

**TENDER FOR RENOVATION OF RAJAKESAVADAS SWIMMING POOL
PROJECT CIVIL AND ELECTRICAL WORKS AT ALAPPUZHA**

TENDER NO : 21/NGS/2012-13

Owner : The Chief Engineer
National Games Secretariat
Chandrasekhar Nair Stadium
Trivandrum 695 033
Tel: 0471 2302287

Consultants : KITCO LTD.

Accepting Authority : The Chief Engineer
National Games Secretariat
Chandrasekhar Nair Stadium
Trivandrum 695 033
Tel: 0471 2302287

Probable Amount of Contract : Rs.41,89,974/-

Earnest Money Deposit : Rs.50,000/- in the form of crossed
demand draft from Nationalised/
Scheduled Bank drawn in favour of
The Chief Engineer, National Games
Secretariat at Trivandrum.

Time of completion : 6 months

Last Date of Receipt of Tender : 14.02.2013 AT 3.00 PM

Date of opening of Tender : 15.02.2013 AT 11.00 AM

Venue of Receipt/opening of Tender : The Chief Engineer
National Games Secretariat
Chandrasekhar Nair Stadium
Trivandrum 695 033
Tel: 0471 2302287

Issued by : The Chief Engineer
National Games Secretariat
Chandrasekhar Nair Stadium
Trivandrum 695 033
Tel: 0471 2302287

Issued to :

CONTENTS

- 1.00 Notice Inviting Tender
- 2.00 General Conditions of Contract
- 3.00 Special Conditions of Contract
- 4.00 Forms for Different Deeds
- 5.00 Technical Specifications
- 6.00 Specification and Schedule of Quantities
- 7.00 Drawings

1. NOTICE INVITING TENDER

1.0 NOTICE INVITING TENDER

- 1.01 Sealed percentage rate tenders are invited on behalf of National Games Secretariat, Trivandrum (hereinafter called the ACCEPTING AUTHORITY) for Renovation of Raja Kesavadas Swimming Pool at Alapuzha from eligible Contractors possessing appropriate class registration in CPWD, State PWDS, MES, Government Undertakings for executing this work. A certified copy of the Contractor's License shall be enclosed with the Tender. Partnership firms shall furnish full names of all partners in the tender. It may, however, be signed in the partnership name by one of the partners or by a duly authorized representative, followed by the name and designation of the persons signing.

Eligibility Criteria

1. The tenderer should have satisfactorily completed two similar works of value not less than 50% of PAC of the work in a single Contract, during the last 3 years as Prime Contractor (satisfactory completion certificate from the Client for the work done should be submitted along with the application for issue of tender document).
2. The tenderer should have a valid Service tax Registration Certificate (A copy of the same shall be submitted along with the application for issue of tender document)

The schedule of quantities, tender drawings, specifications and commercial conditions of the Contract are appended.

1.02 The general information of the project is given in Annexure to this NIT. The information is only indicative. The tenderers are required to visit the site and familiarise themselves with the site conditions, nature of strata, availability of construction materials, etc., before quoting. The drawings, general & special conditions of Contract, schedule of quantities and the specifications may be carefully studied before they offer their quote. No claims for extra compensation over and above the quoted rates will be entertained by ACCEPTING AUTHORITY on the ground that the tenderer have misjudged site conditions, nature of strata, tender conditions or any item of tender. The tender documents can be obtained from the office of National Games Secretariat, Palayam, Thiruvananthapuram-695033 on cash payment of Rs.6,300/- + tax 5% (Rupees Six thousand and Three hundred only) on any working days during office hours from 01.02.2013 upto 14.02.2013 or download from the official website of the National Games Secretariat, www.35thnationalgames.in. Those who download the bidding documents from the website shall enclose a separate Demand Draft along with the bidding document towards the cost of the tender form mentioned.. This payment is not refundable.

- 1.03 The quoted tender documents signed and completed in all respects shall be forwarded so that it reaches the office of National Games Secretariat, Palayam, Thiruvananthapuram-695033 on or before 3 PM on 14.02.2013. Any tender received after the due time on this date will be rejected.

- 1.04 Tender shall be deposited in a sealed envelope superscribing Tender No. and name of work and shall contain:

Tenderer

Chief Engineer 4

1. Earnest Money Deposit as specified
 2. Tender Drawings
 3. Tender documents
 4. Preliminary agreement duly executed on non-judicial stamp paper of value not less than Rs.100/- as per proforma attached.
 5. Cost of tender documents in the form of DD.
- 1.05 Tender will be opened in the presence of tenderers or their authorized representatives who are present at 11.00 AM on 15.02.2013 at the venue specified. In the event of the specified date of Bid opening being declared a holiday for the ACCEPTING AUTHORITY, the tender will be opened at the same location at same time on the next working day.
- 1.06.01 After the public opening of the tenders, the information relating to the examination, clarification, evaluation and comparison of tenders and recommendations concerning the award of Contract shall not be disclosed to the tenderer and other persons not officially concerned with such process.
- .02 Subject to ACCEPTING AUTHORITY's right to accept any tender and reject any or all tenders; the work will be awarded to the tenderer whose bid has been determined to be substantially responsive to the tender documents and who has offered the lowest Evaluated Tender Price provided further that the tenderer has the capability and resources to carry out the Contract effectively.
- .03 Prior to the expiry of the period of validity of the tender ACCEPTING AUTHORITY will notify the successful tenderers in writing their name the sum which ACCEPTING AUTHORITY will pay to the Contractor in consideration of the execution, completion, operation, maintenance and guarantee of the work by the Contractor as specified by the Contract (hereinafter called the Contract price). This letter of acceptance will constitute the formation of a Contract.
- .04 Before commencing the work and within 14 days after the letter of acceptance of the tender has been intimated to him, the tenderer shall make a security deposit as given in clause 1.10 of this notice and furnish the same for the proper fulfillment of the Contract and shall execute an agreement for the work in required non-judicial stamp paper of value not less than Rs.100 in the prescribed format.
- .05 If the tenderer fails to execute the agreement as stated above within the specified period, the earnest money deposit shall be forfeited to ACCEPTING AUTHORITY and fresh tenders called for or the matter otherwise disposed off. If as a result of such measures due to the default of the tenderer to pay the required deposit, execute the agreement or take possession of the work site, any loss to ACCEPTING AUTHORITY results, the same will be recovered from the tenderer by deducting from any amount due to him from other works or revenue recovery or by suitable course of action including legal proceedings.
- .06 Tenders not properly filled, mutilated with incorrect calculations or generally not complying with the conditions are susceptible to be rejected.
- 1.07 In the case of percentage rate Contract only a single rate as an overall percentage above or below or at par with the rate given in the schedule by a single entry at the

bottom of the schedule under the head quoted rate, may be made. The overall percentage rate accepted and specified in the agreement shall not be varied on any account whatever. The rate thus quoted will be deemed to include the cost of all materials, labour, hire charges for all machinery's, cost of fuel, power, all leads and lifts, taxes, levies, royalties all over heads contingencies, profits, etc. and the quoted price is all inclusive. The total Contract price shall also be worked out and entered in.

1.08 If the tender is made by an individual it shall be signed with his full name and his complete address shall be given. If it is made by partnership firm it shall be signed with the co-partnership name by a member of the firm who shall sign his own name and give the name and address of each partner of the firm and attach a copy of 'Power of Attorney' with the tender authorising him to sign on behalf of the other partners. A certified copy of the 'Registered Partnership Deed' shall also be submitted along with the tender. A certified copy of the registered deed shall also be submitted along with the tender. The tender should be in a sealed cover.

1.09 **EMD**

.01 Earnest Money Deposit is Rs.1,31,300/-. It shall be drawn from Nationalised/ Scheduled bank in the form of crossed demand draft in favour of The Chief Engineer, National Games Secretariat, Trivandrum.

.02 EMD of the unsuccessful tenders will be refunded without any interest on finalisation of the Contract with the successful Tenderer or on the expiry of the validity period whichever is earlier.

.03 EMD deposited with ACCEPTING AUTHORITY will be forfeited,

- i) if a bidder withdraws his bid during the period of validity specified.
- ii) if the successful bidder fails within the time limit to sign the Contract document or fails to furnish the required security deposit.

1.10 **SECURITY DEPOSIT**

.01 The successful tenderer on receipt of the letter of acceptance will deposit an amount equal to 5% of the Contract Price subject to a maximum of Rs.2,00,000/- in the form of a crossed demand draft drawn in favour of National Games Secretariat, Trivandrum payable at Trivandrum. If the Probable Amount of Contract is more than Rs.2 crore the security deposit will be 10% of the PAC without any limit.

.02 EMD will be refunded to the Contractor after remittance of the security deposit and execution of the agreement.

1.11 **RETENTION MONEY**

.01 Retention Money at the rate of 10% of the value of work done from each running bill will be deducted from first and following part bills until such time as the cumulative total of such deductions including security shall amount to 10% of the Contract value.

.02 Provided that when the Retention money reaches above 1% of the Contract value or Rs.5 lakh, whichever is higher, subject to the discretion of Accepting Authority, if the Contractor so demand may convert the amount coming above the said value, on its

accumulation to a minimum amount of Rs.5 lakh into one of the Government securities or Bank guarantee from any nationalised bank; the bank guarantee being valid till the completion of the defect liability period and subject to the condition that such bank guarantee shall be for a minimum amount of Rs.5 lakh; except for the last one.

.03 All the deposits of EMD, SECURITY DEPOSIT and RETENTION MONEY will not bear any interest whatsoever.

.04 No retention money will be paid if the contract value is more than Rs.2 crore.

1.12 REFUND OF SECURITY DEPOSIT & RETENTION MONEY

1.12.1 On satisfactory completion of the work and on recording of completion certificate, the retention money will be released based on the report from the Engineer-in-charge.

1.12.2 On expiry of the defects liability period or on payment of the amount of the Final Bill which ever is later, the Engineer-in-charge, shall recommend on demand from the Contractor to refund to him the security deposit (i.e. amount retained as per clause 1.10 above) and the same will be refunded by the Accepting Authority provided that the Engineer-in-charge is satisfied that there is no demand outstanding against the Contractor.

1.13 STATUTORY DEDUCTIONS

1.13.1 Income-tax at the rate prevailing at the time of payment will be deducted from each running account bill and final bill.

1.13.2 All statutory payments in connection with the employment of the workmen for this work will be borne by the Contractor.

1.13.3 The Contractor is the employer of all the worker's engaged for this work and should therefore take all required registrations and pay premium correctly to labour welfare funds constituted by the Union Government and Government of Kerala from time to time as per the existing rules.

1.13.4 All statutory deductions shall be made from the amount eligible to the Contractor in each part bill at current rates. The deduction towards the work Contract tax shall be as per the prevailing rates of Kerala Government Sales Tax Rules. Any tax omitted, to be deducted in any part bill shall be deducted in the subsequent bills/final bill.

1.14 QUANTUM OF WORK

1.14.01A schedule of approximate quantities for various items accompanies this tender. It shall be definitely understood that ACCEPTING AUTHORITY do not accept any responsibility for the correctness or completeness of this schedule in respect of items and quantities and this schedule is liable to alteration by deletions, deductions or additions at the discretion of ACCEPTING AUTHORITY without affecting the terms of the Contract.

1.14.02ACCEPTING AUTHORITY reserves the right to increase or decrease the quantum of work at site without assigning any reason.

1.14.03 Variations in the quantities put to tender will not be the basis of any claim or disputes. The rates agreed by the Contractor shall hold good for any amount of variation in the quantities and no claims whatsoever will be entertained on this amount. The Contractor shall carry out all works as directed by ACCEPTING AUTHORITY at the same agreed rates.

1.15 ALL INCLUSIVE RATES

The Contractor's rate must be firm and include the cost of transportation of material to the site, all taxes such as Sales Tax, Service tax, Excise and octroi, etc. and the fixing or placing in position for which the item of work is intended to be operated. The rates quoted by the Contractor shall be firm throughout the Contract period and there shall be no upward revision of the rates quoted by the Contractor for any reasons whatsoever. It should be clearly understood that any claims for extra Sales Tax, Service Tax, Excise duty, Construction Tax or any Additional tax, etc., shall not be entertained in any case whatsoever once the tenders are opened.

1.16 INTERPRETING SPECIFICATIONS

1.16.01 In interpreting the specifications, the following order of decreasing importance shall be followed:

- a. Specification mentioned in Schedule of Quantities
- b. Unit Rate Specifications and Technical Specifications,
- c. Special Conditions of Contract,
- d. Drawings,

1.16.02 Matters not covered by the specifications given in the Contract, as a whole shall be covered by the relevant Indian Standard Codes. If such codes on a particular subject have not been framed, the decision of ACCEPTING AUTHORITY shall be final.

1.17 ALTERATIONS

No alterations shall be made by the tenderer in the Notice Inviting Tender, Instructions to the Contractors, Contract form, General Conditions of the Contract, Special Conditions of Contract, drawings and specifications and if any such alterations are made or any conditions attached, the tender is liable to be rejected.

1.18 ACCEPTANCE OF THE TENDER

1.18.01 The acceptance of a tender rests with the Authorised Representative of ACCEPTING AUTHORITY who does not bind himself to accept the lowest tender and reserves to himself the authority to reject any or all the tenders received without assigning any reason(s) whatsoever.

1.18.02 The authorised representative of ACCEPTING AUTHORITY reserves the right of accepting the whole or any of the tenders received and the tenderer shall be bound to perform the same at the rates quoted.

1.18.03 The work shall be carried out under the direction and supervision of ACCEPTING AUTHORITY or their representative at site. On acceptance of the tender, the Contractor shall intimate the name of his accredited representative who would be supervising the construction and would be responsible for taking instructions for carrying out the work.

1.18.04 ACCEPTING AUTHORITY's decision with regard to the quality of the material and workmanship will be final and binding, any material rejected thus shall be immediately removed by the Contractor and replaced by materials as per specifications and standards.

1.19 **DEFECTS LIABILITY PERIOD**

Defect Liability Period will be 12 months from the date of completion of work. Any defect developed within 'Defect Liability Period' will have to be rectified by the Contractor at their own cost and in case the defects are not rectified by the Contractor, ACCEPTING AUTHORITY or their representative shall get the work done at the risk and cost of the Contractor.

1.20 **DELAYS IN COMMENCEMENT**

The Contractor shall not be entitled to any compensation for any loss suffered by him on account of delays in commencing or executing the work, whatever the cause for such delays may be including delays in procuring Government Controlled or other materials.

1.21 **OCCUPATION IN PART & CO-OPERATION**

1.21.01 If ACCEPTING AUTHORITY wants to occupy areas in part, the Contractor shall complete the work of these areas in conjunction with ACCEPTING AUTHORITY and hand over the same to ACCEPTING AUTHORITY without affecting any of the clause of Contract agreement.

1.21.02 The Contractor must co-operate and co-ordinate with other Contractors involved in other works at the site. The Contractor should also note that they shall have to clear the site of vegetation, debris, etc. before the commencement of the work and that no extra payment is permissible on this account.

1.22 **ISSUE OF MATERIALS, TOOLS AND PLANT**

1.22.01 The Contractor should inspect the source of materials, their quality, quantity and availability. All materials must strictly comply with the relevant B.I.S. specifications.

1.22.02 ACCEPTING AUTHORITY shall issue the following material or Tools and Plants required for the execution of the works.

- a) Materials **Nil**
- b) Tools and Plants **Nil**

1.23 **PERIOD OF CONSTRUCTION**

Time is the essence of this contract. The construction period shall be 6 months. Commencement of the work shall be considered from the date of receipt of letter of acceptance and handing over possession of the site. The Contractor shall draw a detailed schedule of programme in the form of a Bar Chart on whole work, within one week of award of work and submit to the Consultants for their approval.

1.24 **INSURANCE**

The successful tenderer shall take out Contractor's All Risk (CAR) insurance policy, jointly in the name of ACCEPTING AUTHORITY and the Contractor, and the original policy shall be deposited with ACCEPTING AUTHORITY.

1.26 This Notice Inviting Tender will form part of the tender document and the agreement executed by the successful tenderer.

**The Chief Engineer
National Games Secretariat.**

ANNEXURE TO NIT

GENERAL INFORMATION OF THE PROJECT

1. Name of Project : Renovation of Raja Kesavadas Swimming Pool Project Civil and Electrical at Alappuzha
2. Site and location : Alappuzha
3. Nature/scope of work : Renovation of Raja Kesavadas Swimming Pool Project Civil and Electrical at Alappuzha
4. Nearest Railway Station : Alappuzha
5. Nearest Airport : Nedumbassery
6. Owner/Client : The Chief Engineer
National Games Secretariat
Chandrasekhar Nair Stadium
Trivandrum 695 033
Tel: 0471 2302287
7. Consultants : KITCO Ltd.,
P.B.No. 4407,
Femith's, Puthiya Road,
NH By Pass, Kochi – 682 028.
8. Accepting Authority : The Chief Engineer
National Games Secretariat
Chandrasekhar Nair Stadium
Trivandrum 695 033
Tel: 0471 2302287
9. Payment Authority : The Chief Engineer
National Games Secretariat
Chandrasekhar Nair Stadium
Trivandrum 695 033
Tel: 0471 2302287
10. Period of completion of work : 6 months.
11. Schedule taken : KPWD Schedule of Rates 2012

2. GENERAL CONDITIONS OF CONTRACT

2.00 GENERAL CONDITIONS OF CONTRACT

2.01.00 Definitions

2.01.01 In the contract (as hereinafter defined) the following words and expressions shall have the meaning hereby assigned to them except where the contract otherwise requires.

2.01.02 The “Owner/Client” shall mean the Corporation/Board/Department/Person for whom the work is being arranged.

2.01.03 The ACCEPTING AUTHORITY shall mean the Accepting Officer/Firm with whom the Contractor executes the Agreement and this shall be mentioned in NIT.

2.01.04 The “Contractor” shall mean person or persons, firm or company whose tender has been accepted and includes the contractor’s legal representatives, successors and permitted assigns.

2.01.05 The “Consultants” shall mean KITCO Ltd. who are consultants to the Owner for this project and having their office at P.B.No.4407, Femith’s, Puthiya Road, NH By Pass, Vennala, Kochi-28, for the present or any other competent agency duly appointed by OWNER/CLIENT to act as consultants for the purpose of the contract. The words “Consultants” “Consulting Engineers” appearing elsewhere in the tender shall also mean consultants.

2.01.06 “Tender” shall mean the tender submitted by the contractor for acceptance before the ACCEPTING AUTHORITY.

2.01.07 The “work” shall mean and include all works to be executed in accordance with the contract or part thereof as the case may be and shall include all extras, additional, altered or substituted works required for the purpose of the contract.

2.01.08 The “Contract Document” shall mean the agreement between ACCEPTING AUTHORITY and the contractors for the execution of the work including therein all documents such as the Notice Inviting Tender, Tender Forms, General Conditions of Contract, Technical Specification, Schedule of Quantities, Special Conditions of Contract, Letter of Acceptance, Agreed variation if any, drawings, work orders, and / or any other / correspondences or negotiations, etc.

2.01.09 “Specifications” shall mean all directions, various technical specifications, provisions and requirements attached to the contract which pertain to the method and manner of performing the work, and the materials to be furnished under the contract for the work as may be amplified or modified by ACCEPTING AUTHORITY/Consultant, drawings for the performance of the contract in order to provide the unforeseen conditions or in the best interest of the work. It shall also include the latest revised version of the relevant B.I.S. specification and other relevant codes.

2.01.10 “Site” shall mean the land allotted by the Owner/Client under in or through which the work is to be carried out.

- 2.01.11 “Letter of Acceptance/Award of Work” shall mean an intimation by letter, telegram, telex or fax to the tenderer that the tender has been accepted in accordance with the provisions contained therein.
- 2.01.12 “Engineer” shall mean the Engineering Personnel representing ACCEPTING AUTHORITY/Consultant and entrusted with work of supervision of work at the site.
- 2.01.13 “Contract sum/price” shall mean the total sum referred to in the schedule of quantities and rates and accepted by ACCEPTING AUTHORITY.
- 2.01.14 The ‘Probable Amount of Contract’ (PAC) shall mean the Estimated amount/ Tendered amount of the work.
- 2.01.15 The “Payment Authority” shall mean the Officer/Firm who makes payments of the bills for the work done and this shall be mentioned in NIT.

2.02.00 **SITE**

- 2.02.01 Location and details of site are specified in NIT.
- 2.02.02 Entry into the project area will be restricted. Passes and permits will have to be obtained from Owners for entry of all persons and vehicles into the project area. During working, the contractor shall provide barricades and screens and working place shall be isolated from other places. Working place shall be visible from other areas.

2.03.00 **SCOPE OF WORK**

- 2.03.01 The scope of work is described in the NIT.
- 2.03.02 The scope of work further includes variation or modification of design, quantity or quality of work, addition, omissions or substitution of any work, under the instruction of ACCEPTING AUTHORITY/Consultant. Such instructions shall be complied forthwith.
- 2.03.03 The Contractor shall provide all necessary labour, materials, equipments and management and supervisory personnel to complete the works provided under this contract in time.

2.04.00 **ASSIGNMENT AND SUB-CONTRACTING**

2.04.01 **ASSIGNMENT**

The contractor shall not assign the contract or any part thereof or any benefit or interest therein or thereunder without the written permission of ACCEPTING AUTHORITY; not shall transfers be made by Power of Attorney authorizing others to carry out the work or receive payment on behalf of the tenderer.

2.04.02 SUB-CONTRACTING

The contractor shall as soon as practicable, after signing the contract, notify to the Engineer-in-Charge, in writing, the names of the subcontractors proposed for the work.

The Contractor shall be fully responsible to ACCEPTING AUTHORITY for the acts and omissions of his subcontractors and of persons directly or indirectly employed by them, as he is for the acts and omissions of persons employed by him.

Nothing contained in the contractual documents shall create any contractual relation between any subcontractor and the ACCEPTING AUTHORITY.

Subcontracting shall be limited to NOT exceeding 40% of the total amount of contract. In case of specialised nature of work requiring very high quality stipulations, such works shall not be subcontracted unless:-

- a) The subcontractor firm has sufficient expertise, equipment/plant back up and experience in the similar nature of work.
- b) The subcontractor firm has sufficient financial background. The firm should have atleast 20% of the value of work to be sublet as net assets.
- c) The subcontractor firm has a track record of completing the works on time and to the quality stipulations.
- d) The subcontractor firm has not run into litigation/ arbitration in the past three years with the clients.

In no event can any delay or unsatisfactory work conducted by the subcontractor can either be accepted or can be contractor adduce such delay or unsatisfactory work attributable to subletting of work. The main contractor shall be fully responsible for the contract and Management of subcontractors.

2.05.00 DRAWING

2.05.01 ISSUE OF DRAWINGS

Drawings approved for construction will be issued to the Contractor progressively during the contract period and the Contractor shall arrange for the execution of the works and the procurement of materials accordingly. The Contractor shall give adequate notice in writing to ACCEPTING AUTHORITY or his representative of any further drawings or specifications that may be required for the execution of the works or otherwise under the contract.

2.05.02 COPIES OF DRAWINGS TO BE KEPT AT SITE

One copy of the drawings furnished to the Contractor as aforesaid shall be kept at the site and the same shall at all reasonable times be available for inspection and use by ACCEPTING AUTHORITY or their representative and by any other person authorised by ACCEPTING AUTHORITY in writing.

2.05.03 ISSUE OF FURTHER DRAWINGS AND INSTRUCTIONS

ACCEPTING AUTHORITY shall have full power and authority to supply to the Contractor from time to time through his representative, during the progress of the works such further drawings and instructions as shall be necessary for the purpose of proper and adequate execution and maintenance of the works and the Contractor shall carry out and be bound by the same.

2.05.04 OWNERSHIP OF DRAWINGS

All drawings supplied to the Contractor are deemed to be the property of KITCO. The Contractor should not divulge or use, except for the purpose of this contract, any information contained in the drawings.

2.05.05 EXECUTION AS PER DRAWINGS

The Contractor must not vary or deviate from the drawings in any respect while executing the work or executing any extra work of any kind whatsoever unless authorised by ACCEPTING AUTHORITY.

2.05.06 PLANS AND DRAWINGS TO BE SUBMITTED BY CONTRACTOR

The Contractor shall submit the following information in triplicate to ACCEPTING AUTHORITY for approval within the time stipulated: each item below:-

- a) A general tentative layout plan of construction plant and equipments for the execution of work within 7 days from the date of receipt of work order.
- b) Drawings or prints showing the location of major plants and other facilities which he proposes to put up at the site, including any changes in the general layout, at least 7 days prior to the commencement of the respective work.

Layout and details of temporary works that the contractor wants to carry out to fulfil his obligation under the contract. Within 15 days ACCEPTING AUTHORITY will give their approval/comments sufficient to proceed with the work or objections/instructions to the Contractor based on which the drawings shall be revised and submitted again for approval by the Contractor.

All these plans and drawings submitted by the Contractor and approved by ACCEPTING AUTHORITY shall become part of the contract.

2.05.07 ROYALTIES AND PATENT RIGHTS

All royalties or other sums payable in respect of the supply and use in carrying out the work as desired by or referred to in the schedule of quantities of any patented articles, process or inventions shall be deemed to have been included in the contract sum and the Contractor shall indemnify ACCEPTING AUTHORITY from and against all claims, proceedings, damages, costs and expenses which may be brought or made against ACCEPTING AUTHORITY or to which he may be put by reason

of the Contractor infringing or being held to have infringed any patent rights in relation to any such articles, process and inventions.

2.06.00 GENERAL OBLIGATIONS

2.06.01 INSPECTION OF SITE ETC. BEFORE SUBMISSION OF TENDER

The Contractor shall inspect and examine the site and its surroundings, and shall satisfy himself before submitting his tender, as to the nature of the ground, form and nature of the site, the quantities and nature of work and materials and its availability required for the completion of the works, the means of access to the site, the local labour conditions, the accommodation he may requires and in general shall obtain all necessary information as to the risks, contingencies and other circumstances which may influence or affect his tender. He must go through all the drawings, specifications and other tender documents. Any further clarifications in the drawings and documents can be had from ACCEPTING AUTHORITY at the above mentioned address.

2.06.02 SUFFICIENCY OF TENDER

The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the works and of the rates and prices stated in the priced bill of quantities and the schedule of rates and prices, if any, with tender rates and prices shall cover all is obligations under the contract and all matters and things necessary for the proper completion and maintenance of the work.

2.06.03 DISCREPANCY OR ERROR IN TENDER DOCUMENT

Should the Contractor notice any discrepancy or error in the tender document, in the statement made, or quantities or units shown against items, he shall immediately bring to the notice of ACCEPTING AUTHORITY and obtain the clarification before submitting the tender. The tender shall be based on such clarifications received and shall be recorded as such in the covering letter to the tender, failing which ACCEPTING AUTHORITY shall have the right to ask the Contractor to execute the work according to the corrected statement made or quantities or units shown in the tender, without any compensation; when the same has come to the notice of the ACCEPTING AUTHORITY.

2.06.04 RATES QUOTED FOR FINISHED WORK

The rates quoted in the tender by the Contractor must be for the finished work as per the drawings and specifications.

2.06.05 LOCATION OF WORK

Unless specifically mentioned in the item, the work described there-in may be at any location or elevation.

2.06.06 FIRM PERIOD

The tender shall remain open for acceptance for a period of **120 days** from the date of opening of the tender. If any tenderer withdraws his tender before the said period or makes any modifications in terms and conditions of the tender, then Accepting Authority has the liberty to forfeit the said Earnest Money Deposit.

2.06.07 COMMENCEMENT OF WORK

The Contractor shall commence the work at site, within 14 days from the date of receipt of letter of award of work or handing over of the site whichever is later and shall proceed with the same with due expedition.

2.06.08 PROGRAMME OF WORK

As per the clause in special conditions of contract.

2.06.09 CONTRACTOR'S EMPLOYEES

The Contractors shall provide and employ sufficient qualified personnel at site in connection with the project management.

Only such technical assistants as are skilled and experienced in their respective fields and such-agents, foreman and leading hands as are competent to give proper supervision to the work they are required to supervise and,

Such skilled, semi-skilled and un-skilled labour as is necessary for the proper and timely execution and maintenance of works.

2.06.10 REMOVAL OF WORKMEN

ACCEPTING AUTHORITY shall be at liberty to object to and require the Contractor to remove forthwith from the works any person employed by the Contractor in or about the execution or maintenance of the works who in the opinion of ACCEPTING AUTHORITY misconduct himself or is incompetent or negligent in the proper performance of his duties or whose employment is otherwise considered by ACCEPTING AUTHORITY to be undesirable and such person shall be replaced by the Contractor without delay by a competent substitute approved by ACCEPTING AUTHORITY.

2.06.11 COMMUNICATIONS TO BE IN WRITING

All references, communications, correspondences made by ACCEPTING AUTHORITY, ACCEPTING AUTHORITY's representative or the Contractor concerning the works shall be in writing and no reference, communication, or complaint which is not in writing, shall be recognised.

2.06.12 OCCUPATION AND USE OF LAND

No land, building belonging to or in the possession of the Owner/Client/ Consultant shall be occupied by the Contractor. The Contractor shall not use, or allow to be used, the site for any purpose other than that for executing the works.

2.06.13 CONTRACTOR'S STORE AND SITE OFFICE

Any site-shed, proposed to be temporarily constructed by the Contractor for his office work, storage of materials, etc. shall conform to the standard sketch, or to the plan approved by ACCEPTING AUTHORITY. Permission for the construction of such sheds shall be obtained in writing. Suitable area in the site of work shall be allowed to the contractor free of cost for constructing company structures for storing his tools and plants, materials site office and cement Godown. However, the structure will be provided by him at his own expense and he will be solely responsible for guarding his property with requisite insurance against theft, fire, etc. The contractor however will have to dismantle the sheds and vacate the land of all debris, etc. at his own expense after completion of work.

2.06.14 MATERIALS, TOOLS AND PLANT

All materials required for the execution of the works other than those mentioned in the Notice Inviting Tender shall be supplied by the Contractor. Materials so supplied shall have the approval of ACCEPTING AUTHORITY before using on the works. All the rejected materials shall be removed at once from the site of work at the Contractor's own cost.

2.06.15 TOLLAGES, ETC.

The Contractor shall pay all tollages and other royalties, rent and other payments or compensations, if any, for getting stone, gravel, sand, clay and all other materials required for the works.

2.06.16 SETTING OUT

The Contractor shall be responsible for the true and proper setting out of the works and for the correctness of the position, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection therewith. If at any time during the progress of the works any error shall appear or arise in the position, level, dimensions or alignment of any part of the works, the Contractor on being required to do so by ACCEPTING AUTHORITY or ACCEPTING AUTHORITY's representative, shall at his own cost rectify such error to the satisfaction of ACCEPTING AUTHORITY or his representative. The checking of any setting out or of any way relieve the Contractor from the responsibility of true and proper setting out of the works. The Contractor shall provide all necessary instruments, appliances and labour required by ACCEPTING AUTHORITY or his representative for checking if any, of the setting out. The Contractor shall carefully protect and observe all bench marks, site levels, pegs and other things used in setting out the works. The rates quoted for the work shall also include the cost of reference and level pillars and other dismantling, when no longer required.

2.06.17 DAMAGE TO PERSONS AND PROPERTY

The Contractor shall identify and keep indemnified ACCEPTING AUTHORITY against all losses and claims for injuries or damages to any person or property whatsoever which may arise out of or in consequence of the construction and

maintenance of works and against all claims, demands proceedings, damages, costs, charges, expenses, whatsoever in respect thereof in relation thereto.

2.06.18 CO-OPERATION WITH OTHER AGENCIES

The Contractor shall co-operate with the work of other agencies or Contractors that may be employed or engaged by ACCEPTING AUTHORITY/ CONSULTANT and as far as it relates to the Contractor's work. The sequence of work shall be so arranged that the work of other agencies are also in progress simultaneously.

2.06.19 BARRICADING AROUND EXCAVATED TRENCHES, ETC.

The Contractor shall at his own cost provide around excavation, temporary barricading with bellies and bamboo with warning signals during day and night and shall maintain it so long as the trenches are not filled up. Similar barricades shall also be provided at all dismantling work, erection of structural, sheeting work, etc. No extra claim shall be entertained for providing, maintaining and removing such barricades.

2.06.20 FABRICATION DRAWINGS

Contractor shall prepare at his own cost all fabrication drawings of all structural steel works and bar bending schedule for R.C.C. works and submit them to ACCEPTING AUTHORITY for their approval at least before 15 days of commencing the fabrication. All the details like sizes, capacities, dimensions, arrangement of fabrication, etc. should be clearly indicated on these drawings.

2.06.21 PROTECTION OF UNDERGROUND SERVICES

The contractor must take precautionary measures to protect the underground and other services lines viz. Cables, water and sewer lines, etc. and observe any specific instructions which may be given in this regard by ACCEPTING AUTHORITY.

2.06.22 DEWATERING TRENCHES AND PITS

The tendered rates shall always be deemed to have taken into account the cost of removal of silt and materials that may slip in the trenches and pits and dewatering the trenches or pits of water accumulated or collected through seepage or subsoil water or rain water. The contractor shall in no case be entitled to claim any extra amount for the above work. The contractor shall remain prepared with necessary pumps and equipment for dewatering the trenches or pits so as to avoid unnecessary delay and possible damage to the property, etc.

2.06.23 WORK IN OR AROUND OPERATING PLANT OR OFFICES ETC.

Where the work is being carried out in or around an operating plant where the plant must run uninterrupted, the contractor shall work only at specified place and times as mutually arranged between the Contractor and ACCEPTING AUTHORITY. Similar arrangement must be made while executing works inside the offices, buildings, etc. without causing disturbance to the office work. For this the work may be required to be done during off-hours and Sundays. No extra will be allowed beyond the rates quoted for doing work in the manner described above.

2.06.24 WORK IN SHIFTS AND ON OFF-DAYS

The Contractor shall work in one or more shifts as also on Sundays and off days to complete the work on time, if so required by ACCEPTING AUTHORITY for which ACCEPTING AUTHORITY shall not be liable to pay any extra. If instructed by ACCEPTING AUTHORITY, the Contractor should carry out the work in the night also.

2.06.25 SITE ORDER BOOK AND CEMENT REGISTER

A site order book must be maintained and always be available at site to record the instructions by ACCEPTING AUTHORITY or their representative. The Contractor must see that the instructions noted therein are properly carried out.

A register showing the stock, receipts, daily issue/consumption of cement and balance quantity available etc. should be maintained at site and made available on demand by the ACCEPTING AUTHORITY.

2.06.26 DELAY IN OBTAINING MATERIALS SUPPLIED BY ACCEPTING AUTHORITY

If ACCEPTING AUTHORITY has undertaken to supply any material specified in the special conditions at rates and conditions cited therein, the contractor shall keep himself in touch with day-to-day position regarding the supply of materials from ACCEPTING AUTHORITY and so adjust the progress of the works that labour may not remain idle nor there by any other claim due to or arising from delay in obtaining the materials.

2.06.27 RECORD OF MATERIALS SUPPLIED BY ACCEPTING AUTHORITY

The contractor shall maintain an account of different materials obtained from ACCEPTING AUTHORITY for executing the works under the contract. ACCEPTING AUTHORITY shall have the right to check the position of materials at all times.

2.06.28 SAFE STORAGE OF MATERIALS

The contractor shall be responsible for the safe storage of materials supplied by ACCEPTING AUTHORITY for executing of the works. Surplus materials lost or damaged or unaccounted for or made unserviceable by the Contractor shall be charged at penal rates.

2.06.29 TRANSPORT OF MATERIALS

Unless otherwise specified, all the materials supplied by ACCEPTING AUTHORITY shall be transported by the Contractor from ACCEPTING AUTHORITY's store/yard, to the site of work at no extra cost.

2.06.30 SITE TO BE KEPT CLEAN

The surplus spoil and dismantled debris shall be removed to a place as directed by ACCEPTING AUTHORITY/CLIENT and stacked, levelled and dressed as directed. Rehandling charges will not be allowed.

2.06.31 CONFLICT IN MEANING BETWEEN SCHEDULE OF QUANTITIES AND SPECIFICATIONS

The schedule of quantities shall be read in conjunction with the specification, and in the event of conflict in meaning between the two the corresponding item in the unit rate specification shall always have precedence over the specifications.

2.07.00 LABOUR

2.07.01 LABOUR RULES

In respect of all labour directly or indirectly employed on the works by the Contractor, the Contractor shall comply with the provisions of the contract labour (Regulation and Abolition) Act 1970, Minimum Wages Act 1948, Payment of Wages Act 1936, Employees Provident Funds and Miscellaneous Provision Act 1952, The Employees State Insurance Act, 1948 and any amendments thereof and all legislation and rules of the State and/or Central Government or other local authorities, framed from time to time, governing the protection of health, sanitary arrangements, wages, welfare and safety for labour employed on building and construction works and for bonus, retirement benefits, retrenchment/lay off, compensation and all other matter liabilities of ACCEPTING AUTHORITY to employees. The rules and the other statutory obligations with regard to fair wages, welfare and safety measures, maintenance of register, etc. will be deemed to be part of the contract. The contractor shall produce documentary evidence for compliance of above Acts.

2.07.02 REPORTING ACCIDENT OF LABOUR

The Contractor shall be responsible for the safety of all employees and/or workers employed or engaged by him on and in connection with the works and shall forthwith report all cases or accidents to any of them, however caused and whenever occurring, to ACCEPTING AUTHORITY or his representative and shall make every arrangement to render all possible assistance and aid to the victims of the accident.

2.07.03 PROVISION OF WORKMEN'S COMPENSATION ACT

The Contractor shall at all times indemnify and keep indemnified ACCEPTING AUTHORITY against all claims for compensation under the provisions of the workmen's Compensation Act 1923 or any other law for the time being in force by or in respect of any workmen employed by the Contractor in carrying out the contract and against all cost and expenses or penalties incurred by ACCEPTING AUTHORITY in connection therewith. In any case in which, by virtue of the provision of the said act, ACCEPTING AUTHORITY is obliged to pay compensation to a workman employed by the Contractor in executing the works, ACCEPTING AUTHORITY shall recover from the Contractor the amount of the compensation so paid and without prejudice to the rights of ACCEPTING AUTHORITY under the said Act. ACCEPTING AUTHORITY shall be at liberty

to recover such amount or any part thereof by deducting it from the security deposit or from any amount due by ACCEPTING AUTHORITY to the Contractor, whether under this contract or otherwise without prejudice to any other remedy that may be available to ACCEPTING AUTHORITY, in law. ACCEPTING AUTHORITY shall not be bound to contest any claim made against it under the said Act, except on the written request of the Contractor and upon his giving to ACCEPTING AUTHORITY full security for all cost for which ACCEPTING AUTHORITY might become liable in consequence of contesting such claim.

2.07.04 ACCIDENT OR INJURY TO WORKMEN

ACCEPTING AUTHORITY shall not be liable for, in respect, or any damages or compensation payable as per regulations or in consequence of any accident or injury to any workmen or other person in the employment of the Contractor shall indemnify and keep indemnified ACCEPTING AUTHORITY against all such damages and compensation and against all claims, demands, proceedings costs, charges and expenses whatsoever in respect thereof or in relation thereto.

2.07.05 PRESERVATION OF PEACE

The Contractor shall take requisite precautions to prevent any riotous or unlawful behaviour by or amongst his workmen and/or others employed on the works by him, for the preservation of peace and protection of the inhabitants and security of property in the neighbourhood of the works.

2.07.06 AGE LIMIT OF LABOUR

The age limit for employment of labour shall be in strict accordance with the existing labour legislation.

2.07.07 RETURN OF LABOUR EMPLOYED

The Contractor, if required by ACCEPTING AUTHORITY, shall submit return in detail in such form and at such interval as ACCEPTING AUTHORITY may prescribe showing number of different classes of labour employed on the work from time to time by the Contractor.

2.07.08 OBSERVANCE BY SUB-CONTRACTOR

The Contractor shall be responsible for the observance of the provisions of aforesaid clauses by the sub-contractors employed by him in the execution of the contract.

2.08.00 MATERIAL TESTS AND WORKMANSHIP

2.08.01 QUALITY OF MATERIALS, WORKMANSHIP AND TESTS

All materials and workmanship shall be of the respective kinds described in the contract and in accordance with ACCEPTING AUTHORITY or their representative's instructions and shall be subject, from time to time, to such tests as ACCEPTING AUTHORITY or his representative may direct at the place or any of such places. The contractor 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 material used and shall supply samples of materials before incorporation in the works for approval as may be required by ACCEPTING AUTHORITY.

2.08.02 CONSTRUCTION OF PROTOTYPES OR SAMPLES OF WORK

The Contractor shall construct prototypes or samples of work as laid down in the contract or as instructed by ACCEPTING AUTHORITY. Such prototypes or samples or work, after approval by ACCEPTING AUTHORITY, shall serve as the standards to be achieved in the final construction.

2.08.03 COST OF SAMPLES

All samples shall be supplied by the Contractor at his own cost.

2.08.04 COST OF TESTS

The cost of making any test as per specifications shall be born by the Contractor, and the Contractor should arrange for all facilities like meters, instruments as required for carrying out such tests.

2.08.05 INSPECTION OF OPERATION

ACCEPTING AUTHORITY or their representative shall at all times have access to the works and to the site and to all workshops and places where materials, manufactured articles or machinery are being obtained for the works and the Contractor shall afford every facility for every assistance in obtaining the right to such access.

2.08.06 EXAMINATION OF WORK BEFORE COVERING UP

No work shall be covered up or put out of view without the approval of ACCEPTING AUTHORITY or ACCEPTING AUTHORITY's representative and the Contractor shall afford full opportunity to ACCEPTING AUTHORITY or ACCEPTING AUTHORITY's representative to examine and measure any work which is about to be covered up or put out of view and to examine foundations before permanent work is placed thereon. The contractor shall give due notice to ACCEPTING AUTHORITY's representative wherever any such work or foundations is or are ready or about to be ready for examination and ACCEPTING AUTHORITY's representative shall without unreasonable delay, unless he considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such work or of examining such foundations.

2.08.07 UNCOVERING AND MAKING OPENINGS

The Contractor shall uncover any part of parts of the works or make opening in or through the same as ACCEPTING AUTHORITY may, from time to time, direct and shall reinstate and make good such part of parts to the satisfaction of ACCEPTING AUTHORITY. If any such part of parts have been covered up or put out of view and found to be executed in accordance with the contract, the expenses of uncovering, making openings in or through, reinstating and making good the same shall be borne by ACCEPTING AUTHORITY but in any other case all such expenses shall be

borne by the Contractor and shall be recoverable from him by ACCEPTING AUTHORITY and deducted by ACCEPTING AUTHORITY from any money due, which may become due to the Contractor, without prejudice to any other remedy that may be available to ACCEPTING AUTHORITY, by law.

2.08.08 REMOVAL OF IMPROPER WORK AND MATERIALS

ACCEPTING AUTHORITY or his representative shall during the progress of the works have power to order the following in writing from time to time of which no extra payment will be made to the Contractor.

- a) The removal from the site within such time or times as may be specified in the order of any materials which in the opinion of ACCEPTING AUTHORITY or his representative are not in accordance with the contract.
- b) The substitution of proper and suitable materials.
- c) The removal and proper re-execution notwithstanding a previous test thereof or interim payment thereof of a work which in respect of materials or workmanship is not in the opinion of ACCEPTING AUTHORITY or his representative in accordance with contract.

2.08.09 SUSPENSION OF WORK

The Contractor shall, on the written order by ACCEPTING AUTHORITY suspend the progress of the works or any part thereof for such time or times and in such manner as ACCEPTING AUTHORITY may consider necessary and shall during such suspension, properly protect and secure the work, so far as is necessary in the opinion of ACCEPTING AUTHORITY.

2.09.00 TIME OF COMPLETION AND TAKING OVER

2.09.01 POSSESSION OF SITE

Save in so far the contract may prescribe the extent of portions of the site of which ACCEPTING AUTHORITY is to be given possession from time to time and the order in which such portions will be available to his and subject to any such portions will be available to him and subject to any requirement in the contract as to the order in which the work shall be executed, ACCEPTING AUTHORITY shall give to the Contractor possession of so much of the site as may be required to enable the Contractor to commence with such reasonable proposals of the Contractor as he will make in writing to ACCEPTING AUTHORITY and shall, from time to time as the work proceeds give the Contractor possession of such further portions of the site as may be required to enable the Contractor to proceed with the construction of the works in accordance with the said programme or proposal.

2.9.02 TIME OF COMPLETION

Time is deemed to be the essence of this contract and the whole of the works shall be completed within the time stipulated or within such extended time as has been allowed under Clause 2.9.3 and 2.9.4.

2.9.03 EXTENSION OF TIME OF COMPLETION DUE TO EXTRA/ ADDITIONAL WORKS

Should the amount of extra or additional work of any kind or changes in scope of work or other special circumstances of any kind whatsoever which may occur, be such as fairly to justify the Contractor's request for extension of time for the completion of the works, the Consultants shall determine the amount of such extension and with the approval of the Client shall intimate the Contractor in writing provided that the Consultants is not bound to take into account any extra or additional work or other special circumstances unless the Contractor has within 28 days, after such work has been commenced or such circumstances have arisen, submit to the Consultants full and detailed particulars of any request for the extension of time to which he may consider to be justified. The Contractor is bound to complete the work at the same rates, terms and conditions.

2.9.04 EXTENSION OF TIME OF COMPLETION DUE TO FORCE MAJEURE CONDITIONS

If in the opinion of the Consultants the progress of the work has at any time been delayed due to force majeure conditions like strikes, fire, inclement weather, unavoidable casualties, acts of god or any cause whatsoever beyond the control of the Contractor, continuously for more than one month, then the time of completion of the work may be extended for such reasonable time as the Consultants may decide and this will be indicated in writing. The Contractor shall complete the work at the accepted rates, terms and conditions.

2.09.05 LIQUIDATED DAMAGES

If the contractor fails to complete the work within the period of completion or within any extended time allowed the contractor shall pay or allow to the ACCEPTING AUTHORITY the sum equivalent to 1% of the PAC per month of delay calculated on each day basis and upto a maximum of 10% of PAC as liquidated and ascertained damages for the period of stipulated completion or such extended time as the case may be during which the work shall remain unfinished. Such damages may be deducted by the ACCEPTING AUTHORITY from any money due or that may become due.

2.09.06 WORK TREATED AS COMPLETE

The works shall not be treated as complete until:

- i) The site is clear from all materials, site shed, etc. and ACCEPTING AUTHORITY is satisfied with the job done by the Contractor.
- ii) The Contractor has submitted the reconciliation statement regarding the stores received from ACCEPTING AUTHORITY, and all the surplus and salvaged materials are returned to the stores.
- iii) All equipment, tools, plant taken from ACCEPTING AUTHORITY have been returned by the Contractor.

- iv) Any other material, taken on loan/transfer from other agency have been returned by the Contractor.
- v) All power and water supply connections taken for the execution of the works have been disconnected by the Contractor.
- vi) Rectification of any damage done by the Contractor to the work executed have been completed by the Contractor.
- vii) The works shall not be considered as completed until ACCEPTING AUTHORITY has certified in writing that they have been virtually completed and the Defects Liability Period shall commence from the date of such certificate.

2.09.07 TAKING OVER

After completion of works or any substantial part of the works before the completion of the whole of the works, the Contractor shall notify ACCEPTING AUTHORITY in writing, who within 15 days of receipt of the said notice shall give such certificate with respect to any substantial part of the works which has been both completed to the satisfaction of ACCEPTING AUTHORITY and occupied or used by ACCEPTING AUTHORITY or refuse to issue the same stating the reasons thereof in writing. When any such certificate is given in respect of a part of the works, such part shall be considered as completed for the purpose of taking over and computation of the period of maintenance of such part, that is such period of the work as certified. The works in whole or part shall not however, be treated as completed for the purpose of other relevant clauses hereof unless and until the provision of clause 2.09.07 hereof are fully complied with.

2.09.08 MAINTENANCE

For a period of TWELVE MONTHS commencing immediately after taking over of the work by ACCEPTING AUTHORITY, the Contractors liability shall be to replace the defective parts, rectify/ reconstruct the defective work that may develop of his own construction or those of his sub-contractor approved by ACCEPTING AUTHORITY arising solely from faulty materials or workmanship.

If it is necessary for the Contractor to rectify/reconstruct any defective portions of the work under the contract, the provision of this condition shall apply to the portions of work so replaced or renewed until the expiration of three months from the date of such replacement or renewal or until the end of the above mentioned period of twelve months, whichever may be later. If any defects be not remedied within a reasonable time ACCEPTING AUTHORITY may proceed to do the work at Contractor's risk and expense, but without prejudice to any other rights which ACCEPTING AUTHORITY may have against the Contractor in respect of such defects.

The Contractor shall bear the cost of such repair/rectification carried out on his behalf at site. Immediately upon expiry of the maintenance period the Company shall issue a final certificate indicating that the Contractor has completed his obligation under the contract.

2.10 TERMINATION AND BACK CHARGING OF CONTRACT

2.10.01 TERMINATION

If the Contractor has abandoned the contract or has failed to proceed with the work due to negligence or the progress on any particular item, items is slow or has failed to execute the work in accordance with the terms and conditions of the contract, is persistently or frequently neglecting to carry out his obligation under the contract, then it shall be lawful for ACCEPTING AUTHORITY to terminate the contract forthwith under written notice and to proceed with the balance of the work through any other agencies. During the course of execution of the job, in case the Contractor has done any substandard work, he shall be asked in writing to dismantle and redo the same at his own expenses. If the Contractor fails to comply with the above instructions immediately, then ACCEPTING AUTHORITY shall proceed with the above rectification work, through another agency or agencies. Similarly, if the Contractor goes slow on any particulars item or items of work, ACCEPTING AUTHORITY shall have the right to execute this item or items through another agency or agencies, including its own department.

2.10.02 BACK CHARGING THE CONTRACTOR

Extra cost and expenses incurred for completing the work of balance work or carrying out the rectification of any work as mentioned above through another agency or agencies including its own department, shall be debited to Contractor's account and shall be recovered from any money due or that may become due to the contractor without prejudice to any other remedy that may be available to ACCEPTING AUTHORITY in law. If there is any savings in cost due to re-arrangement or supplementing through other agencies the original contractor will not have any claim on this.

2.11.00 ALTERATIONS, ADDITIONS AND OMISSIONS

2.11.01 VARIATION

CONSULTANT with the approval of ACCEPTING AUTHORITY/OWNER shall be entitled to make any variation of the quality or quantity of the works or any part thereof that may in his opinion, is necessary and for that purpose, or if for any other reason it shall, in his opinion be desirable, he shall have power to order the Contractor to do and the Contractor shall do any of the following:

- a) Increase or decrease the quantity of any work included in the contract.
- b) Omit any portion of work.
- c) Change the character or quality or kind of any such work.
- d) Change the levels, lines, position and dimensions of any part of the works and
- e) Execute additional work of any kind necessary for the completion of the works, and no such variation shall in any way vitiate or invalidate the contract by the value, if any, of all such variations shall be taken into account in ascertaining the amount of the contract price.

2.11.02 ORDER FOR VARIATIONS TO BE IN WRITING

No such variation shall be made by the Contractor without an order in writing of ACCEPTING AUTHORITY, provided that no order in writing shall be required for increase or decrease in the quantity of any item or work where such increase or decrease is the result of the actual quantities exceeding or being less than those stated in the bill of quantities which are estimates. In such cases, the Contractor shall be paid only for the actual quantity of work done as certified by ACCEPTING AUTHORITY at the accepted unit item rate and no compensation shall be allowed. Provided also that if for any reason ACCEPTING AUTHORITY shall consider it desirable to give any such order verbally, the Contractor shall comply with such order but it must be followed by confirmation in writing of such verbal order given by ACCEPTING AUTHORITY, which shall be deemed to be an order writing within the meaning of this clause.

2.11.03 EXTRA ITEMS

- .01 Any item of work that do not find a place in the schedule of quantities, in the original tender or in the accepted tender or contract as has been directed by ACCEPTING AUTHORITY to execute is deemed as an extra item of work. All such works that are necessary to be carried out under the direction of ACCEPTING AUTHORITY shall be carried out by the contractor. No such variation will violate the Contract.
- .02 Extra items of work thus carried out by the contractor will be paid at the rates worked out by ACCEPTING AUTHORITY in the following manner.
- .03 In the case of all extra items whether additional, altered or substituted, if accepted rates for identical items are provided for in the contract such rates shall be applicable.
- .04 In the case of extra items whether altered or substituted, for which similar items exists in the contract, the rates shall be derived from the original item by appropriate adjustment of cost of affected components. The percentage excess or deduction of the contract rate for the original item with reference to the estimated rate shall be applied in deriving the rates for such items.
- .05 In the case of extra items, whether altered or substituted, for which similar items do not exist in the contract, the rates shall be arrived at on the basis of provisions of standard data book and schedule of rates followed in arranging rates for original works / agreement. Tender excess/deductions will not be applied.
- .06 In the case of extra items, whether additional altered or substituted, for which the rates cannot be derived from similar items in the contract, and only partly from similar items in the contract and only partly from the public work department rates, the rates for such part or parts of items as are not covered in the schedule of rates shall be determined by ACCEPTING AUTHORITY on the basis of the prevailing market rates giving due consideration to the analysis of the rate furnished by the contractor with supporting document including contractor's profit. No tender excess will be applied on market rates.

- .07 In the case of extra item whether additional, altered, substituted, for which the rates cannot be derived either from similar items of work in the contract or from the departmental schedule or rates, the contractor after execution of the work as mentioned in 2.11.03.01 above and shall within 14 days of the receipt of order to carry out the said extra item of work, communicate to the Engineer the rate which he proposes to claim for the item, supported by analysis of the rate claimed and ACCEPTING AUTHORITY shall be within one month thereafter, determines, the rate on the basis of the market rate giving due consideration to the rate claimed by the Contractor.

2.11.04 **REBATE/EXTRA OVER ORIGINAL ITEM**

If there is a deviation in the specification of particular item of the tender, rebate/extra over the quoted rate shall be generally derived as follows:

- a) For items not covered in the schedule, rebate/extra shall be derived based on observation/ analysis of labour and materials involved in such items.

2.11.05 **ITEMS OF AD-HOC NATURE**

The Contractor shall procure necessary materials and carry out miscellaneous work of ad-hoc nature specifically provided with necessary tools and tackles as may arise during execution of the contract. The actual quantum of work shall be certified and settled by ACCEPTING AUTHORITY and payment for the same shall be fixed on the basis of actual cost plus overheads, profits and establishments taken at 15% of the cost.

2.11.06 **CLAIMS**

The contractor shall send to ACCEPTING AUTHORITY's representative an account, giving full and detailed particulars with proper analysis of all claims for any additional expenses to which the Contractor may consider himself entitled to authorise payment to be made for any such work notwithstanding the Contractor's failure to comply with this condition if the Contractor has at the earliest practicable opportunity notified ACCEPTING AUTHORITY in writing, that he intends to make a claim for such work.

2.12.00 **MEASUREMENTS**

2.12.01 **QUANTITIES**

The quantities set out in the bill of quantities are the estimated quantities of the work. They are not to be taken as the actual and correct quantities of the works, to be executed by the Contractor in fulfillment of his obligations under the contract.

2.12.02 **WORKS TO BE MEASURED**

- .01 ACCEPTING AUTHORITY or their Representative shall, except as otherwise stated, ascertain and determine by measurement the value in terms of the contract. He shall when he requires any part or parts of the works to be measured, give notice to the Contractor's authorised agent or representative, who shall forthwith attend or send a qualified agent to assist ACCEPTING AUTHORITY or his representative in

making such measurement, and shall furnish all particulars required by either of them. Should the Contractor not attend or neglect or omit to send such agents, then the measurement made by ACCEPTING AUTHORITY or their representative and approved by him, shall be taken to be the correct measurement of the work. For the purpose of measuring such permanent work as is to be measured by record and drawings, ACCEPTING AUTHORITY 's representative shall prepare records and drawings month by month and the Contractor, as and when called upon to do so in writing, shall within fourteen days, attend to examine and agree such records and drawings with ACCEPTING AUTHORITY's representative and shall sign the same when so agreed. If the Contractor does not so attend to examine and agree such records and drawings they shall be taken to be correct if, after examination of such records and drawings, the contractor does not agree to the same or does not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor shall, within fourteen days of such examination, lodge with ACCEPTING AUTHORITY 's representative for decision by ACCEPTING AUTHORITY, notice in writing of the respects in which such records and drawings are claimed by him to be incorrect.

- .02 The contractor shall raise bills once a month or for a minimum payment of 10% of contract amount, unless otherwise agreed by Chief Engineer, National Games Secretariat.
- .03 Payment towards all interim bills will be made by ACCEPTING AUTHORITY within 21 days of presentation by the contractor.
- .04 Period of final measurement shall be three months from the time of completion of the project.

2.12.03 METHOD OF MEASUREMENT

The works shall be measured in accordance to relevant IS codes notwithstanding any general or local custom, except where otherwise specifically described or prescribed in the contract.

2.13.00 PROVISIONAL SUMS

2.13.01 "Provisional sum means a sum included in the contract and so designated in the bill of quantities for execution of works or the supply of goods, materials or services or for contingencies, which sum may be used, in whole, or in part or not at all, at the direction or discretion of ACCEPTING AUTHORITY. The contract price shall include only such amounts in respect of the work, supply or services to which provisional sums relate as ACCEPTING AUTHORITY shall approve or determine.

2.13.02 The contractor shall when required by ACCEPTING AUTHORITY, produce all quotations, invoices, vouchers and accounts or receipts in connection with expenditure in respect of provisional sums.

2.14.00 FURTHER INSTRUCTIONS

2.14.01 In this tender item specifications are given in the following sections:

A. TECHNICAL SPECIFICATIONS

**B. SCHEDULE OF QUANTITIES
with Unit Rate Specifications**

Technical specifications are the general instructions for carrying out the works.

- 2.14.02 The Contractor has to work out his rate as an overall percentage above or below or at the rate given in the Schedule by a single entry. The contractor's over all percentage shall be worked out based on the unit rate specification and rates provided against each specification.
- 2.14.03 The rate has to be entered by a single entry at the end the schedule both in words and in figures.
- 2.14.04 Every contractor should furnish along with his tender income-tax clearance certificate and information regarding the income-tax circle of Ward of the District in which he is assessed by income-tax, the reference No. of assessment and the assessment year.
- 2.14.05 The rates should be quoted in decimal coinage system.
- 2.14.06 Certified copies of Registration Certificate, Partnership Deed and Power of Attorney or Articles of Agreement in case of Limited companies will have to be furnished for considering the acceptance of the tender.
- 2.14.07 Should the contractor notice any discrepancy or error in the statement made, or quantities or units shown against items, he shall immediately bring it to the notice of ACCEPTING AUTHORITY and obtain the clarification before submitting the tender. The tender shall be based on such clarifications received and shall be recorded as such in the covering letter to the contractor to execute the work according to the corrected statement made for quantities or units shown in the tender, without any compensation.
- 2.14.08 The tender of the Contractor not complying with the above instructions may be rejected.
- 2.14.09 The tenderer should put the signature on all pages of the tender documents.

2.14.10 MATERIALS OBTAINED FROM EXCAVATION

The contractor shall treat all materials obtained during dismantling of a structure, excavation of the site for a work, etc. as property of the OWNER and such materials shall be disposed off to the best advantage of the OWNER according to the instructions issued by the Engineer-in-Charge.

2.14.11 TREASURE TROVE, FOSSILS, ETC.

All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall be the

absolute property of the OWNER and the Contractor shall take reasonable precautions to prevent his workmen or any other person from removing or damaging any such article or thing. The Contractor shall immediately upon discovery thereof and before removal, acquaint the Engineer-in-Charge with such discovery and carry out the Engineer-in-Charge's directions as to the disposal of the same at the expense of the OWNER.

The Chief Engineer,
NATIONAL GAMES SECRETARIAT

I/We have carefully read the above said instructions and shall comply with the same.

Signature of the tenderer.

Place:

Date :

Tenderer

Chief Engineer 33

TENDER FORM

TENDER NO:21/NGS/2012-13

To

The Chief Engineer,
National Games Secretariat, Thiruvananthapuram

Dear Sirs,

Sub: **TENDER FOR RENOVATION OF RAJA KESAVADAS SWIMMING POOL
PROJECT CIVIL & ELECTRICAL WORKS AT ALAPPUZHA**

With reference to the tender invited by you for the above proposed work, I/We do hereby Tender for the same after having:

- a) Examined the designs, drawings, details, specifications schedule of quantities, instructions to tenders, agreement and the conditions of contract annexed thereto (hereinafter called the Contract Documents).
- b) Visited the site of work, studied the site conditions, nature of strata, availability of construction materials etc., and
- c) Acquired the requisite information on all prevailing factors affecting the tender.

I/We undersigned hereby offer to construct the proposed work in strict accordance with the Contract document for the consideration to be calculated in terms of the priced schedule of quantities.

I/We have noted that time is the essence of the contract and ready to undertake and complete the whole of the works as per the attached schedule from the date of issue of an intimation by you that our tender has been accepted and upon receiving possession of site. I/We further undertake that on failure subject to the conditions of the contract relating to extension of time, I/We are willing to pay the agreed Liquidated Damages/Penalty for the period during which the work remains incomplete beyond the due date of completion.

I/We further agree to the deduction of retention money and security deposit amounting to a total of 10 percent of value of work which will be returned to me/us as per the relevant clauses in the agreement. The deduction will be as explained in clause 1.12.01 of Notice Inviting Tender.

I/We undertake to execute the work of electrification of various facilities if any, through a licensed electrical contractor of appropriate class as given in the tender condition. All the requirements of supervision, testing, commissioning and energizing will be fulfilled by us.

We have also executed the preliminary agreement as is enclosed.

Tenderer

Chief Engineer 34

Further we undertake to execute the works which will be entrusted to us in the most workman like manner within the stipulated completion period. If our Tender is found acceptable, we agree to enter into a contract as specified by you within one week of this receipt of intimation of acceptance of our tender.

Our Bankers are:

1.....

2.....

Place:

Date :

Signature of tenderer

Name of the partners of the firm

OR

Name of the person having power of Attorney to sign the contract.

Postal Address :

Telephone Number

i) Land :

ii) Mobile :

Email:

Income Tax PAN No. :

VAT TIN :

Service Tax Registration No. :

Tenderer

Chief Engineer 35

3. SPECIAL CONDITIONS OF CONTRACT

3.0 **SPECIAL CONDITIONS OF CONTRACT**

3.01 **MOBILISATION ADVANCE**

No mobilization will be paid to the Contractor

3.02 **SECURED ADVANCE**

No secured advance will be paid to the Contractor

3.03 **BANK GUARANTEE**

3.03.01 Additional bank guarantee as performance guarantee has to be remitted by the Contractor who quote very low rates as below:

- i. If the quoted rate is below 50%, the same will be rejected
- ii. If the quoted rate is between 25% and 50% below PAC, the Contractor will remit performance guarantee equal to the difference between PAC and the quoted amount and the same will be released after the satisfactory completion of the work.
- iii. Performance security for specialized items of work like antitermite treatment, glass work etc. shall be retained by the Company at the rate of 10% of the value of such items, for a period of 5 years. No interest shall be paid for the security so retained.

3.04 **WATER**

Water required for the construction will have to be provided by the Contractors at their own cost. It will be the responsibility of the Contractor to make arrangements for drawing and bringing it to the various construction points. Non availability of water from the owner's property will not be ground for any delay in work or any claim for any compensation whatsoever.

3.05 **ELECTRICITY**

Electricity required for the construction and general lighting of the site will have to be provided by the Contractors at their own cost. Non availability of power from KSEB will not be a ground for any delay in work or any claims for any compensation whatsoever.

3.06 **DRAINAGE ARRANGEMENTS**

The contractor shall control the grading in the vicinity of the buildings and trenches, so that surface water is prevented from running into excavated areas. The contractor shall also be responsible to see that no area around his works becomes flooded during the rainy season because of his piled up material, etc. and subsequently floor another buildings. At the discretion of the Engineer-in-charge the contractor shall take steps to prevent flooding. It shall be the contractor's responsibility to keep areas around his work dry. The cost of repairing flood damage shall be the sole responsibility of the contractor.

3.07 APPROACH ROAD

The contractor will be required to construct suitable approach roads leading to the construction site from the main road Engineer-in-Charge and shall maintain it at his own cost.

3.08 FABRICATION WORKS

The contractor shall furnish to the Engineer-in-Charge 3 copies of detailed fabrication/erection drawing showing clearly all the joint details, two weeks before the commencement of actual fabrication/erection works. The Engineer-in-charge will have the right to suggest such modification to these details as found necessary by them, which shall be duly incorporated in the works by the Contractor. For the purpose of this clause, the two weeks period shall be deemed to begin from the date of the said drawings are received in the Engineer-in-charge office.

3.09. TAXES & DUTIES

Royalty charges & taxes if any on account of supply of materials for all works shall be paid by the Contractor at his own cost. No extra claim in this regard shall be admissible.

3.10. TURNOVER TAXES/WORKS CONTRACT TAXES:

Deductions will be made from the bills towards Sales Tax as per the K.G.S.T Act. As per the existing provisions.

- a. Cess for the construction of works under building and other Construction Workers Welfare Cess Act-1996. The Contractor shall remit the building and other Construction Workers Welfare Cess at 1% on the total cost of construction including the cost of materials and shall produce the certificate of remittance of Cess to ACCEPTING AUTHORITY. In case the Contractor fails to remit the Cess the applicable Cess will be recovered from the final bill of the contractor.
- b. The Contractor shall engage an authorised agent experienced and qualified technical personnel for managing and supervising the work and shall see that all of them are always at the workspot during the working hours, personally checking all items of work. He shall take such orders as may be given to him by the Engineer-in-charge from time to time and shall be responsible to carry them out properly. In case contractor fails to provide an agent as per terms given above, ACCEPTING AUTHORITY reserves the right to deduct a reasonable amount from the contractor's bill, subject to a maximum of Rs.25,000/- per month, for every month of absence.
- c. All plumbing and sanitary works shall be executed by a qualified and licensed plumber. The Contractor shall satisfy the Engineer-in-charge as to the competence and qualification of the workmen employed for plumbing and sanitary works.
- d. All shuttering used in the work shall be either steel shuttering or of plywood with smooth surfaces so as to give a smooth finish to the concrete.

- e. All fixtures & fittings (plumbing fixtures, sanitary materials, doors & window fixtures etc.) have to be got approved by the Engineer-in-charge in writing before fixing the same. However samples of all these fixtures & fittings have to be got approved well in advance of bulk procurement action.

3.11. PROCUREMENT OF MATERIALS

Contractor shall make his own arrangements for the procurement of all materials required for the work including cement, steel and bitumen. No assistance will be provided by ACCEPTING AUTHORITY for arrangement for quarries for sand, metal or earth.

3.11.1 CEMENT

The cement to be used shall be ordinary portland cement conforming to IS: 8112-1989 for 43 Grade OPC unless otherwise mentioned. The cement should be procured from reputed manufacturers such as Malabar Cements, ACC, L&T, India Cements, etc. and as approved by the Engineer-in-Charge. Whenever possible, all the cement shall be obtained from one constant source throughout the contract. Cement of different types shall not be mixed one with the other. Different brands of cements or same brand of cement from different sources shall be not used without prior approval of the Engineer-in-Charge.

The cement shall be delivered at site in original sealed bags which shall be labelled with the weight, date of manufacture, brand and type. Cement received in torn or hand-stitched bags shall not be used. For volumetric batching of, concrete, cement should be mixed only by box measurement. All cement should be fresh when delivered and shall be stored in an approved manner in stores built by the Contractor at his own cost. Set cement shall not be allowed to be used for any work.

With each and every delivery of cement, the Contractor shall provide a certificate that the cement conforms to the relevant Indian standards. Seven days test, to determine the strength of cement, of each batch shall be done immediately upon arrival of the said material and the cement shall be used only after the test result is approved by the Engineer-in-Charge. The cost of the above tests shall be borne by the Contractor.

3.11.2 QUALITY CONTROL ON CEMENT CONSUMPTION

After the completion or at the stage of the determination of the contract, the theoretical quantity of cement shall be computed on the basis of statement showing quantity of cement to be used in different items of work as provided in KPWD Data Book. In case any item is executed for which standard co-efficient for the consumption of cement is not available in the above mentioned statement or cannot be derived from the statement, the same shall be calculated on the basis of formula to be laid down by the Engineer-in-Charge.

Over this theoretical quantity of cement required a variation upto (-) 2% may be allowed for less consumption of cement at the discretion of the Engineer-in-Charge provided Engineer-in-Charge is otherwise satisfied with the quality of the works executed. Such variation if more than (-) 2% will attract action of levy of compensation at the rate of twice the prevailing market rate of cement of the quantities

consumed less over permissible (-) 2% variation provided Engineer-in-Charge decides to accept the work depending upon its quality etc.

3.11.3 CONSUMPTION OF CEMENT

Quantity of cement will be decided based on the DESIGN MIX. For concreting under water, 10% extra quantity will be allowed.

The contractor should submit design for the same before starting the work and after getting the trial mix approved by the Engineer, follow the same for execution of work.

Only the approved design mix shall be used for the concrete. The following minimum quantity of cement should be used of various grades of concrete:

M20	:	350 Kgs/Cum	} With 43 grade OPC
M25	:	400 Kgs/Cum	
M35	:	450 Kgs/Cum	

3.11.4 CONCRETE PLANT

Modern dependable batch type mixing plants capable of producing concrete at the desired output to meet the scheduled requirements shall be provided at locations and in the manner approved by the Engineer.

3.11.5 STEEL

Steel reinforcing bars shall be round bars of grade I quality conforming to IS: 432 or High Yield Strength Deformed Round Bars conforming to IS:1786 and have to be purchased from SAIL/TISCO/IISCO/Vizag or any other approved manufacturer approved by ACCEPTING AUTHORITY. The Contractor shall place direct order on the manufacturing company without involving dealer or distributor.

With each and every delivery of consignment of steel the contractor shall provide the certificate that the steel conforms to the relevant Indian Standard. Any test required to be carried out on steel at all stages of construction shall deemed to be included in Contractor's scope of work. Type of test, frequency of test, acceptance criteria etc. for steel will be as per KPWD specification.

Conversion of length of various sizes of MS bars and for Tor Steel bars into weight are as under:-

Size (Dia) mm	Weight : Kg/M	Size (Dia) mm	Weight : Kg/M
6	0.222	25	3.855
8	0.395	28	4.836
10	0.617	32	6.316
12	0.888	36	7.994
16	1.579	40	9.869
18	1.999	45	12.490
20	2.467	50	15.424
22	2.985		

The actual quantity of steel shall be taken for measurement purpose as the quantity fixed as per approved design/drawings or as authorised by ACCEPTING AUTHORITY including authorised lap length/chairs etc. as per the standard sectional weights given in the above table or the actual weight whichever is less. Actual sectional weight of the steel if weighs less than 2% of the standard weights shown above shall be rejected. Nothing will be paid extra for wastage and rolling margin.

In the case of structural steel sectional the theoretical weight shall be calculated from the steel tables or actual weight whichever is less.

The average sectional weight for each diameter shall be arrived at from samples from each lot of steel received at site. The actual steel consumed shall be worked out by this procedure. The discretion of the Engineer-in-Charge shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site at work each day will constitute one single lot for this purpose.

3.11.6 **SITE OFFICE**

A site office of size 4mx3m to be provided by the Contractor for the use of Consultant. The Office should have with required furniture toilet facility, water and power.

The following minimum furniture shall be provided.

- a. Executive tables - 1 No
- b. Chairs - 3 Nos
- c. Steel Almirah - 1 No

The Contractor has to dismantle and remove the temporary office after the completion of the Project.

3.11.7 **SUPERVISORY STAFF**

The Contractor shall appoint sufficient experienced and qualified technical and supervisory staff at the site for supervising the work as per the direction of Chief Engineer, National Games Secretariat and shall see that all of them are always at the work spot during the working hours, personally checking all items of work. He shall take such orders as may be given to him by the Engineer-in-charge from time to time and shall be responsible to carry them out properly. In case Contractor fails to provide sufficient person as per terms given below, Owner/Client reserves the right to deduct a reasonable amount from the Contractor's bill, subject to a maximum of Rs.25,000/- for every month of absence.

3.11.8 **PROGRAMME OF WORKS AND PROGRESS REPORTS**

- a) The entire work is scheduled to be completed as stipulated in NIT. The Contractor shall programme the different items of work in accordance with the detailed time schedule approved by the Engineer-in-charge.

b) **CONTRACTOR TO SUBMIT PROGRAMME**

After the acceptance of his Tender, the Contractor shall, within fifteen days, submit to the Engineer-in-Charge for his approval, a detailed programme taking into account the total time period stipulated in the contract showing the order, the procedure and method in which he proposes to carry out the works.

He shall furnish the particulars in writing of his arrangements of manpower, plant and machinery, shuttering and all other resources owned and dedicated to this work. Cash flow during the execution of project for procurement of materials and for carrying out of the works including temporary works which the Contractor intends to construct shall also be furnished.

In support of this programme, the Contractor shall submit a work schedule in the form of a CPM/PERT Chart. The Engineer-in-Charge shall if necessary modify the programme submitted by the Contractor and approval shall be given by the Engineer-in-Charge indicating the major milestones. The programme approved by the Engineer-in-Charge shall be final and binding on the Contractor. The approval by the Engineer-in-Charge of such programme, or furnishing of such particulars shall not relieve the Contractor of any of his duties or responsibilities under the contract.

During the progress of work, the Contractor shall be required to furnish the resource mobilisation plan as required by Engineer-in-Charge to keep up the target date of completion.

This CPM/PERT programme will be required to be updated every three months or more frequently as directed by the Engineer-in-Charge, based on the actual progress, resource mobilisation and other field conditions actually prevailing.

c) **PROGRESS REPORTS AND SCHEDULES**

The Contractor shall submit to the Engineer-in-Charge by the third day of every fortnight, six (6) copies of a report in a duly approved format showing the progress made in construction of the works mobilisation of resources etc. during the previous fortnight.

d) The Contractor shall also submit by the end of every month his anticipated progress schedule for all items of work for the following month in six (6) copies in an approved proforma to the Engineer-in-Charge.

e) The Contractor shall also submit Photographs of completed works along with Monthly Progress Report and Two copies of Photographs (both soft copy & hard copy of approved size) of the completed project with the final bill

3.12 **DOCUMENTATION**

The Contractor shall prepare the detailed documentation of all the structures by means of Photography (hard copy and soft copy), Video by a professional

photographer covering various views of the project up to the satisfaction of the Consultant/Client and as built drawings after the execution of the work.

3.13 **PAYMENT TERMS FOR THE SUPPLY AND INSTALLATION OF ELECTRICAL WORKS**

On progress of supply: Upto 75% of the supply value as assessed by the Engineer-in-Charge, for the materials supplied shall be paid as on account payment on the strength of certificate issued by the Engineer-in-charge.

On progress of erection: Upto 90% of the contract amount, less the initial payments till date, shall be paid on final completion of the entire supplies & installation work under contract, for which payments are claimed.

On taking over: 100% of the contract amount, less amount already paid and security deposits due, if any, shall be paid on completion of testing, trial run and satisfactory commissioning of the installation and issue of the final completion certificate, and on acceptance of the same by NGC, after obtaining the clearance from the statutory authorities.

3.14 Approval form statutory Authorities

3.14.1 All the equipment to be supplied and works to be executed shall conform to the State Electrical Inspectorate / Central Electrical Authority Standards including all protection and metering accessories. Nothing extra will be paid in this regard.

3.14.2 Contractor has to obtain necessary scheme approval, if any, from the statutory authorities concerned immediately after the award of work.

3.14.3 All testing/calibration etc., are to be carried out as per the requirements of statutory authorities concerned.

3.14.4 On completion of work, the contractor has to obtain necessary safety/energization certificate from the statutory authorities concerned by submitting necessary completion certificate, drawings, equipment details, load details, test results etc., before energization.

3.14.5 All costs incurred in obtaining such approval/certificates are to be borne by the contractor. Statutory fees paid shall be reimbursed on presentation of documents.

3.14.6 If the current rating of any of the switchgears including circuit breakers mentioned in the Schedule of requirements is not available or is not in conformation to the Inspectorate standards then it shall be rated to the nearest higher rating available with the current rating/fuse rating as specified.

3.15 Structural Alterations to Building

No structural member in the building shall be damaged/ altered, without prior approval from the Engineer-in-charge.

Structural provisions like openings, if any, provided by Purchaser for the work, shall be used. Where these require modifications, such contingent works shall be carried out by the contractor, at his cost.

All cut out openings in floors provided by Purchaser shall be closed, after installation, in accordance with the schedule of work.

All cuttings made by the contractor in connection with the works shall be filled by him at his cost to the original finish.

3.16 Completion Drawings and Certificate

For all work completion report as given in the pro-forma for test results shall be submitted to the Engineer-in-charge, after completion of work.

On completion of work, the Contractor shall submit "As fitted drawings" drawn to a suitable scale in tracing sheet indicating the following along with three copies and one set of computer floppy diskettes/CD ROMS of the same to the Engineer-in-charge before the submission of the final bill.

1. The Schematic diagram of LT & control wiring showing all protective schemes, if applicable.
2. General layout of the site showing therein routes of cables and equipment position.
3. Schedule of lengths, types and sizes of cables.
4. Position of all cable joints type wise, supports, stays, struts, lightning arrestors, feeder pillars, structures, earthing and pipes or closed ducts.
5. Position of cable route markers and joint markers with respect to permanent land marks available at site.
6. Name of work, job number, accepted tender reference, actual date of completion, names of Division/Sub-Division, and name of the firm who executed the work with their signature(s).
7. Routine and type test certificates (3 sets)
8. Detailed Operation and Maintenance Manuals (3 sets)
9. Detailed erection, testing and commissioning manuals (3 sets).

3.17 Deviations from Purchaser's Specification

Deviations from the purchaser's specification, if any, proposed by the bidder will be considered, provided they meet with the purchaser's requirements and are necessary to improve utility, performance and efficiency. The deviations proposed by the bidder shall include the technical merits and the financial implications.

3.18. Conformity to IE Act, IE Rules and Standards

3.18.1 The work shall be carried out in the best workmanlike manner in conformity with this specification, the relevant specification/codes of practice of the Bureau of Indian Standards or IEC recommendations (Except where specified otherwise) and other relevant standards with latest amendments, approved drawings and the instructions issued by the Engineer-in-charge or his authorised representative, from time to time. Equipment meeting any other authoritative standard, which ensures an equal or better quality than the above standards, will also be acceptable.

3.18.2 In addition to the standards, all works shall also conform to the requirements of the followings:

- a) All Electrical works shall be carried out in accordance with the provisions of Indian Electricity Act- 1910, Indian Electricity Rules 1956 amended upto date (Date of call of tender unless specified otherwise)
- b) The works shall also conform to relevant Bureau of Indian Standards' Codes of practice (COP) for the type of work involved.
- c) Materials to be used in work shall be ISI marked wherever applicable.
- d) In all electrical installation works, relevant Safety codes of practices shall be followed.
- e) Fire Insurance Regulations/Tariff Advisory Committee.
- f) Regulations laid down by the Chief Electrical Inspector of the State Electrical Inspectorate/State Electricity Board/ Central Electrical Authority or any other agencies concerned.
- g) Regulations laid down by the Factory Inspector of the State.
- h) Any other regulations laid down by the local authorities.
- i) Installation & operating manuals of original manufacturers of equipment.

3.19 Data/Drawings/Documents

The bidder shall submit the following data/information/drawings/documents as indicated below:

- i) List of deviations clause by clause and reasons.
- ii) Descriptive literature of the various equipment offered with catalogues, if any.
- iii) Guaranteed technical particulars of the equipment and performance particulars
- iv) Approximate dimensions and weights and preliminary G.A drawings.
- v) List of optional features with extra price.
- vi) Make of various equipment and associated components/accessories.
- vii) Where applicable, preliminary schematic of the equipment/ system offered in the tender.

Within 4 weeks of order, Contractor shall submit 4 sets of following documents for purchaser/Consultant's approval.

- i) G.A Drawings with dimensions and weight, plan and sections and fixing/ foundation details.
- ii) Where applicable, control scheme drawings with write-up and all terminal numbers for external hook up.

Subsequently, 4 sets of the revised documents shall be submitted incorporating Consultants comments as Final Drawings for Purchaser's reference and records before the equipment is offered for inspection.

Liaison with all statutory authorities including KSEB for getting sanction/approval/safety certificate/ power connection including submission of necessary forms to KSEB/ Electrical inspectorate as required is included in the scope of this work. Necessary fee for the above will be reimbursed from National Games Secretariat on production of actual bills.

3.20 SETTLEMENT OF DISPUTES

3.20.1 Arbitration shall not be a means of settlement of disputes arising out of this contract. In case of any dispute or difference between the parties to the contract either during the progress or after the completion of the works or after the determination, abandonment or breach of the contract as to the interpretation of the contract or as to any matter or thing arising there under except as to the matters left to the sole discretion of the Chief Engineer, or to the holding by the Chief Engineer of payment of any bill to which the Contractor may claim to be entitled, then either party shall forthwith give to the other notice of such dispute or difference, and such dispute or difference shall be referred to the Secretary to Government, Sports & Youth Affairs, Government of Kerala and the award of the Secretary to Government, Sports & Youth Affairs shall be final and binding on the parties. Provided however that in cases whether the Chief Engineer has entered into the contract on behalf of the C.E.O and Secretary, the dispute or difference shall, in the first instance, be referred by or through the Chief Engineer to the C.E.O and Secretary and his/her decision thereon obtained before referring such dispute or difference to the Secretary to Government, Sports & Youth Affairs, under this clause. Progress of the work shall not be suspended or delayed on account of the reference of any dispute or difference to the Chief Executive Officer & Secretary, National Games Secretariat and his/her decision thereon obtained before referring such dispute or difference to the Secretary to Government, Sports & Youth Affairs, under this clause. Either party may within a period, which shall be fixed by the Secretary, file before the Secretary to Government, Sports & Youth Affairs a statement of the case and also all the documents relating to or having a bearing in the case. The Secretary to Government, Sports & Youth Affairs, shall see that a decision is made if reasonably possible, within a period of one month from the date of his entering upon the reference, but if any, extension of the period is considered by him to be necessary, such extension shall forthwith be communicated by him in writing to each of the parties hereto. The Secretary to Government, Sports & Youth Affairs shall not be bound to observe the ordinary rules of procedure applicable to trials before judicial tribunals and not to hear or receive formal evidence but may pass an order on the documents of statements of the case filed by both the parties and/or on personal inspection. The Secretary to Government, Sports & Youth Affairs shall have power to view the subject matter of the dispute with or without the parties or their agents. The Secretary to Government, Sports & Youth Affairs shall also have power to open up, review and revise any certificate, opinion, decision, requisition or notice, save in regard to the matters expressly excepted and determine all matters in dispute which shall be submitted to him and of which notice shall have been aforesaid, in the same manner as if no such certificate, opinion, decision, requisition or notice had been given. Provided that Government shall not be liable to any claim in respect of any such dispute or difference until the liability and the amount thereof shall have been referred to and decided by the Secretary to Government, Sports & Youth Affairs. If the contractor(s) do/does not make any demand for reference of dispute to the Secretary to Government, Sports & Youth Affairs in respect of any claim(s) in writing within 30 days of receiving the intimation from the Employer that the bill is ready for payment, the claim of the contractor(s) will be deemed to have been waived and absolutely barred and the Employer shall be discharged and released of all liabilities under the contract in respect of those claims.

3.20.2 Legal jurisdiction

All litigations relating to the subject matter of the agreement can only be filed before the appropriate courts having jurisdiction in the respective district of construction.

**The Chief Engineer
National Games Secretariat**

4. FORMS FOR DIFFERENT DEEDS

4. PROFORMA OF PRELIMINARY AGREEMENT

(To be executed on stamp paper of value Rs.100/- and submitted along with tender).

Preliminary agreement entered into on this day of
Between (name of Accepting Authority) (Hereinafter called ACCEPTING AUTHORITY on one part and Shri..... (name and address of the Contractor) (Hereinafter called the Contractor) on the other part for the execution of the agreement as well as the execution of the (NAME OF WORK) And where as the notice inviting tenders it is stated as follows. Before commencing the work of within a week of the date when the acceptance of tender has been intimated to him, the tenderer shall deposit a sum of Rs.....(2.5% of PAC) which shall be treated as security for the proper fulfillment of the same and he shall execute an agreement for the work in the scheduled form of agreement. If he fails to do this or fail to maintain a specified rate of progress, the security deposit shall be forfeited to ACCEPTING AUTHORITY and fresh tenders shall be called for or the matter otherwise disposed. If as a result of such measures due to the default of the tender to pay the requisite deposit sign contracts to take possession of the work any loss to the ACCEPTING AUTHORITY results, the same will be recovered from him as arrears of revenue but should it be a saving to ACCEPTING AUTHORITY the original contractor shall have no claim whatever to the difference. Recoveries to this or any other account will be made from the sum that may be due to contractor on this or any other contracts or under the Revenue Recovery Act or otherwise as ACCEPTING AUTHORITY may decide.

Now therefore these present witness and it is mutually agreed as follows:

1. The terms and condition for the said contract having been stipulated in the said tender form to which the contractor has agreed, a copy of which is appended, and which forms part of this agreement, it is agreed that the terms and conditions stipulated there in shall bind the parties to this agreement, except to the extent to which they are abrogated or altered by express terms and conditions herein, agreed to and in which respect the express provisions herein shall supercede those of the said tender form.
2. The Contractor hereby agree and under take to perform and fulfil all the operation and obligations connected with the execution of the said contract work viz. – (NAME OF WORK)
3. If the Contractor does not come forward to execute the original agreement after the said work is awarded and letter of acceptance issued in his favour or commits breach of any of the conditions of the contract as stipulated in clause 1.06.4 of the Notice inviting Tenders as quoted above within the period stipulated, ACCEPTING AUTHORITY may rearrange the works otherwise or get it done otherwise at the risk and cost of the contractor and the loss so sustained by ACCEPTING AUTHORITY can be realising from the contractor under the Revenue Recovery Act as if arrears of land revenue as assessed, quantified and fixed by an adjudicating authority consisting of ACCEPTING AUTHORITY or any other officer or officers authorised by ACCEPTING AUTHORITY taking into consideration the prevailing rates and after giving due notice to the Contractor. The decision taken by such authorised officer or officers shall be final and conclusive and shall be binding on the contractor.
4. The contractor further agrees that any amount found due to ACCEPTING AUTHORITY under or by virtue of this agreement shall be recoverable from the

Tenderer

Chief Engineer 48

Contractor from the Contractor from his EMD and his properties, movable and immovable as arrears of land revenue under the provision of the Revenue Recovery Act for the time being in force or in any other manner as ACCEPTING AUTHORITY may deem fit in this regard.

In witness where of Sri....., NAME OF ACCEPTING AUTHORITY and Sri.....

Contractor, have set their hands on the day and year first above written,

Signed by Sri..... NAME OF ACCEPTING AUTHORITY

In the presence of witness

1.

2.

Signed and delivered by Sri....., Contractor in the presence of witness.

1.....

2.....

FORM OF BANK GUARANTEE

(To be executed in non-judicial stamp paper)

1. In consideration of the Chief Engineer,(Name of accepting authority) (hereafter called ACCEPTING AUTHORITY) having demanded from Shri.....(here hereafter called “Contractor”) the production of a Bank Guarantee for Rs.....(Rupees.....) as.....for the due fulfillment by the Contractor of the terms and conditions in clause of for the work of “.....) on demand by ACCEPTING AUTHORITY.

2. We.....do hereby undertake to pay (indicate the name of Bank)

The amounts due and payable under this guarantee without any demure, merely on a demand from the ACCEPTING AUTHORITY stating that the amount claimed is required to meet the recoveries due or likely to be due from the said contractor (s). Any such demand made on the bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs.....

3. We undertake to pay to ACCEPTING AUTHORITY any money so demanded not withstanding any dispute or disputes raised by the contractor (s) in any suit or proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal.

The payments so made by us under this bond shall be a valid discharge of our liability for payment thereunder and the contractor (s) shall have no claim against us for making such payment.

4. We(indicate the name of Bank.) further agree that the guarantee here in contained shall remain in full force and effect during the period that would be taking for the performance of the said agreement and that it shall continue to be enforceable till all the dues of ACCEPTING AUTHORITY under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till the ACCEPTING AUTHORITY certifies that the terms and conditions of the said agreement have been fully and properly carried out by the said contractor (s) and accordingly discharges this guarantee.

5. We(indicate the name of Bank) further agree with the ACCEPTING AUTHORITY that the ACCEPTING AUTHORITY shall have the fullest liberty without our consent and without affecting in any manner our obligations here under to vary any of the terms and conditions of the said contractor (s) from time to time or to postpone for any time or from time to time any of the powers exercisable by ACCEPTING AUTHORITY against the said contractor (s) and to forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said contractor (s) or for any forbearance, act or omission on the part of ACCEPTING AUTHORITY or any indulgence by ACCEPTING AUTHORITY to the said contractor (s) or by any such manner or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).
7. We.....(indicate the name of Bank) lastly undertake not to remove this guarantee except with the previous consent of ACCEPTING AUTHORITY in writing.
8. This guarantee shall be valid upto unless extended on demand by ACCEPTING AUTHORITY. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rs.....(Rupeesonly and unless a claim in writing is lodged with us within six months of the date of expiry or the extended date of expiry of this guarantee, all our liabilities under this guarantee shall stand discharged.

Dated the.....day of.....20.....

For.....

.....

(indicate the name of the Bank)

Seal and signature of the authorised signatories of the Bank.

THE KERALA VALUE ADDED TAX RULES, 2005

FORM NO.20

Declaration

(To be filed before the Awarder by Contractor)

(See Rule 42 (1))

Sl.No.	DATE	D D	M M	Y Y
	TIN*			
	PIN*			
	CIN*			

TO	Status	VAT	Presumptive
	Compounded Tax		
	Payer	Payer	Payer Tax

M/s.....

([^] as appropriate)

(Address of the Awarder)

Gentlemen,

I/We request you to kindly effect deduction of tax at source (TDS) in respect of the Works Contract executed/being executed by me/us as per particulars furnished hereunder:

1.	Work Order No. & date	:	
2.	Work site address	:	
3.	Gross value of contract	:	
4.	Payment relating to this declaration	:	
5.	Progressive payment already received including this declaration	:	
6.	Total assessable value of works contract relating to this declaration	:	
7.	Taxable value of works contract relating to this declaration	:	
8.	VAT due @ 4%	:	Rs.

Tenderer

Chief Engineer 52

9.	VAT due @ 12.5%	:	Rs.
10.	Total VAT due and deductible as TDS	:	Rs.
11.	Total compounded tax @ 2% deductible on total assessable value	:	Rs.
12.	Total compounded tax @ 4% deductible on total assessable value	:	Rs.

DECLARATION

**I/We S/o
on behalf of M/s
hereby affirm and declare that the particulars furnished herein are true, correct and complete to the best of my knowledge and belief and that nothing is concealed therein. I/We do hereby under take to obtain and provide to you the Quarterly Certificate in Form No.20A and Certificate in Form No.20B in relation to final payment promptly.**

Signature of authorised person

5.0 TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATIONS

The following technical specification, code of practice etc. referred herein is form a part of the Item Specification and work shall be executed accordingly. Items which are not covered under Technical Specification shall be carried out as per relevant IS Specification or as per manufactures specification or as directed by Engineer-in-charge.

In case of discrepancy between technical specification and item specification provided along with Bill of Quantities, the Item Specification shall prevail.

All the measurements shall be as per latest edition of B.I.S.

1.0 EARTH WORK

1.1 Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

- a) IS - 4081 Safety code for blasting and related drilling operation.
- b) IS - 1200 Method of measurement of building works.
- c) IS - 3764 Safety code for excavation work.
- d) IS - 3385 Code of practice for measurement of Civil Engineering works.
- e) IS - 2720 Part II Determination of moisture content.

Part VIII Determination of moisture content dry density relation using light compaction.

Part XXVIII Determination of dry density of soils, in-place by the sand replacement method.

Part XXIX Determination of dry density of soils, in-place, by the core cutter method.

1.2 General

- 1.2.1 Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such as earthwork in excavation for levelling, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines, etc. It is necessary to establish permanent bench mark at such point which will not be affected by subsequent work. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 5 m intervals or nearer as determined by Engineer-in-charge based on ground profile.
- 1.2.2 The area to be excavated/filled shall be cleared of fences, trees, plants, logs, slumps, bush, vegetations, rubbish slush, etc., and other objectionable matter. If any roots or stumps of trees are found during excavation, they shall also be removed. The material so removed shall be burnt or disposed off as directed by Engineer. Where earthfill is intended, the area shall be stripped of all loose/soft patches, top soil containing deleterious matter/materials before fill commences.
- 1.2.3 In firm soil if the excavation is deeper than 2 m and in loose, soft or slushy soil, the width of the step shall be suitably increased or the sides sloped or shoring and strutting may be done as per the Engineer's instructions without any extra cost.

- 1.2.4 For excavation in trenches for pipes nothing extra shall be payable for the lift irrespective of the depth unless specifically mentioned otherwise in the Schedule of Quantities.
- 1.2.5 The trenches which are ready for concreting shall be got approved by the Engineer.
- 1.2.6 The excavated stacked earth shall be refilled in the trenches and sides of foundation in 200 mm layers and the balance surplus shall be first filled in layers in plinth and the remaining surplus shall be disposed off by uniform spreading within the site/outside the site as directed by the Engineer.
- 1.2.7 Adequate protective measures shall be taken by the Contractor to see that the excavation for the building foundation does not affect the adjoining structure's stability and safety. Contractor will be responsible if he has not taken precaution for the safety of the people, workers property or neighbour's property caused by his negligence during the constructional operations.

1.2.8 Lead

Lead for disposal of excavated material inside the site and at convenient places in the surrounding areas have been specified in the respective items of work and no other extra lead is intended.

1.3 Classification

Any earthwork will be classified under any of the following categories:

1.3.1 All kinds of soils

These shall include all kinds containing kankar, sand, silt, moorum and/or shingle, gravel, clay, loam peat, ash, shale, etc., which can generally be excavated by spade, pick-axe and shovel and which is not classified under ordinary rock, and hard rock defined below. This shall also include excavation in macadam and tarred roads and pavements. This shall also include rock boulders up to 200 dm¹. Rubble masonry to be dismantled below ground level will also be measured under this item.

1.3.2 Ordinary Rock

These shall include generally any rock which can be excavated by splitting with crowbars or picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and unreinforced cement concrete below ground level.

1.3.3 Hard Rock

This shall include rock which cannot be easily excavated with pick-axes, hammer, crow bars and wedges but has to be either heated where blasting is prohibited or has to be blasted. They shall be stacked separately for measurement as directed by the Engineer-in-charge.

1.3.4 Blasting in rocks

- 1.3.4.1 Unless otherwise stated herein, IS 4081, safety code for blasting and related drilling operations shall be followed. After removal of over burden, if any, excavation shall be continued in rock to such widths, lengths, depths and profiles as are shown on the

drawings or such other lines and grades as may be specified by Engineer. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions, shall be taken to preserve the rock below and beyond the lines specified for the excavating, in the soundest possible condition. The quantity and strength of explosive used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Engineer shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structure as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Engineer at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

1.3.4.2 Specific permission of Engineer will have to be taken by Contractor for blasting rock and he shall also obtain a valid blasting license from the authorities concerned. If permission for blasting is refused by Engineer, the rock shall be removed by wedging, pick barring, heating and quenching or other approved means. All loose/loosened rock in the sides shall be removed by barring wedging, etc. The unit rates for excavation in hard rock shall include the cost of all these operations.

1.3.4.2.1 Contractor shall employ a competent and experienced supervisor and licensed blaster in charge for each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.

1.3.4.2.2 Before any blasting is carried out, Contractor shall intimate Engineer-in-charge and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.

1.4 Filling in plinth with selected excavated earth

1.4.1 Plinth shall be filled in layers 15 - 30 cm, of thickness or as specified in items specification watered and compacted with hand rammers as directed by the Engineer-in-charge, so as to avoid any settlement at later stage. For the final layer the surface shall be flooded with water and water allowed to stand for 24 hours. The finished level of the filling shall be trimmed to the level specified.

1.4.2 Where specified in the item description given in the Schedule of Quantities that the compaction of the plinth fill shall be carried out by means of 10/12 tonnes rollers smooth wheeled, sheep-foot or wobble wheeled rollers. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill.

1.5 Filling excavated earth in ground for land development

1.5.1 No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by Engineer-in-charge.

1.5.2 Filling shall be carried out as indicated in the drawings and as directed by Engineer-in-charge. If no compaction is called for, the fill may be deposited to the full height in

one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 600 mm and levelled uniformly and compacted before the next layer is deposited.

- 1.5.3 Field compaction is called for, test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well. The tests for field compaction shall be specified by the Engineer and the Contractor shall arrange to carry out such tests to the satisfaction of the Engineer-in-charge.
- 1.5.4 Contractor shall protect the earthfill from being washed away by rain or damaged in any other way. Should any slip occur, Contractor shall remove the affected material and make good the slip at his own cost.
- 1.5.5 The fill shall be carried out to such dimension and levels as indicated on the drawings after the stipulated compaction. The fill shall be considered as incomplete if the desired compaction has not been obtained.

1.6 Filling in plinth and ground with earth brought from outside

- 1.6.1 Filling shall be carried out with approved material. The material and source shall be subject to prior approval of Engineer-in-charge. The approved area, from where the fill material is to be dug, shall be cleared of all bushes, roots plants, rubbish, etc., top soil containing salts, sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by Engineer-in-charge. The Contractor shall make necessary access roads to those areas and maintain the same, if such access road does not exist, at his cost.
- 1.6.2 If any material is rejected by Engineer-in-charge, Contractor shall remove the same forthwith from the site at no extra cost to the owner. Surplus fill material shall be disposed of by uniform spreading within the site as instructed by the Engineer-in-charge.
- 1.6.3 At places backfilling shall be carried out with local sand if directed by Engineer. The sand used shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded condition shall be to Contractor's account. The surface of the consolidated sand shall be dressed to require level or slope. Construction of floors or other structures on sand fill shall not be started until Engineer has inspected and approved the fill.

2.0 CONCRETE AND ALLIED WORKS

2.1 Applicable Codes

The following codes and standards are made a part of the Specifications. All standards, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall prevail.

2.1.1 Materials

- 1) IS 269 : Specification for ordinary, rapid hardening and low heat portland cement
- 2) IS 455 : Specification for Portland blast furnace slag.
- 3) IS 1489 :Specification for Portland-pozalana cement
- 4) IS 4031 :Methods of physical tests for hydraulic cement
- 5) IS 650 :Specification for standard sand for testing of cement
- 6) IS 383 :Specification for coarse and fine aggregates from natural sources for concrete
- 7) IS 2386 (Parts I to VIII) : Methods of test for aggregates for concrete
- 8) IS 516 :Methods of test for strength of concrete
- 9) IS 1199 :Methods of sampling and analysis of concrete
- 10) IS 2396 (I) IS 5640 :Flakiness Index of aggregates
- 11) IS 3025 : Methods of sampling and test (physical and chemical water used in industry)
- 12) IS 432(Part I & II) :Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
- 13) IS 1139 : Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement
- 14) IS 1566 :Specification for plain hard drawn steel wire fabric for concrete reinforcement
- 15) IS 1785 :Specification for plain hard drawn (Part I) steel wire for prestressed concrete
- 16) IS 1786 :Specification for cold twisted steel bars for concrete reinforcement
- 17) IS 2090 :Specification for high tensile steel bars used in prestressed concrete
- 18) IS 4990 :Specification for plywood for concrete shuttering work
- 19) IS 2645 :Specification for integral cement water-proofing compounds

2.1.2 Equipment

- 1) IS 1791 :Specification for batch type concrete mixers
- 2) IS 2438 :Specification for roller pan mixer
- 3) IS 2505 :Specification for concrete vibrators immersion type
- 4) IS 2506 :Specification for screed board concrete vibrators
- 5) IS 2514 :Specification for concrete vibrating tables
- 6) IS 3366 :Specification for pan vibrators
- 7) IS 4656 :Specification for form vibrators for concrete

- 8) IS 2722 :Specification for portable swing weigh-batchers for concrete (single and double bucket type)
- 9) IS 2750 : Specification for steel scaffoldings

2.1.3 Codes of Practice

- 1) IS 456 : Code of practice for plain and reinforced concrete
- 2) IS 1343 :Code of practice for prestressed concrete
- 3) IS 457 :Code of practice for general construction of plain and reinforced concrete for dams and other massive structures
- 4) IS 3370 (Part I to IV) :Code of practice for concrete structures for storage of liquids.
- 5) IS 3935 : Code of practice for composite construction
- 6) IS 3201 : Criteria for design and construction of precast concrete trusses
- 7) IS 2204 : Code of practice for construction of reinforced concrete shell roof
- 8) IS 2210 : Criteria for the design of RC shell structures and folded plates
- 9) IS 2751 : Code of practice for welding of mild steel bars used for reinforced concrete construction
- 10) IS 2502: Code of practice for bending and fixing of bars for concrete reinforcement
- 11) IS 3558 :Code of practice for use of immersion vibrators for consolidating concrete
- 12) IS 3414 :Code of practice for design and installation of joints in buildings
- 13) IS 4014 (Part I&II) :Code of practice for steel tubular, scaffolding
- 14) IS 2571 :Code of practice for laying insitu - cement concrete flooring

2.1.4 Construction Safety

- 1) IS 3696 : Safety code for scaffolds and ladders

2.1.5 Measurement

- 1) IS 1200 :Method of measurement of building works
- 2) IS 3385 :Code of practice for measurement of civil engineering works

2.2 General

The quality of materials, method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise shall conform to the applicable portions of this specification.

2.3 Materials

The ingredients to be used in the manufacture of standard concrete shall consist solely of standard type portland cement, clean sand, natural coarse aggregate, clean water and admixtures.

2.3.1 Cement

2.3.1.1 If the Contractor is instructed to supply cement, then the following points shall be applicable:

- a. The cement to be used shall be ordinary Portland/Portland Pozzolana cement conforming to IS: 8112-1989 & IS:1489 part I respectively for 43 Grade OPC/PPC unless otherwise mentioned. The cement procured should be of reputed brands such as Malabar Cements, ACC, L&T, Shankar Cement, etc. and as approved by the Engineer-in-Charge. As far as possible, all the cement shall be obtained from a single source throughout the contract. Cement of different types shall not be mixed together. Different brands of cements or same brand of cement from different sources shall not be used without prior approval of the Engineer-in-Charge.
The cement shall be delivered at site in original sealed bags which shall be labelled with the weight, date of manufacture, brand and type. Cement received in torn or hand-stitched bags shall not be used. For volumetric batching of, concrete, cement should be mixed only by box measurement. All cement should be fresh when delivered and shall be stored in an approved manner in stores built by the Contractor at his own cost. Set cement shall not be allowed to be used for any work.
- b. A certified report attesting to the conformance of the cement to IS specifications by the cement manufacturer's chemist shall be furnished to engineer if demanded.
- c. Cement held in storage for a period of sixty (60) days or longer shall be tested. Should at any time Engineer have reasons to consider that any cement is defective, then irrespective of its origin, and/or manufacturers test certificate, such cement shall be tested immediately at contractor's cost at an approved laboratory and until the results of such tests are found satisfactory, it shall not be used in any work. Contractor shall not be entitled to any claim of any nature on this account.
- d. Contractor will have to make his own arrangements for storage of adequate quantity of cement.
- e. The site engineer shall be regularly notified when supplies of cement are made to the site store. Copies of invoices shall be made available to the site engineer and a common cement register shall be kept at his office showing the supply stock and issue on a daily basis.

2.3.1.2 If the cement is supplied by the Client

- a) Contractor will have to make his own arrangements for the storage of cement. If supplies are arranged by owner, cement will be issued in quantities to cover work requirements of one month or more, as deemed fit by Engineer and it will be the responsibility of contractor to ensure adequate and proper storage. The storage arrangements shall be such that there is no dead storage. The storage arrangement shall be approved by Engineer.

2.3.2 Aggregates

2.3.2.1 Aggregate in general designates both fine and coarse inert materials used in the manufacture of concrete. Fine aggregate is aggregate all of which passes through 4.75 mm IS sieve. Coarse aggregate is aggregate most of which is retained on 4.75 mm sieve. Specification mentioned against various item of work may also be followed.

2.3.2.2 All fine and coarse aggregates proposed for use in the work shall be subject to Engineer's approval and after specific materials have been accepted the source of supply of such materials should not be changed without prior approval of Engineer.

2.3.2.3 Aggregates shall, except as noted above, consist of natural sands, crushed stone and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, durable against weathering, of limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and/or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the mix design and preliminary tests on concrete specified later.

2.3.2.4 Sampling and testing

Samples of the aggregates for mix design and determination of suitability shall be taken under the supervision of Engineer and delivered to the laboratory, well in advance of the scheduled placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to Engineer in advance of the work for use in determining aggregate suitability. The costs of all such tests, sampling, etc., shall be borne by contractor.

2.3.2.5 Storage of Aggregates

All coarse and fine aggregates shall be stacked in stock separately in stock piles in the materials yard near the work site or if instructed in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials and with earth during storage and while heaping the materials shall be avoided. The aggregate must be of specified quality not only at the time of receiving at site but more so at the time of loading into mixer.

2.3.2.6 Screening and Washing

- a) Sand shall be prepared for use for such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions.
- b) Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by Engineer

2.3.2.7 Water

2.3.2.7.1 Water used for both mixing and curing shall be free from injurious amounts of deleterious materials. Potable waters are generally satisfactory for mixing and curing concrete.

2.3.2.7.2 In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in IS-456. The sample of water taken for testing shall be typical of the water proposed to be used for

concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

2.3.3 Brick aggregates

The brickbats shall be of new bricks well burnt, hard, durable and broken to sizes, well graded. It shall be free from dust, the size shall be of 37 mm and down. It shall be free from earth and other impurities.

2.3.4 Mix Design

2.3.4.1 Classification

2.3.4.1.1 In case of concrete works, mix design may be necessary as per IS:456 for certain items as directed by Engineer-in-charge. All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8, 1:5:10. Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification shall be divided into the following classifications. (Also refer Clause 5.2.6.3 for testing of concrete).

MINIMUM COMPRESSIVE STRENGTH OF 15 CM CUBES AT
7 AND 28 DAYS AFTER MIXING, CONDUCTED IN ACCORDANCE WITH IS 516

Class	Preliminary N/SQ.MM		Work test N/SQ.MM		Max. size of aggregates
	at 7 days	at 28 days	at 7 days	at 28 days	
M 30	28.0	42.0	20.0	31.0	40 or 20
M 25	21.5	35.0	17.0	28.0	40 or 20
M 20	19.4	29.0	11.5	22.0	40 or 20
M 15	14.0	17.0	10.0	16.0	40 or 20

2.3.4.1.2 It shall be very clearly understood that whenever the class of concrete such as M 20 is specified it shall be the Contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works. The maximum total quantity of aggregate by weight per 50 kg of cement shall not exceed 250 kg except when otherwise specifically permitted by Engineer.

- 2.3.4.1.3 To fix the grading of aggregates, water cement ratio, workability and the quantity of cement required to give preliminary and works cubes of the minimum strength specified, the proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to Indian Standard Specifications.
- 2.3.4.1.4 Whenever there is a change either in required strength of concrete or water cement ratio or workability or the source of aggregates and/or cement, preliminary tests shall be repeated to determine the revised proportions, of the mix to suit the altered conditions.
- 2.3.4.1.5 While fixing the value for water cement ratio for preliminary mixes, assistance may be derived from the graph (appendix IS 456) showing the relationship between the 28 day compressive strengths of concrete mixes with different water cement ratios and the 7 days compressive strength of cement tested in accordance with IS 269.

2.3.4.2 Preliminary tests

- 2.3.4.2.1 Test specimens shall be prepared with at least two different water/cement ratios for each class of concrete, consistent with workability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those to be actually employed in the works as the object of these tests is to determine the proportions of cement, aggregates and water necessary to produce concrete of required consistency and to give the specified strength. It will be the Contractor's sole responsibility to carry out these tests and he shall therefore furnish to Engineer a statement of proportions proposed to be used for the various concrete mixes.
- 2.3.4.2.2 Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water, cement and aggregates for each mix shall be determined by weight/volume to an accuracy of 1 part in 1000 parts.
- 2.3.4.2.3 Mixing shall be done by a mixer machine as per IS 516 in such a manner as to avoid loss of water. The cement and fine aggregate shall first be mixed dry until the mixture is uniform in colour. The coarse aggregate shall then be added, mixed and water added and mixed thoroughly for a period of not less than 3 minutes until the resulting concrete is uniform in appearance. Each mix of concrete shall be of such a quantity as to leave about 10% excess concrete after moulding the desired number of test specimens.
- 2.3.4.2.4 The consistency of each mix of concrete shall be measured immediately after mixing, by the slump test in accordance with IS 1199. If in the slump test, care is taken to ensure that no water or other materials is lost, the materials used for the slump test may be remixed with the remainder of the concrete for making the specimen test cubes. The period of remixing shall be as short as possible yet sufficient to produce a homogeneous mass.
- 2.3.4.2.5 Compression tests of concrete cubes shall be made as per IS 516 on 15 cm cubes. Each mould shall be provided with a metal base having a plane surface so as to support the mould during filling without leakage. The base plate shall be preferably attached to the mould by springs or screws. The parts of the mould when assembled shall be positively and rigidly held together. Before placing concrete the mould and

base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits:

2.3.4.2.6 Height and distance between the opposite faces of the mould shall be of specified size plus or minus 0.2 mm. The angle between the adjacent internal faces and between internal faces and top and bottom planes of mould shall be 90 Deg. plus or minus 5 Deg. The interior faces of the mould shall be plane surfaces with a permissible variation 0.03 mm.

2.3.4.2.7 Concrete test cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in IS 516.

2.3.4.2.8 Curing shall be as specified in IS 516. The cubes shall be kept in moist air of at least 90% relative humidity at a temp. of 27 Deg. Cent. plus or minus 2 Deg. Cent. for 24 hours plus or minus half hour from the time of adding water to the dry ingredients. Thereafter they shall be removed from the moulds and kept immersed in clean, fresh water and kept at 27 Deg. Cent. plus or minus 2 Deg. Cent. temp. until required for test. Curing water shall be renewed every seven days. A record of maximum and minimum temperatures at the place of storage of the cubes shall be maintained during the period they remain in storage.

2.3.4.2.9 Testing of specimens

The strength shall be determined based on not less than five cubes test specimens for each age and each water cement ratio. All these laboratory test results shall be tabulated and furnished to Engineer. The test result shall be accepted by Engineer if the average compressive strengths of the specimens are tested subject to the condition that only one out of the five consecutive test may give a value less than the specified strength for that age. The Engineer may direct the Contractor to repeat the tests if the results are not satisfactory and also to make such changes as he considers necessary to meet the requirements specified. All these preliminary tests shall be conducted by the Contractor at his own cost in an approved laboratory.

2.3.4.3 Proportioning, consistency, batching and mixing of concrete

2.3.4.3.1 Aggregate

The proportions which shall be decided by conducting preliminary test shall be by volume. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete mixing. The supply of properly graded aggregate of uniform quality shall be maintained over the period of work, the grading of aggregates 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 stock piles. The grading of coarse and fine aggregate shall be checked as frequently as possible as determined by Engineer, to ensure maintaining of grading in accordance with the samples used in preliminary mix design. The material shall be stock piled well in advance of use.

2.3.4.3.2 Cement

The cement shall be measured by weight.

2.3.4.3.3 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. The water added to the mix shall be such as not to cause segregation of material or the collection of excessive free water on the surface of the concrete.

The water cement (W/C) ratio will be decided by Engineer-in-charge on weight basis and this shall be strictly followed at site.

2.3.4.3.4 Proportioning by Water/Cement ratio

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

2.3.4.3.5 Consistency and slump

Concrete shall be of a consistency and workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factor tests, in accordance with IS 1199 shall be conducted from time to time to ensure the maintenance of such consistency.

2.3.5 Slumps for Various Types of Construction

Only sufficient quantity of water shall be added to concrete during the mixing to produce a mix of sufficient workability to enable it to be well consolidated, to be worked into the corners of the shuttering and around the reinforcement, to give the specified surface finish, and to have the specified surface strength. The following slumps shall be adopted for different kinds of works:

Placing Conditions	Degree of Workability	Slump (mm)
[1]	[2]	[3]
Blinding concrete: } Shallow sections; } Pavements using pavers } Mass concrete: } Lightly reinforced sections in } slabs, } beams, walls, columns: } Floors; } Hand placed pavements; } Canal lining; } Strip footings } Heavily reinforced sections in } slabs, } beams, walls, columns; }	Very low Low Medium High Very high	25-75 50-100 75-100 100-150

Slipform work; Pumped concrete Trench fill; <i>In-situ pilling</i> <i>Tremie concrete</i>		
---	--	--

2.3.6 Sampling and testing concrete in the field

2.3.6.1 Facilities required for sampling materials and concrete in the field shall be provided by the Contractor at no extra cost. The following equipment with operator shall be made available at Engineer's request (all must be in serviceable condition):

- a) One concrete cube testing machine suitable for 15 cm cubes of 100 tonnes capacity with proving calibration ring.
- b) Twelve cast iron cube moulds of 15 cm size
- c) One Lab. balance to weigh upto 5 kg with sensivity of 10 gm.
- d) One set of sieves for coarse and fine aggregates
- e) One set of slump cone complete with tamping rod
- f) A set of measures from 5 litre to 0.1 litre
- g) One electric oven with thermostat upto 120 Deg. Cent.
- h) One flakiness gauge
- i) One elongation index gauge
- j) One sedimentation pipette
- k) One Pyconometer
- l) Two calibrated glass jar of 1 litre capacity

2.3.6.2 Arrangement can be made by the contractor to have the cubes tested in an approved laboratory in lieu of a testing machine at site at his expense, with the prior consent of the Engineer.

2.3.6.3 At least 6 test cubes of each class of concrete shall be made for every 15.0 cu.m. of concrete or part thereof. Such samples shall be drawn on each day for each type of concrete. Of each set of 6 cubes, three shall be tested at 7 days age and three at 28 days age. The laboratory test results shall be tabulated and furnished to Engineer. Engineer will pass the concrete if average strength of the specimens tested is not less than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength. The cubes shall be tested on 7th and 28th day from the day of casting of the cubes.

2.3.7 Admixtures

2.3.7.1 Admixtures may be used in concrete only with the approval of Engineer based upon evidence that, with the passage of time, neither the compressive strength nor its

durability reduced. Calcium chloride shall not be used for accelerating setting of the cement for any concrete containing reinforcement, or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1.5% of the volume of the cement in concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instructions and in the manner and with the control specified by Engineer-in-charge.

2.3.7.2 Air entraining agents

Where specified and approved by Engineer, neutralised vinyl resin or any other approved air-entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6260, air entraining admixtures for concrete. The recommended total air content of the concrete is 4% plus minus 1%. The method of measuring air content shall be as per IS 1199.

2.3.7.3 Water reducing admixtures

Where specified and approved by Engineer-in-charge water reducing lignosulfonate mixture shall be added in quantities specified by Engineer. The admixtures shall be added in the form of a solution.

2.3.7.4 Retarding admixtures

Where specified and approved by Engineer-in-charge retarding agents shall be added to the concrete mix in quantities specified by Engineer.

2.3.7.5 Water proofing agent

Where specified and approved by Engineer-in-charge water proofing agent conforming to IS 2645 shall be added in quantities specified by Engineer.

2.3.8 Optional tests

2.3.8.1 Engineer-in-charge may order tests to be carried out on cement, sand, coarse aggregate and water in accordance with the relevant Indian Standards. Tests on cement shall include (i) fineness test (ii) test for normal consistency (iii) test for setting time (iv) test for soundness (v) test for tensile strength (vi) test for compressive strength (vii) test for heat of hydration by experiment and by calculations in accordance with IS 269. Tests on sand shall include (i) sieve test (ii) test for organic impurities (iii) decantation test for determining clay and silt content (iv) specific gravity test (v) test for unit weight and bulkage factor. Tests on coarsed aggregate shall include (i) test for sieve analysis (ii) specific gravity and unit weight of dry loose and rodded aggregate (iii) soundness and alkali aggregate reactivity (iv) petrographic examination (v) deleterious materials and organic impurities (vi) test for aggregate crushing value. Any or all these tests would normally be ordered to be carried out only if Engineer feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by contractor at site or at an approved test laboratory.

2.3.8.2 If the work cubes do not give the stipulated strengths Engineer-in-charge reserves the right to ask contractor to dismantle such portions of the work which in his opinion are unacceptable and re-do the work to the standard stipulated at contractor's cost.

2.3.9 Preparation prior to concrete placement

2.3.9.1 Before the concrete is actually placed in position, the insides of the form work shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns and walls forms to permit removal of saw dust, wood shavings, binding wire, rubbish dirt, etc. Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings/holes shall be later suitably plugged.

2.3.9.2 The various agencies shall be permitted ample time to install drainage and plumbing lines in floor and trech drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedments to be cast in the concrete as indicated on the drawings or as is necessary for the proper execution of the work. Contractor shall cooperate fully with all such agencies and shall permit the use of scaffolding form work, etc., by other agencies at no extra cost.

2.3.9.3 All embedded parts, inserts, etc., supplied by Owner or Contractor shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.

2.3.9.4 Anchor bolts shall be positioned and kept in place with the help of properly manufactured templates. The use of all such templates, fixture, etc., shall be deemed to be included in the rates.

2.3.9.5 Slots, openings, holes, pockets, etc., shall be provided in the concrete work in the positions indicated in the drawings or as directed by Engineer-in-charge.

2.3.9.6 Prior to concrete placement all work shall be inspected and approved by Engineer and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at Contractor's cost. Cat ladders shall be provided on the reinforcement to facilitate labour movement.

2.3.9.7 Approval by Engineer for all materials and work as required herein shall not relieve contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.

2.3.9.8 No concrete shall be placed in wet weather or on water covered surface. Any concrete that has been washed by heavy rains, the work shall be entirely removed, if there is any sign of cement and having been washed from the concrete mixture. To guard against damage which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/around freshly placed concrete, suitably drains and sumps shall be provided.

2.3.9.9 Immediately before concrete placement begins, proposed surfaces except framework, which will come in contact with the concrete to be placed, shall be covered with a bonding mortar.

2.3.10 Transportation

2.3.10.1 All buckets, containers or conveyors used for transporting concrete shall be mortar tight. Irrespective of the method of transportation adopted, concrete shall be delivered with the required consistency and plasticity without segregation or loss of slump. However, chutes shall not be used for transport of concrete without the written permission of Engineer and concrete shall not be rehandled before placing.

2.3.10.2 Concrete must be placed in its final position before it becomes too stiff to work. On no account, water shall be added after the initial mixing concrete which has become stiff or has been contaminated with foreign materials shall be rejected and disposed off as directed by Engineer.

2.3.10.3 All equipment used for mixing, transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipelines and other equipment shall be thoroughly cleaned after each period of placement.

2.3.11 Procedure for placing of concrete

2.3.11.1 Before any concrete is placed, the entire placing programme, consisting of equipment, layout proposed procedures and methods shall be submitted to engineer for approval if so demanded by Engineer and no concrete shall be placed until Engineer's approval has been received. Conveyor for conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.

2.3.11.2 Concrete shall be placed in its final position before the cement shall normally be compacted in its final position within thirty minutes of leaving the mixer and once compacted it shall not be disturbed.

2.3.11.3 Concrete, in all cases, be deposited as nearly as practicable directly in its final position, and shall not be rehandled or caused to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible, and in narrow forms, contractor shall provide suitable drop and elephant trunks to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height especially if reinforcement is in the way, particularly in columns and thin walls.

2.3.11.4 Except when otherwise approved by Engineer, concrete shall be placed in shovels or other approved implements and shall not be dropped from a height more than 1 M or handled in a manner which will cause segregation.

2.3.11.5 The following specification shall apply when placing of concrete by use of mechanical equipment is specifically called for while inviting bids or is warranted considering the nature of work involved. The control of placing shall begin at the

mixer discharger, concrete shall be discharged by a vertical drop into the middle of the bucket or hopper and this principle of a vertical discharge of concrete shall be adhered to thoroughly all stages of delivery until the concrete comes to rest in its final position.

2.3.11.6 Central bottom dump buckets of a type that provides for positive regulation of the amount and rate of deposition of concrete in all dumping position, shall be employed.

2.3.11.7 In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1 M. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.

2.3.11.8 Concrete placed in restricted forms by wheel barrows, buggies, cars, short chutes or hand shovelling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.

2.3.11.9 Where it is necessary to use transfer chutes, specific approval of Engineer must be obtained to the type, length, slopes, baffles, vertical terminals and timing of operations, the discharge and without segregation. To allow for the loss of mortar against the sides of the chutes, the first mix shall have less coarse aggregate. During cleaning of chutes the waste water shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1 M. Chutes when approved for use shall have slopes not flatter than 1:2 chutes shall be of metal or metal lined and of rounded cross section. The slopes of all chutes sections shall be approximately the same. The discharge end of the chutes shall be maintained above the surface of the concrete in the forms.

2.3.11.10 Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers only with the written permission of Engineer. The slump shall be held to the minimum, necessary for conveying concrete by this method.

2.3.11.11 When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

2.3.11.12 When pneumatic placer is used, the manufacturer's advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at this end. Manufacturer's advice shall be followed regarding concrete quality and all other related matters when pumping or pneumatic placing equipment are used.

2.3.11.13 Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 to 90 mm as directed by Engineer. These shall be placed as rapidly practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of

deposit shall be spotted progressively along the face of the layer with such overlap as well facilitate spreading the layer to uniform depth and texture with a minimum of shovelling. Any tendency to segregation shall be corrected by shovelling stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by Engineer.

2.3.11.14 The top surface of each pour and bedding planes shall be approximately horizontal unless otherwise instructed.

2.3.12 Compaction

2.3.12.1 Concrete shall be compacted during placing with approved vibrating equipment until the concrete has been consolidated to the maximum practicable density, is free of pockets of coarse aggregate and fits tightly against all form surfaces, reinforcement and embedded fixtures. Particular care shall be taken to ensure that all concrete placed against the forms faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix and caution exercised not to over-vibrate the concrete to the point that segregation results.

2.3.12.2 Vibrators shall conform to IS specifications. Type of vibrator to be used shall depend on the structure where concrete is to be placed. Shutter vibrators to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrators shall have no load frequency, amplitude and acceleration as per IS 2505 depending on the size of vibrator. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.

2.3.12.3 The exact manner of application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift e.g. in a column or wall.

2.3.12.4 When placing concrete in layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, blending and mixing of the concrete between the succeeding layers.

2.3.12.5 The immersion vibrator shall penetrate the layer being placed and also penetrate the layer below with the underlayer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

2.3.12.6 Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement

steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.

2.3.12.7 Form attached vibrators shall be used only with specific authorisation of Engineer.

2.3.12.8 The surface vibrators will not be permitted under normal conditions. However for thin slabs vibration by specially designed vibrators may be permitted upon approval of Engineer.

2.3.12.9 The formation of stone pockets or mortar bondages in corner and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for through bonding, as directed by Engineer.

2.3.13 Placement interval

Except when placing with slip forms each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete and before the start of a subsequent placement.

2.3.14 Special provision in placing

When placing concrete in walls with openings and in floors of integral slab and beam construction and other similar conditions, the placing shall stop when the concrete reaches the top of the opening in walls and bottom horizontal surface of the slab, as the case may be placing shall be resumed before the concrete in place takes initial set, but not until it has time to settle as determined by Engineer.

2.3.15 Placing concrete through reinforcement steel

When placing concrete through reinforced steel, care shall be taken to prevent segregation of the coarse aggregate. When the congestion of steel makes placing difficult it may be necessary to temporarily move the top steel aside to get proper placement and restore reinforcing steel to design position.

2.3.16 Bleeding

Bleeding of free water, on top of concrete being deposited, in to the forms shall be caused to stop the concrete pour. The conditions causing this defect corrected before any further concreting is resumed.

2.3.17 Curing, protecting, repairing and finishing

2.3.17.1 Curing

2.3.17.1.1 All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or ponded water continuously saturated covering of sacks, canvas, hessian, polythene sheets or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot water as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

2.3.17.1.2 Certain types of finish or preparation for overlaying concrete must be done at certain stage of the curing process and special treatment may be required for specific concrete surface finish.

- 2.3.17.1.3 Curing of concrete made of high alumina cement and supersulphated cement shall be carried out as directed by Engineer.
- 2.3.17.1.4 Fresh concrete shall be kept continuously wet for a minimum period of 15 days from the date of placing of concrete following a lapse of 12 to 14 hours after laying of concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied uniformly to concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.
- 2.3.17.1.5 Curing shall be assured by use of an ample water supply under pressure in pipes with all necessary appliance of hose, sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Engineer.
- 2.3.17.1.6 Whenever, by the judgement of Engineer, it may be necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during the curing period.
- 2.3.17.1.7 For curing of concrete in pavements, side-walks floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer. Special attention shall be given to edges and corners of the slabs to ensure proper protection to this area. The ponded area shall be kept continuously filled with water during the curing period.
- 2.3.17.1.8 Surface coating type compounds shall be used only by special permission of Engineer, curing compounds shall be liquid type white pigmented. Other curing compounds shall be used on surfaces where future blending with concrete, water or acid proof membrane or painting is specified.
- 2.3.17.1.9 All equipment and materials required for curing shall be on hand and ready for use before concrete is placed.

2.3.17.2 Protecting fresh concrete

- 2.3.17.2.1 Fresh concrete shall be protected from defacements and damage due to construction operation by leaving forms in place for an ample period as specified later in this specifications. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps as approved by Engineer shall also be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion or contact with other materials, etc., that may impair the strength and/or durability of the concrete. Workmen shall be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete, Engineer may require that bridges be placed over the area.

2.3.17.3 Repair and replacement of unsatisfactory concrete

- 2.3.17.1.1 Immediately after the shuttering is removed, the surface of concrete shall be very carefully inspected and all defective areas called to the attention of Engineer who may permit patching of the defective areas or also reject the concrete unit either partially or entirely. Rejected concrete shall be removed and replaced by contractor at no additional expense to owner. Holes left by form bolts, etc., shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm IS sieve after removing any loose stones adhering to the concrete shall be finished as described under the particular items of work.
- 2.3.17.1.2 Superficial honeycombed surfaces and rough patches shall be similarly made good immediately after removal of shuttering in the presence of Engineer and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by Engineer the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities and necessary care being taken to avoid damage to the surface. Surface irregularities shall be removed by grinding.
- 2.3.17.1.3 If reinforcement is exposed or the honey combing occurs at vulnerable positions eg. ends of beams or columns it may be necessary to cut out the member completely or in part and reconstruct. The decision of Engineer shall be final in this regard. If only patching is necessary, the defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25 mm) the edges being cut perpendicular to the affected surface or with small under cut if possible. Achors, tees or dovetail slots shall be provided whenever necessary to attach the new concrete securely in place an area extending several centimetres beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.
- 2.3.17.1.4 The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Engineer. Epoxy shall be applied in strict accordance with the instructions of the manufacturer.
- 2.3.17.1.5 Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bottom, grout insert holes and slots cut for repair of cracks shall be repaired as follows. The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.
- 2.3.17.1.6 A 5 mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by the patching concrete which shall be well consolidated with a wooden float. The concrete patch shall be built up in 10 mm thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and smooth finish obtained by wiping with hessian, a steel trowel shall be used for this purpose. The mix for patching shall be of same materials and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.
- 2.3.17.1.7 Mortar filling by air pressure (guniting) shall be used for repairing of areas too large and/or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. While

cement shall be substituted for ordinary cement, if so directed by Engineer, to match the shade of the patch with original concrete.

2.3.17.1.8 The patched area shall be covered immediately with an approved non-staining water saturated material such as gunny bag which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by fine spray of sprinkling for not less than 10 days.

2.3.17.1.9 All materials, procedures and preparation used in the repairing of concrete and also the finished repair work shall be subject to the approval of Engineer. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and finished.

2.3.17.4 Finishing

2.3.17.4.1 The type of finish for formed concrete surface shall be as follows, unless, otherwise specified by the Engineer.

2.3.17.4.2 For surfaces against which backfill or concrete is to be placed, no treatment is required except repairing of defective area.

2.3.17.4.3 For surface below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing material which is specified for use.

2.3.17.4.4 Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repairing of damage or defective concrete removal of fins and abrupt irregularities, fillings of holes let by form ties and rods and clean up of loose or adhering debris.

2.3.17.4.5 Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless the drawing specifies such as stair treads, walls shall be sloped across the width approximately 1 in 30 broader surface such as walkways, roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete subfloors to be covered either concrete topping, terrazzo or quarry tile and similar surfaces shall be smooth screeded and levelled to produce even surfaces. Surface irregularities shall not exceed 6 mm. Surfaces which will not be covered by backfill, concrete or tile toppings such as outside decks, floors of galleries and sumps, parapets, gutters, sidewall floors and slabs shall be consolidated, screeded and floated. Excess water and laitance shall be removed before finishing. Floating may be done with hand or power tools and started as the screeded surface has attained a stiffness to permit finishing operation and these shall be the minimum required to produce a surface uniform in texture and free from screed marks or other imperfections. Joints edges panels and forms linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off and all blemishes, projections etc., removed leaving the surfaces reasonably smooth and unmarked.

2.3.17.4.6 Integral cement concrete finish

When specified on the drawings and integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded as specified on the drawing as per IS 2571. The surface shall be compacted and then floated with

a wood float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

2.3.17.4.7 Exposed Concrete finish/Rendering

A rubbed finish shall be provided only on exposed concrete surfaces as specified on the drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, off-sets levelled and voids and damaged sections be immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface. Then surface shall be thoroughly wetted and rubbed with carborundum or other abrasive. Cement mortar may be used in the rubbing, but the finished surface shall be brush coated with either cement grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

2.3.18 Form Work

2.3.18.1 The formwork shall consist of shores, bracings, sides of beams and columns, bottom of slabs, etc., including ties anchors, hangers inserts, etc., complete which shall be properly designed and planned for the work. False work shall be so constructed that necessary adjustment can be made to compensate for take up and settlements. Wedge may be used at the top or bottom of timber shores but not at both ends to facilitate vertical adjustment or dismantling of the formwork.

2.3.18.2 Design of formwork

The design of the formwork as well as its construction shall be the responsibility of Contractor. If so instructed, the drawings and/or calculation for the design for the formwork shall be submitted to Engineer for approval before proceeding with work, at no extra cost. Engineer's approval shall not however relieve Contractor of the full responsibility for the design and construction of the formwork. The design shall take into account all the load vertical and lateral that the forms will be carrying live and vibration loadings.

2.3.18.3 Type of formwork

Formwork may be of timber, plywood, metal, plastic or concrete. For special finishes the formwork may be lined with plywood, steel, sheets, oil, tempered hard board, etc. Sliding forms and slip forms may be used with the approval of Engineer.

2.3.18.4 Form work requirements

2.3.18.4.1 Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for on the drawings. Ample studs, braces, ties, straps, etc., shall be used to hold the forms in proper position without any distortion whatsoever until the concrete is set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases form vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned,

free from sap, shakes, loose knots, worm holes, warps or other surface defects in contact with concrete. Faces coming in contact with the concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight splits or other defects. Joints shall be sufficiently tight to prevent loss of water or any fine material from concrete.

2.3.18.4.2 Plywood shall be used for exposed concrete surfaces; where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planed to remove irregularities or unevenness in the face. Formwork with linings shall be permitted.

2.3.18.4.3 All new and used form timber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form timber unsatisfactory in any respect shall not be used and if rejected by Engineer shall be removed from the site.

2.3.18.4.4 Shores supporting successive members shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundations.

2.3.18.4.5 Formwork, during any stage of construction showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be removed completely and the formwork be corrected prior to placing of new concrete.

2.3.18.4.6 Excessive construction camber to compensate for shrinkage, settlement may impair the structural strength of members and shall not be permitted.

2.3.18.4.7 Forms shall be so designed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and be as directed by engineer.

2.3.18.4.8 Where exposed smooth or rendered concrete finishes are required the forms shall be constructed with special care so that the resulting concrete surfaces require a minimum finish.

2.3.18.5 Formwork For Slope Surfaces

2.3.18.5.1 Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration inspection and repair of the concrete.

2.3.18.5.2 The formwork shall also be built so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 4 horizontal: 1 vertical shall be formed as required herein.

2.3.18.6 Formwork for Curved Surfaces

2.3.18.6.1 The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form timber shall be built up of laminated splines cut to make tight, smooth form surfaces.

2.3.18.6.2 After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be deressed to the specified curvature.

2.3.18.7 Formwork for Exposed Concrete Surfaces

2.3.18.7.1 Where it is desired, directed or shown on the drawings to have original fair face finish of concrete surface without any rendering or plastering, formwork shall be carried out by using wood planks, plywood or steel plates of approved quality and as per direction of the Engineer.

2.3.18.7.2 The contractor shall use one type of material for all such exposed concrete faces and the forms shall be constructed so as to produce uniform and consistent texture and pattern on the face of the concrete. Patches or forms for these surfaces will not be permitted. The formwork shall be placed so that all horizontal formworks are continuous across the entire surface.

2.3.18.7.3 To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features, chills, window heads or change in direction of the surface. All joints between shuttering plates or panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be provided between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.

2.3.18.7.4 To achieve a finish which shall give the rough appearance of concrete cast against sawn boards, formwork boards unless otherwise stated shall be of 150 mm wide, securely jointed with tonge and grooved joints if required to prevent grout loss with tie rod positions and direction of boards carefully controlled. Sawn boards shall be set horizontally, vertically or at an inclination shown in the drawings. All bolt holes shall be accurately aligned horizontally and vertically and shall be filled with matching mortar recessed 5 mm back from the surrounding concrete face.

2.3.18.7.5 Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicated top of pour) at horizontal construction joints, unless the use of groove strips is specified on the drawings. Such forms shall be removed and reset from lift to lift, they shall not be continuous from lift to lift. Sheeting of reset forms shall be tightened against the concrete so that the forms will not be spread and permit abrputing irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

2.3.18.7.6 For fair faced concrete, the position of through bolts will be restricted and generally indicated on the drawings.

2.3.18.7.7 Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce 20 mm bevelled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be bevelled unless shown on the drgs. Mouldings for grooves, drip courses and bands shall be made in the form itself.

2.3.18.7.8 The wood planks, plywood and steel plates used in formwork for obtaining exposed surfaces shall not be used for more than 3 times in case of wood planks, 6 times for plywood and 10 times for steel plates respectively. However, no forms will be allowed for reuse, if in the opinion of the Engineer it is doubtful to produce desired texture of exposed concrete.

2.3.18.7.9 In order to obtain exposed concrete work of uniform colour it shall be necessary to ensure that the sand used for all exposed concrete work shall be of approved uniform colour. Moreover the cement used in the concrete for any complete element shall be from single consignment.

2.3.18.7.10 No exposed concrete surface shall be rendered or painted with cement or otherwise. Plastering of defective concrete as a means of achieving the required finish shall not be permitted, except in the case of minor porosity on the surface, the Engineer may allow a surface treatment by rubbing down with cement and sand mortar of the same richness and colour as for the concrete. This treatment shall be made immediately after removing the formwork.

2.3.18.7.11 The contractor shall also take all precautionary measures to prevent breaking and chipping of corners and edges of completed work until the building is handed over.

2.3.18.8 Bracings struts and props

2.3.18.8.1 Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bearers.

2.3.18.8.2 The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be generally lowered vertically while striking the shuttering. If the shuttering for a column, is erected for the full height of the column, one side shall be left open and built up in sections as placing of concrete from the sides to limit the drop of concrete to 3 M or as directed by Engineer.

2.3.18.9 Mould Oil

Care shall be taken to see that the faces of form work coming in contact with concrete are perfectly cleaned and two coats of mould oil or any other approved material applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the concrete shall not be placed until coating of the forms is complete,

adjoining concrete surface shall also be protected against contamination from the coating material.

2.3.18.10 Chamfers and fillets

All corners and angles exposed in the finished structure shall be formed with moulding to form chamfers or fillets on the finished concrete. The standard dimension of chamfers and fillers, unless otherwise specified shall be 20 mm x 20 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the mouldings shall be planned or surfaced to the same texture as the forms to which it is attached.

2.3.18.11 Wall ties

Wire ties passing through the walls shall not be allowed. In their place bolts through sleeves be used.

2.3.18.12 Reuse of forms

Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer. Warped timber shall be resized. Contractor shall equip himself with enough shuttering material to complete the job in the stipulated time.

2.3.18.13 Removal of forms

2.3.18.11.1 Contractor shall record on the drawings and in a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed therefrom. The Contractor shall remove the shuttering after obtaining the approval of the Engineer.

2.3.18.11.2 In no circumstances shall forms be struck until the concrete reaches a strength of at least twice the stress due to self weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

2.3.18.11.3 In normal circumstances (generally where temperatures are above 20 Deg. Cent.) forms may be removed after expiry of the following periods:

		Ordinary portland cement concrete	Rapid hardening portland cement
a)	Walls columns and vertical sides of beams	24 to 48 hrs as directed by the Engineer	24 hrs.
b)	Slabs prods left under	3 days	2 days
c)	Beam soffits prods left under	7 days	4 days
d)	Removal of props to slabs:		
	i) Spanning upto 4.5m	7 days	4 days
	ii) Spanning over 4.5m.	14 days	8 days

e)	Removal of props to beams & arches	14 days	8 days
	i) Spanning upto 6m	21 days	12 days
	ii) Spanning over 6m		

2.3.18.11.4 Striking shall be done slowly with utmost care to avoid damage to arises and projections and without shock or vibration, by gently easing the wedges. If after removing the form work, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

2.3.18.11.5 Reinforced temporary openings shall be provided as directed by Engineer to facilitate removal of formwork which otherwise may be inaccessible.

2.3.18.11.6 Tie rods, clamps, form bolts etc., which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours nor later than 40 hrs. after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time, Ties, withdrawn from walls and grade beams shall be pulled towards the inside face cutting ties back from the faces of walls and grade beams will not be permitted.

2.3.18.11.7 For liquid retaining structures no sleeves for through bolts shall be used nor shall through bolts be removed as indicated above. The bolts, in this case, shall be cut at 25mm depth from the surface and then the hole shall be made good by sand, cement mortar of the same proportions as the concrete just after striking the formwork.

2.3.19 Reinforcement Steel

2.3.19.1 General

2.3.19.1.1 Reinforcement bars, if supplies are arranged by contractor unless otherwise specified, shall be either plain round mild steel bars grade I as per IS 432 (Part I) or medium tensile steel bar as per IS 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per IS 1139 or cold twisted steel bars as per IS 1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with IS 1566. Substitution of reinforcement will not be permitted except upon written approval from Engineer.

2.3.19.1.2 Plain round mild steel bars grade II as per IS 432 (Part I) may be used with prior approval of Engineer in writing and with 10% increase in the reinforcement area but its use shall not be permitted in structures located in earthquake zones subjected to severe damage (as per IS 1895) and for structures subject to dynamic loading (other than wind loading), such as frames supporting rotary or reciprocating machinery, etc.

2.3.19.1.3 All reinforcement shall be clean, free from grease, oil, paint, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used.

2.3.19.1.4 All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise,

all design mix concrete works to be carried out under this specification shall be divided into the following classifications:

2.3.19.2 Providing, fabricating and placing in position reinforcement steel

2.3.19.2.1 The quality of the steel shall be as mentioned in the materials section. The bars shall be fabricated as per the drawings. Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be approved by Engineer. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

2.3.19.3 Bending

2.3.19.1.1 Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is considered as a part of reinforcement binding fabricating work.

2.3.19.1.2 All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and rebent in a manner that will injure the material, bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 32 mm in diameter which may be bent hot if specifically approved by Engineer. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 845°C) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebending shall not injure the material. No reinforcement shall be bent when in position in the work without approval whether or not it is partially embedded in hardened concrete. Bars having kind orbends other than those required by design shall not be used.

2.3.19.4 Fixing

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the drawings by the use of block, spacers and chairs as per IS 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be strongly bound together at all such points with two no. 16 gauge annealed soft iron wire. The vertical distance required between successive layers of bar in beams or other members shall be maintained by providing of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

2.3.19.5 Cover

2.3.19.5.1 Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:

- a) At each end of reinforcing bar, not less than 25 mm nor less than twice the diameter of the bar whichever is less.

- b) For a longitudinal reinforcing bar in a column, not less than 40 mm, nor less than the diameter of the bar. In case of columns of minimum dimensions of 20 cm or under, with reinforcing bars of 12 mm and less in diameter, a cover of 25 mm may be used.
- c) For longitudinal reinforcing bars in a beam 25 mm nor less than the diameter of the bar.
- d) For tensile, compressive, shear, or other reinforcement in a slab or wall not less than 12 mm nor less than the diameter of such reinforcement.
- e) For any other reinforcement not less than 12 mm nor less than the diameter of such reinforcement.
- f) For footings and other principal structural members in which the concrete is deposited directly against the ground, cover to the bottom reinforcement shall be 75 mm. If concrete is poured on a layer of lean concrete the bottom cover may be reduced to 50 mm.
- g) For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, footing sides and top, etc., not less than 50 mm for bars larger than 16 mm dia and not less than 40 mm for bars 16 mm dia or smaller.
- h) Increased cover thickness shall be provided, as indicated on the drawings, for surfaces exposed to the action of harmful chemicals (or exposed to earth contaminated by such chemical, acid, alkali, saline atmosphere, sulphurous smoke, etc.
- i) For reinforced concrete members, totally or periodically immersed in sea water or subject to sea water spray, the cover of concrete shall be 50 mm more than those specified in (i) to (v) above.
- j) For liquid retaining structures the minimum cover to all steel shall be 40 mm or the diameter of the main bars, whichever is greater. In the presence of sea water and soils and waters of a corrosive character the cover shall be increased by 10 mm.
- k) Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing a dense impermeable concrete with approved protective coatings, as specified by the Engineer.
- l) The correct cover shall be maintained by cement mortar cover blocks. Reinforcement for footings, beams and slabs on sub-grade shall be supported on precast concrete blocks as approved by engineer. The use of pebbles or stones shall not be permitted.

2.3.19.6 Inspection

Erected and secured reinforcement shall be inspected, jointly measured and recorded and approved by Engineer prior to placement of concrete.

2.4. MASONRY WORKS

2.4.1 Applicable codes and specifications

- a) The following codes, standards and specifications are made a part of this specification. All standards, tentative specifications, codes of practices referred to

herein shall be the latest edition including all applicable official amendments and revisions.

- IS:1077 - Common burnt clay building bricks
- IS:3102 - Classification of burnt clay bricks
- IS:2180 - Burnt clay building bricks, heavy duty
- IS:3495 - Method of sampling and testing clay building bricks
- IS:2691 - Burnt clay facing bricks
- IS:2221 - Code of practice for brick work
- IS:2185 - Load bearing hollow concrete blocks
- IS:5498 - Lime-cement-cinder hollow concrete blocks
- IS:3115 - Lime-cement cinder solid blocks
- IS:1597 - Code of practice for construction of stone masonry (Part I)

2.4.1.1 Brick

2.4.1.2 Bricks used in works shall be bricks of specified crushing strength as described in the Schedule of Quantities. They shall have the following general properties:

2.4.1.3 They shall be sound, hard, homogenous in texture, well burnt in kiln without being verified, table moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square edges and parallelled faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing unground particles and which absorb water more than 1/5th of their weight when soaked in water for twenty four hours shall be rejected. Overburnt or under burnt bricks shall be liable to rejection. These bricks shall give a clear ringing sound when struck.

2.4.1.4 Samples of bricks shall be submitted before starting the brickwork to the Engineer for approval. Bricks supplied shall conform to these approved samples. Brick sample shall be got tested as per IS:3495 by Contractor at no extra cost. Bricks rejected by Engineer shall be removed from the site of works within 24 hours.

2.4.2 Mortar

2.4.2.1 Mix for cement mortar shall be as specified in the respective items of work. Gauge boxes for sand shall be of such dimensions that one complete bag of cement containing 50 kgs. of cement forms one unit. The sand shall be free from clay, shale, loam, alkali, and organic matter and of sound, hard, clean and durable practices. Sand shall be approved by the engineer. If so directed by the engineer sand shall be thoroughly washed till it is free of any contamination.

2.4.2.2 For preparing cement mortar the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall preferably be machine mixed, through mixing in a thorough manner may be allowed. The mortar so mixed shall be used within 30 minutes of mixing. Mortar left unused in the specified period shall be rejected.

2.4.2.3 The Contractor shall arrange for test on mortar samples if so directed by the engineer retempering of mortar shall not be permitted.

2.4.3 Workmanship

2.4.3.1 All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work. Brick work 230 mm thick and over shall be laid in english bond unless otherwise specified. While laying bricks shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

2.4.3.2 All brick work shall be plumb, square and true to dimensions. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes. No broken bricks shall be used except as closers. Care shall be taken that the bricks forming the top corners and ends of the wall shall be properly radiated and keyed into position. Holes kept in masonry for scaffolding shall be closed before plastering. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressure on the supporting structure) and no portion of the work shall be left more than one course lower than the adjacent work where this is not possible, the work shall be raked back accordingly to bond (and not saw toothed) at an angle not exceeding 45°.

2.4.3.3 Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joint shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green so as to provide a proper key for the plaster or pointing to be done. Where plastering or pointing is not required to be done the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If the mortar in the lower course has begun to set the joints shall be raked out to depth of 12 mm before another course is laid.

2.4.3.4 All brick work shall be built tightly against columns, floor slabs or other structural member.

2.4.3.5 Where drgs. indicate that structural steel columns are to be fireproofed with brick work the brick shall be built closely against all flanges and webs with all spaces between the steel and bricks works filled solid with mortar. Steel members partly embedded in brickwork and not indicated to be fireproofed with concrete shall be covered with not less than 12 mm thick mortar unless directed otherwise by engineer.

2.4.3.6 The work shall be cured for 15 days.

2.4.3.7 Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural sheet, steel lintels, etc., shall be installed by the Contractor. Furnishing fixing of any of these inserts by the Contractor will be paid for separately under steel work. Openings, arches, etc., shall be provided as shown on the drawings, chasses, pockets,

etc., shall be provided as shown on the drawings to receive rain water pipes, etc. Wall ties and flashings shall be built into the brickwork in accordance with the drawings and specifications.

2.5 FINISHING WORKS

2.5.1 Applicable Codes

- 1) IS:2394 - Code of practice for application of lime plaster finish
- 2) IS:1477 - Code of practice for painting of ferrous metals in buildings and allied finishes (Part I & II)
- 3) IS: 427 - Distemper, dry colour as required
- 4) IS:2395 - Code of practice for painting concrete, masonry and plaster surfaces
- 5) IS: 428 - Distemper, oil emulsion, colour as required

2.5.2 Plastering

2.5.2.1 The surface to be plastered shall be washed with fresh clean water free from all dirt, loose material grease, etc., and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be plastered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall. The junction between the brick work and RCC should be fixed with chicken wire mesh/PVC strip as directed before plaster.

2.5.2.2 The proportion of the mortar shall be as specified under the respective items of work. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as mentioned in the Specifications for Concrete & allied works. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to stand for more than 30 minutes after mixing with water. The plaster shall be laid in a single coat. The mortar shall be splashed on the prepared surface with a trowel and finished smooth by trowelling. The plastered surface shall be rubbed with iron plate till the surface shows cement paste. The work shall be in line and level. Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

2.5.2.3 The plaster shall be carried out on jambs, lintel and sill faces top and undersides, etc., as shown in the drawing or as directed by the engineer.

2.5.3 Providing & Applying Cement paint

This may be "SNOWCEM" or of equivalent make. The surface shall be prepared as specified in the specification for white wash. This shall be applied with brush on the plastered wall. The strokes shall be even and it shall be cured atleast for 7 days. No patch or brush stroke shall be seen. Three coats shall be applied.

2.5.4 Providing & Fixing chicken wire mesh

The wire mesh shall be of 24 gauge and it shall be fixed with nails at the junction of brick masonry and RCC elements or as specified by the Engineer-in-charge. The chicken wire mesh shall not sag in between the nails. This shall be done before the application of plaster. It should be extended atleast 15 cm on both sides. The rate includes for carrying out the work at all heights.

2.6 FLOORING

2.6.1 Applicable codes

- 1) IS:1443- Code of practice for laying and finishing of cement concrete flooring tiles.
- 2) IS:2114 -Code of practice for laying in situ terrazzo floor finish
- 3) IS: 777 - Glazed earthenware tiles

2.6.2 Vitrified Tile Flooring

The vitrified tiles shall be of approved quality, size and uniform thickness and shall be hard, sound, dense and homogeneous in texture. It shall be uniform in shade free from stains, cracks and defects.

The Dimensional variations, surface quality, physical properties and chemical properties of tiles shall be as per internationally accepted relevant standards.

The edges are straight, with square edges and free from chippings. Tiles should be laid on a bed of cement mortar as specified in item specifications. Thickness of mortar bedding shall be specified in the item specifications and a neat cement shall be spread over the mortar bed. The tiles shall be placed one by one, keeping in check the level and line of the flooring. Tiles are wetted before placing. The tiles are then gently tapped with wooden mallet till it is firmly and properly bedded. There should be no voids left. The joint should be finished with tile joint filler of approved make and shade. The pattern of the flooring shall be as per the architectural drawings or as directed by Engineer-in-charge.

The base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, batted and mopped. the minimum thickness of bed mortar shall not be less than 12mm. Any undulation in the base concrete or RCC slab shall be corrected by cement mortar without any extra cost and any additional leveling required beyond max. mortar thickness to be carried out with cement concrete.

The flooring shall be cured for a minimum period of 7 days. The surface of the flooring shall be laid to levels and slopes as directed by Engineer-in-charge.

The tiles which are fixed in the floor adjoining the wall shall enter not less than 12mm under the skirting or dado. The junction between the wall plaster and the floor shall be finished neatly and without waviness.

The free edges shall be cut as per the pattern and shall be polished to match with flooring.

Engineer-in-charge has liberty to ask for any tests with respect to physical and chemical properties, etc. and the contractor shall arrange the same without any extra cost.

2.7 STEEL WORK

2.7.1 Providing and fixing steel doors/windows/ventilators

2.7.1.1 The steel doors, windows, ventilators shall conform to IS:7452 and 1036. All steel doors, windows, ventilators, louvres, etc. shall be of sizes as specified and conform to the description in the respective items of work. Whether or not specifically mentioned, all fixtures and fittings necessary for the satisfactory operation of the doors and windows shall be provided. Doors, windows and ventilators shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained before hand. Sample shall also be got approved before further manufacture starts, unless this is waived in writing by the ENGINEER. All steel door shall be of pressed steel (18 gauge) flush type with or without removable transome. All doors shall be provided with a three way bolting device and locking arrangement with duplicate keys and handles on both sides and operable from either side. The CONTRACTOR shall obtain windows with friction hinges in place of windows with pegstays if so directed by the ENGINEER. For centre hung and top hung ventilators suitable spring catch/pulley and chord arrangement shall be provided for facility of opening. Whenever fly mesh over windows have been called for, they shall be fixed on the window and suitable lever type or rototype arrangement shall be provided for opening or closing of the glazed panels from inside. Prior approval of Engineer shall be taken before order is placed with the manufacturer.

2.7.1.2 Where specified, steel door supplied shall be airtight. For this purpose, the CONTRACTOR shall provide necessary padding material such as rubber, felt or any other approved material.

2.7.1.3 The rate quoted shall be inclusive of glazing with 4mm thick glass free from all blemishes. The workmanship shall conform to IS:1081. The rate quoted shall also be inclusive of fixing doors, windows, ventilators, louvres, etc. in brick work, steel framing, etc. by making holes/drilling holes in steel work where required complete.

2.7.1.4 The rate shall also include cost of painting two coats of approved enamel paint over two coat of approved zinc chromate primer.

2.7.2 Providing and fixing inserts in concrete works

2.7.2.1 Inserts are required to be fixed/embedded as indicated in construction drawings and/or as directed by Engineer- in-charge in foundations, columns and other miscellaneous concrete works. These inserts comprise plates, angles, pipe sleeves, anchor bolt assemblies, etc.

2.7.2.2 The rate quoted by the Tenderer shall hold good for accurately fixing the inserts at the correct levels/alignment and shall include for the cost of any temporary or permanent supports/anchors such as bars including cutting, bending, welding, etc. as required.

2.7.2.3 Steel templates shall be used by Contractor to locate and very accurately position bolts, group of bolts, inserts, embedded parts, etc. at his cost. Such templates shall be

previously approved by the Engineer. Templates shall invariably be supported such that the same is not disturbed due to vibration, movement of labourers, materials, shuttering work, reinforcement, etc. while concreting. The Contractor will have to suitably bend, cut or otherwise adjust the reinforcement in concrete at the locations of inserts as directed by the Engineer at no extra cost to OWNER. If the Engineer so directs, the inserts will have to be welded to reinforcement to keep them in place. Contractor shall be responsible for the accuracy of dimensions, levels, alignments and centre lines of the inserts in accordance with the drawings and for maintenance of the same until the erection of equipment/structure or final acceptance by Owner.

2.7.2.4 Contractor shall ensure proper protection of all bolts, inserts, etc. from weather and other damages by greasing or other approved means such as applying white lead putty and wrapping them with gunny bags or canvas or by other means as directed by Engineer to avoid damage due to movement of his labourers, material, equipment, etc. No extra claim from the Contractor on this account shall be entertained. Contractor shall be solely responsible for all the damages caused to bolts, inserts, etc. due to his negligence and in case damages do occur, they shall be rectified to the satisfaction of Engineer at the Contractor's cost.

2.7.3 Providing and fixing in position grill, railing, steel ladder, etc.

This work shall be carried out as per the detailed drawings. The MS sections shall be of approved quality. The welding shall be perfect and the junctions shall be ground properly. The frames shall be provided with hold fasts and the same shall be grouted with CC blocks in brick work. It shall be painted with two coats of zinc chromate primer and two coats of synthetic enamel paint of approved make and colour.

2.7.4 Providing & Fixing MS holding down bolts

The MS holding down bolts of specified dia, length and shape shall be provided as per the drawings in line & level. These shall be fixed to RCC work or brick work by grouting it with concrete. The bolt shall be provided with nuts and washers. The grease shall be applied to the threaded portion with the help of templates. If the bolts need some adjustment it shall be provided with a wooden piece 75x75 mm or 50 mm dia GI pipe around bolt shall be provided at the time of concreting and shall be removed after initial set.

2.8.0 ROOFING

2.8.1 Providing, Fabricating & Erecting MS Structural steel work for trusses, purlins, girders, columns, rafters, struts, wind ties, bracings, etc.

All structural steel materials such as angles, RS joists, flats, tees, plates, channels, etc., shall conform to the latest edition of IS 226. All structural steel shall be free from twist before fabrication. Cutting of members shall be done by shearing, cropping, sawing or gas cutting. Contact surfaces of plates and butt joints shall be accurately machined over the whole area so that the parts connected shall butt over the entire surface of contact. Welding of pieces shall be done with the approval of the Engineer.

The components parts shall be assembled in such a manner that they are not damaged in any way and specific cambers as shown in the drawing or as directed by the Engineer, shall be provided.

For bolted connection, where necessary washers shall be tapered or otherwise suitably shaped to give satisfactory bearing. The threaded portion of the bolt shall project beyond the nut by at least 1.5 thread.

Welding shall be done in accordance with the latest edition of IS 813 and 814, Code of Practice for use of Electric Arc welding for general Construction in mild steel. In welding it must be ensured that the base metal is in fused state when filler metal makes contact with it; filler metal does not overflow upon any unfused base metal; base metal is not cut along the weld edges; flowing metal floats the slag, oxide and gas bubbles at the surface behind advance pole. For this current shall be adjusted or the electrode size is changed. Welding shall be free from cracks, discontinuity, under or over size welding thickness.

Surface to be welded shall be free from loose mill scale, rust, grease, paint and any other foreign material. As far as possible avoid the welding at heights and at difficult positions. Generally fillet welding is preferred. The parts to be welded are brought in as close contact as practicable and rigidly clamped together.

Before erection, steel work shall be thoroughly cleaned of rust, loose scale, dust, welding slag, and shall be given one coat of zinc chromate primer of approved make and one coat of synthetic enamel paint of approved make as specified in the item before erection and final coat of painting after the erection as directed.

Steel members shall be hoisted and put in position carefully without any damage to the member and to the building and labour. The trusses shall be lifted at such points that they do not buckle or deform or be unduly stressed. The end of the truss which faces the prevailing wind shall be fixed and the other end may be kept free to move. The steel work shall be securely fastened wherever necessary, temporarily braced, to provide for all loads to be carried by the member during erection including the load due to the erection equipment and its operation. No permanent bolting or welding is done until proper alignment has been obtained. The holes for the rivets shall be determined with the help of templates and drilled. Erection clearance of the cleared ends shall not be more than 1.5 mm and without cleating end clearance shall not be more than 3 mm. Grouting or embedding of structural steel members done after the approval of the alignment, level & position of the members by the Engineer.

2.8.2 Important points

Before the actual execution of the job, the Contractor shall prepare fabrication drawings for all structural steel work from the structural drawings supplied to him and determine the exact cutting lengths of the members, sizes of gusset plates, welding lengths by marking out on a level platform to full scale.

Welding plant, electrodes and other equipments, scaffolding, labour shall be arranged by the Contractor at his cost. Erection equipment of required capacity, sufficient number of spare parts and staff shall be maintained by the Contractor at site at his cost.

2.8.3 Providing & Fixing MS holding down bolts

The MS holding down bolts of specified dia, length and shape shall be provided as per the drawings in line & level. These shall be fixed to RCC work or brick work by grouting it with concrete. The bolt shall be provided with nuts and washers. The grease shall be applied to the threaded portion with the help of templates. If the bolts need some adjustment it shall be provided with a wooden piece 75x75 mm or 50 mm dia GI pipe around bolt shall be provided at the time of concreting and shall be removed after initial set.

2.9 SANITARY AND WATER SUPPLY

2.9.1 Applicable Codes:

1. IS:77-1984 Flushing Cisterns for water closets and urinals
2. IS:775/1970 Cast iron brackets and supports for wash basins and sinks
1. IS:1300/1994 Phenolic moulding materials
4. IS:1795/1982 Pillar taps for water supply purposes
5. IS:2326/1987 Automatic flushing cisterns for urinals
6. IS:2548/1983 Plastic seats and covers for water closets (Part-I & II)
7. IS:2556/1994 Specification for vitreous sanitary appliances
8. IS:2963/1979 Copper alloy waste fittings for wash basins and sinks
9. IS:3076/1985 Low density polyethylene pipes for potable water supplies
10. IS:3489/1985 Specification for enameled steel bath tubs
11. IS:4984/1987 High density polyethylene pipes for potable water supplies, sewage and industrial effluents
12. IS:4985/1988 Specification for unplasticised PVC pipes for potable water supplies
11. IS:6411/1985 Specification for gel-coated-glass fibre reinforced polyester resin bath tub
14. IS:7231/1984 Plastic flushing cisterns
15. IS:13983/1994 Stainless steel sinks for domestic purposes
16. IS:13592 Code of practise for PVC pipes for sanitary applications
17. IS:14735 PVC pipe fittings
18. IS:5382 Rubber rings

2.9.2 Scope of Work

2.9.2.1 Scope of work shall cover the following

1. Supplying, laying, jointing and testing PVC SWR pipe (type B), with specials such as tees, bend, door bend, coupling, Y with door, unions, rubber ring, etc. cutting, earth work excavation, back filling, making good the walls, testing the line, etc.
2. Supplying and fixing gully traps with gully chamber, ventilation cowl, floor trap, etc.
 - i. Commissioning the Sanitary Piping System
 - ii. Maintaining the commissioned line for a defect liability period of 12 months.

2.9.2.2 Drawings

Checked and approved drawings showing location of sanitary and water supply fixtures will be furnished to the Contractor and all drawing so furnished shall form a part of this specification. The Contractor shall refer these drawings for all information contained thereon which pertains to and required for this work.

2.9.2.3 All connected works will be measured and paid under respective items of work unless specifically mentioned otherwise.

2.9.3 Providing & Laying non-pressure hume pipe

2.9.3.1 The pipe shall be with or without reinforcement as required and of the class as specified. These shall conform to IS:456. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process while unreinforced cement concrete pipes by spun or pressure process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws, the external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. The unreinforced pipes (non pressure pipes) shall withstand a test pressure equivalent to 0.7 kg/sq.cm (7 m head) of water.

Concrete used for the manufacture of unreinforced and reinforced concrete pipes and collars shall not be leaner than 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate). The max. size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight. The minimum cover for reinforcement of spun pipes and for all other pipes shall be as given below:

Pipe thickness	Spun pipes mm	Pipes other than spun pipe mm
Less than 30 mm	9	12
30 mm to 75 mm	12	18
75 mm and over	18	18

2.9.3.2 Where the pipe shall be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe.

2.9.3.3 Loading, transporting, and unloading of concrete pipes shall be done with care. Handling shall be as to avoid impact. Gradual unloading by inclined plane or by chain block is recommended. All pipe sections and connections shall be inspected carefully

before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to the line and grade as specified, laying of pipe shall proceed upgrade of a slope.

2.9.3.4 If the pipe have spigot and socket joints, the socket ends shall face up-stream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

2.9.3.5 In case where the foundation conditions are unusual such as in the proximity of trees or holes under existing or proposed tracks, manholes etc. the pipe shall be encased all-round in 15 cm thick cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) or compacted sand or gravel.

2.9.3.6 In case where the natural foundation is inadequate the pipes shall be laid either in concrete or cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be atleast $\frac{1}{4}$ th of the internal dia of the pipe subject to a minimum of 10cm and a maximum of 30cm. The concrete shall extend up the sides of the pipes at least at a distance of $\frac{1}{4}$ th of the outside diameter for pipes 300 cm and over in diameter. The pipe shall be laid in this concrete bedding before the concrete has set, pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipes as to safely transit the load expected from, the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under the curve of the pipe to form an even bed. Necessary provision shall be made for joint wherever required. When the pipe is laid in a trench in rock, hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalising bed of concrete, sand or compacted earth. In no case shall pipe be laid directly on such hard material. When the pipes are laid completely above the ground the foundations shall be made and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable arrangements shall be made to retain the pipe line in the proper alignment such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pole shall be supported as far as possible close to the joints. In no case shall the joint come in the centre of the span. Care shall be taken to see that superimposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted. Suitably designed anchor blocks at change of directions and grades for pressure line shall be provided where required.

2.9.3.7 Jointing of the pipes shall be done as described below:

- a) Collar shall be spaced symmetrically over the two pipes and the space between collar and pipe filled with cement mortar 1:1 thoroughly rammed with caulking tools. The joint shall be finished with a fillet sloping at 45 ° joints shall be protected and cured for about 10 days. If specified in the item specification wedge shaped groove in the end of the pipe shall be filled with a special bituminous plastic compound for bitumen soaked spunyarn. The collar shall then be slipped over the end of pipe and next pipe butters well against the plastic compound by suitable

appliance so as to compress the plastic compound in the grooves, care being taken not to disturb concentricity and level of the pipes.

2.9.4 Providing & Laying concealed PVC rain water line

The strength of the pipe shall be 4kg/sqcm. It shall be of approved make. It shall be provided with all necessary specials. It shall be jointed with adhesive as per the manufacturer's specifications.

2.9.5 Specification for laying and jointing sanitary pipes

2.9.5.1 Jointing

1. Make sure the spigot end and inside of socket is clean and the sealing ring is placed evenly in the socket
2. During cutting of pipes, make sure that they are cut square. Chamfer the end cut to angle of 15° with a medium file.
3. A correct depth of entry of the spigot into the socket is required to allow thermal movement. To achieve this, push spigot fully into the socket (remove sealing ring at this time) and make a mark on the spigot. Withdraw the spigot by 10mm and mark the spigot with a bold line. This bold mark indicates the correct depth of entry to allow the necessary expansion gap.
4. Apply rubber lubricant evenly on the chamfered spigot and the sealing ring. Then insert the spigot into socket and pull out the pipe to allow 10mm expansion gap.

2.9.5.2 Precautions

1. Avoid over tightening of door caps. Proper placement of rubber ring should be confirmed before tightening
2. Avoid misalignment of vertical Pipe stacks and incorrect spacing of Pipe clips.
3. Cutting of pipes should be straight, as diagonal cutting leads to leakages.
4. All entry to main stacks should be protected with water seal trap, wherever there is mixing of Soil & Waste lines.
5. Keep a gap of 10mm between all Pipes and Fittings to accommodate thermal expansion and contraction of pipes for longer life of the system.
6. Horizontal lines within bathrooms should be cement encased and tested before compacting of sunken floor to avoid any accidental damages.

2.9.5.3 Installation in walls/concrete

The wall/concrete slots should allow for a stress-free installation.

2.9.5.4 Testing Non-pressure Installation above ground

The PVC drainage system can be put to use immediately after installation, as no waiting time required for joints to be set and dried. The water level shall then be raised to a height of not less than three meters above the highest point of the section being tested as directed by the Engineer-in-charge. Every joint shall be carefully examined for leaks

2.9.5.5 Providing & Laying PVC line for Sanitary application.

The strength of the pipe shall be to withstand 4kg/cm^2 pressure rating. It shall be of approved make. It shall be provided with all necessary specials. It shall be jointed with manufacturer's specifications.

2.9.6 PVC PIPING

A. Transportation and Stacking

Because of the lightweight, there may be a tendency for the PVC pipes to be thrown much more than their metal counterparts. This should be discouraged and reasonable care should be taken in handling and storage to prevent damage to the pipes. On no account should pipes be dragged along the ground. Pipes should be given adequate support at all times. These pipes should not be stacked in large piles, specially under warm temperature conditions, as the bottom pipes may be distorted thus giving rise to difficulty in pipe alignment and jointing. For temporary storage in the field, where racks are not provided, care should be taken that the ground is level, and free from loose stones. Pipes stored thus should not exceed three layers and should be so stacked as to prevent movement. It is also recommended not to store one pipe inside another. It is advisable to follow the practices mentioned as per IS 7634 - Part I.

Laying and Jointing procedure

B. Trench Preparation

The trench bed must be free from any rock projections. The trench bottom where it is rocky and uneven a layer of sand or alluvial earth equal to $1/3$ dia of pipe or 100mm whichever is less should be provided under the pipes.

The trench bottom should be carefully examined for the presence of hard objects such as flints, rock, projections or tree roots. In uniform, relatively soft fine grained soils found to be free of such objects and where the trench bottom can readily be brought to an even finish providing a uniform support for the pipes over their lengths, the pipes may normally be laid directly on the trench bottom. In other cases, the trench should be cut correspondingly deeper and the pipes laid on a prepared under-bedding, which may be drawn from the excavated material if suitable.

C. Laying and Jointing

As a rule, trenching should not be carried out too far ahead of pipe laying. The trench should be as narrow as practicable. This may be kept from 0.30m over the outside diameter of pipe and depth may be kept at 1.0 to 1.2m depending upon traffic conditions. Pipe lengths are placed end to end along the trench. The glued spigot and socket jointing technique as mentioned later is adopted. The jointed lengths are then lowered in the trench and when sufficient length has been laid, the trench is filled.

If trucks, lorries, or other heavy traffic will pass across the pipeline, concrete tiles 600 x 600mm of suitable thickness and reinforcement should be laid about 2m above the pipe to distribute the load. If the pipeline crosses a river, the pipe should be buried at least 2m below bed level to protect the pipe.

For bending, the cleaned pipe is filled with sand and compacted by trapping with wooden sticks and pipe ends plugged. The pipe section is heated with flame and the portion bent as required. The bend is then cooled with water, the plug removed, the sand poured out and the pipe (bend) cooled again. Heating in hot air over hot oil bath, hot gas or other heating devices with solvent cement. Threaded joints are also feasible but are not recommended. Jointing of PVC pipes can be made in following ways:

- i) Solvent cement
- ii) Rubber ring joint
- iii) Flanged joint
- iv) Threaded joint

For further details on laying & jointing of PVC pipes, reference can be made to IS 4985-1998, IS 7634 - Part 1-1.

Socket and spigot joint is usually preferred for all PVC pipes upto 150mm in dia. The socket length should at least be one and half times the outer dia for sizes upto 100mm dia and equal to the outer dia for larger sizes.

For pipe installation, solvent gluing is preferable to welding. The glued spigot socket connection has greater strength than can ever be achieved by welding. The surfaces to be glued are thoroughly scoured with dry cloth and preferably chamfered to 30°. If the pipes have become heavily contaminated by grease or oil, methylene cement is applied with a brush evenly to the outside surface of the spigot on one pipe and to the inside of the socket on the other. The spigot is then inserted immediately in the socket upto the shoulder and thereafter a quarter (90°) turn is given to evenly distribute the cement over the treated surface. The excess cement which is pushed out of the socket must be removed at once with a clean cloth. Jointing must be carried out in minimum possible time, time of making complete joint not being more than one minute. Joints should not be disturbed for at least 5 minutes. Half strength is attained in 30 minutes and full in 24 hours. Gluing should be avoided in rainy or foggy weather, as the colour of glue will turn cloudy and milky as a result of water contamination.

D. Pre-fabricated Connections

In laying, long lengths of pipe, prefabricated double socketed connections are frequently used to join successive pipe lengths of either the same or one size different. The socket in this case must be formed over a steel mandrel. A short length of pipe is flared at both ends and used as the socket connection. The mandrel used is sized such that the internal dia of the flared socket matches the outer dia of the spigot to be connected. By proper sizing of the two ends of a connector, it is possible to achieve reduction (or expansion) of pipe size across the connector.

E. Standard Threaded Connections

Normally PVC pipes should not be threaded. For the connections of PVC pipes to metal pipes, a piece of a special thick wall PVC connecting tube threaded at one end is

used. The other end is connected to the normal PVC pipe by means of a glued spigot and socket joint. Before installation, the condition of the threads should be carefully examined for cracks and impurities.

Glue can be used for making joints leak proof. Yarn and other materials generally used with metal pipe and fittings should not be used. Generally, it is advisable to use PVC as the spigot portion of the joint.

F. Pressure Testing

The method which is commonly in use is filling the pipe with water, taking care to evacuate any entrapped air and slowly raising the system to appropriate test pressure. The field test pressure to be imposed should be not less than the maximum of the following:

- a. 1 1/2 times the maximum sustained operating pressure
- b. 1 1/2 times the maximum pipeline static pressure
- c. Sum of the maximum sustained operating pressure and the maximum surge pressure.
- d. Sum of the maximum pipeline static pressure and maximum surge pressure, subject to a maximum equal to the work test pressure for any pipe fitting incorporated.

After the specified test time has elapsed, usually one hour, a measured quantity of water is pumped into the line to bring it to the original test pressure, if there has been loss of pressure during the test. The pipe shall be judged to have passed the test satisfactorily if the quantity of water required to restore the test pressure of 30m for 24 hours does not exceed 1.5 litres per 10mm of nominal bore for a length of 1 Km.

2.9.6.1 Testing

Water test and air test shall be conducted as stipulated in IS:5329.

2.9.7 Providing & Constructing Road gully chambers/yard gully

The chamber shall be of brick masonry and shall have a CI Cover with frame fixed in cement concrete. The size of the chamber shall be taken as clear internal dimensions of the CI frame. The chamber shall have a connection pipe. The cover shall be hinged to the frame to facilitate its openings for cleaning and repairs. The weight of cover shall be 4.5 kg minimum and the frame not less than 2.7 Kg.

After the completion of the work the exposed surfaces of the frame shall be painted with two coats of synthetic enamel paint.

2.9.8 Providing & Constructing manholes

Manholes of different types and sizes as specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawings or as directed by the engineer. The size indicate the inside dimensions of the manhole.

2.9.8.1 Excavation and back filling shall be as per respective specifications.

2.9.8.2 Manhole shall be built on a bed of brickbat cement concrete 1:4:8 (1 cement : 4 sand : 8 brickbats of 40mm nominal size). The thickness of the bed concrete shall be 150mm unless otherwise specified.

2.9.8.3 Brick work shall be in cement mortar 1:6 (1 cement : 6 sand). The external joints of the brick masonry shall be finished smooth. The joints of the pipes with the masonry shall be made perfectly leak-proof with cement concrete 1:2:4.

2.9.8.4 The brick walls of the manholes shall be plastered inside with 12mm thick cement plaster 1:4 (1 cement : 4 sand) finished smooth with a floating coat of neat cement.

2.9.8.5 Channels and benching shall be in cement concrete 1:2:4 (1 cement : 2 sand : 4 graded stone aggregate).

2.9.8.6 All manholes deeper than 1.0m shall be provided with CI foot rest. These shall be embedded 20 cm deep with 20x20x10 cm blocks of cement concrete 1:2:4 (1 cement : 2 sand : 4 graded stone aggregate). The block with CI foot rest placed in its centre shall be cast-in-situ along with the masonry and the surface finished with 12mm thick cement plaster 1:4 (1 cement : 4 sand) finished smooth. Foot rests shall be fixed 30cm apart vertically and staggered the wall. The top foot rest shall be 45 cm below the manhole cover. Foot rests shall be painted with coal tar, the portion embedded in cement concrete block painted with thick cement slurry before fixing.

2.9.8.7 The depth of channels and benching shall be as indicated in the table given below.

Size of drain (mm)	Top of channel at the centre above bed concrete (cm)	Depth of benching at side walls above bed concrete (cm)
100	15	20
150	20	30
200	25	35
250	30	40
300	35	45
350	40	50
400	45	55
450	50	60

2.9.8.8 CI manhole covers and frames shall conform to IS:1726. The covers and frames shall be cleanly cast and they shall be free from air and sand holes and from cold struts. They shall be neatly dressed and carefully trimmed. All casting shall be free from voids whether due to shrinkage, gas inclusion or other causes. Cover shall have a raised chequered design on the top surfaces to provide an adequate non slip grip. The cover shall be capable of easy opening and closing. It shall be fitted in the frame in workmanship like manner. The cover shall be gas tight and water tight. Covers and frames shall be coated with a black bitumenous paint. It shall not flow when exposed to a temperature of 63 Deg. Cent. and shall not be brittle as to chip off at temperature of 0 Deg.Cent.

- 2.9.8.9 Manhole cover and frame shall conform to medium duty 500 mm internal diameter and shall weigh not less than 75kg unless otherwise mentioned in the item description. (Weight of cover 58kg and weight of frame 58kg).
- 2.9.8.10 Manholes shall be measured in numbers. The depth of the manhole shall be reckoned from top level of CI cover to the invert levels of channel. The depth shall be measured correct to centrimetes.
- 2.9.8.11 Sewers of unequal sectional area shall not be jointed at the same invert level in a manhole. The invert of the smaller sewer at its junction with main shall be, at a height at least $\frac{2}{3}$ the diameter 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 care so that flow in the main is not impeded. No drains from house fittings eg. GT, soilpipe etc. exceeding a length of 6m shall be connected unless it is inevitable.
- 2.9.8.12 The frame of the manhole cover shall be firmly embedded to correct alignment and levels in plain cement concrete 100mm thick 1:2:4 (1 cement :2 sand :4 graded stone aggregate) on top of the brick masonry. After completion of the work manhole covers shall be smeared by means of thick grease.

2.9.9 Providing & Constructing Soak pit

The earth excavation shall be carrying out to the exact dimensions as shown in the drawing. The soak pit shall be constructed of honey-comb dry brick work of 250 mm thick in cement mortar 1:6, RCC 1:2:4 precast or cast-in-situ slabs 150 mm thick for top cover with reinforcement, CI manhole cover 500 mm dia of 80 kg weight, 150 mm dia SW tee, outlet vent, 75 mm dia CI pipe 2 m high fixed on masonry pedestal with cowl and bituministic painting, refilling, watering, consolidating etc., all complete.

2.9.10 Providing & Constructing Drop connection

- 2.9.10.1 In cases where branch sewer enters the manholes of main pipe sewer at a higher level than the main sewer, a drop connection should be provided. Pipes and specials conforming to IS:1729 shall be of the same size as the branch pipe sewer.
- 2.9.10.2 For 150 mm and 250 mm main line if the difference in level between the water line (peak flow level and the invert level) of branch line is less than 60 cm a drop connection may be provided within the manhole by giving a suitable ramp. If the difference in level is more than 60 cm the drop should be provided externally.
- 2.9.10.3 The excavation shall be done for the drop connection at the place where the branch line meets the manhole. The excavation shall be carried up to the bed concrete of the manhole and to the full width of the branch line excavation and backfilling shall be done as per respective specifications.
- 2.9.10.4 At the end of branch sewer line SCI tee shall be fixed to the line which shall be extended through the wall of manhole by a horizontal piece of SCI pipe to form an inspection of cleaning eye. The open end shall be provided with chain and lid. The SCI drop pipe shall be connected to the tee at the top and to the SCI bend at the bottom. The bend shall be extended through the wall of the manhole by a piece of

pipe which shall discharge into the channel. Necessary channel shall be made with cement concrete of grade M-150 and finished smooth to connect the main channel. The joint between CI pipe and fittings shall be lead caulked. The joint between SCI tee and SW branch line shall be made with cement mortar 1:1 (1 cement : 1 fine sand) as for emased alround with minimum 15 cm thick concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) and cured. For encasing the concrete around the drop connection the necessary centering and shuttering shall be provided the holes made in the walls of the manhole shall be made good with brick work in cement mortar 1:5 (1 cement : 5 coarse sand) and plastered with cement mortar 1:3 (1 cement : 3 fine sand) on the inside of the manhole wall. The excavated earth shall be back filled in the trench in level with the original ground level.

2.10 Anti Termite Treatment

The chemicals used for anti termite treatment shall be Chloropyrifos E.C. with a concentration of 1% (by weight) (5 lts. to be mixed with 100 lts. of water).

Method of Treatment

The treatment shall be as per IS specifications vide IS : 6313 part II 1981.

Treatment for Masonry Foundations and Basements

The bottom surface and the side (upto a height of about 300mm) of the excavations made for masonry foundations and basements shall be treated with the chemical at the rate of 5 litres per square metre surface area.

After the masonry foundations and the retaining wall of the basements come up, the backfill in immediate contact with the foundation structure shall be treated at the rate of 7.5 litres per square metre of 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 150 mm centres close to the wall surface and working the rod backward and forward parallel to the wall surface and spraying the chemical emulsion at the above dosage. After the treatment, the soil should be tampted in place. 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 masonry surfaces so that the earth in contact with these surfaces is wall treated with the chemical.

Treatment for RCC Foundations and Basements

The treatment described in the above paras applies essentially to masonry foundations where there are voids in the joints through which termites are able to seek entry into the buildings. Hence the foundations require to be completely enveloped by a chemical barrier. In the case of RCC foundations, the concrete is dense being a (cement : fine aggregates : coarse aggregates, by volume) mix or richer, the termite are unable to penetrate it. It is, therefore, unnecessary to start the treatment from the bottom of excavations. The treatment shall start at a depth of 500mm below the ground level except when such ground level is raised or lowered by filling or cutting after the foundations have been cast. In such case the depth of 500mm shall be determined from the new soil level resulting from the filling or cutting mentioned

above, and soil in immediate contact with the vertical surfaces of RCC foundations shall be treated at the rate of 7.5 litres per square metre.

Treatment of Top Surface of Plinth Filling

The top surface of the consolidated earth within plinth walls shall be treated with chemical emulsion at the rate of 5 litres per square meter of the surface before the sand bed or sub-grade is laid. If the filled earth has been well rammed and the surface does not allow the emulsion to see through, holes up to 50 to 75 mm deep at 150mm centres both ways may be made with 12mm diameter mild steel rod on the surface to facilitate saturation of the soil with the chemical emulsion.

Treatment at Junction of the Wall and the Floor

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surface from ground level up to the level of the filled earth surface. To achieve this, a small channel 30x30mm shall be made at all the junctions of wall and columns with the floor (before laying the sub-grade) and rod holes made in the channel upto the ground level 150mm apart and the iron rod moved backward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 7.5 litres per square metre of the vertical wall or column surface so as to soak the soil right to the bottom. The soil should be tamped back into place after this operation.

Treatment of Soil along External Perimeter of Building

After the building is complete, the earth along the external perimeter of the building should be rodded at intervals of 150mm and to a depth of 300mm. The rods should be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall at the rate of 7.5 litres per square metres of vertical surfaces. After the treatment, the earth should be tamped back into place. Should the earth outside the building be graded on completion of building, this treatment should be carried out on completion of such grading.

In the event of filling being more than 300mm, the external perimeter treatment shall extend to the full depth of filling up to the ground level so as to ensure continuity of the chemical barrier.

LIST OF APPROVED MAKE

1	Cement	Malabar, Ultra Tech, Zuari, Ramco, ACC, India Cements or any other approved brand
2	Steel	Tata, Vizag, SAIL, TISCO, IISCO or equivalent as approved
3	Vitrified tile	HR & Johnson, Euro, Kerroges, Nitco, Somany or equivalent as approved

4	Paint & Primer, Distemper	ICI, Berger, Asian, Jotun or equivalent as approved
5	Rolling shutter	Kaniampuram, Jacobs Engg. Works or equivalent as approved
6	Sanitary fittings	Hindware, Cera, Parryware or equivalent as approved
7	Plumbing Fixtures	Nova, Essco, Gem, Jaquar or equivalent as approved
8	Polyethylene Storage tank	Sintex or equivalent as approved
9	GI Pipe & specials	Tata, Zenith, Jindal or equivalent as approved
10	PVC, CPVC, PPR Pipe specials	Supreme, Hycount, Saroplast or equivalent as approved
11	Stainless steel sink	Diamond or equivalent as approved

2.11 TECHNICAL SPECIFICATION-ELECTRICAL WORKS

2.11.1 General

The bidder should note that the specifications furnished in the tender is of general nature only and it is the responsibility of the bidder to design, supply, install and commission the equipment and services required for the satisfactory performance of the installation. All the items of equipment required for the safe and satisfactory operation of the installation shall be supplied and installed by the bidder.

The intent of this specification is to define the requirements for the design, manufacture, supply, installation, testing and commissioning of the electrical system like Power cables, internal electrification, earthing network etc. Requirement shall be as specified in schedule of requirements/approved drawing of the Purchaser/Consultant or as per the battery limits fixed by the Purchaser/Consultant. The bidder shall furnish complete details of the equipment with all necessary drawings.

2.11.2 Details of Tender

The tender specifications consists of 8 sub heads as shown below:

- LT Panel Board
- Wiring System
- MCB distribution boards
- Cables and Cabling
- Earthing
- Installation.

- Measurement.
- Approved Makes of Equipment and Materials

The items involved along with the quantities and units are shown in the bill of quantities (Schedule of Requirements) attached.

2.11.3 LT Panel Boards

2.11.3.1 General:

The switch boards are to be factory built or to be fabricated by a firm preferably having CPRI test certificate for short circuit rating and IP classification.

2.11.3.2 Statutory Requirement:

Switch Distribution Boards are to be manufactured/ assembled as per the latest BIS Specifications, IP 42 classification for Indoor application and IP 54 for outdoor applications, Indian Electricity Rules, including special requirements of State Electrical Inspectorate and the detailed specifications mentioned. The panel board shall be floor mounted, free standing type suitable for indoor installation in dust and vermin proof construction.

2.11.3.3 Housing Details:

The panel board shall be fabricated out of 14 SWG CRCA sheet steel and shall consist of free standing front and back openable panels arranged to form a continuous line-up of uniform height. Cold rolled sheets shall be used for doors and front covers. Front doors shall be concealed hinged type and bus bars and cable alleys covers shall be bolted type. The switch board shall be totally enclosed, dust, weather and vermin proof. Gaskets of durable material shall be provided for doors and other openings. Suitable hooks shall be provided for lifting the boards. These hooks when removed shall not leave any opening in the board. All hardware shall be corrosion resistant. All joints and connections shall be made by galvanised zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers secured against loosening.

The switch board shall be in cubicle design (each feeder components are housed in individual cubicle) and fully compartmentalized. Suitable cable and busbar alleys as well as separate metering and relaying compartments shall be provided. All components of the switch board shall be approachable from front. The maximum and minimum operating handle/push button height of any feeder shall not be more than 1800mm or less than 400 mm with reference to panel bottom. Supporting arrangement for dressing of power and control cables in cable alleys also shall be provided.

2.11.3.4 Painting:

All metal sheets shall undergo 7 tank metal treatment, thorough derusting-rinsing-degreasing-rinsing- phosphating-rinsing and then passivation. All metal surfaces shall be thoroughly cleaned and degreased to remove all scales, rust, grease and dirt. Fabricated structures shall be pickled and treated to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The undersurface shall be made free from all imperfections before undertaking the final coat.

After preparation of the under surface, the panel shall be spray painted with final two coats of approved enamel paint. Contractor shall obtain details of approved paint from the Engineer-in-charge before final painting.

The finished panels shall be dried in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run-off paint, etc.

All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust, corrosion, etc.

2.11.3.5 Name Plates:

Name plates for all incoming and outgoing feeders shall be provided on doors for each compartment. Name plates shall be fixed by screws only and not by adhesives. Special danger plates shall be provided as per requirement.

Inside the panels, stickers should be provided for all components giving identification no. as per detailed wiring diagram.

2.11.3.6 Busbar sizing connection and supports:

The busbars shall be made from high conductivity electrolytic grade aluminium alloy conforming to IS 5082. The busbars and supports shall be capable of withstanding the rated and short circuit current as per the single line diagram/ feeder details. Minimum size of main power bus bars shall be 200 Amps. rating. Maximum current density permissible for aluminium bus bars shall be 0.8 Amps/Sq.mm. An earthing busbar of minimum 150 sq.mm section copper shall be provided outside panel at bottom throughout the length of the panel.

The busbars shall be provided with heat shrinkable PVC insulating sleeve. Supports for busbars shall be made of suitable size cast resin ribbed insulators and these should be adequate in number so as to avoid any sag in the busbars. (Hylam supports may not be used)

Minimum clearance between phase to phase shall be 32mm and that between phase to neutral/ earth shall be 26 mm.

2.11.3.7 Power Connection:

a) For power interconnections within the panel board

Rigid Aluminium conductor, with PVC insulation, of adequate cross section i.e., current carrying capacity not less than the outgoing fuse rating shall be used. Cable lugs/ sockets of suitable size and type shall be used for all interconnections.

For incoming and outgoing feeders of the switch boards, aluminium conductor cable will be used and hence the panel has to be designed for receiving these and wherever required cable boxes shall be provided in panel by removable gland plates and shall be provided on top/bottom of panel, for cable entries.

To prevent accidental contacts, all interconnecting cables/ busbars and all terminals also shall be shrouded.

Standard colour code of red, yellow and blue for phases and black for Neutral to be followed for all busbars/conductors.

b) Auxiliary wiring and Terminals

Wiring for all controls, protection, metering, signaling, etc. inside the switchboard shall be done with 650 volts grey colour PVC insulated copper conductors. **Minimum size of these conductors shall be 2.5 sq.mm.** Control wiring to components fixed on doors shall be flexible type.

The complete panel would be sub-divided into different sections and each section shall have its own control circuit with fuse and indication.

All control wiring should be provided with necessary cable sockets/ lugs at both ends. Conductors shall be terminated using compression type lugs. Each termination shall be identified at both the ends by PVC ferrules.

The identification termination numbers should match with those on the drawings.

2.11.3.8 Component of switch boards

The panel shall be provided with MCCBs, SDFUs, Isolators, meters and instruments etc. of size, capacity as specified in schedule of requirements.

2.11.3.9 Moulded case Circuit Breakers

General

Moulded case circuit breakers (MCCBs) shall be incorporated wherever required and shall be of **current limiting type** and preferably **double break**. MCCBs shall conform to IS 13947-1/IEC 947-1 for general rules and IS 13947-2/IEC 947-2 for circuit breakers in all respects. MCCB shall be suitable for single phase 240V or three phase 415 V, 50Hz, AC and shall have a rated insulation voltage of 750 V AC. All the breakers shall have tropicalisation as a standard feature. MCCBs rated from 250A and above shall be of plug in type.

Construction:

The MCCB case & cover shall be made of high strength heat resistant and flame retardant thermosetting insulating material.

The operating handle shall be quick make, quick break trip free type. The operating handle shall have suitable 'ON', 'OFF', 'TRIPPED' indicators.

In order to ensure suitability for isolation complying with IS13947-2/IEC947-2, the operating mechanism shall be designed such that the toggle or handle can only be in 'OFF' position.

Three phase MCCBs shall have a common operating handle for simultaneous operation and tripping of all the three phases.

Rating & Breaking Capacity:

The rating of the circuit breaker shall be as per the drawings and schedule of quantities.

The MCCB shall have minimum Service Breaking Capacity (Ics) equal to Ultimate Breaking capacity (Icu).

The Service S/c Breaking Capacity (Ics) in kA for different ratings at 415V AC, 50Hz, 0.2 p.f shall preferably be as follows:

25kA for ratings upto 100A

35KA for ratings above 100A and upto 250A

50KA for ratings above 250A and upto 630A.

Protection:

Unless specified all breakers upto 125A shall have thermal-magnetic trip unit with adjustable overload protection from 80% to 100% of rated current (Ir) and adjustable short circuit protection from 3 to 6 times of Nominal Current (In).

The MCCBs ratings above 125A shall be microprocessor based fitted with electronic trip unit. The overload setting adjustable from 40% to 100% of the nominal current(In). The short circuit protection should be adjustable from 1.5 to 8 times the rated current(Ir) with tripping time fixed. The Instantaneous Short Circuit protection to be fixed, without any time delay at 12 times the nominal current(In).

The Earth fault protection , if specified in schedule, shall have **adjustable** sensitivity with adjustable time delay settings.

The MCCBs shall be **possible to fully co-ordinate** the over-load & short-circuit tripping of the circuit breakers with the upstream and downstream circuit breakers **to provide Total Discrimination.**

There should be no line load restriction for MCCBs

Accessories:

MCCBs shall be provided with the following accessories,

Shunt trip, if specified in the BOQ

Extended terminals.

Rotary operating handle

Interlocking:

MCCBs shall be provided with the following interlocking devices for interlocking the door of the switchboard.

Handle interlock to prevent unnecessary manipulations of the breaker.

Door interlock to prevent door being opened when breaker is in ON or OFF position

Door-interlock defeat to open the door even if the breaker is in ON position.

Front operated rotary handle should have OFF-position pad-locking facility.

Testing:

Test certificate

Original Test certificate of the MCCB as per IS13947-2/IEC947-2 shall be provided.

2.11.3.10 **Measuring instruments**

These shall be of square pattern having approximate dimensions 144mmx144mm, flush mounting type in the case of main LT panel and 96x96 mm in sub switch boards. Necessary auxiliary instruments like CTs, etc. are also included in the scope of supply.

All AC meters shall be of moving iron type having class 1.0 accuracy.

Voltmeter shall be suitable for direct line connection. Voltmeters shall be connected through fuses only.

All voltmeters and ammeters shall be provided with selector switches.

Ammeters shall be CT operated.

2.11.3.11 **Current Transformers (CTs)**

CTs shall be cast resin insulated type. Primary and secondary terminals shall be marked indelibly. CTs shall preferably be mounted on stationery parts. CT rating and ratios shall be as per feeder ratings. These shall be capable of withstanding momentary short circuit and symmetrical short circuit current for 1 second. Neutral side of CTs shall be earthed. Protection CTs shall have low reactance, accuracy class "PS" and an accuracy limit factor greater than "10". Instrument CTs shall be of accuracy class "1.0" and accuracy limit factor less than "5.0".

2.11.3.12 Indicating Lamps

Type	:	Panel mounting LED type (Immune to electromagnetic interference and over voltage).
Standards applicable	:	IEC 947-5-1
Diameter	:	22mm
Operating voltage	:	230V AC
Current consumption	:	15 mA
Colour of lamps	:	as per standards

2.11.3.13 Connection

Connections to the busbars shall be made by drilling holes. However, no holes shall be left in the busbars. The bolts & nuts used for connections to busbars shall be of Aluminium alloy of tinned forged brass. For tapping of connections from busbars suitable size PVC insulated copper conductor (minimum size 4.0 Sq.mm) shall be used with suitable size and type of crimped lugs/cable sockets. For connection of feeder above 63 Amps only busbar links with PVC tapes/heat shrinkable PVC shall be used. Suitable size cable boxes shall be provided for incoming/outgoing cables. For all outgoing cables, cable alleys of suitable sizes in sides and tops, as required for proper cable connections/laying inside the panel, shall be provided. Switch board shall be

suitable for Aluminium conductor PVC insulated incoming and outgoing cables. Removable gland plates shall be provided for cable entries.

2.11.3.14 Earthing

Two independent earthing points shall be provided outside the panel near bottom and these shall be inter-connected with Cu earthing busbars of size 25 x 6 mm. All earthing points inside the distribution board shall be interconnected to these earthing points with suitable size copper conductor.

2.11.3.15 Name plates

Switch board/distribution board shall be provided with danger plate and name plates for all incoming and outgoing feeders. These name plates shall be of PVC (black colour base & white letters engraved) screwed to panel. PVC identification ferrule numbers shall be used for all internal wiring.

2.11.3.16 Approvals

The drawing showing general arrangements and detailed wiring diagram for the Panels shall be submitted to the Engineer-in-charge for approval, prior to manufacture and the same shall be got inspected, prior to despatch to project site. The complete switch board and its component shall conform to Indian Electricity Rules & Relevant BIS. Prior approval is required from Electrical Inspector and shall be obtained by contractor and changes if desired by Electrical Inspector, shall be carried out by the contractor.

2.11.3.17 Bus Bar Chambers

2.11.3.17.1. Construction

Enclosure

- i) Bus bar chamber shall be fabricated with MS angles for frame work and covered all rounds with sheet steel of thickness not less than 2 mm (14 gauge) in a box form. Front covers of the busbar chambers shall be detachable and cover(s) on the remaining sides may or may not be detachable as may be specified. The covers shall be fitted with dust excluding gasket, secured with sufficient number of cadmium plated iron screws to ensure that the covers are dust tight. Suitable openings shall be provided for cable/conduit entries as required. Busbar chambers for busbar of more than 90 cm length shall have horizontal and vertical stiffeners welded to the main frame.
- ii) Alternatively, the busbar chamber shall be made of sheet steel of thickness not less than 2 mm (14 gauge), with detachable covers and dust excluding gasket. The joints shall be continuous welded. The detachable cover(s) shall be secured to the box with sufficient number of cadmium plated iron screws. This type of busbar chamber shall be restricted for busbar upto 90 cm length.
- iii) Bus bar chambers for busbars upto 90 cm length shall have detachable end covers so that the same can be extended.

- iv) Two numbers of GI earth studs of appropriate size with double washers shall be provided on the body of the enclosure. The terminals shall be permanently marked 'E'.
- v) The enclosure shall be painted with two coat of primer paint after cleaning the surfaces, and after derusting and degreasing. Two coats of finish paint shall thereafter be applied by spray painting process. This shall be done in the works before bringing the material to site.

2.11.3.17.2 Supports

Busbars shall be rigidly fixed to the supports, if not porcelain or of SMC/DMC solid block type base. Busbars shall be firmly held within the slots in sheet type supports, which in turn shall be rigidly fixed to the chamber.

2.11.3.17.3 Clearances

The minimum clearances to be maintained for enclosed indoor air insulated busbars for medium voltage applications shall be as follows:

<u>Between</u>	<u>Min. clearances</u>
Phase to earth	26 mm
Phase to phase	2 mm

2.11.3.17.4 Arrangement of busbars and main connections

Busbars and main connections, which are substantially in one plane, shall be arranged in the order given below:

i) AC. System

- .01 The order of phase connections shall be red, yellow and blue.
- .02 When the run of the conductors is horizontal, the red shall be on the top, or farthest away as viewed from the front.
- .03 When the run of the conductors is vertical, the red shall be on the left, or farthest away as viewed from the front.
- .04 When the system has a neutral connection in the same plane as the phase connections, the neutral shall occupy the bottom position if horizontal and extreme right if vertical, or nearest position when viewed from the front.
- .05 Unless the neutral connections can be readily distinguished from the phase connections, the order shall be red, yellow, blue and black.

2.11.3.18 **Data/Drawings/Documents**

The bidder shall submit the following data /information /drawings /documents as indicated below:

- i) List of deviations clause by clause and reasons.
- ii) Descriptive literature of the various equipment offered with catalogues, if any.
- iii) Guaranteed technical particulars of the equipment

Tenderer

Chief Engineer 110

- iv) Approximate dimensions and weights and preliminary G.A drawings.
- v) List of optional features with extra price.
- vi) Make of various equipment and associated components/ accessories.
- vii) Where applicable, preliminary schematic of the equipment/ system offered in the tender.
- viii) Brief write-up on control scheme and features.

Within 4 weeks of order, Contractor shall submit 4 sets of following documents for purchaser/Consultant's approval.

- i) Guaranteed technical and performance particulars.
- ii) G.A Drawings with dimensions and weight, plan and sections and fixing/foundation details
 - a) Where applicable, control scheme drawings with write-up and all terminal numbers for external hook up.

Subsequently, 4 sets of the revised documents shall be submitted incorporating Consultants comments as **Final Drawings** for Purchaser's reference and records before the equipment is offered for inspection.

At Final Execution Stage

The following shall be submitted after inspection but before dispatch of the equipment.

- i) "As Built" drawings (one set of film reproducible)
- ii) Routine and type test certificates (8 sets)
- iii) Detailed Operation and Maintenance Manuals (4 sets)
- iv) Detailed erection, testing and commissioning manuals (4 sets).

2.11.4 Wiring Systems

Rigid PVC Conduit Wiring System as per IS: 9537

2.11.4.1 Materials

A. Conduits

- i) All rigid conduit pipes shall be of PVC and be ISI marked. The wall thickness shall be not less than 1.6 mm for conduit upto 32 mm dia and not less than 2 mm for conduits above 32 mm dia.
- ii) The maximum number of PVC insulated cables conforming to IS:694-1990 that can be drawn in one conduit is given size wise in Table 1, and the number of cables per conduit shall not be exceeded. Conduit sizes shall be selected accordingly in each run.

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

Flexible conduits will only be permitted for interconnections between switchgear, DB's and conduit terminations in wall.

B. Conduit Accessories

- i) The conduit wiring system shall be complete in all respects, including their accessories.
- ii) All conduit accessories shall be of solvent cement plastering type, and under no circumstances pin grip type of clamp grip type accessories shall be used.
- iii) Bends, couplers, etc. shall be solid type in recessed type of works and may be solid or inspection type as required.
- iv) a) Saddles for surface conduit work on wall shall not be less than 0.55 mm (24 gauge) for conduits up to 25 mm dia. and not less than 0.9 mm (20 gauge) for larger diameter.
b) The minimum width and the thickness of grider clips used for fixing conduits to steel joists, and clamps shall be as per Table II.

C. Outlets

- i) The switch box or regulator box shall be made of metal on all sides, except on the front. In the case of cast boxes, the wall thickness shall be at least 2 mm and in case of welded mild steel sheet boxes, the wall thickness shall not less than 1.2 mm (18 gauge) for boxes upto a size of 20 cm x 30 cm, and above this size 1.6 mm (16 gauge) thick MS boxes shall be used. The metallic boxes shall be duly painted with anticorrosive paint before erection.
- ii) An earth terminal with stud and 2 metal washers shall be provided in each MS box for termination of protective conductors and for connection to socket outlet/metallic body of fan regulator etc.
- iii) Clear depth of the box shall not be less than 60 mm, and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.
- iv) The fan regulators can also be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by the Engineer-in-charge.
- v) Except where otherwise stated, 3 mm thick phenolic laminated sheets as per clause shall be fixed on the front with brass screws, or cadmium plated iron screws as approved by the Engineer-in-charge.

2.11.4.2 Wires

Wires shall comply the following features:

- i) PVC insulated bright annealed copper stranded conductors.

- a. 660 V grade wires for single phase circuits and 1000 V grade for 3 phase circuits.
- ii) Colour coded as below:
 - Phase – R -Red
 - Phase – Y - Yellow
 - Phase – B -Blue
 - Neutral - Black
 - Earth - Green

2.11.4.3 Installation

1) Common aspects for recessed and surface conduit works

i) Conduit joints

- a) The conduit work of each circuit or section shall be completed before the cables are drawn in.
- b) Conduit pipes shall be joined by means of couplers and accessories only.
- c) Cut ends of conduit pipes shall have neither sharp edges, nor any burrs left to avoid damage to the insulation of the conductors while pulling them through such pipes.

ii) Bends in conduit

- a) All necessary bends in the system, including diversion, shall be done either by neatly bending the pipes without cracking with a bending radius of not less than 7.5 cm, or alternatively, by inserting suitable solid or inspection type normal bends, elbows or similar fittings, or by fixing cast iron inspection boxes, whichever is most suitable.
- b) No length of conduit shall have more than four bends from outlet to outlet.

Additional requirements for recessed conduit work

i) Making chase

- a) The chase in the wall shall be neatly made, and of ample dimensions to permit the conduit to be fixed in the manner desired.
- b) In the case of buildings under construction, the conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit.

c) 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.

ii) Fixing conduits in chase

- a) The conduit pipe shall be fixed by means of staples, hooks, or by means of saddles, not more than 60 cm part, or by any other approved means of fixing.
- b) All joints of conduit pipes shall be treated with some approved preservative compound to secure protection.

iii) Fixing conduits in RCC work

- a) The conduit pipe shall be laid in position and fixed to the steel reinforcement bar by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.
- b) Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius which will permit easy drawing in of conductors.
- c) Location of inspection/junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

iv) Fixing inspection boxes

- a) Suitable inspection boxes to the minimum requirement shall be provided to permit inspection, and to facilitate replacement of wires, if necessary.
 - b) These shall be mounted flush with the wall or ceiling concrete. Minimum 65 mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be as per IS:2667-1977.
 - c) Suitable ventilating holes shall be provided in the inspection box covers.
- v) Fixing switch boxes and accessories.

Switch boxes shall be mounted flush with the wall. All outlets such as switches, socket outlets, etc. shall be flush mounting type, unless otherwise specified in the Additional Specifications.

vi) Fish wire

To facilitate subsequent drawing of wires in conduit, GI fish wire of 1.6 mm/1.2 mm (16/18 SWG) shall be provided along with the laying of the recessed conduit.

vii) **Bunching of cables**

- a) Cables shall always be bunched so that the outgoing and return cables are drawn into the same conduit.
- b) Where the distribution is for single phase loads only, conductors for these phases shall be drawn in one conduit.
- c) In case of three phase loads, separate conduits shall be run for each phase from the distribution boards to the load points, or outlets as the case may be.

2.11.4.4 Earthing requirements

- i) Protective (loop earthing) conductor (s) shall be laid along the runs of the conduit between the metallic switch boxes and the distribution boards/switch boards, terminated thereto. These conductors shall be of such size and material as specified. Depending upon their size and material, the protective earth conductors shall be either drawn inside the conduits. When laid external to the conduits, this shall be properly clamped with the conduit at regular intervals.
- ii) The protective conductors shall be terminated properly using earth studs, earth terminal block etc. as the case may be.
- iii) Gas or water pipe shall not be used as protective conductor (earth medium).
- iv) The size of the earth wire shall be of size 50% of phase conductor subject to a maximum and minimum shown below:

	Copper	Aluminium	GI
Minimum (sq.mm)	1.5	2.5	4
Maximum (sq.mm)	150	175	350

2.11.4.5 Wiring

The wiring in conduit shall comply the following:

- a) Single core PVC insulated copper wire as specified below or as shown on drawings and schedule of requirements.
- b) Wire sizes

Copper conductor

Light point	1.5 sq.mm
Light Circuit Point	2.5 sq.mm
Power points	4.0 sq.mm
Machinery	As per Schedule of requirements

A maximum 3 circuits of same phase can be taken per conduit and each circuit shall have independent neutral and earth wire from DB.

Jointing of wires is not permissible, however looping may be done from point (same circuit) or using a terminal strip in junction box where site condition warrants, prior permission from Consultant shall be obtained.

Control switches to be connected to phase conductor only.

Metallic/non-metallic trunking may be used if number of conduits are many. The metallic trunking shall be earthed security at DB end and throughout the length. Single trunking with metallic partition may be used for wiring different services.

TABLE I
MAXIMUM NUMBER OF PVC INSULATED 650/1100 V GRADE
ALUMINIUM/COPPER CONDUCTOR CABLE CONFORMING TO IS: 694-
1990

Nominal cross sectional area of conductor in sq.mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-

4	3	2	6	5	10	8	-	-	-	-	-	-
8	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

Note:

- 1) The above table shows the maximum size of conduits for a simultaneous drawing of cables.
3. The columns headed **S** apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed **B** applies to runs of conduit which deflect from straight by an angle of more than 15 degrees.
4. Conduit sizes are the nominal external diameters.

**TABLE II
GIRDER CLIPS CLAMPS**

Size of conduit	Width	Thickness
20 mm	19 mm	0.9 mm (20 SWG)
25 mm	19 mm	0.9 mm (20 SWG)
32 mm & above	25 mm	1.2 mm (18 SWG)

2.11.5 M C B Type Distribution Boards (MCB DBs)

All TPN MCB DBs are to be suitable for flush mounting with double door having acrylic front door and to be provided with inbuilt additional compartment for looping of loose wires/adaptor boxes for entry of armoured cables and conform to IS: 8621.

i) Material

The DBs are to be fabricated out of SWG MS sheets suitable for all weather operation. The current carrying parts are to be made of electrolytic grade copper and are to be rated for the duty intended.

ii) Painting

The DBs are to be subjected to seven tank phosphating processes (Degreasing, pickling, surface activation, phosphating and passivation) and to be powder coated ensuring rust prevention and scratch resistant.

iii) Accessories

Following accessories are to be provided: -

- a) Copper bus bars of rated current capacity per phase.
- b) Special brass terminals to ensure perfect connections of incoming cable with the bus bars.
- c) Brass neutral bars isolated and insulated from the enclosures with suitable cross sectional area.
- d) Earth bars for firm earthing and for facilitating individual earthings for each outgoing terminal.
- e) Sufficient number of blanking plates.

2.11.5.1 Miniature Circuit Breakers (MCBs)

All MCBs should conform to IS:8828(1996), BS: 3871, IEC:898(1995) and rated for 10kA category of short circuit duty and tested for breaking capacity upto 10 kA. **B** curve type MCBs should be used for resistive loads, **C** curve type for inductive loads and **D** curve type for UPS loads. MCBs shall be suitable for use in frequency range 40 Hz to 60 Hz and shall accommodate AC/DC supply according to requirements. It should have inverse time overload and short circuit tripping mechanism with trip free operation and toggle shall give positive contact indication. Arc chutes should be provided for effective quenching of arc during operations and fault conditions. Terminals should be provided with proper shrouding arrangement. Silver cadmium Oxide tipped contacts should be provided in MCBs. Pressure clamp terminals for users upto 4 sq.mm and bolted lugs for higher rating should be provided. Multipole MCBs should be provided with common operating handle and integral tripping. The MCBs shall be of IP 20 degree of protection. The power loss per pole shall be in accordance with IS:8828(1996) and shall be furnished by the manufacturer.

MCB casing shall be made of self extinguishing tropicalised material. It shall be suitable for mounting on 35 mm DIN rail/surface mounting. Line supply may be connected to either top or bottom terminals i.e there shall be no line load restriction. Degree of protection, when the MCB is flush mounted, shall be IP 40. MCB shall be supplied with clamping terminals fully open. Contact closing shall be independent of the speed of the operator. The MCB shall be capable of being used as incomer circuit breaker and shall be suitable for use as an isolator. In case of multiple MCBs in a single location (DB), it shall be possible to remove MCB without having to disturb other MCBs in the vicinity.

2.11.5.2 **Miniature Circuit Breaker and Residual current Circuit Breaker (RCBO)**

Miniature Circuit Breaker-and- Residual current Circuit Breakers based on residual current operation should provide complete protection against Earth leakage faults, overloads and short circuits. The breakers should conform to IS: 12640-1988, IEC 601008-1 and IS: 8828-1996 should be rated for 10 kA. The RCCB shall have threshold sensitivities (non-user adjustable) of 30mA, 100 mA & 300 mA with inbuilt time delay of 200 ms for discrimination with downstream RCCB. The short circuit withstand capacity of the RCCB without the associated short circuit/overload protection shall not be less than 3 kA. It shall be operationally independent of line voltage. There should be clear identification of earth fault or overload and short circuit fault on the RCCB. The breaker should be maintenance free. The breaker should be capable of detecting earth leakage currents and disconnecting the faulty lines. The RCCBs should be capable of preventing the risk of unwanted tripping due to transient voltages (lightning, line disturbances on other equipment) and transient currents (from high capacitive circuits). The RCCB should be unaffected by the DC pulsated components, present if any in the circuit, and should not give nuisance tripping. A test device should be incorporated to check the integrity of the system and tripping mechanism. Terminals should ensure easy termination of cables and should provide covers to shield incoming and outgoing terminals with IP 20 degree of protection. The breaker should be suitable for DIN rail mounting.

2.11.6 **Cables & Cabling**

2.11.6.1 Scope

The scope under this section covers the following:

- a) Power cables (LV)
- b) Control cables

2.11.6.2 Armouring and Serving

All multicore cables liable for mechanical damage shall be armoured.

PVC Cables, when armoured, shall have galvanised steel wire (flat or round) for armouring.

Steel wire armouring is preferred where the cables are liable to tensile stresses in applications such as vertical runs, suspended on brackets or laid in soil that is likely to subside.

2.11.6.3 Storage and handling:

1. Storage:

- (i) The cable drums shall be stored on a well drained, hard surface, so that the drums do not sink in the ground causing rot and damage to the cable drums. Paved surface is preferred, particularly for long term storage.
- (ii) The drums shall always be stored on their flanges, and not on their flat sides.
- (iii) Both ends of the cables should be properly sealed to prevent ingress/absorption of moisture by the insulation during storage.
- (iv) Protection from rain and sun is preferable for long-term storage for all types of cables. There should be enough ventilation between cable drums.
- (v) Damaged battens of drums etc. should be replaced, as may be necessary.

2.11.6.4 Handling:

- (i) When the cable drums have to be moved over short distances, they should be rolled in the direction of the arrow marked on the drum.
- (ii) For manual transportation over long distances, the drum should be mounted on cable drum wheels, strong enough to carry the weight of the drum, and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.
- (iii) For loading into and unloading from vehicles, a crane or a suitable lifting tackle should be used. Small sized cable drums can also be rolled down carefully on a suitable ramp or rails, for unloading, provided no damage is likely to be caused to the cable or to the drum.

2.11.6.5 Standards

The following standards shall be applicable:

- | | | | |
|----|-----------|---|---|
| 1. | IS : 1753 | : | Specification for aluminium conductors for insulated cables. |
| 2. | IS : 2982 | : | Specification for copper conductors in insulated cables. |
| 1. | IS : 5831 | : | Specification for PVC insulated and sheath of electric cables. |
| 4. | IS : 6474 | : | Polythene insulation and sheath of electric cables. |
| 5. | IS:3975 | : | Specification for mild steel wires, strips and tapes for armouring of cables. |
| 6. | IS : 694 | : | PVC insulated cables. |
| 6. | IS : 7098 | : | Specification for XLPE insulated PVC sheathed cables. |
| 8. | IS : 3961 | : | Recommended current ratings of cables. |

9. IS : 5819 : Recommended short circuit ratings for high voltage PVC cables.

2.11.6.6 Power cables (LV) 415 V grade XLPE / PVC insulated cable

Power cables for use on 415 V system shall be of 1100 volt grade, aluminium conductor, XLPE/PVC insulated, PVC sheathed, armoured and overall PVC sheathed (PVCAPVC), strictly as per IS : 1554 (Part I) - 1976. Unarmoured cable to be used only if specifically mentioned in schedule of requirements.

The size of these cables shall be as specified in schedule of requirements or as per erection drawings. No cable of size less than 4 sq.mm shall be used.

2.11.6.7 Control Cables

Control cables for use on 415 V system shall be of 1100 volts grade, copper conductor, PVC insulated, PVC sheathed, armoured and overall PVC sheathed, strictly as per IS : 1554 (Part I) - 1976. Unarmoured cables to be used only if specifically mentioned in schedule of requirements.

The size of these cables shall be as specified in schedule of requirements or as per erection drawing. No cable of size less than 2.5 sq.mm. shall be used.

2.11.6.8 Cable Glands

Cable glands shall be of heavy duty compression type of brass, chrome plated. These shall have a screwed nipple with conduit electrical thread and check nut. These shall be suitable for armoured/unarmoured cables, which is being used.

2.11.6.9 Cable Connectors

Cable connectors, lugs/sockets, shall be of copper/aluminium alloy, suitably tinned, solderless, crimping type. These shall be suitable for the cable being connected and type of function (such as power, control or connection to instruments, etc.)

2.11.6.10 Cable Indicators

These shall be self-sticking type and of 2 mm thick lead strap for overall cable. PVC identification numbers, ferrule shall be used for each wire.

2.11.6.11 Cable Route Markers

These shall be galvanised Cast Iron plate with marking (LT) diameter 150 mm with 600 mm long 25x25 mm MS. angle riveted/bolted with this plate.

2.11.6.12 G.I. Pipes for Cables

For laying of cables under floor, G.I. class 'B' pipes shall be used. MS. conduits is not acceptable for this purpose. All accessories of pipes shall be threaded types. Size of pipe shall depend upon the overall outer diameter of cable to be drawn through pipe. No G.I pipe less than 40 mm dia. shall be used for this purpose. To determine the size of pipe, assume that 40% area of pipe shall be free after drawing of cable.

2.11.6.13 Cable entry adaptor boxes/ remote pushbutton stations

All outdoor cable entry adaptor boxes made of MS are to be coated with FRP coating to prevent corrosion. All the welded joints, cutting etc. also should be coated with FRP after erection. Thermoplastic box made of high quality unbreakable, self extinguishing thermoplastic material can also be used for the above purpose. All the outdoor remote push buttons should be housed in self-extinguishing thermoplastic enclosure or FRP coated MS enclosure having IP65 degree of protection.

2.11.7 Earthing

A) Types

The type of earth electrode shall be any of the following, as specified.
Pipe earth electrode; as per IS:3043
Plate earth electrode; as per IS:3043

General

All cladding or steel work should be bonded to the earthing system, as should all structural steel work. A main earth bar should be provided, so disposed as to allow of the shortest subsidiary connections to all major equipment, such as DG set, VCB Panels, Substations, circuit breakers and electrical panel boards. When piles are used they should be bonded by welding and connected to earth bonding bars. All earth connections shall be visible for inspection.

i) Electrode materials and dimensions

- a) The materials and minimum sizes of earth electrodes shall be as per fault level calculation.
- b) GI pipe electrodes shall be cut tapered at the bottom, and provided with holes of 12 mm dia, drilled not less than 7.5 cm from each other upto 2 m of length from the bottom.
- c) Pipe electrode shall be buried in the ground vertically with its top not less than 20cm below the ground level. The installation shall be carried out as per IS:3043 and as directed by the engineer in charge.

- d) Plate electrode shall be buried in ground with its face vertical, and its top not less than 2m below the ground level. The installation shall be carried out as per IS:3043 and as directed by the engineer in charge.
- e) When more than one electrode is to be installed the distance between the pipe electrode shall be 5m and that between plates shall be 8m.
- f) The strip or conductor electrode shall be buried in trench not less than 0.5m deep.
- g) If the conditions necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point or as directed by the Engineer-in-charge.
- h) All joints in copper conductor should be tinned properly.

B) Earthing Conductor

- a) The earthing conductor (protective conductor from earth electrode upto the main earthing terminal/earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper, and in the form of wire or strip as specified.
- b) Protective (Earth continuity/Loop earthing) Conductor)
- c) The material and size of protective conductors shall be as specified by the Engineer-in-charge.

C) Location for Earth Electrodes

- i) Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases, electrodes may be located further away from the building, with the prior approval of the Engineer-in-Charge.

D) Protective (Loop earthing/earth continuity) Conductor:

- i) Earth terminal of every switchboard in the distribution system shall be bonded to the main earth bus.
- ii) Two protective conductors shall be provided for a switchboard.
- iii) A protective conductor shall securely connect the earth connector in every distribution board (DB) to the earth bus.
- iv) All metallic switch boxes and regulator boxes in a circuit shall be connected to the earth connector in the DB by protective conductor.
- v) Provision should be given for the testing of earth electrodes by connecting a group of rod driven electrodes to the main earth grid

through a bolted link adjacent to the electrodes in a sunken concrete box. Simpler disconnecting arrangements are not acceptable.

E) Marking

- i) Earth bars/terminals at all switch boards shall be marked permanently as **E**

Main earth terminal shall be marked **Safety Earth – Do Not Disconnect**.

NOTE: - The specifications indicated above are minimum requirement only. The contractor should design, supply, erect and commission the equipment according to latest editions of IEC and EI/IS standards.

2.11.8 INSTALLATION

2.11.8.1 Scope

The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical items mentioned in the schedule of requirements. The work shall, however at all times carried out strictly as per the instructions of the Engineer-in-Charge.

The Contractor shall furnish all tools, welding equipment, rigging materials, testing equipment, test connections and kits etc. Required for complete installation, testing and commissioning of the items included in the Contract.

The Contractor shall carry out touch-up painting on any equipment indicated by the Engineer-in-Charge, if the finish paint on the equipment is soiled or marred during installation handling.

The interconnecting cables between Meter board, MCBDB etc. should be done by the contractor as required.

The installation shall conform in all respects with Indian Standard Code of Practice.

2.11.8.2 LT Panel Boards

Switchgears shall be installed in accordance with specified code of practice and the Consultants instructions. The panels shall be delivered in convenient shipping section by the contractors. The Contractor shall be responsible for final assembly and inter-connection of busbars/wiring. Foundation channel shall be grouted in the flooring by the Contractor. Switchgear panels shall be aligned and levelled on their base channels and bolted or tack welded to them as per the instructions of the Engineer-in-charge. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. Wherever the instruments and relays are supplied

separately, they shall be mounted only after the associated control panel have been erected and aligned.

After erection the switchboard shall be inspected for dust and vermin proofness. Any hole, which might allow dust or vermin etc. to enter the panel, shall be plugged suitably at no extra cost.

If the instrument transformers are supplied separately they shall be erected as per the direction of the Engineer-in-charge. The Contractor shall fix the cable glands after drilling the bottom top plates of all switch boards with suitable holes at no extra cost.

Range of overload relays/timers etc. shall be checked with requirement of purchaser actually to be connected at site and if the same is under-sized/over-sized, it shall be brought to the notice of Engineer-in-charge and shall arrange procurement of correct rated components. However, the Contractor shall not charge anything extra for cost/labour for such replacements.

2.11.8.2.1 Testing

The Contractor shall perform operating tests on all switchgear and panels to verify operation of switchgear/panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal ac or dc voltage to the circuits and operating the equipment for functional checking of all control circuits, eg. closing, tripping, control interlock, supervision and alarm circuits.

All connections in the switchgear shall be tested from point to point for possible grounds or short circuit.

All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

The Contractor shall arrange testing and calibrations of relays. The testing equipment including primary and secondary injection sets (if required) etc. shall also have to be arranged by the Contractor. Payment for above work shall be deemed to have been included in the erection of switch boards/control panels.

Insulation resistance tests shall be carried out by following rating meggers:

- | | |
|---|------------------------------------|
| a) Control circuits upto 220 V | :by 500 V megger |
| b) Power circuits, busbars, connections
Upto 11kV | :by 1000V meggar |
| c) Power circuits, busbars, connections
above 33kV | :by 5000V motor operated
meggar |

Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contact open. Before switchgear is

energised, the insulation resistance of all DC control circuits shall be measured from line to ground.

The following tests shall be performed on all circuit breakers during erection:

- Contact alignment and wipe shall be checked and adjusted where necessary in accordance with the breakers manufacturer's instructions.
- Each circuit breaker shall be closed manually and its insulation resistance measured from phase to phase and phase to ground before erection.
- All adjustable direct acting trip devices shall be set using values given by the Engineer-in-charge/manufacturer.
- The dielectric strength of insulating oil wherever applicable shall be checked

Before switchgear is energised the following tests shall be performed on each circuit breaker in its test position.

- a) Close and trip the circuit breaker from its local & remote control switch, push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with AC closing with prior permission of the Engineer-in-charge.
- b) Test operation of circuit breaker latch, check carriage limit switch if provided.
- c) Test proper operation of lockout device in the closing circuit, wherever provided by simulating conditions, which would cause a lockout to occur.
- d) Trip breaker either manually or by applying current or voltage to each of its associated protective relays.

Before switchgear is energised, the test covered above shall be repeated with each breaker in its normal operating position.

All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

The Contractor shall arrange testing and calibrations of relays. The testing equipment including primary and secondary injection sets (if required) etc. shall also have to be arranged by the contractor. Payment for the above work shall be deemed to have been included in the erection of switch boards/control panels.

Performa for Panels

1. Circuit (breaker or Supplier module designation/bus no.)
2. Insulation resistance tests (contacts open, breaker racked in position).

- | | |
|---|------------|
| a) Between each phase of bus | : Mega ohm |
| b) Between each phase and earth | : Mega ohm |
| c) DC and AC control & auxiliary circuits | : Mega ohm |

Tenderer

Chief Engineer 126

d) Between each phase of CT/PT and
CT & PT circuit if any

: Mega ohm

3. CT checks:
 - i) CT ratio
 - ii) CT secondary resistance
 - iii) CT polarity check
4. Check for contact alignment and wipe.
5. Check/test all releases/relays.
6. Check mechanical interlocks.
7. Check switchgear/control panel wiring.
8. Check electrical interlocks.
9. Checking of breaker/control circuits for
 - i) Closing-local and remote (wherever applicable)
 - ii) Tripping-local and remote (wherever applicable)
10. Opening time of breaker/contactors.
11. Closing time of breaker/contactors.

(This Performa shall be jointly signed by the Engineer-in-charge and the Contractor.)

2.11.8.2.2 Completion tests

After supply and installation of complete project or a particular building/area, the contractor shall carry out following tests before switching on the power to installation and the results shall be recorded and submitted to the engineer-in-charge. If results are not satisfactory/as per the standard, the contractor shall identify the defects/short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

2.11.8.2.3 Insulation resistance to earth

This to be measured with all fuse links in place all switches on all lamps and appliance in position by applying a voltage not less than twice the working voltage (subject to a limit of 500V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 Megaohms divided by the number of outlets (points and switch positions) except that it need not exceed 1 Megaohm for the whole installation.

2.11.8.2.4 Insulation resistance between conductors

Test to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or

neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put on. The result of the test must be 50 Megaohms divided by the number of outlets (point and switch positions) but need not exceed one Megaohm for the whole installation.

2.11.8.2.5. Polarity of single pole switches

Test shall be made to verify that all non-linked single pole switches are on phase conductor (Live) and not on the neutral or earthed conductor.

2.11.8.2.6 Resistance of metal conduits/sheaths (Earth continuity test)

In case of cables encased in metal conduit or metallic sheathing, the total resistance of the conduit or sheathing from the earthing point to any other position in the completed installation shall not exceed 2 ohms.

2.11.8.2.7 Bus bar chamber

Bus bar chambers shall be installed on fixed type switch boards with GI bolts and nuts.

2.11.8.2.8 Connections

- i) Connections to bus bars shall be made either by clamping arrangement, or by bolts and nuts as required. Tapped holes with studs may be permitted only for copper bus bars for tapping conductor size upto 16 sq.mm.
- ii) All connections shall be made such that there is a clear metal to metal area contact at the tappings so that the current density of the bus bars at the point of connection does not exceed permissible limits, avoiding local heating.
- iii) For tap-off connections from bus bars, PVC insulated wiring cables may be used for current capacity upto 100A. and for higher current capacities, solid conductors/strips suitably insulated with PVC sleeve/tape shall be used.
- v) The bolts and nuts used for connections to bus bars shall be of aluminium alloy, tinned forged brass or galvanised iron. Suitable precaution shall be taken against heating due to bi-metallic contact, spring washers and plate washers, shall be used with the studs/nuts to ensure proper contact pressure.

2.11.8.3. Cabling

Cable network shall include power, control and lighting cables, which shall be laid in underground trenches, Hume pipes, open trenches, cable trays, GI pipes, or on building structure surfaces as detailed in the relevant drawings. Cable schedules or as per the Engineer-in-charge's instructions. Supply and installation of cable trays, GI pipes/conduits, cable glades

sockets at both ends, isolators, junction boxes, remote push buttons stations, etc. shall be under the scope of the Contractor.

2.11.8.3.1 General requirements for handling of cables

- a) Before laying cables, these shall be tested for physical damage, continuity absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500/1000 volt Megger.
- b) The cables shall be supplied at site, wound on wooden drum as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case the cable will be rolled on, as it produces kinks which may damage the conductor.
- c) Sharp bending and kinking of cables shall be avoided. The bending radius for PVC insulated and sheath armoured cable shall not be less than 10 D Where 'D' is overall diameter of the cable.
- d) While drawing cables through GI pipes, conduits, RCC pipe, ensure that size of pipe is such that, after drawing cables, 40 % area is free. After drawing cable, the end of pipe shall be sealed with cotton/bituminous compound.
- e) High voltage (11 kV and above), medium voltage (230 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes/trays.
- f) Armoured cables shall never be concealed in walls/floors / roads without GI pipes, conduits RCC pipes.
- g) Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxy resin type joint shall be made, without any additional cost.
- h) A minimum loop of 3 M shall be provided on both ends of the cable, or after every 50 M of unjointed length of cable and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future. Cable for this loop shall be paid for supply and laying.
- i) Cable shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Contractor.
- j) All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The routes indicated in the drawings is indicative only and the same may be rechecked with the

Engineer-in-charge before cutting of cables. While selecting cable routes, interference with structures, foundations, pipe line, future expansion of buildings, etc. should be avoided.

- k) All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.
- l) Wherever cable rises from underground/concrete trenches to motors/switchgears/push buttons, these shall be taken in GI pipes of suitable size, for mechanical protection upto 300 mm distance of concerned cable gland or as instructed by the Engineer-in-charge.
- m) Where cables pass through foundation/walls of other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures the electrical Contractor shall determine their location and obtain approval of the Engineer-in-charge before cutting is done.

2.11.8.3.2 Installation of Cables

Wherever cables are taken through masonry works and road crossings etc., they shall be protected by running through GI pipes and Hume pipes respectively. Depth shall be 1200 mm from top of finished road surface and it shall extend for about 1070 mm on both sides of the roads.

Utmost care shall be taken to avoid scratches, kinks and cuts on the conductor while transporting the cables to site or during installation. Suitable inhibiting grease shall be liberally applied to bare conductors, wherever they exist.

The junction boxes, cable end boxes etc. wherever required to be provided shall have sufficient wiring spaces with regard to the sizes of cables indicated in the drawings. Wherever required, the items to be supplied for electrification shall be complete with requisite type of cable glands, cable boxes, termination etc. and other accessories which are necessary for the satisfactory installation/operation of the installations as per relevant statutory rules and regulations.

Installation of all cables should be as per E.I. Standards. Fuses should be graded properly and should be selected based on the rating of cables. The cables shall be laid in trenches/overhead racks wherever available. The cables from cable trenches to the switcher shall be buried (as per standard practices and or taken through GI pipes to 1.2 m above ground/racks floor level. The cables taken over racks/ walls/ columns/ trusses shall be properly clamped using aluminium clamps of 16 SWG 1/4 hard or 3/4 hard sheet, the width varying from 12.5 to 25 mm at intervals of 750 mm. 225 mm minimum horizontal interaxial spacing shall be maintained when more than one cable is laid in same trench. Suitable and permanent type of

cable markers is to be provided indicating the route and position of joints of cable. Loops should be provided at either ends of the cable. Identification tags should be provided for each cable in the trench at a distance of 3 metres.

Supply and installation of danger notice boards, where required, and other provisions under the statutory rules and regulations shall be included in the scope of this work.

The Contractor has to provide materials and carry out the wiring work including earthing according to IS 3043 unless otherwise specified and get it approved before using for work, by the authorised engineer of the Purchaser.

Sufficient number of earth pits shall be provided, if found necessary and inter-connected so as to have the resistance of the earthing installations not more than 0.5 ohm. In case the soil resistivity is found to be very high, a high sensitive relay may be used to co-relate the relay setting with high earth resistance.

The complete installation work shall be conforming to NEC-1985 and complying with the Indian Electricity Rules and to meet the approval of the State Electrical Inspector etc. Installation of all switch boards and distribution boards should be in conformity with Rule 51(1)(c) of I.E.R. 1956. MV installation should conform to I.S. 7732.

The cable terminations and earth terminations, wherever required, shall only be using compression type cable glands and suitable lugs.

All the materials to be supplied for this work shall be got approved by the concerned engineer at site.

The work will be considered complete only if the following tests are conducted, by the contractor at his own cost, satisfactorily in the presence of the site Engineer and are:

- a) Insulation test
- b) Earth resistance test and
- c) Continuity test

2.11.8.3.3 Laying of Cables (underground system)

- a) Cables shall be so laid in ground that these will not interfere with other underground structures. All water pipes, sewage lines or other structures, which become exposed by excavation, shall be properly supported and protection from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded diverted as directed by the Purchaser.

- b) Cables shall be laid at minimum depth of 750 mm in case of LT & 1200 mm in case of HT, from ground level. Excavation will be generally in ordinary alluvial soil. The width of the trench shall be sufficient for laying of required number of cables.
- c) Sand bedding 75 mm thick shall be made below and above the cables. A layer of bricks (full size) shall be laid on the edge, above sand bedding on the sides of cables and a flat brick to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However the relating location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction to the Engineer-in-charge.
- d) For all underground cables, route markers should be used.
 - i) Separate cable route markers should be used for LT, HT and telephone cables.
 - ii) Route markers should be grounded in ground with with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm.
 - iii) Cable markers should be installed at an interval not exceeding 50 M along the straight routes of cables at a distance of 0.5 M away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable. Cable markers should also be used to identify change in direction of cable route and for location of every joint in underground cable.
- e) RCC hume pipes for crossing road in cable laying shall be provided by Contractor. RCC hume pipe at the ends shall be sealed by bituminous compound after laying and testing of cable by electrical Contractor without any extra charge.

2.11.8.3.4 Laying of Cables under Floors

- a) GI class A pipe shall be used for laying of outgoing cables from distribution boards to various equipment. Preferably one cable shall be drawn through one pipe. Size of pipe shall be such that after drawing of cable 40 % area is free. If length of pipe is more than 30 M, free area may be increased to 50 %.
- b) Use of elbows is not allowed at all and number of bends shall be kept minimum. Instead of using bends with sockets, pipe bending machine shall be used for making long smooth bends at site.
- c) Ends of pipe shall be sealed temporarily while laying with cotton/jute/rubber stopper etc. to avoid entry of building material.
- d) Exact locations of equipment shall be ascertain prior to laying of pipe.

2.11.8.3.5 Laying of Cable in Masonry Trenches

- a) Masonry/concrete trenches of laying of cable shall be provided by Contractor. However steel members such as MS angles/flats etc. shall be provided & grouted by electrical Contractor to support the cables. Cables shall be clamped to these supports with aluminium saddles/damps. More than one tier of cables can be provided in the same trench if the number of cables is more.
- b) Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

2.11.8.3.6 Laying of Cables in Cable Racks

Cable Racks to be used for cables laid indoors except for single cables. The cable racks shall be of ladder type fabricated out of structural steel, MS, GI or aluminium perforated as indicated. The cable racks shall be of adequate strength to carry the weight of cables with out sagging. Structural bracket grouted in the build up trenches to support the cable such supports shall be at intervals of not less than 750 mm centres. All the structural steel work shall be finished with two coats of paint over primer.

- i) Cables shall be fixed in cable trays in single tier formation and shall be clamped with aluminium flat clamps and galvanised bolts/unit.
- ii) Earthing flat/wire can also be laid in cable tray along with cables.
- iii) After laying of cables minimum 20 % area shall be spare.

2.11.8.3.7 Laying of Cables on Building Surface/Structure

- a) Such type of cable laying shall be avoided as far as possible and will be allowed only for individual cables or small group of cables which run along structure.
- b) Cables shall be rigidly supported on structural steel/masonry using individual cast/malleable iron galvanised saddles and these supports shall be approximately 400 to 500 mm for cables upto 25 mm overall diameter and maximum 1000 mm for cables larger than 25 mm. Unsightly sagging of cables shall be prevented. Only aluminium/GI clamps with GI bolts/nuts shall be used.
- c) If drilling of steel structure must be resorted to, approval must be secured from the Engineer-in-charge and steel must be drilled where the minimum weakening of the structure will result.

2.11.8.3.8 Termination and Jointing of Cables

a) Use of Glands

All PVC cable upto 1.1 kV grade, armoured or unarmoured shall be terminated at the equipment/junction box/ isolators/push buttons/control

accessories, etc. by means of suitable size compression type cable glands armour of cable shall be connected to earth point. The Contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanised threaded reducing bushing shall be used for approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit holes should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

b) Use of Lugs/Sockets

All cable leads shall be terminated at the equipment terminals, by means of crimped type solder less connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs/sockets.

The following is the recommended procedure for crimped joints and the same shall be followed:

- i) Strip off the insulation of the cable end with every precaution, not to severe or damage any stand. All insulation to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
- ii) The cable should be kept clean as far as possible before assembling it with the terminal/socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be fitted with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.
- iii) Correct size and type of socket/ferrule/lug should be selected depending on size of conductor and type of connection to be made.
- iv) Make the crimped joint by suitable crimping tool.
- v) If after crimping the conductor in socket/lug, same portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.

c) Dressing of Cable inside the Equipment

After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cableways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.

For motors of 20 HP and above, terminal box if found not suitable for proper dressing of an aluminium cables, the Contractor shall modify the same without any additional cost.

Cables inside the equipment shall be measured and paid for.

d) Identification of Cables/Wires/Cores

Power cables shall be identified with red, yellow & blue PVC tapes for trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear/control panels and control switches.

In case of control cables all cores shall be identified at both ends by their wire numbers by means of PVC ferrules or self sticking cable markers, wire numbers shall be as per schematic/connection drawing. For power circuit also wire numbers shall be provided if required as per the drawings of switchgear manufacturer.

2.11.8.3.9 Testing of Cables

- a) Before energising, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
- b) Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Report measurements after splices and/or terminations are complete.
- c) DC High Voltage test shall be made after installation on the following:
 - i) All 1100 Volts grade cables in which straight through joints have been made.
 - ii) All cables above 1100 V grade.

For record purposes test data shall include the measured values of leakage current versus time.

The DC High Voltage test shall be performed as detailed below:

Cables shall be installed in final position with the entire straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.

The test voltage and duration shall be as per relevant codes and practices of Indian Standards Institution.

2.11.8.3.10 **Proforma for Testing Cables**

Proforma - A

Date of Test

- a) Drum No. from which cable taken

Tenderer

Chief Engineer 135

- b) Cable from _____ to _____
- c) Length of run of this cable _____ metre
- d) Insulation resistance test :

Voltage of Megger _____ Volts

- i) _____ between core-1 to earth..... Megaohm
- ii) _____ between core-2 to earth..... Megaohm
- iii) _____ between core-3 to earth..... Megaohm
- iv) _____ between core-1 to core-2..... Megaohm
- v) _____ between core-2 to core-1..... Megaohm
- vi) _____ between core-3 to core-1..... Megaohm

- e) High voltage test _____ Voltage _____ Duration _____
- i) between cores and earth
 - ii) between individual cores

Signature of
Engineer-in-Charge

Signature of
Contractor

Proforma - B

Cable Laying

(To be shown for each cable separately, voltage wise)

Date(s) of Test:.....
Voltage of Megger used:.....

Continuity of cores	IR value (mega ohm)
Before laying	Before back filling
Between value	Between Value

- 1) From.....To.....PVC/XLPE.....x.....sq.mm
LV/MV/HV cable.....m in length.

R-N

R-N

Tenderer

Chief Engineer 136

(c) Between R & E
 Y & E
 B & E
 N & E

Insulation resistance (Mega ohm) of Jointed cable

Cable I - (a) Between R & Y
 Y & B
 B & R

(b) Between R & N
 Y & N
 B & N

(c) Between R & E
 Y & E
 B & E
 N & E

Signature of
 Engineer-in-Charge

Signature of
 Contractor

Proforma - D

Testing Before Commissioning

(a) Cable Work Date(s) of Test:.....

a) Details of high Voltage test conducted

System of supply.....
 Test Voltage applied.....kV.....Minutes
 Result of test-Satisfactory/Unsatisfactory.

Voltage of Megger used:-
 Result of Megger testing:-

Between R & Y
 Y & B
 B & R
 Between R & N
 Y & N
 B & N
 Between R & E

b) FEEDER PILLAR:-

- i) Pillar Number:
- ii) Voltage of megger used:
- iii) Result of megger testing:

2.11.9 Earthing

2.11.9.1 Scope

The scope of this section shall cover the following:

- a) Earthing station
- b) Earthing conductors
- c) Earthing of equipment and installation

2.11.9.2 Standards

The following standards shall be applicable:

- IS : 3043 COP for earthing
- IS : 5216 Safety procedures & practice in electrical work

2.11.9.3 Earth Station

The earth station shall be made by excavating the ground to a depth of not less than 2.5 m and the excess earth after back filling shall be removed from site. Ground with rocky strata, the depth of excavation shall be less. However additional earthing stations or earth matting to be provided to achieve the system earthing less than one ohm.

2.11.9.4 Electrodes

i) Various types of electrodes

- i) Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in the figure and as directed by the Engineer-in-charge.
- ii) Plate electrode shall be buried in ground with its face vertical, and its top not less than 2 m below the ground level. The installation shall be carried out as directed by the Engineer-in-charge.
- iii) When more than one electrode is to be installed, the distance between pipe electrodes shall be 5m and that between plates shall be 8m.

- iv) a) The strip or conductor electrode shall be buried in trench not less than 0.5 m deep.
- b) If conditions necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point or as directed by the Engineer-in-charge.

2.11.9.5 Earthing Conductor (Main earthing lead)

The earth conductors shall be fixed to the wall/columns etc. at every 500 mm centres with 10 mm spacers. The total earthing system shall be mechanically and electrically connected to provide independent path to earth.

- i) In the case of plate earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, checknuts and washers.
- ii) A double C-clamp arrangement shall be provided for terminating tape type earthing conductor with GI watering pipe coupled to the pipe earth electrode. Galvanised "C" shaped strips, bolts, washers, nuts and checknuts of adequate size shall be used for the purpose.
- iii) The earthing conductor from the electrode upto the building shall be protected from mechanical injury by a medium class, 15 mm dia. GI pipe in the case of wire, and by 40 mm dia. medium class GI pipe in the case of strip. The protection pipe in ground shall be buried atleast 30 cm deep to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth in due co-ordination with the building work.
- iv) The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switch board by bolt, nut and washer.

2.11.9.6 Earth bus and main earthing terminal

- i) The Main Earth bus shall be laid as directed by the Engineer-in-charge.
- ii) Following conductors shall be terminated into the main earthing terminal/earth bus.
 - a) Earth connection from the Sub station.
 - b) Earthing conductor from electrode.
 - c) Protective conductors;
 - d) Equi-potential bonding conductors.

2.11.9.7 Protective (Loop earthing/earth continuity) Conductor

- i) Earth terminal of every switch board in the distribution system shall be bonded to the main earth bus.
- ii) Two protective conductors shall be provided for a switchboard.
- iii) A protective conductor shall securely connect the earth connector in every distribution board (DB) to the earth bus.
- iv) All metallic switch boxes and regulator boxes in a circuit shall be connected to the earth connector in the DB by protective conductor.
- v) The earth pin of socket outlets as well as metallic body of fan regulators shall be connected to the earth stud in switch boxes by protective conductor.

2.11.9.8 Marking

- i) Earth bars/terminals at all switch boards shall be marked permanently, either as **E** or as
- ii) Main earth terminal shall be marked “**Safety Earth – Do Not Disconnect**”.

Proforma for testing Earth Electrodes

- i) Total number of earth electrodes.....
- ii) Earth resistance of each earth electrode:

Sl.No.	Location	Value

Signature of
Engineer-in-Charge

Signature of
Contractor

2.11.10 **Light Fixtures / Fans**

2.11.10.1 Installation of Lighting Fixtures

- a) Scope of work under this item shall start from light point, ie from the ceiling rose or metal box whichever is applicable with a 15A bakelite connector, 3 core 1sq.mm PVC insulated copper wires from this connector to the connector inside the lighting fixture, connections, fixing of lighting fixture complete with all accessories, lamps on wall/roof/steel truss, etc. testing the lighting fixture and commissioning.
- b) Contractor shall clarify from Engineer-in-charge for type of installation (direct on ceiling/hanging) of lighting fixture, if not specifically mentioned on drawings. Length of the suspension rods shall also be decided in consultation with the Engineer-in-charge.

2.11.10.2 Installation of Ceiling Fans

Scope of work under this item shall start from the ceiling rose of the fan point with 3 core 1 Sq.mm PVC insulated copper wires to the connector in the fan,

connections, fixing of fan (complete with all accessories) to the fan hook of fan point, testing the fan with regulator and commissioning.

Extension/replacement of hanging rod of fans shall be carried out only if advised by the Engineer-in-charge on drawing/site instruction book. Only GI pipe ('B' class) shall be used for ceiling fan hanging. Screwed joint within the length of fan hanging rod is not allowed and shall never be adopted. Fan hanging rod should be preferably of one piece and if not possible, welded joint can be allowed.

2.11.10.3 Installation of wall fans/air circulators

Specification same as for ceiling fans except that fan has to be fixed on wall with screws/bolts grouting instead of fan hooks.

2.11.10.4 Installation of Exhaust fan

Scope of work under this item shall start from the ceiling rose of exhaust fan point, with PVC insulated copper wire from ceiling rose to connector of exhaust fan, connections, including fixing of exhaust fan complete with accessories and louvers on walls with hold-fasts, testing the exhaust fans and commissioning.

2.11.10.5 Special notes

- a) Location of lighting fixtures/fans shall be shown on the working drawings and the same shall be followed. However, if due to site conditions the location can not be adhered to, the same shall be brought out to the notice of the Engineer-in-charge for advice.
- b) Maintenance and custody of light fixture/fans after installation/commissioning would be with contractor till that building/area is completed and handed over to Purchaser / Engineer-in-charge in satisfactory working order.

2.11.11 MEASUREMENT

2.11.11.1 Quantities

The quantities set out in the Schedule of Requirements are the estimated quantities of the work, but they are not to be taken as the actual and exact quantities of the Work to be executed by the Contractor in fulfilment of his obligations under the Contract.

2.11.11.2 Works to be measured

The Consultants shall, except as otherwise stated, ascertain and determine by measurement the value in terms of the Contract of work done in accordance with the Contract. He shall, when he required any part or parts of the Work to be measured, give notice to the Contractor's authorised agent or representative, who shall forthwith attend or send a qualified agent to assist the Engineer in making such measurement, and shall furnish all particulars required by either of them. Should the Contractor not attend, or neglect or omit to send such agent, then the measurement made by the Engineer or agent approved by him shall be taken to be the correct measurement of the work. For the purpose of measuring such permanent work as is to be measured by records and drawings, the Consultant shall prepare records and drawing month by month of such work and the Contractor, as and when called upon to do so in writing, shall, within fourteen days, attend to examine and agree such records and drawings with

the Consultant and shall sign the same when so agree such records and drawings, they shall be taken to be correct. If, after examination of such records and drawings the Contractor does not agree the same or does not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor shall, within fourteen days of such examination, lodge with the Consultant, for decision by the Consultant, notice in writing of the respects in which such records and drawing are claimed by him to be incorrect.

2.11.11.3 **Mode of Measurement**

The Works shall be measured net, as prescribed in the specification of work, notwithstanding any general or local custom, except where otherwise specifically described or prescribed in the Contract. Wherever not specifically mentioned in the Contract, the mode of measurement as prescribed in the relevant IS codes shall be applicable and binding to the Contract. Only the latest editions of all the codes of practices including all latest official amendments and revisions shall be applicable.

2.11.11.4 **Battery Limit**

Scope of work includes:

1. Supply, installation, testing and commissioning of meter boards, LT panel boards etc.
- a. Cable laying, termination at both ends, testing & commissioning of LT cables from meter boards to LT panel boards, MCB DBs, Internal electrification etc.,
 - i. Earthing system includes supply, installation and testing of earth pits and relevant earth conductors as per specification Meter board, LT panel Board, MCB DBs etc.
 - ii. Wherever buried cables are envisaged, scope of work includes digging of earth along the cable route, filling up of sand protective covering as per specification, laying of cable, covering the cables with sand bricks, back filling of earth etc., as per specification. Installation of Hume pipes including excavation, erection, back filling etc. Cable markers shall be supplied & installed as per specification.
 - iii. Civil work includes grouting of equipment, complete supply & erection of meter boards, LT panel boards, MCB DBs, fixing of pipes with all necessary supports.
6. The rates quoted for installation should include the charges for painting the conduits & supports as directed by Purchaser/ Consultant.
7. Supply, installation, testing and commissioning of Wiring System, MCB distribution boards, installation of light fixtures and fans, exhaust fans, power plugs, 5A plugs etc.

8. Liaison with all statutory authorities including KSEB for getting sanction/approval/safety certificate/ power connection including submission of necessary forms to KSEB/ Electrical inspectorate as required is included in the scope of this work. Necessary fee for the above shall be reimbursed on production of actual bills.

3.0 MAKE OF MATERIALS

3.1 Scope

The scope of this section covers the recommended makes of equipment, material components. The final choice of makes shall be indicated at the time of finalization of order.

The makes of material offered by the contractor shall be indicated at the space provided for proper evaluation of the offer and shall be one of the recommend makes. In the absence of such indication, the decision rests with the Purchaser/consultant.

3.2 Makes recommended

The makes of material recommended are exhibited in respective section. The offers shall be strictly on the basis of the makes recommended. However, the bidders can offer alternative makes under deviation. Such deviations shall follow with technical literature of the material/equipment offered. Such deviation shall be considered only if the offer is furnished for the specified make as per the tender.

Where specified make and model nos. are indicated in the schedule of requirements, the bidder should quote for the same items.

3.1 LIST OF APPROVED MAKES OF EQUIPMENT AND MATERIALS

Sl.No	Item	Make of Materials/Equipment
1	1.1 kV grade XLPE insulated PVC sheathed Al./ Cu. Cable	CCI, NICCO, Torrent, Universal, Havells, Gloster
2	SDFU, Isolator	L&T, Siemens, Schneider Electric, ABB, GE.
3	Push Buttons	Technic, Schneider, Siemens, BCH, C&S
4	Indicating lamps (LED type)	Tecnic, Schneider, Siemens, BCH, C&S, L&T
5	Fuses/Fuse carriers	Siemens, L & T, Schneider Electric, ABB, GE
6	Indicating meters	AE, MECO, Rishab
7	Integrating meters	SIMCO, L&T, ABB, HPL
8	Current Transformer	AE, Intrans, Kappa, Intech, PGR
9	Selector switches	Reco, Essen, Kaycee, L&T.
10	Modular type switches, Sockets, bell push, etc	Crabtree Athena, Legrad mosaic, MK blenze, Wipro North West
11	660/1100 volt grade stranded unsheathed wire with copper conductor	Finolex, RR Kabel, Lapp Kabel, Havells.
12	Cable glands, lugs, End termination kits	Lapp Kabel, Gripwel, HMI, Denson, Multipressings, Yamuna Gasses.
13	MCB, RCBO	Legrand, Siemens, L&T Hager, Schneider Electric, ABB, Indo Asian Gold plus.
14	MCB Distribution Boards/ Load banks	Legrand, L&T, Siemens, Schneider Electric, GE, ABB, Indo Asian Gold plus
15	Light fitting	Philips, Wipro, Crompton, K-lite, GE
16	Ceiling fans	Usha, Crompton, Khaithan
17	Exhaust fan	Almonard, Crompton
18	PVC Conduit	Precision, Balco, Conceal
19	Street Light Poles	Bajaj, Kumaran Pole, Unique Pole

6.0 SCHEDULE OF QUANTITIES