.
b) Control panel shall be provided with hidden hinged door(s) with pad locking arrangement and suitable brackets/channels shall be provided for floor mounting.
c) All doors, removable covers and plates shall be casketed all around with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual switches, fuses, MCCBS without danger of contact with live metal.
d) All live parts shall be provided with at least phase to phase and phase to earth clearances in air of 25mm and 20mm respectively.
e) Adequate interior cabling space and suitable removable cable gland plate shall be provided. Necessary number of cable glands shall be supplied and fitted on to this gland plate. Cable glands shall be screwed on type and made of brass.
f) Two number of earthing terminals shall be provided.
g) All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of zinc chromate primer and powder coat finishing both inside and outside of shade 631 (gray).

14.6.2 AMF Control of Diesel Generating Sets:

a) All DG Sets shall be controlled independently.
b) Diesel Generator shall be capable of being stopped manually from remote as well as local. However, interlock shall be provided in the DG local control panel to prevent shutting down operations as long as circuit breaker is closed.
c) Auto Operation:

When mains power is available, the healthiness of this power will be monitored through a mains voltage monitor. If voltages on the 3 phases are within limits, the monitor will send a closing signal to the mains breaker and mains power will be connected to the load.

If the voltage drops on any phase or on all phases, the monitor will sense this drop through a timer, and if this drop persists for more than a pre-adjusted period of time (say 1 to 20 seconds) a signal is sent to the engine starting circuit while at the same time opening the mains supply breaker and disconnecting load from mains as voltage is below acceptable limits.

The engine starting control monitor will send a signal to the D.C. battery supply for starting the engine through the starting solenoid. When the engine is healthy, it starts up in a few seconds and the generator develops voltage. The generator voltage monitor, monitors the voltage and when the voltage is developed, this give a signal to the generator breaker which closes and connects the diesel generator to the load. Simultaneously, it sends a signal to de-energize the engine starting circuit and the starter motor is disengaged. The engine protection circuits for high water temperature and low lubricating oil pressure are also energized.

d) Resumption of Supply:

If voltage from mains is resumed, the main voltage monitor will sense this voltage for healthiness, i.e. for maintained correct voltage for a period of time (adjustable up to three minutes) and then send a signal to stop the engine and to change over the breakers from generator to mains and normal supply is resumed to the load. The solenoid operation and closing and tripping of breakers should be done through control voltage 24 V.D.C.

e) Failure to Start:

A three attempt starting facility using two impulse timers and a summation timer for engine shall be provided and if voltage fails to develop within 30 seconds from receiving the first start impulse, the set
shall lockout automatically and a visual and audible alarm shall be given in the control panel. The remote panel shall receive “DG Trouble Alarm”.

14.6.3 The control panel shall have the following provisions for the control of each DG Set:
1. MCCB’s & ACB’s as per BOQ.
2. Master engine control which for OFF/AUTO/MANUAL/TEST with a facility for starting and stopping of the set.
3. Voltmeter 144 Sqmm with selector switches for alternator/Mains/Phases complete with protection.
4. Local/Remote selector switch to facilitate remote starting/stopping of the DG Set.
5. Frequency meter 144 Sqmm reed type.
7. Ammeter 144 Sqmm with C.T. & selector switch, KWH Meter, KW 144 Sqmm.
8. Mains Supply, voltage monitor.
10. Alternator voltage monitor.
12. Engine protection system for low oil lubricating pressure and high water temperature.
13. Window type annunciator with static relays, alarm/hooter and accept, test, rest, push buttons for all functions.
14. Engine hours run counter.
15. Control fuses.
16. Lifting Hooks.
17. Gland Plates.
18. Power/Control Contactors.
20. Antivibration pads.
21. IDMT relays [CDG – 31]
22. Under Voltage Relays
23. Over Voltage Relays

14.6.4 Indication/Annunciation:

Pilot indicating lamps/shall be provided for the following:
1. Charger - ON/OFF
2. Earth Fault
3. Set shutdown due to `Engine high water temp.’
4. Set shutdown due to `Low oil pressure’
5. Set shutdown due to `Lock of fuel’
6. Over speed trip Indicating lamp shall be of the panel mounting filament type with series resistors.

14.6.5 The DG Sets would normally be controlled from remote for which following provisions are being made on the remote control panel. The necessary control devices/contacts for these external connections shall be wired out to the DG control panel terminal blocks.

1. Starting and stopping of the DG Set
2. DG running indication

14.7 ENGINE SAFEGUARDS:
Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

a) Energising a solenoid coupled to the stop lever on the fuel injection pump rack.
b) De-energising the “fuel on” solenoid
c) Energising the “fuel - cut off” solenoid.

The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.

The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel. At the set at a easily accessible place an “EMERGENCY STOP” mushroom head stay put type P.B shall provided to stop the set in emergency mode. The safeguard to “STOP THE SET” shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

a) Emergency stop P.B’s operation
b) Over speed.
c) Low lube oil pressure.
d) Earth fault

15.00 PROCUREMENT, INSPECTION OF EQUIPMENT & APPROVALS;

Approved list of makes and vendors are given in the end of technical specifications. The makes of equipment/materials supplied shall be
strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same. All equipments/material supplied shall be brand new and shall be procured directly from the manufacturers, dealers or authorised agents. HSCC Electrical Engineer shall have access to the manufacturer’s premises for stage inspection/final inspection of any item during its design, manufacturing, and assembly and testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded along with the call for carrying out the inspection at the manufacturer’s works. Based on the inspection certificate, HSCC Electrical Engineer reserves the right to carry out the inspection at a mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection. It is the responsibility of the contractor to ensure that all electrical works are carried out as per the IE Rules & regulations, National Building Code and IS Codes & Standards. All necessary drawings and details as required by Electricity Board, Electrical Inspector, Fire Department and other Local Statutory agencies, shall be prepared by the contractor. The contractor is responsible to submit the drawings and other details as required to the Local Authorities (refer above) and obtain necessary approvals including sanction of load/enhancement of electrical load from WBSEDCL before energizing and commissioning. All official fee required for getting the approval will be reimbursed on account of Client on submission of original documents.

16.00 ELECTRICAL RISING MAIN

16.01 SCOPE

This section covers manufacture, supply, installation, resting and commissioning of rising mains, indoor type.

16.02 Supply voltage

415/ 440 Volt, 3 phase, 4 wire, 50 Hz AC supply.

16.03 Standards for compliance:
16.04 Construction:
The enclosure will be made from 16 SWG GI/ CRCA sheet steel powder coated of approved shade. Bus bars would be of high conductivity aluminium in “Sandwich” construction and the conductors will be individually insulated with halogen free, fire retardant class– H – epoxy insulation. No drilling of Bus bar is permitted. Length of the section will be limited to maximum three metre. Bus bar of one section will be connected to bus bar of adjacent section by uni-block joint system removable as separate sub-assembly, so that it can be inserted or removed without disturbing the adjacent sections.

16.04.1 Technical Parameters:

Rising main shall be designed to withstand short circuit current of 35 KA for one second. Rising main system should be designed for high temperatures withstand capability of 55 degree Celsius over 50 degree Celsius as normal operating temperature.
Insulation voltage 1.1 KV
Rising Main will be suitably chosen to give permissible voltage drop.
Rated impulse withstand voltage 12 KV at 1000 volt.
Single bolt bridge system to be incorporated.

Plug in boxes
Plug in boxes will be of draw out type. Contacts will be of silver plated copper and spring loaded. Earth connection will be the first to make and last to break during insertion and withdrawal. Plug in boxes will be made from 1.6 mm CRCA sheet steel powder coated. Inside the plug in Boxes MCCB will be located as per requirements. The operating handle will be interlocked with plug in box cover so that MCCB can be operated only with the suitable cover in closed position. The plug in box will be interlocked with Rising Main so that it can not be inserted or removed with the plug in box lid open. MCCB will be of 4 pole type unless otherwise specified in BOQ. Short circuit breaking capacity of MCCB in PIB should be 35 KA.

16.05 List of test to be carried out:
16.05.1 Routine tests:
i. Verification of insulation resistance.
ii. Inspection of assembly, interlocks, locks etc.
iii. Dielectric test.

Copies of the following certificate should be submitted:
i. Verification of temperature rise limits
ii. Verification of di-electric properties.
iii. Verification of short circuit strength.
iv. Verification of degree of protection.
Insulation resistance test with 500 volt megger. The insulation resistance shall be not less than 100 mega ohm.

17.00 CAPACITOR PANEL (APFC)

17.01 SCOPE

Supply, installation, testing and commissioning of medium voltage capacitors and Automatic Power Factor Correction Panel (APFC) for improvement in power factor of electrical system. It will be connected to main LT panel. It shall improve power factor up to 0.98 legging from initial power factor. Capacitor panel shall be provided with day/ night mode selector switch and double ratio C.Ts, for day/ night mode. Day/ night mode shall be selected based on estimated day / night load requirement.

17.02 RATING

Capacitor units as specified in the BOQ shall be used to form a bank of capacitors.

17.03 ENCLOSURE

The panel shall be indoor, floor mounted and free standing type with IP-42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure and shall be finished with powder coating in the approved colour shade. Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided. The front portion shall house the switchgear and the rear portion shall house
capacitors and series reactors (7%). The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

17.04 APFC Relay

Microprocessor based APFC relay, (intelligent VAR controller) of suitable steps as mentioned in the BOQ, shall sense the PF in the system and automatically switch ON/OFF the capacitor unit or bank to achieve the preset target PF. The controller shall have digital settings of parameters like PF, switching time delay, step limit etc, indication of PF, preset parameter, minimum threshold setting of 1% of CT current.

17.05 CAPACITORS

The capacitor shall generally confirm to IS:13341-1992 and 13340-1993 and IEC60831-1 &2.
General specification: three phase, delta connected, 50 Hz.
i. **Voltage:** Must be designed to withstand system over voltage, increased voltage due to series reactor and harmonics.
ii. **Capacitor type:** The capacitor unit shall be super heavy duty mix dielectric type. The dielectric should be made of metalised tissue paper. These elements shall be combination of capacitor tissue paper and BOPP film impregnated with non PCB bio-degradable impregnant or film foil capacitor manufactured using Poly Propylene film placed between 2 layers of metal foil and winding. Capacitor should be fitted with safety device like pressure sensitive disconnector. The capacitor should be low loss type (total losses should not exceed 0.45 W/ KVAR).
iii. **Temperature category:** -25 degree C to 70 degree C.
iv. **Over voltage** +10% (12h in 24 hours), +15%( 30 minutes in 24 hours), +20% (5 minutes) and 30% for 1 minute as per clause 6.1 of IS 13340-1993.
v. **Over current:** 2.5x In
vi. **Peak inrush current withstand:** 350 x In
vii. Capacitor shall be provided with permanently connected discharge resistors so that residual voltage of capacitors is reduced to 50 volts or less within one minute after the capacitors are disconnected from the source of supply.
viii. Each capacitor bank shall be provided with a terminal chamber and cable glands suitable for AYFY cable as specified.
ix. Two separate earthing terminals shall be provided for earth connection of each bank.

17.06 SWITCHGEAR & PROTECTION:

Incomer switchgear will be as specified in BOQ. Suitable contactor for each step shall be used and must be capable of capacitor switching duty. Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports. Power cable used shall have superior mechanical, electrical and thermal properties. Internal wiring between main bus bars, contactor, capacitor etc shall be made with 1100 volt grade PVC insulated FRLS copper conductor of appropriate size by using suitable copper crimping terminal ends etc suitable bus links for input supply cable termination shall be provided. Control circuit shall be duly protected by using suitable rating MCB. An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset). 440 Volt caution board shall be provided on the panel.

17.07 TESTS AT MANUFACTURER’S WORKS:

All routine and type tests as per IS:2834 relevant to capacitor banks as amended upto date shall be carried out at manufacturer’s works and test certificates to be submitted to HSCC.

17.08 TESTS AT SITE:

Insulation resistance with 500 V DC Megger shall be carried out and test results should be recorded. Residual voltage shall be measured after switching of the capacitors and the same shall not be more than 50 volts after one minute. Each discharge resister shall be tested for its working. Drawings and Instruction manual:

17.09 INSTALLATION:

Capacitor bank shall be installed at least 30 CM away from the walls on suitable frame work of welded construction. The earth terminals
provided on the body of capacitor bank shall be bonded to main capacitor panel earth bus with 2 nos 8 SWG copper or 6 SWG GI earth wire.
Contractor shall submit four copies of the following certified drawings:
i. General arrangement of capacitor bank and control panel indicating main dimensions, type of mounting, location of various devices etc., including foundation details.
ii. Schematic diagram for automatic sequential switching with terminals and ferrules numbers.
iii. Wiring diagram of control panel indicating terminal blocks and various apparatus.
iv. Final list of components of control panel.
Contractor shall also submit four sets of installation and maintenance manual.

18.01 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.

18.02 SPARES:
The bidder shall quote for minimum spares required for two years safe operation along with the offer separately.

18.03 TRANSPORT, DELIVERY & STORAGE;

The prices shall be F.O.R site basis including packing & forwarding charges as per site condition. The quoted price must include all the costs for necessary mode of transportation up to the final location of site or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.

18.04 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 or eighteen months from the date of dispatch, whichever is earlier. 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.

18.05 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.

18.06 POWER SUPPLY:

The apparatus shall be designed to operate on 415 + 5% Volts, 3 Phase, 4 wires, 50Hz A.C. Supply for illumination signal equipment shall be 240 Volts + 5% single phase 50Hz A.C.
19.0 AIRCONDITIONING SYSTEM SPECIFICATION AT ADMINISTRATIVE BUILDING, NEW TOWN RAJARHAT

BASIS OF DESIGN & EQUIPMENT SELECTION

Ambient Conditions: 105°F DB & 83°F WB (Summer),
Inside Design Conditions: 75°F (23°C+ 2) with RH around 60%
General Illumination: 1.0 Watt/ Sq-ft
Floor above: Non-AC and insulated
Floor below: Non AC

Equipment Selection: - PLEASE REFER TO THE ANNEXURE I ATTACHED.

System description

VARIABLE REFRIGERANT FLOW (VRF)

19.1 General:

The scope of this section comprises the design, supply, erection, testing and commissioning of Digital scroll Variable Refrigerant Flow type system of air conditioning conforming to these specifications and in accordance with the requirements of Drawing and bill of Quantities. The prices quoted shall include all the equipment ancillary material as specified and all such items whatsoever and which may be required to fulfill the intent and purpose as laid down in the specification and the approved drawings. The contractor shall calculate equipment capacity based upon design parameters specified for the system design & verify all the quantities and sizes of refrigerant pipe, fitting/cables, control cable, pipes, insulation, indoor units, outdoor units etc. before placing the order to avoid any shortfall or surplus. The tenderer shall also include all necessary civil work/MS frame work for installation of outdoor and indoor units in VRF based air-condition system. The cost
quoted by tenderer shall also include the refrigerant gas R-410 & its charging for proper & specified functioning of air-conditioning system.

The scope in the tender schedule also covers detailed designing of complete air-conditioning system based on Digital Scroll VRF air-conditioner with air-cooled outdoor units system capable of cooling as per individual or season requirement suitable for operation on 415V, 3 phase, 50 Hz AC electric supply.

The outdoor units shall have cooling mode, consisting of one/multiple outdoor unit with single circuit of refrigerant piping and multiple indoor units of various types. Each indoor unit should have capability to cool as per seasonal weather changes. The scope of work shall include SITC of

1. Outdoor units.
2. Indoor units.(Ductable, cassette, wall mounted type)
3. Refrigerant piping.
5. Supply air ducting of Ductable units.
6. Control Cables between Outdoor units & Indoor units.

While designing the system care should be taken to select outdoor units of suitable capacity based on design data provided & to economize on available floor area for installation of outdoor units as well as optimum utilization of outdoor units. The indoor units should be designed based upon the heat load calculations for individual rooms/areas to be air-conditioned and over capacities should be avoided. The design should also specifically take care of disposal of condensate drain water so that there is no leakage of condensate water inside the room as well in the route of condensate water pipe line. The layout of refrigerant piping is to be designed in such a way so that it should not disturb the aesthetic of the building / room, inadvertent damage in the route of pipe should not occur in failure & optimum length of pipe line for efficient air-conditioning. After completion of the work four set of ‘as erected/commissioned drawing’ of activities listed above shall be submitted.
Design Data

The work of air-conditioning and indoor units as specified in BOQ. The specified design parameters are only tentative in nature, however, all efforts shall be made to achieve the following specified design parameters and if at any design stage need for higher capacity outdoor capacity is required, necessary approval shall be accorded based on design analysis and discussions on the subject.

19.2 OUTDOOR UNIT:

i. For testing and evaluation consideration, JIS B8616 or equivalent standard shall be applicable.

ii. The outdoor unit shall be factory assembled, weatherproof casing (Material of construction of casing shall be vendor’s standard design), constructed from heavy gauge GI sheets steel panels and coated with baked enamel finish. The outdoor unit shall be completely factory wire, tested with all necessary controls & filled with first charge of refrigerant before delivering at site.

iii. Digital Scroll VRF equipment should be capable so that refrigerant piping between indoor units and outdoor unit shall be Extendable upto 150m with maximum height difference between outdoor & indoor unit of 50m & level difference between two indoor unit maximum upto 15m. However such long pipeline and head difference may not be applicable for this project.

The minimum acceptable value of Coefficient of Performance (COP) of the offered system, in conformance with JIS B8616 or equivalent, shall be not less than 4.1 at 50% rated load with 40.5 deg C outdoor and 28.3 deg C wet bulb conditions for 30TR or equivalent nearest size outdoor unit as per OEM standard catalogue. In case, tests have been done to work out COP from other than JIS B 8616, the standards alongwith
necessary test procedure shall be furnished along with the tender.

*The tenderers will, however, be at liberty to supply outdoor units in ratings as specified above or higher.

(a) The above COP values, as indicated in (iii) above are required to be furnished, in original, by the tenderer directly from the original equipment manufacturer (OEM) with OEM’s seal and signatures on all the documents pertaining to the back up information for example cooling capacity at capacity indexes varying from 130% to 10% (stepless) for outdoor temperature (deg C DB) varying from 32 to 45 deg. and indoor temperature (deg C WB) varying between 24 deg. duly indicating the total cooling capacity and power input in kW.

(b) The tenderers may please note that above guaranteed figures may be checked by the client, at any stage of the work, through its nominated inspection agency either at OEM’s works or duly certified laboratory in accordance with J15B8616 or equivalent standard.

iv. The outdoor unit shall be factory tested and filled with first charge of refrigerant R-410 before delivering at site. It should be of cooling module type

v. It should also be provided with duty cycling for Digital scroll compressors capable of changing the capacity of load by Digital controller to follow variation in cooling and heating loads & switching starting sequence for better stability and prolonging equipment life. Outdoor units should have minimum 2 compressors and shall be able to function with one of the compressors in failed condition.

vi. The compressors installed in the outdoor units shall be preferably equipped with at least one digital scroll compressor upto, Digital scroll so that operation is not disturbed on failure of any of the compressor.
vii. The outdoor unit shall be suitable for mix match connection of all types of indoor units.

viii. It should be provided with duty cycling for switching the starting sequence of multiple outdoor units.

ix. The outdoor unit shall be modular in design and should be allowed for side-by-side installation.

x. The unit shall be provided with its own microprocessor control panel with provision for integration with the Building Management System for air-conditioning System.

xi. The outdoor units should have anti corrosion paint free plate for easy mounting of unit.

xii. The machine must have a sub cool feature to use coil surface more effectively thru proper circuit/bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings.

xiii. The outdoor unit should be fitted with low noise level and should not be more than 65 db (A) at normal operation when measured at 1.5m distance from ground level.

xiv. The outdoor unit should be fitted with low noise aero spiral design fan with aero fitting grill for spiral discharge airflow to reduce pressure loss.

xv. The outdoor units are connected to multiple indoor units of various types as such the combined operating loads of indoor units may touch 100 to 120% of the nominal capacity. The outdoor unit shall be able to perform at the combined loads demands as indicated above.
xvi. In case of trouble occurs in an indoor unit(s), the continuous operation of system should be possible.

xvii. The unit shall be designed in such a way that cleaning of drain Pan should be easy & inspection/replacement of compressor should be easy.

xviii. The condensing unit shall be designed to operate safely when connected to multiple fan coil units.

19.3 Compressor:

i. The compressor in Digital Scroll system shall be highly efficient. The system should response efficiently in accordance to the variation in cooling load requirement.

ii. All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.

19.4 Refrigerant Circuit:

The refrigerant circuit shall include liquid and gas shut-off valves and a solenoid valves at condenser end.

The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution.

All necessary safety devices shall be provided to ensure the safe operation of the system.

19.5 Heat Exchanger:

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

The unit should be with bye-pass/e-pass heat exchanger to optimize the path of heat exchanger and for better arranged for vertical discharge. Each fan shall have a safety guard.

**19.6 Safely Devices:**

All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be part of outdoor unit, high pressure switch, fuse, fan drive overload protector, fusible plug, crankcase heater overload relay, overload protection for digital scroll.

The outdoor roof mounted units shall be provided in such a fashion that these do not affect the overall aesthetics and ambience of the building. If required these units shall be suitably camouflaged to give good aesthetic look. These provisions, however, shall be discussed, if required, at a later date and the prices for the same shall be worked out separately as extra item.

Noise levels for outdoor units shall not be more than 67 db (measured at a point 1 meter in front of the unit at a height of meters.

**19.7 INDOOR UNITS:**

**Ductable Type Indoor Unit:**

The Unit shall be Ductable type (ceiling suspended). The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated/heat treated galvanized steel. The unit shall have high static fan for ductable arrangement and it should also have suitable arrangement for drain water.

**CASSETTE type indoor** - The indoor can be cassette type with drain pump facility, with pre-filter, fan section and DX coil

**HI - WALL SPLIT type** – The indoor can be Hi wall split type unit, with Pre-filter, fan section and DX coil.
Y-joint/Ref net separation

Supply & installation of the Y-joint/ref.-net 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 Expanded polystyrene/Equivalent.

Refrigerant piping

i. The Refrigerant pipe material shall be of hard seamless copper tubes with pipes material being hard drawn copper pipe. Forged copper fittings shall be used for the refrigerant piping. The refrigerant piping arrangements shall be in accordance with good engineering practice as applicable to the air-conditioning industry, and shall include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits except y joint/separation tubes.

ii. Before joining any copper pipe or fittings, its internals shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently it shall be thoroughly blown out using nitrogen gas.

iii. After completion of installation of the refrigerant piping, the refrigerant 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 700 mm Hg and held for 24 hours.

iv. The supplier of air-conditioning system shall choose sizes as designed and erect proper interconnections of the complete refrigerant circuit the thickness of copper piping shall not be less than 18 SWG for pipes upto 19.1 mm and 16 SWG for larger dia.

v. 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.

vi. The refrigerant piping should be laid in such a way that it should not distort the interior of the room, wherever the refrigerant pipe has to be laid across the room, it should be laid in a concealed manner by making appropriate boxing arrangement matching with the interior of the room. All associated minor Civil Engineering works (like chasing on wall, ceiling & replastering and repainting etc.) related with the above items are included in the scope of work. The above scope does not include false ceiling wherever required.

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

19.8 AIR SIDE WORK:

- Velocity of air in any section of duct shall not exceed 9 M/Sec.

- The general layout of the ducting and location of air handling units, grilles, diffusers etc., shall conform to the arrangement shown in the drawings enclosed with the specification.

- Ducting shall be fabricated at site from galvanized steel or aluminum as specified.

- The construction of ducts shall conform to IS : 655 in so far as applicable. All duct seams shall be filled with bitumastic cold emulsion or equivalent vapour seal.

- All duct supports shall be provided at centres preferably not exceeding 2.5 Meter. The duct supports shall consist of structural steel angles and if required flats and jointed by bolting. Whenever duct support angles are to be fixed with reinforced concrete roof/floor slab, the anchoring screw shall be connected with duct support angles by means of intermediate angle plates with bolted connection, so as to facilitate early erection and dismantling.
For protecting the insulation from damage, duct support saddles of proper length shall be used at each support point for the entire width of the interface between insulated duct bottom surface and the top of the angle iron support member. The saddle plate shall be made from galvanized steel or aluminum.

Canvas or equal flexible connection shall be provided at each connection between duct work and AHU so as to isolate vibration. 

Damper blades shall be manufactured of minimum 20 BWG Sheet Steel.

All diffusers and grilles shall be made up of extruded aluminum section finished in powder coating of approved colour.

Design of diffusers, grilles etc. shall be made by he contractor matching the lighting fitting and the décor of the office.

19.9 RECOMMENDED LIST OF MAKES:

- Copper pipe : Nippon/ Nissan / Rajco/Totaline
- Cables : Nicco/Gloster/Finolex.
- Fans / Blowers : Nicotra / Kruger / Comefri
- Vibration Isolartors : Dunlop / Resistoflex
- Insulation : Beardsell, Lloyd,Twiga
- Grilles/ Diffusers : Premier/ Dynacraft/ Ravistar
- G I Sheets : Jindal / Sail / VSP / Nipon.
- Nitrile Rubber Insulation : Aflex , K Flex , Armacell.
- VRF Units : Mitsubishi , Carrier mea , Blue Star
The following works and services to be provided by client and is beyond the Scope of HVAC vendor:

⇒ Provision & termination of 3 phase 415 V, 50 Hz power along with double earthing at the Electrical Panel of individual outdoor units.

⇒ Provision & termination of 1 phase 220 V, 50 Hz power along with double earthing near to the individual indoor units.
⇒ Free Power for installation, testing and commissioning of the Air conditioners
⇒ All carpentry work such as enclosure for system components, provision / modification of false ceiling/ false flooring, partition above false ceiling, partition below false flooring, duct concealment (if applicable), providing return air path, opening in the false flooring / false ceiling, cut-outs for grilles / diffusers, window modification if any etc.
⇒ Suitable provision for the drain line termination & its outlet.
⇒ Under-deck insulation for the exposed ceiling
⇒ Lockable storage place at site.
⇒ Outdoor Structural network.
⇒ Any electrical works, MCC PANEL, other than control cabling.
⇒ Thermal Insulation above false ceiling
⇒ Free provision of workmen to stay at site during execution.
⇒ All kind of civil/ concealment and foundation work.
⇒ Any other item not specifically mentioned in bill of quantities.
20.0 FIRE HYDRANT AND WET SYSTEM

20.1.0 GENERAL
This document shall be read in conjunction with all relevant commercial documents. In case of contradiction between the technical specifications and other documents, data in technical specification shall prevail.

20.2.0 All work under this job shall be carried out in accordance with the technical specifications and the Latest revisions of Indian Standards, Codes, Indian Electricity Rules and also regulations and Norms of West Bengal Fire Services.

20.3.0 TECHNICAL PARAMETERS
Four (4) nos. Fire Pump consisting of one (1) Main Electrical driven Pump for Hydrant, one (1) Electrical driven Pump for Sprinkler arrangement, One (1) no. Diesel Engine driven Fire Pump and one (1) Jockey Pump electric driven shall be installed in the Fire Pump Room, pumping water from the underground Fire water Reservoir. The common outlets of Fire Pump delivery system shall cater the following:
   a) Internal Fire Hydrants in each floor.
   b) External Fire Hydrants.
   c) Fire First Aid Hose Reel in each floor.
   d) Sprinkler Arrangements.

20.4.0 OPERATION

Fire Hydrant System and Sprinkler System
Water Header up-to hydrant/landing valves shall be kept pressurized by the jockey pump which shall be started automatically on receiving the impulses from the pressure switch in case of any leakage in the header and subsequent fall in the pressure. It shall stop at a present pressure as soon as pressure builds up in the header.
For smaller fires, first aid hose reel would be used while hydrant valve would be used for bigger fires.
In the event of the fire outbreak, opening of hydrant valve/hose reel will result in fall of pressure in the header and electric motor driven fire pump shall come into operation automatically through the impulse from the pressure switch. The fire pump shall be stopped manually only.
In case the electric driven main fire pump fails to start, the diesel engine driven pump shall come into action automatically on further fall of pressure and receiving impulse from pressure switch. The setting of the pressure switches shall be done keeping the above sequence in consideration.

20.5.0 SPECIFICATIONS (TECHNICAL)

20.5.1 PUMPS

a) Electric Motor driven Main Fire Pumps
End suction type, horizontally mounted centrifugal pump (as per IS 1520), TAC/Local authority approved each capable to deliver 2850 LPM of water at minimum 80.0 M delivery head, coupled to a suitably powered electric motor mounted on a common base frame, cushy foot and rubber fiction pad coupling, coupling guard and fixing bolts etc. Motor HP to be suitably selected to suit minimum discharge and residual head at the top most or farthest hydrant and sprinkler.

b) Electric Motor driven Jockey Fire Pump
End suction type, horizontally mounted centrifugal pump (as per IS 1520), TAC/Local authority approved each capable to deliver 185 LPM of water at minimum 80.0 M delivery head, coupled to a suitably powered electric motor mounted on a common base frame, cushy foot and rubber fiction pad coupling, coupling guard and fixing bolts etc. Motor HP to be suitably selected to suit minimum discharge and residual head at the top most or farthest hydrant and sprinkler.

20.5.2 Diesel Engine driven Fire Pump
End suction type, horizontally mounted centrifugal pump (as per IS 1520), TAC/Local authority approved each capable to deliver 2850 LPM of water at minimum 80.0 M delivery head, coupled to a suitably Diesel engine, continuously rated for suitable horse power, direct injection, four stroke, water cooled type complete with coupling, coupling guard common base frame, cushy foot & rubber friction pad, Instrument panel with RPM indicator, pressure gauge, radiator with engine cooling system, fuel tank, tool kit, air filtration unit, exhaust piping with silencer, engine shut down mechanism, staring mechanism, for both automatic and manual mode, batteries with charging system.
etc. The engine shall be provided with an adjustable governor to control the engine speed within 10% of its rated under any condition of load up to the full load rating.

20.5.3 Specification Of Diesel Engine Auto Control Panel

The diode based diesel engine auto control panel consists of single battery charger capable of charging two sets of battery (1 set working and 1 set of standby) trickle and boost charge mode. The panel should give three cracking trials of 5 second duration at 15 seconds interval. The panel should consists of mechanical LOP gauge, electrical LOT gauge, electrical water temperature gauge, digital hour cum rpm meter, charge indicating lamp, ammeter, 3 way start key, stop push button, termination for following safeties: pressure switch NO / NC, high water temperature switch, over speed switch, remote stop, remote start.

LED Indication

AC Supply ON
- Start failure
- Low lube oil pressure
- High water temperature
- Over speed trip
- Low fuel level
- Water heater on
- Engine running
- Hooter off
- Hydrant Pressure Normal

Switches
- Start
- Stop
- Reset
- Hooter ON / OFF

Selector Switches
- Supply on/off
- Charge selection
• Auto / Off / Manual
• Water Heater on

**Meters**

• DC Ammeter
• DC Voltmeter

**INTERLOCKING**

Jockey pump shall not start / stop / trip when fire pumps comes in operation.

**20.5.4 CI SLUICE VALVE ( IS : 14846 )**

All Gate/Sluice shall be of ISI marked and should be PN-1.6 Pressure rating

**1.0 TYPE : NON-RISING SPINDLE TYPE.**

**2.0 MATERIAL OF CONSTRUCTION**

A) BODY : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
B) VALVE TRIM : GUN METAL.
C) BONNET : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
D) STUFFING BOX : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
E) GLAND : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
F) HAND WHEEL : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
H) WEDGE NUT : LEADED TIN BRONZE LTB-2 OF IS:318-1981(2nd. REV.)
I) BODY SEAT RING : LEADED TIN BRONZE LTB-2 OF IS:318-1981(2nd. REV.)
J) WEDGE FACE RING : LEADED TIN BRONZE LTB-2 OF IS:318-1981(2nd. REV.)
K) GLAND PACKING : JUTE & HEMP TO IS:5414-1969(Amendments I)
   Reaffirmed 1992
L) GASKET: FIBRE BOARD TO IS:2712-1979 (2nd. REV.)(Amendments 3)

**20.5.5 FLANGE PARTICULARS: AS PER IS: IS: 780-1984/IS: 1538**

**20.5.6 TEST PRESSURE**

A) SEAT: 16 KG./CM2.
B) BODY: 24 KG./CM2
20.5.7 AIR/ PRESSURE RELEASE VALVE

1.0 MANUFACTURER : ISI MARKED
2.0 TYPE : Spring Type , Screwed 25 MM NB.
4.0 MATERIAL OF CONSTRUCTION

A) BODY : LTB - GR 2,IS:318-1981 (2ND. REVISION)
B) SPRING : Stainless Steel, IS: 6528
C) INLET NIPPLE : GUN METAL
D) AIR RELEASE NIPPLE : GUN METAL

20.5.8 SWING TYPE NON RETURN / CHECK VALVE

1.0 STANDARD : IS: 5312/PART – I/84
2.0 MARKING : ISI MARKED

3.0 MATERIAL OF CONSTRUCTION

3.1 BODY : CI TO IS: 210 GR.FG 200
3.2 COVER : DO
3.3 FLAP : DO
3.4 HINGE BRACKET : DO
3.5 BODY SEAT RING : LEADED TIN BRONZE, IS:318 LTB2
3.6 FLAP SEAT RING : DO
3.7 HINGE PIN : H.T. BRASS IS:320 HT2
3.8 GASKET : RUBBER IS:638 TYPE B
3.9 BOLTS,NUTS & STUDS : C.S., IS:1367

20.5.9 SPECIFICATION FOR MS PIPES & FITTINGS

1.0 FIRE WATER PIPES & FITTINGS
1.1 MATERIAL : MILD STEEL
1.2 SPECIFICATION : IS:1239 ,Part-1,1992 (6th. REVISION)
(Amendments 3)
(PART I) UPTO 150 NB AND ABOVE
150 NB IS: 3589-1991 (6.35 mim. THICKNESS)
1.3 TYPE : E.R.W.
1.4 CLASS : Medium Grade up to 150NB & above 6.35 min.thickness.
1.5 TYPE OF JOINT : WELDED / FLANGED AS PER SITE REQUIREMENT.
1.6 FITTINGS : HEAVY Gr. AS PER IS:1239,Part-2-1992 (3rd. REV.)
(Amendment 1) FOR UP 65 NB TO 150NB. PIPES
FOR 200NB & ABOVE BUT WELDED FITTINGS SHALL
BE USED.
FOR 50NB & BELOW DIA. OF PIPES NO BUTT WELDED
FITTINGS SHOULD BE USED, ONLY SOCKET WELDED
FITTINGS TO BE USED.
1.7 BOLTS AND NUTS : IS:1367-1980 (2nd. REVISION)
Reaffirmed 1991
91.9 GASKET : NATURAL RUBBER

20.5.10 SPECIFICATION FOR HYDRANT/LANDING VALVES

1.0 HYDRANT / LANDING VALVE
2.0 STANDARD : IS:5290-1993, TYPE-A
3.0 TYPE & SIZE : OUTLET 63 mm. FEMALE, OBLIQUE TYPE.
4.0 BONNET : SCREWED
5.0 STEM TYPE : RISING
6.0 ENDS
INLET : FLANGED (FLAT FACED) OF SIZE 80NB.
OUTLET : S.S. FEMALE INSTANTANEOUS COUPLING WITH
SPRING S.S. LOCK WITH BLANK CAP & CHAIN.
7.0 MATERIAL SPECIFICATION
BODY BONNET : Stainless Steel, IS: 3444
SPINDLE : Stainless Steel, IS: 6603
STOP VALVE,VALVE
SEAT & TRIM : Stainless Steel, IS: 3444
INSTANTANEOUS
COUPLING(F) : Stainless Steel, IS: 3444
BLANK CAP : PVC
HAND WHEEL : CI TO IS: 210

WASHER/GASKETS : RUBBER IS:638
SPRING : Stainless Steel, IS: 6528
8.0 COLOUR/SHADE : FIRE COLOUR AS PER SHADE NO.536 IS:5-1978
9.0 TEST PRESSURE : 21 KG./CM2

20.5.11 SPECIFICATION FOR BRANCH PIPE WITH NOZZLE

1.0 BRANCH PIPE WITH NOZZLE
2.0 STANDARD : IS:903
3.0 TYPE & SIZE : 63mm MALE INST. INLET THREADED OUTLET.
20 MM BORE NOZZLE.
4.0 MATERIAL SPECIFICATION
BODY : STAINLESS STEEL
WASHER : TYPE B, IS: 937
5.0 TEST PRESSURE : 21 KG./CM2

20.5.12 (1) (A) SPECIFICATION FOR DELIVERY HOSE COUPLING

1.0. COUPLING
2.0 STANDARD : IS:903
3.0 TYPE & SIZE : PAIR OF MALE & FEMALE PARTS 63 MM x 63 MM SIZE.
4.0 MATERIAL SPECIFICATION
BODY : STAINLESS STEEL, HEAVY DUTY AND INSTANTANEOUS PATTERN, IS:318
5.0 TEST PRESSURE : 21 KG./CM2

( B ) SPECIFICATION FOR RRL HOSE

1.0 STANDARD : IS:636 TYPE – A
2.0 TYPE : Synthetic Rubber Lined, Non percolating
3.0 SIZE : 63 MM
4.0 LENGTH : 15 MTR. EACH
5.0 TESTING PRESSURE : 14 KG./CM2
6.0 BURSTING PRESSURE : 38 KG./CM2
7.0 MARKING : IS:636 TYPE – A & ISI

( 2 ) SPECIFICATION FOR CP HOSE

1.0 STANDARD : IS : 8423
2.0 TYPE : Controlled Percolating fire Hose With special inner rubber coating
3.0 SIZE : 63 MM
4.0 LENGTH : 15 MTR EACH
5.0 TESTING PRESSURE : 14 KG/CM2
6.0 BURSTING PRESSURE : 38 KG/CM2
20.5.13 SPECIFICATION FOR Q.B. SPRINKLER

1.0 SPRINKLER
2.0 STANDARD : UL LISTED
3.0 TYPE : PENDENT AND SIDE WALL TYPE
4.0 RATED WORKING PRESSURE : 12.3 KG/CM. (175 PSI)
5.0 MATERIAL : BRASS
6.0 WEIGHT : 0.120 KG. (APPROX.)
7.0 FINISH : NICKEL CHROME PLATED

20.5.14. SPECIFICATION FOR 3 WAY FIRE BRIGADE CONNECTOR

Fire Brigade connections to Wet Riser and for underground reservoir shall be with three number 63 mm instantaneous inlets.

1.0 4 WAY FIRE BRIGADE CONNECTOR
2.0 STANDARD : IS:904
3.0 MATERIAL OF CONSTRUCTION
3.1 BODY : SS 304
3.2 COLLECTING HEAD : 3WAY INSTANTANEOUS. MALE
3.3 INLET : FLANGED

20.5.15. SPECIFICATION FOR INSTALLATION CONTROL VALVE

1.0 TECHNICAL PARAMETERS
1.1 CODES/STANDARD/APPROVAL : UL / FM
1.2 RATED WORKING PRESSURE : 12.3 KG./CM2
1.3 END CONNECTION : FLANGED, DRILLING AS PER IS:1538
1.4 MOUNTING : VERTICALLY
1.5 HYDRAULIC TEST PRESSURE : 25 KG./CM2
1.6 FINISH : FIRE RED EPOXY PAINTED
1.7 ACCESSORIES : CONSTANT PRESSURE TRIM,DRAIN VALVE, WATER MOTOR GONG, PRESSURE GAUGE, STOPVALVE ETC.
1.8 APPROX. WT. WITHOUT TRIM: 59 KGS.
2.0 MATERIAL OF CONSTRUCTION
2.1 HOUSING & COVER PLATE: CI, CONFOMING TO IS: 210 GR. 260
2.2 SEAT, CLAPPER, BUSH: BRONZE; IS: 318, LTB-II
2.3 GASKET, VALVE SEAT: NEOPRENE RUBBER
2.4 HINGE PIN, CLAMP: SS 304
2.5 BOLT: MS, IS: 1363
20.5.16. SPECIFICATION FOR BUTTERFLY VALVE

1.0 Body – Aluminium Die Cast/equivalent ASTM B85 -84-383
2.0 Neck – A351 GR. CF8
3.0 Stem – Equivalent ASTM A 276 TYPE - 410
4.0 Disc - A351 Gr. CF8M
5.0 O-ring - EPDM
6.0 Rubber seat  - EPDM
7.0 Bottom stem - Equivalent ASTM A276 Type 410

20.5.17. SPECIFICATION FOR PRESSURE GAUGE

Pressure gauges with controlling cocks etc. shall be of approved make having pressure range, bourdon material and dial.

20.5.18. SPECIFICATION FOR PRESSURE SWITCHES

Pressure switches with accessories shall be approved make and design and shall actuate at preset pressure.

20.5.19 ADDRESSABLE FIRE ALARM PANEL( FAP)

It shall be possible to Command Test, Reset and Alarm Silence individual devices from the FAP

Initiate smoke control procedures as described in the plans. FAP switches shall allow authorised personnel to accomplish the following, independent of the main operating console:

- Initiate a general alarm condition.
- Silence the local audible alarm.
- Silence the alarm signals.
- Reset all devices, after all initiating devices have been returned to normal.
- Test all panel LEDs for proper operation without causing a change in the condition for any zone.

The FAP electronics shall be contained in an enclosure made of minimum 16 gauge steel. Access to FAP switches and all electronics shall
be via key-lock; no other tools shall be required. Visual indicators of FAP status for each zone shall be visible without opening the key-locked cover. The FAP should be compatible for Public Address System

**20.5.20 FIRE ALARM DEVICES**

**Addressable Photo Electric type Smoke Detector (PED)**

The Photoelectric type Smoke Detector shall be addressable type and shall connect with two wires to the FAP. The detector shall use a photoelectric light scattering principle to measure the visible products of combustion.

All electronic circuits shall be solid state and hermetically sealed to prevent the effects of dust, dirt or humidity. All circuitry shall be protected against electrical transient and electro-magnetic interference, and reversed polarity or faulty loop wiring shall not damage the detector.

The detector shall be capable of self-test and provide pre-maintenance signal. Hence it shall not be necessary to either poll or adjust the sensitivity of each and every detector manually from time to time. The detector shall connect to the local control unit via a fully supervised circuit.

The detectors shall be ceiling mounted. The detectors shall provide a test means whereby they shall simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by using a test set, or may be activated remotely on command from the fire alarm panel.

**Addressable Heat /Thermal Detectors ( Fixed-Rate-of-Rise)**

The Heat Detector shall utilise a principle of operation based on a combined rate-of-rise and a fixed temperature heat detector. Combined rate-of-rise/fixed temperature detectors shall consist of two independent thermostats, designed to automatically compensate for changes in ambient conditions. All electronic circuits shall be solid state and hermetically sealed to prevent the effects of dust, dirt or humidity.

All circuitry shall be protected against usual electrical transients and electromagnetic interference and reversed polarity or faulty loop wiring shall not damage the detector.

The detector shall be capable of self-test and provide pre-maintenance signal. Hence it shall not be necessary to either poll or adjust the
sensitivity of each and every detector manually from time to time. The detector shall connect to the local control unit via a fully supervised circuit. The detectors shall be ceiling mounted. The detectors shall provide a test means whereby they shall simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by using a test set, or may be activated remotely on command from the fire alarm panel.

**Addressable Pull type Manual Pull Station**

The manual break glass unit shall be of the conventional type and suitable for connection with two wires to FAP. The manual break glass unit shall be electrically compatible with the standard range of automatic detectors so that it can be connected directly into a supervised two-wire zone of the manufacturer's standard range of control units for wiring.

The unit shall consist of the base plate, insert and cover. The units shall be designed for fast, simple and failure proof dismantling and assembling. The unit shall have sealable openings for wire introduction through compression cable glands on top and at the bottom of its housing. The lid of unit shall be permanently fixed to the body of the call point by a hinge. Every opening/removal of the cover shall release an alarm. The alarm contacts shall be of self cleaning design to prevent failure after a prolonged period of inactivity in unclean environments. The manual break glass units shall be designed for fail safe operation. The units shall be designed to permanently withstand corrosion, as defined by international standards and consists of aluminium cast housing. Closing the box after opening it shall automatically perform the reset function.

**Addressable Alarm Hooters cum Strobe**

Fire Alarm Hooters cum Strobe shall be of addressable type and connect with two wires to one of the FAP and also compatible for Public Address System. The alarm hooter cum speaker would be used for fire alarm and announcement for evacuation in the event of fire. The hooters being located at vital places shall have minimum 80 Db output and shall have adequate range to cover a radius up to 1 KM diametric range.
**Addressable Control Relay Module**

For monitored control of an extinguishing system activation of outdoor control units tripping (NO/NC Contact) with the option to reset the activated control output from the control panel, with monitoring short – circuit and interruption, Housing is designed for surface mounting of flush mounting.

**Fault Isolation Module**

Fault Isolator module shall be loop on panel intelligent loop communication circuit along with other modules and sensors. It detects a wire to wire short and electrically isolates that condition from the circuit so that communication is maintained with unaffected devices on the same circuit. The isolator shall be placed preferable every 15/20 devices in the loop.

**20.5.21. Specification For Co2 Type Fire Extinguisher**

1.0 CAPACITY, KG. : 4.5 KG  
2.0 STANDARD : IS:2878/86  
3.0 CYLINDER BODY : SEAMLESS CONFORMING TO IS:7285  
4.0 CONTROLLED VALVE : CONFORMING TO IS: 3224  
5.0 DISCHARGE HOSE : 1 MTR. LONG  
6.0 DISCHARGE HORN : FITTED WITH DISCHARGE HOSE  
7.0 CARRYING HANDLE & WALL  
8.0 MOUNTING BRACKET : TO BE PROVIDE WITH EXTINGUISHER  
9.0 INITIAL GAS REFILL : YES

**20.5.22. SPECIFICATION FOR WATER CO2 FIRE EXTINGUISHER**

1.0 CAPACITY, LTR. : 9 LTRS  
2.0 STANDARD : IS:940  
3.0 CAP : GUN METAL  
4.0 INITIAL REFILL : YES
20.5.23 SPECIFICATION FOR MECHANICAL FOAM FIRE EXTINGUISHIER

1.0 CAPACITY, LTR. : 9 LTRS.
2.0 STANDARD : IS:10204
3.0 CYLINDER BODY : MS
4.0 CO2 GAS CARTRIDGE : CONFORMING TO IS:4947
5.0 AFFF : CONFIRMING TO IS:4989
6.0 CARRYING HANDLE & WALL
7.0 MOUNTING BRACKET : TO BE PROVIDE WITH EXTINGUISHER
8.0 INITIAL REFILL : YES

20.5.24 SPECIFICATION FOR DCP TYPE EXTINGUISHIER

1.0 CAPACITY, KG. : 5 KG.
2.0 STANDARD : IS:2171/85
3.0 CAP : GUN METAL
4.0 INITIAL REFILL : YES
5.0 MARKING : ISI MARKED

20.5.25 MODULAR CLEAN AGENT TYPE FIRE EXTINGUISHIER

Exclusive assortment of NAF P1V Clean Agent (LPC Approved), which is used for computer, data center, server, Epabx, Critical Software rooms. Having ratings of 70B and 5A, our series of products are developed in compliance with the CEN standard EN3. These are used when it requires an inert and electrically non-conducting media.
## LIST OF DRAWINGS

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