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 "Tender" shall mean the tender submitted by the Contractor for acceptance before the ACCEPTING AUTHORITY.

2.01.06 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.

2.01.07 The "Contract" 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 Form, General Conditions of Contract, Special Conditions of Contract ,Technical Specification, Specification and Schedule of Quantities, Letter of Acceptance, Agreed variation if any, drawings, work orders, and / or any other / correspondences or negotiations, etc.

2.01.08 "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.

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

2.01.10 "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.

2.01.11 "Engineer" shall mean the Engineering Personnel representing ACCEPTING AUTHORITY/Consultant and entrusted with work of supervision of work at the site.

2.01.12 "Contract sum/price" shall mean the total sum referred to in the schedule of quantities and rates and accepted by ACCEPTING AUTHORITY.

2.01.13 The 'Probable Amount of Contract' (PAC) shall mean the Estimated amount/Tendered amount of the work.

2.01.14 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 ACCEPTING AUTHORITY. The Contractor should not divulge or use, expect 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 4 months 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 7 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**

Soon after the award of contract, the Contractor shall submit to ACCEPTING AUTHORITY or to their representative for his approval a programme to match with the planned completion of the whole job showing the order of procedure and method in which he proposes to carry out the works and shall whenever required by ACCEPTING AUTHORITY or ACCEPTING AUTHORITY's representative, furnish further detailed programme and particulars in writing of the Contractor’s arrangements for carrying out the works and of the constructional plant and temporary works, which Contractor intends to supply use or construct as the case may be. The Contractor shall draw a detailed schedule of programme in the form of PERTCHART and a bar Chart on whole work, within one week of award of work and submit to ACCEPTING AUTHORITY for their approval. The submission to and approval, if any, by ACCEPTING AUTHORITY or its representative of such programmes or particulars shall not relieve the Contractor of any of his duties or representatives under the 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.

2.09.02 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 2.09.03 and 2.09.04.

2.09.03 EXTENSION OF TIME OF COMPLETION

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 ACCEPTING AUTHORITY shall determine the amount of such extension and shall intimate the Contractor in writing provided that ACCEPTING AUTHORITY 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 ACCEPTING AUTHORITY full and detailed particulars of any request for the extension of time to which he may consider to be justified.

2.09.04 EXTENSION OF COMPLETION TIME DUE TO STRIKE, FIRE, ETC.

If in the opinion of ACCEPTING AUTHORITY the progress of the work has at any time been delayed by strikes, fire, inclement weather, un-avoidable casualties, etc. beyond the control of the Contractor then the time of completion of the work may be extended for such reasonable time as ACCEPTING AUTHORITY may decide and this will be indicated in writing.

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 prevailing at the time of tender of KPWD SOR by adding profit of 10% and 5% overhead charges applying the Contractor's quoted percentage above or below.

.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.

.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 10% 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 not withstanding 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.

.03 Payment towards all interim bills will be made by ACCEPTING AUTHORITY within 30 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 not withstanding 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.

Unit rate specifications are the descriptions of items for which unit rates are to be worked out by the tenderer by considering all tender information.

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.

Sd/-
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

3.00 SPECIAL CONDITIONS

NAME OF WORK: MULTI SPORTS ACCRYLIC COURTS

1. All works shall be done in conformity with the specifications and conditions in the contract in force in the P.W.D. The tenderer shall quote only single rate for each item given in the schedule by a single entry and attesting all the corrections. The rates quoted shall be inclusive of covering all the operations contemplated in the specifications and tender schedule and all incidental works necessary for such operations such as shoring, bailing, form work, scaffolding etc. The rates quoted shall be inclusive of all applicable taxes.

2. The rates quoted by the contractor for the various items shall be inclusive of all tools and plants required for the proper execution of work and all other incidental charges and separate claim for these will not be entertained under any circumstances.

3. The quantities shown in the schedule are only approximate and are subject to variation and the contractor is bound to do additional quantities of work if found necessary at his quoted rates.

4. All the rates quoted should be inclusive of all commercial taxes also.

5. All corrections and insertions in the original tender or schedule whether in the printed matter or elsewhere shall be attested by the tenderer.

6. The contractor has to quote for the specification and unit noted in the schedule. No correction of specification unit or quantity is admissible and if they make any correction in the specification etc., the same will be rejected. If they have to note anything, they shall note the same as a foot note at the bottom of the page.

7. The contractor is bound to carry out items of works which are not expressly or impliedly described in the tender schedule, plants, specifications and agreement but which are found necessary for the proper completion of the work during execution.

8. It will be the responsibility of the contractor to obtain necessary land for stacking the materials, for arranging the work.

9. Aggregate of the required sizes alone should be brought to the site of the work. Breaking boulders or rubble into aggregate will not be allowed either on or the side of the road. Aggregate should be stacked on one side of the road only and in such

a way as not to cause any hazards to traffic. The stacks should be formed as per the standards profile current in the department.

10. Granite stone metal supplied should be sound, hard, tough and durable, free from any decayed matter and of uniform colour and texture. Each piece should have sharp angular edges. The aggregate should not also contain any quarry dust or earth.

Siliceous gravel shall consist of only hard nodules not more than 40mm. nor less than 6mm dia, in any direction, scraped from the hill side and free from admixture of earth or laterite chips.

11. Sand supplied should be clean, sharp and gritty to the touch, free from clay and other impurities and obtained from running water sources.

12. Excess supplies or deficiency in supplies over 10 percent however will be accepted only at the discretion of the Chief Engineer subject to its being penalized at half of the agreed rates. The maximum penalty shall however be limited to 10 percent of the contract.

13. The contractor will have to make his own arrangements to convey all materials supplied and for stacking, of materials and site shed, etc., which are found necessary for the proper execution of the work. He will also be responsible for the safe custody of the materials till they are used on works.

14. The payment of the earth items will be made as per level measurements or tape measurements as per rules prevailing in the department.

15. All items should be carried out as per the relevant specification in the M.D.S.S. and all clauses of preliminary specification should be complied with.

16. The moulds, shuttering etc., required for the work should be made by the contractor and got approved by the departmental officers at site before use.

17. The contractor alone is responsible for the safety of his labourers and damages, if any payable under: Workmen's Compensation Act' will be to his debit.

18. It shall be the contractor's responsibility to protect the public and his employees against accident from any cause during execution of the work and he shall intimate the Government against any claims for injury to person or property resulting from any such accident, and he shall, where provision of the "Workmen's Compensation Act" apply, take steps to properly insure against any claims there under.

19. The contractor shall be liable for any loss caused by the Government on account of the above work including any that may arise due to non-fulfillment of the contract. He should comply with the rules laid down in the Central P.W.D. contract regulations regarding fair wages.

20. The work shall be completed in all respects and also at the rate of progress within the time limit and stipulations, failing which the contactor is liable to the fined.

21. Defects, if any noticed within 36 months from the date of completion of the work will be got rectified by the contractor, in default of which this will be attended by the department and the cost made good from the contractor.

22. The contractor should produce latest sales tax and income tax clearance certificate for receiving final payment.

23. The contractor shall be responsible for the payment of all commercial taxes as per rules in force from time to time and rates quoted for various items remain unaffected by any changes that may be made from time to time in the rate at which such tax is levied. Sales tax and Income tax due to Government from the contractor will be recovered from his bill for the work as per the advice of the authorities concerned.

24. All sums due to the Government under or by virtue of this contract shall be recoverable first from the security furnished by the contractor and if the same is found insufficient, such deficit amount shall be recoverable under the provisions of the Revenue Recovery Act for the time being in force as though the same were arrears of Land Revenue or in any other manner ‘as the Government may deem fit.

25. The contractor agrees that before final payment shall be made on the contract, he will sign and deliver to the Chief Engineer either in the measurement book or otherwise as demanded, a valid release and discharge from any and all claims and demands whatsoever for all matters arising out or connected with the contract. Provided that nothing in this clause shall discharge or release the contractor from his liabilities under the contract. It is further expressly agreed that the Chief Engineer in supplying the final measurement certificate need not be bound by the preceding measurement and payments. The final measurements, if any, of the Chief Engineer shall be final, conclusive and binding on the contractor.

26. 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 NGS the sum equivalent to 0.5% of the agreed PAC per week of delay calculated on each day basis and upto a maximum of 10% of agreed 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 NGS from any money due or that may become due.

27. The contractor would engage at his own cost one Engineering Graduate and one diploma holder (Civil Engineering) for works costing Rs. 10 lakhs upto 25 lakhs and according to the tenure of contract.

28. All other conditions and specifications of contract are the same as those current in the department.

29. The method of measurements will be as per Indian Standard 1200-1958.

30. All concrete should be machine mixed and vibrated.

31. Stage payment towards interim bills shall be made by NGS as given below

    a) 1st part bill - On completion of WBM

    b) 2nd part bill - On completion of Asphalt

    c) 3rd part bill - On completion of fencing & lighting

    d) 4th part bill - On execution of accrylic Flooring

    :

    60% on delivery of Material at site.

    30% on completion of laying satisfactorily

    10% after completion of the defect liability period

32. On expiry of the defects liability period or on payment of the amount of the Final Bill whichever is later, the Engineer-in-charge, shall recommend on demand from the contractor to refund to him the security deposit & retention money and the same will be refunded by NGS provided that the Engineer-in-charge is satisfied that there is no demand outstanding against the Contractor

FAIR WAGE CLAUSE

(a) The contractor shall pay not less than fair wage to labourers engaged by him on the work.

"Fair Wage" means wage whether for time or piece work notified at the time of inviting tenders for the work and where such wages have not been so notified, the wage prescribed by the Central P.W.D. for the District in which the work is done.

(b) The contractors shall, notwithstanding the provisions of any contract to the contrary, cause to pay a fair wage to labourers indirectly engaged on the work including any labour engaged by his sub contractor in connection with the said work as if the labourers had been immediately employed by him.

(c) In respect of all labour directly or indirectly employed in the works for the performance of the contractor's part of this agreement the contractor shall comply with or cause to be complied with (the Central P.W.D. Contractor's labour) regulations made by Government in regard to payment of wages, wage period deductions from wage, recovery of wage not paid and deduction unauthorisedly made, maintenance of wage register, other terms of employment, inspection and submission of periodical returns and all wage cards, publication of scale of wages and returns and all other matters of a like nature.

(d) The Chief Engineer or his subordinate concerned shall have the right to deduct from the amount due to the contractor and any sum required or estimated to be required for making good the loss suffered by a worker or workers by reasons of non-fulfillment of the conditions of the contract for the benefit of the works, non-payment of wages or deductions made from his or their wages which are not justified by their terms of the contract or non-observance of the regulations.

(e) The regulation aforesaid shall be deemed to be a part of this contract and breech thereof shall be a breach of this contract.

CLAUSE 45 OF M.D.S.S. – Accidents-

Hoarding-Lighting-Observations-

Watchmen

(a) When excavations have been made or obstacles have been put in public thoroughfares or in places where there is any likelihood of accidents, the contractor shall comply with any requirement of law on the subject, and shall provide suitable boarding, lighting and watchmen as necessary.

(b) It shall be the contractor's sole responsibility to protect the public and his employees against accident from any cause and he shall indemnify Government against any claims for damages for injury to person or property, resulting from any such accidents and he shall, where the provisions of the Work-men's Compensation Act, apply, take steps to property insure against any claims there under.

(c) On the occurrence of an accident which results in the death of any of the workmen employed by the contract or which is so serious as to be likely to result in the death of any such workmen, the contractor shall within 24 hours of the happening of such accidents, intimate in writing to the Chief Engineer, the fact of such accident. The contractor shall indemnify the NGS against all loss or damage sustained by the NGS resulting directly or indirectly from his failure to give intimation in the manner aforesaid including the penalties or fines if any payable by the NGS as a consequence of Government's failure to give notice under the Workmen's Compensation Act or otherwise conform to the said Act in regard to such accident.

(d) In the event of an accident in respect of which compensation may become payable under the Workmen's Compensation Act (VIII of 1923) whether by the contractor or by the Government as principal is shall be lawful for the Chief Engineer to retain out of moneys due and payable to the contractor such sum or sums of money as may, the opinion of the said Chief Engineer, be sufficient to meet such liability. The opinion of the Chief Engineer shall be final in regard to all matters arising under this clause.

Contractor Chief Engineer, NGS

Notice to proceed with the work

…….2013

To

……
……..
……..

Dear Sirs:

Signing of the contract agreement for the construction of Multisport Synthetic courts @ a Bid Price of Rs……../-, you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents.

Yours faithfully,

Chief Engineer
National Games Secretariat

Tenderer Chief Engineer

NATIONAL GAMES SECRETARIAT
SPECIFICATIONS

PART I GENERAL

1. The rates tendered by a Contractor for the work shall include the cost of

   (a) All labour and supervision thereof, all materials, tools and plant of every description, machinery, cordage, tackle etc. as well as the provision of safe and substantial scaffolding required for the proper execution of the work in conformity with the specifications for the various terms of works.

   (b) Supplying the requisite agency with necessary equipments, to set out the work as well as to provide facilities for such examination of the work as the Board Officers may at any time be considered desirable, as also to count, weigh and assist in the measurement or check measurement of the work or materials.

   (c) Providing and maintaining temporary fences, shelters, lights, watchmen and danger signals and such other precautions as are necessary for the protection of the work or materials, as well as to protect the public and those connected with the work from accidents at the site, of or on account of the work.

   (d) All sheds, and mixing platform of every kind required for the proper execution of the work according to the specifications.

   (e) All fees and royalties of materials; and

   (f) Finally clearing away of all rubbish, surplus materials, plants etc. on completion of the work and dressing and levelling off and restoring the site to a tidy condition, prior to handing over the work to the Chief Engineer or his authorized assistant and also its maintenance until so taken over.

2. In the case of supplies of materials such as rubble, broken stones, gravel, sand etc., which may have to be measured prior to being used for the work, the Contractor must always stack or arrange them neatly on level ground or on ground cleared and levelled by him for the purpose in such manner as may be ordered by the Officer-in-charge so that it may be easily susceptible to inspection and measurement, the cost of such clearing, levelling and stacking or arranging being included in the rates for work. Each stack must be straight and of uniform section throughout and of dimensions specified by the Officer-in-charge. Materials not stacked or arranged in accordance with the instructions issued will not be measured and paid for.

3. The Contractor shall be bound to bear the expenses of defense of any action or legal proceedings that may be brought by any person for any injury sustained owing to neglect of above precautions in connection with the execution of the work, and to pay any damages and cost which may be awarded in consequence.

4. The Contractor shall also help himself out of any difficulties of penalties arising from interference with private property in the execution of the contract.

5. The tenderer should state whether he has all the plants necessary for execution of the work. If in the opinion of the Chief Engineer, Contractor's own plant is neither sufficient not suitable for the proper execution of the work, the Contractor has to hire other additional plant and machinery at his expense and no additional cost shall be

payable to the Contractor on this account by the CEO and Secretary. The Chief Engineer's decision in the matter shall be final and binding on the Contractor.

6. Unless otherwise specifically provided for in the contract, the Contractor shall at his own cost keep all portions of the work free from flooding whether due to springs, soakage or inclement weather and in a neat and sanitary condition and shall also see that drainage and sewage are prevented from entering the site of work or accumulating therein.

7. The Contractor shall be responsible for the proper use and bear the cost of protection of materials made over to him by the Department for use on the work and bear any loss from deterioration or from faulty workmanship or any other cause. The cost of materials thus allowed to deteriorate amounting as it does to an excess issue over sanctioned quantities, will be recovered at the rate of 20 percent over the actual cost. The orders of the Chief Engineer in the matter shall be final and binding on the Contractor.

8. The Contractor shall be responsible to see that the level or other pegs, profiles, bench marks, masonry pillars or other marks set up by the department for guidance in the execution of the work are not disturbed, removed or destroyed. If any such marks are in the opinion of the Chief Engineer found disturbed, removed or destroyed, they will be replaced by the Board at the cost of the Contractor.

9. Any materials brought to the site of the work or any work done by the Contractor but rejected by the Officer-in-charge as being not up to the specification shall be then and there removed from or broken up at the site of work, and in the case of work done be dismantled or rectified at the expenses of the Contractor, as may be ordered by the Officer-in-charge.

10. In all cases whether so specified in the contract or not, the work shall be executed strictly in accordance with the Contractor's accepted tender and these specifications and with such further drawings and specifications and order as may from time to time be issued by the Chief Engineer.

11. Whenever the Contractor is ordered by the Chief Engineer or his authorized Assistant or Subordinate to execute any extra item work which is not in the tender schedule it shall be the contractor's duty to get a special price arranged for the item and see that it is written in the work spot order book (which shall be provided by the Chief Engineer and kept in the work site by the subordinate-in-charge) and that this order is initialed and dated by the Contractor and the officer ordering that particular item of work. For any extra item executed by the Contractor and not so entered in the work spot order book and got initialed both by the Contractor and the Department Officer ordering such extra item, the Contractor shall have no claim for extra payment.

12. Any dispute or difference that may arise between the Chief Engineer and the Contractor on account of the contract shall at the instance of either party be referred to the Chief Executive Officer, National Games Secretariat whose decision given in writing shall be final, conclusive and binding. The Chief Engineer may at his discretion delegate in writing to any of his subordinate any of these powers regarding these Specifications.

Signature of tenderer …….

(Sd.)

TECHNICAL SPECIFICATIONS

1. 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.

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

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

5.1.00 EARTH WORK

5.1.1 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.

5.1.2 General

5.1.2.1 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.

5.1.2.2 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.

5.1.2.3 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.
5.1.2.4 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.
5.1.2.5 The trenches which are ready for concreting shall be got approved by the Engineer.
5.1.2.6 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.
5.1.2.7 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.

5.1.2.8 **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.

5.1.3 Classification

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

5.1.3.1 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 excavted 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 dm^3. Rubble masonry to be dismantled below ground level will also be measured under this item.

5.1.3.2 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.

5.1.3.3 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.

5.1.4 Blasting in rocks

5.1.4.1 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.

5.1.4.2 Specific permission of Engineer will have to be taken by Contractor for blasting rock and he shall also obtain a valid blasting licence 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.

5.1.4.2.1 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.

5.1.4.2.2 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.

5.1.5 Filling in plinth with selected excavated earth

5.1.5.1 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.

5.1.5.2 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.

5.1.6 Filling excavated earth in ground for land development

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

5.1.6.2 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.

5.1.6.3 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.

5.1.6.4 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.

5.1.6.5 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.

5.1.7 Filling in plinth and ground with earth brought from outside

5.1.7.1 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.

5.1.7.2 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.

5.1.7.3 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.

5.2.00 CONCRETE AND ALLIED WORKS

5.2.1 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.

5.2.1.1 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

5.2.1.2 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

5.2.1.3 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

5.2.1.4 Construction Safety

1) IS 3696 : Safety code for scaffolds and ladders

5.2.1.5 Measurement

1) IS 1200 :Method of measurement of building works

IS 3385 :Code of practice for measurement of civil engineering works

5.2.2 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.

5.2.3 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.

5.2.3.1 Cement

5.2.3.1.1 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 Pozolana 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.

5.2.3.1.2 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.

5.2.3.2 Aggregates

5.2.3.2.1 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.

5.2.3.2.2 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.

5.2.3.2.3 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.

5.2.3.2.4 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.

5.2.3.2.5 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.

5.2.3.2.6 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

5.2.3.3 Water

5.2.3.3.1 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.

5.2.3.3.2 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.

5.2.3.4 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.

5.2.4 Mix Design

5.2.4.1 Classification

5.2.4.1.1 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	40 or 20
M 30	28.0	42.0	20.0	33.0	40 or 20
M 25	23.5	35.0	17.0	28.0	40 or 20
M 20	19.4	29.0	13.5	22.0	40 or 20
M 15	14.0	17.0	10.0	16.0	40 or 20

5.2.4.1.2 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.

5.2.4.1.3 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.

5.2.4.1.4 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.

5.2.4.1.5 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.

5.2.4.2 Preliminary tests

5.2.4.2.1 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.

5.2.4.2.2 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.

5.2.4.2.3 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.

5.2.4.2.4 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 reminder 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.

5.2.4.2.5 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:

5.2.4.2.6 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.

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

5.2.4.2.8 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.

5.2.4.2.9 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.

5.2.4.3 Proportioning, consistency, batching and mixing of concrete

5.2.4.3.1 **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.

5.2.4.3.2 **Cement**

The cement shall be measured by weight.

5.2.4.3.3 **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.

5.2.4.3.4 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.

5.2.4.3.5 Consistency and slump

Concrete shall be of a consistency and worability 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.

5.2.5 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	Very low	

Mass concrete: Lightly reinforced sections in slabs, beams, walls, columns: Floors; Hand placed pavements; Canal lining; Strip footings	Low	25-75
Heavily reinforced sections in slabs, beams, walls, columns; Slipform work; Pumped concrete	Medium	50-100 75-100
Trench fill; *In-situ pilling*	High	100-150
Tremie concrete	Very high	

5.2.6 Sampling and testing concrete in the field

5.2.6.1 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

5.2.6.2 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.

5.2.6.3 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.

5.2.7 Admixtures

5.2.7.1 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.

5.2.7.2 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.

5.2.7.3 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.

5.2.7.4 Retarding admixtures

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

5.2.7.5 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.

5.2.8 Optional tests

5.2.8.1 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) pertrographic 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.
5.2.8.2 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.

5.2.9 Preparation prior to concrete placement

5.2.9.1 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.
5.2.9.2 The various agencies shall be permitted ample time to install drainage and plumbing lines in floor and treech 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.
5.2.9.3 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.
5.2.9.4 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.
5.2.9.5 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.
5.2.9.6 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.
5.2.9.7 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.
5.2.9.8 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.
5.2.9.9 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.

5.2.10 Transportation

5.2.10.1 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.

5.2.10.2 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.

5.2.10.3 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.

5.2.11 Procedure for placing of concrete

5.2.11.1 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.

5.2.11.2 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.

5.2.11.3 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.

5.2.11.4 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.

5.2.11.5 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.

5.2.11.6 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.

5.2.11.7 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.

5.2.11.8 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.

5.2.11.9 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.

5.2.11.10 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.

5.2.11.11 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.

5.2.11.12 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.

5.2.11.13 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.

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

5.2.12 Compaction

5.2.12.1 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.

5.2.12.2 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.

5.2.12.3 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.

5.2.12.4 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.

5.2.12.5 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.

5.2.12.6 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.

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

5.2.12.8 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.

5.2.12.9 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.

5.2.13 Placement interval

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

5.2.14 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.

5.2.15 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.

5.2.16 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.

5.2.17 Curing, protecting, repairing and finishing

5.2.17.1 Curing

5.2.17.1.1 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.

5.2.17.1.2 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.

5.2.17.1.3 Curing of concrete made of high alumina cement and supersulphated cement shall be carried out as directed by Engineer.

5.2.17.1.4 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.

5.2.17.1.5 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.

5.2.17.1.6 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.

5.2.17.1.7 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 these area. The ponded area shall be kept continuously filled with water during the curing period.

5.2.17.1.8 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.

5.2.17.1.9 All equipment and materials required for curing shall be on hand and ready for use before concrete is placed.

5.2.17.2 Protecting fresh concrete

5.2.17.2.1 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.

5.2.17.3 Repair and replacement of unsatisfactory concrete

5.2.17.3.1 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.

5.2.17.3.2 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.

5.2.17.3.3 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.

5.2.17.3.4 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.

5.2.17.3.5 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.

5.2.17.3.6 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.

5.2.17.3.7 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.

5.2.17.3.8 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.

5.2.17.3.9 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.

5.2.17.4 Finishing

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

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

5.2.17.4.3 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.

5.2.17.4.4 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.

5.2.17.4.5 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.

5.2.17.4.6 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.

5.2.17.4.7 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 abrassive. 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.

5.2.18 Form Work

5.2.18.1 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 dismandling of the formwork.

5.2.18.2 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.

5.2.18.3 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.

5.2.18.4 Form work requirements

5.2.18.4.1 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.

5.2.18.4.2 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.

5.2.18.4.3 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.

5.2.18.4.4 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.

5.2.18.4.5 Formwork, during any stage of construction showing signs of distortion or distored 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.

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

5.2.18.4.7 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.

5.2.18.4.8 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.

5.2.18.5 Formwork For Slope Surfaces

5.2.18.5.1 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.

5.2.18.5.2 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.

5.2.18.6 Formwork for Curved Surfaces

5.2.18.6.1 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.

5.2.18.6.2 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.

5.2.18.7 Formwork for Exposed Concrete Surfaces

5.2.18.7.1 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.

5.2.18.7.2 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.

5.2.18.7.3 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.

5.2.18.7.4 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.

5.2.18.7.5 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 abrupting irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

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

5.2.18.7.7 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.

5.2.18.7.8 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.

5.2.18.7.9 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.

5.2.18.7.10 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.

5.2.18.7.11 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.

5.2.18.8 Bracings struts and props

5.2.18.8.1 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.

5.2.18.8.2 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.

5.2.18.9 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.

5.2.18.10 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.

5.2.18.11 Wall ties

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

5.2.18.12 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.

5.2.18.13 Removal of forms

5.2.18.13.1 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.

5.2.18.13.2 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.

5.2.18.13.3 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 proos 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 ii) Spanning over 4.5m.	 7 days 14 days	 4 days 8 days
e)	Removal of props to beams & arches i) Spanning upto 6m ii) Spanning over 6m	 14 days 21 days	 8 days 12 days

5.2.18.13.4 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.

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

5.2.18.13.6 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.

5.2.18.13.7 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.

5.2.19 Reinforcement Steel

5.2.19.1 General

5.2.19.1.1 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.

5.2.19.1.2 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.

5.2.19.1.3 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.

5.2.19.1.4 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:

5.2.19.2 Providing, fabricating and placing in position reinforcement steel

5.2.19.2.1 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.

5.2.19.3 Bending

5.2.19.3.1 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.

5.2.19.3.2 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^{o}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.

5.2.19.4 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 anhealed 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.

5.2.19.5 Cover

5.2.19.5.1 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.

5.2.19.6 Inspection

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

5.3.00 FINISHING WORKS

5.3.1 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

5.3.2 Plastering

5.3.2.1 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.

5.3.2.2 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. 5.3.2.3 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.

5.3.3 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.

5.3.4 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.

LIST OF APPROVED MAKES

1	Cement	Malabar, Ultra Tech, Zuari, Ramco, ACC, India Cements or any other approved brand
2	Steel	Tata, Vizag, SAIL, TISCO or equivalent as approved

5.4 PARTICULAR SPECIFICATION-ELECTRICAL WORKS

5.4.1 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.

5.4.2 Details of Tender

The tender specifications consists of 5 sub heads as shown below:

1. Cables and Cabling
2. Earthing
3. Installation.
4. Measurement.
5. 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.

5.4.3 Cables & Cabling

5.4.3.1 Scope

The scope under this section covers the following:

a) Power cables (LV)
b) Control cables

5.4.3.2 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.

5.4.3.3 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.

5.4.3.4 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.

5.4.3.5 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.
3.	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.

5.4.3.6 Power cables (LV) 415 V gradeXLPE / 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.

5.4.3.7 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.

5.4.3.8 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.

5.4.3.9 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.)

5.4.3.10 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.

5.4.3.11 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.

5.4.3.12 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.

5.4.3.13 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.

5.4.4 INSTALLATION

5.4.4.1 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.

5.4.4.2. 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.

5.4.4.2.1 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 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.

5.4.4.2.2 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

5.4.4.2.3 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.

5.4.4.2.4 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.

5.4.4.2.5 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.

5.4.4.2.6 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 grounted 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.

a) Cables shall be fixed in cable trays in single tier formation and shall be clamped with aluminium flat clamps and galvanised bolts/unit.

b) Earthing flat/wire can also be laid in cable tray along with cables.

c) After laying of cables minimum 20 % area shall be spare.

5.4.4.2.7 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.

5.4.4.2.8 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.

5.4.4.2.9 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.

5.4.4.2.10 **Proforma for Testing Cables**

Proforma - A

Date of Test

a) Drum No. from which cable taken

b) Cable from to

c) Length of run of this table 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-3..... 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.			

Tenderer Chief Engineer

R-N	R-N
Y-N	Y-N
B-N	B-N
R-Y	R-Y
B-R	B-R
Y-B	Y-B
R-E	R-E
Y-E	Y-E
B-E	B-E

Signature of
Engineer-in-Charge

Signature of
Contractor

Proforma – C

Cable Jointing

(To be shown for each cable separately, voltage wise)

Date(s) of Test:.....
Voltage of Megger used:.....

	1	2	3
Number of Joint			
Location			
Type of cable(s)			
Type of joint (Indoor/Outdoor, straight through/termination, LV/MV/HV)			

Insulation resistance (Mega ohm) before jointing

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
Cable II -	(a) Between	R & Y
		Y & B
		B & R

Tenderer

Chief Engineer

	(b) Between	R & N
		Y & N
		B & N
	(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:.....

(i) 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
	Y & E
	B & E
	N & E

b) FEEDER PILLAR:-

i) Pillar Number:

ii) Voltage of megger used:

iii) Result of megger testing:

5.4.5 Earthing

5.4.5.1 Scope

The scope of this section shall cover the following:
a) Earthing station

b) Earthing conductors
c) Earthing of equipment and installation

5.4.5.2 Standards

The following standards shall be applicable:

IS : 3043 COP for earthing
IS : 5216 Safety procedures & practice in electrical work

5.4.5.3 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.

5.4.5.4 Electrodes

a) 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.

5.4.5.5 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.

5.4.5.6 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.

5.4.5.7 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.

5.4.5.8 Marking

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

i) 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

5.4.6 MEASUREMENT

5.4.6.1 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.

5.4.6.2 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.

5.4.6.3 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.

5.4.6.4 Battery Limit

Scope of work includes:

1. Cable laying, termination at both ends, testing & commissioning of LT cables from DB to flood lights.

3. Earthing system includes supply, installation and testing of earth pits and relevant earth conductors as per specification flood lights etc.

4. 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.

5. 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 flood lights.

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.**

6.0 MAKE OF MATERIALS

6.1 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.

6.2 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.

6.3 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, V-Guard
2	Cable glands, lugs, End termination kits	Lapp Kabel, Gripwel, HMI, Denson, Multipressings, Yamuna Gasses.
3	Light fitting	Philips, Wipro, Bajaj, Crompton, K-lite
4	Light pole	Bajaj, Unique Pole, Metal Coats