TWO COVER SYSTEM

STATE INDUSTRIES PROMOTION CORPORATION OF TAMIL NADU LIMITED,

19-A, RUKMANI LAKSHMIPATHY ROAD, EGMORE, CHENNAI-8

T. No. 21/2022-23

TENDER DOCUMENT

(PRICE BID – COVER-II)

FOR

Name of work : Formation of Approach Road from Km 143/4 of NH-44 to SIPCOT Industrial Park, Dharmapuri.

EMD Rs. 7,07,300/-

TENDER DUE ON 23.08.2022

TENDER SUBMITTED TO:

THE MANAGING DIRECTOR,
SIPCOT LIMITED,
NO.19-A, RUKMANI LAKSHMIPATHY ROAD,
EGMORE, CHENNAI-600 008.

STATE INDUSTRIES PROMOTION CORPORATION OF

TAMIL NADU LIMITED, CHENNAI-8

TENDER DOCUMENTS

FOR THE WORK OF

NAME OF WORK: FORMATION OF APPROACH ROAD FROM KM 143/4 OF NH-44 TO SIPCOT INDUSTRIAL PARK, DHARMAPURI.

PRICE BID DOCUMENTS

PART-II

(SECTION-I TO X)

LAST DATE FOR SUBMISSION – 23.08.2022

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SECTION-I

INSTRUCTIONS TO TENDERERS

1. SCOPE OF THE TENDER:

This is a "Lumpsum comprehensive Contract" and the contractor is responsible for the execution of development of infrastructures such as roads, drains and building works including the supply delivery and laying of all materials, machineries, equipments etc. and testing in accordance with the specifications stipulated in the Bid Document and in conformity with the Quality Parameters laid down in the relevant BIS, MORT & H, TNBP, TWAD, CEIG, IE & TNEB rules & regulations etc. and completing the entire works in all respects satisfactorily and commissioning within the stipulated period.

1.1. The Managing Director (hereinafter referred as "Employer" in these documents) invites bids for the construction of works (as defined in these documents and referred as "the works") as detailed in the Bill of Quantities. The bidder shall submit unit price both in figures and in words for all the items of work detailed in the BOQ. Line total, page total and cumulative total tender amount shall be worked out and furnished in figures without fail.

1.2. The successful bidder should complete the works within the period stipulated for completion in the Programme Schedule.

1.3. In these tender documents, the terms bid and tender and their derivatives (bidder, tenderer, bid, tender, bidding, tendering etc.) are synonymous.

SPECIAL INSTRUCTIONS TO THE TENDERERS

The Bidders should carefully go through the following and tender schedule and quote their rates for all the items.

1.1. All machineries referred in Schedule-G of the Technical Bid shall be deployed till the completion of the works by the contractor. Proof or evidence for completing the special nature of work within the specified period shall be enclosed with the tender.

2. ONE BID PER BIDDER

2.1. Each bidder shall submit only one bid for the whole scheme and in the case of packages, only one bid for a package.

3. COST OF BIDDING

3.1. The bidder shall bear all the costs associated with the preparation and submission of his bid. The Employer will in no case be responsible for those costs, regardless of the conduct or the outcome of the bidding process.

3.2. The unit rates offered shall be inclusive of All Taxes and levies by the Central or State Governments or Local Authority as applicable excluding GST including any variation during contract period and any agreed extension of time. No claim in respect of Tax and levies by the Central or State Governments or Local Authority whether existing or future shall be entertained. Rates shall also be inclusive of all incidental charges and charges for taking all Insurance Policies, such as CAR Policy, Workmen's Compensation, Third Party Liability, Transport Policy, etc.

3.3. The tenderer shall quote the rates and prices for all the items of the works described in the bill of quantities excluding GST at the end (both in figure and words)

3.4. The unit rates offered shall be for finished work at site

4. SITE VISIT

4.1. The bidder, at the bidder's own responsibility and risk is advised to visit and examine the site of work and its surroundings and obtain on his own, all information that may be necessary for preparing the bid and entering into contract for the construction of the works. The costs of visiting the site and its surroundings shall be at the bidder's expense. Site levels, soil data made available, are only for the information of bidder and the Employer is not responsible for their correctness.

4.2. The bidder and any of his personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder, his personnel or agents, will release and indemnify the Employer and his personnel or agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs and expenses incurred as a result of the inspection.

5. JURISDICTION OF COURT

In the event of any dispute arising between the parties hereto in respect of any matter comprised in the contract, the same shall be settled by High Court having jurisdiction over the place at Chennai where the contract is awarded and agreement is concluded and by no other Court.

CONTRACTOR

6. ARBITRATION

a. APPEAL: Except in the matters where the decision of the Engineer-in-Charge is said to be final, if the contractor believes that the decision of the Engineer-in Charge was either outside the authority given to the Engineer in Charge by the contract or that decision was wrongly taken inviting extra expenditure over the price stipulated or not contemplated in the agreement, then the contractor shall appeal to the Employer within thirty days of the decision of the Engineer in charge. During the appeal, the Employer will give an opportunity to the Contractor for being heard and adduce evidence if the latter so desires, in support of his appeal. The Employer shall give his decision within forty-five days.

b. If the Contractor is dissatisfied with the decision of the Employer, the contractor shall within thirty days from the receipt of the decision, give notice to the Employer for appointment of arbitrator failing which the said decision of the Employer shall be final and conclusive not referable to Arbitration.

c. On receipt of notice from the Contractor, the Employer within thirty days shall send to the Contractor, a panel of three serving or retired officers not below the rank of Managing Director. The Contractor shall within fifteen days of the date of receipt of such panel, select one name from the panel and communicate the same to the Employer, who will appoint the sole arbitrator immediately.

d. If the Contractor fails to communicate his selection of name within the stipulated time, the Employer shall without delay select one from the panel and appoint the sole arbitrator under intimation to the Contractor.

e. The arbitration shall be conducted in accordance with the Provisions of Arbitration and Conciliation (Amendment) Act, 2019.

f. Performance under the contract shall continue during arbitration and payments due to the contractor shall not be withheld unless they are subject matter of arbitration proceedings or ordered by the arbitrator to the contrary.

g. It is also a term of this contract that if the contractor does not make any demand for appointment of arbitrator in respect of any claims in writing within thirty days of the decision in appeal from the Employer, the claim of the contractor shall be deemed to have been settled absolutely and the Employer shall be discharged and released from all liabilities under this contract.

CONTRACTOR

PART-II

PRICE BID

SECTION-II

DETAILED TENDER NOTICE

PART-II
PRICE BID
SECTION-II
DETAILED TENDER NOTICE FOR PRICE BID

1. For and on behalf of State Industries Promotion Corporation of Tamilnadu Limited sealed tenders are invited by The Managing Director, SIPCOT, Chennai-8 for the work of "Formation of Approach Road from Km 143/4 of NH-44 to SIPCOT Industrial Park, Dharmapuri". Price Bid (Cover-II) of the pre-qualified tenderers alone will be opened at a date to be fixed and communicated only to the pre-qualified tenderers. The tenderers or their authorised agents are expected to be present at the time of opening of the Price Bid. The Tender Opening Authority / SE SIPCOT will open each Price Bid and prepare a statement of the attested and unattested corrections therein and hand it over to the tenderer concerned and initial all such corrections in the presence of the tenderer. If any of the tenderers or their agents find it inconvenient to be present at the time, then in such a case, the tender receiving officer will open the tender of the absentee tenderer, make out a statement of the unattested corrections and communicate it to him. The absentee tenderer shall then accept the statement of corrections without any question whatsoever.

2. Tenders must be submitted in sealed covers and should be addressed to the Managing Director, State Industries Promotion Corporation of Tamilnadu Limited, Chennai-8. The name of the tenderer with address and the name of the work must be superscribed on the cover as per Clause-14 of Pre-Qualification Tender Notice (Section-II of Technical Bid Documents).

3. When a tender is to be accepted, the tenderer whose tender is under consideration shall attend the SIPCOT Office, Chennai-8 before the end of the period specified by written intimation to him. If the tenderer fails to attend the office before the end of the period so specified, his tender will not be considered. He shall forthwith upon intimation being given to him by the SIPCOT, of acceptance of his tender, shall produce the balance amount of Security Deposit as specified in Clause-9 of the Pre-Qualification Tender Notice accompanying the Technical Bid Documents (Section-II of the Technical Bid Documents) and Non-Judicial Stamp Paper for the value of Rs.100/- for preparing agreement. He shall then sign the original agreement first, which will be accepted and signed by the Competent Authority of SIPCOT. If Consortium of Contractors happens to be the successful tenderer, the agreement shall be signed by all the Constituent Partners of the Consortium. The security deposit together with the Earnest Money Deposit and the amount withheld shall be retained as security for the due fulfillment of his contract. Failure to enter into the required agreement or to make the security deposit as defined in this paragraph within 15 days from the intimation shall entail forfeiture of the earnest money. The written agreement to be entered into between the contractor and the SIPCOT shall be the foundation of the rights of both the parties and the contract shall not be deemed to be complete until the agreement has first been signed by the contractor and then by the proper officer authorised to enter into contract on behalf of SIPCOT.

CONTRACTOR

4. The tenderer shall examine closely the Tamilnadu Building practice specifications and sign the copy of the detailed standard specifications and its amendments volume in token of such study before signing the contract documents. Unit rates shall be for finished work in the site. He shall also carefully study the drawings and additional specifications and all the documents, which form part of the agreement to be entered into by the accepted tenderer. The Tamilnadu Building Practice Specifications and other documents connected with the contract such as specifications, plans, descriptive specifications sheets regarding materials etc. can be seen during office hours from 10.00 am to 5.45 pm on any working day in the office of the SIPCOT, Chennai-8.

5. The tenderer's attention is directed to the requirement for materials under the clause "Materials and workmanship" in the 'Preliminary specifications". Materials conforming to the Indian Standard specifications shall be used on the work and the tenderer shall quote his rates accordingly.

6. Every tenderer is expected before quoting his/their rates to inspect the site of the proposed work, and the quarries where the materials, conforming to the standards and specifications is available sufficiently and he /they also shall have to examine and ascertain the lead involved from the quarries selected by them to the work site before quoting his rates and satisfy himself/themselves about the quality and availability of materials. Once the tenderer has quoted his/their rates, it is to be concluded that he / they have taken into account all the leads involved, availability of sufficient quantity of materials etc. Any litigation, later on in this regard will not be entertained. The best class of materials to be obtained from the quarries or other source defined shall be used on the work. In every case the materials must comply with relevant standard specifications or as specified in this tender notice or as required by the SIPCOT Officer in charge of the work. In any case, samples shall be submitted for the approval of the Engineer-in-charge of the work before the supply to site of work. The SIPCOT will not however after acceptance or contract rates, pay any extra charges for lead or for any other reason in case the contractor has found later on to have misjudged the materials available. Attention of the contractor is directed to the standard "Preliminary Specification" regarding payment of seigniorage, tolls etc.

7. The tenderer's particular attention is drawn to the sections and clauses in the standard 'Preliminary specifications' dealing with

1. Test, Inspection and Rejection of Defective Materials and work
2. Carriage
3. Water and Lighting
4. Cleaning up during progress and for delivery
5. Construction Plant
6. Accidents
7. Delays
8. Particulars of payment

CONTRACTOR

The contractor should closely peruse all the specification clauses, which govern the rates for items for which he is tendering.

8. A schedule of quantities accompanies this Price Bid Documents. It shall be definitely understood that the SIPCOT does not accept any responsibility for the correctness or completeness of this schedule and that this schedule is liable to alteration by omissions, deductions or additions at the discretion of the SIPCOT Officer in charge of the work, or as set-forth in the conditions of contract. The tenderer will however, base his lump sum tender on this schedule of quantities. He should quote specific rates for each item in the schedule and the rates should be in rupees and paise. The rates should be written both in words and in figures and the units in words. The tenderer should also show the totals of each item, page total and the grand total of the whole contract and quote in the tender a lump sum for which he will undertake to do the whole work subject to the conditions of contract, such lump sum agreeing with the total amount of schedule. This schedule accompanying the lump sum tender shall be written legibly and free from erasures, overwriting or conversions of figures. Corrections, where unavoidable, should be made by scoring out, initialing, dating and re-writing.

9. Tenders offering a percentage deduction from or increase on the estimate amount and those not submitted in proper form/or in due time will be rejected. Rates of lump sum amounts for items not called for shall not be included in the tender. No alteration which is made by the tenderer in the contract form, the conditions of contract, the drawings, specifications or quantities accompanying the same will be recognized and if any such alterations are made, the tender will be deemed to be void.

10. The tenderer should workout his own rates without reference being made to the SIPCOT estimate rates which are not open for inspection by tenderers.

11. No material will be supplied by SIPCOT. All materials conforming to the standard and specification should be procured. Rates should be quoted taking into account the quality and lead involved from quarry to work site.

12. The attention of the tenderers is directed to the contract requirements as to the time of beginning work, the rate of progress and the dates for the completion of the whole work and its several parts. The following rate of progress and proportionate value of work done from time to time as will be indicated by the SIPCOT Officer's certificates of the value of work done will be required. Date of commencement of this programme will be the date on which the site (or premises) is handed over to the contractor.

CONTRACTOR

The programme / schedule for completion of the project shall be as follows:-

IMPLEMENTATION SCHEDULE

PERIOD OF COMPLETION – (6 MONTHS) CALENDAR MONTHS

Period after date of commencement	**SCHEDULE-A**
First Month	10% (Ten percentage)
Upto Second Month	20% (Twenty percentage)
Upto Third Month	40% (Forty percentage)
Upto Fourth Month	60% (Sixty percentage)
Upto Fifth Month	80% (Eighty percentage)
Upto Sixth Month	100% (Hundred percentage)

13. No part of the contract shall be sublet without written permission of the SIPCOT nor shall transfer be made by power of attorney, authorizing others to receive payment on the contractor's behalf.

14. If further necessary information is required, the SIPCOT will furnish such, but it must be clearly understood that tenders must be received in order and according to instructions.

15. The SIPCOT reserves the right to reject any tender or all the tenders.

16. The tenderers shall undertake to employ technical personnel as detailed in the Criteria-IX under Minimum Criteria for Pre-qualification accompanying the Technical Bid (Section-V of the Technical Bid Documents).

NOTE:

1. For non employment of such technical personnel penalty of Rs.2000/- per month for Diploma Holder and Rs.5,000/- per month for Degree Holder will be levied.
2. An attendance register for the technical personnel is to be maintained. Every technical personnel should sign their initials in the register whenever they leave and arrive. The Register should be produced for inspection by the officials of SIPCOT as and when required.
3. One Technical Assistant may be employed by the contractor for more than one work situated within one kilometre, provided the monetary limit prescribed for the nature of technical staff to be employed is adhered to by one and the same contractor.

17. Tenderers who have already registered themselves in PWD or in any other Government Department as contractors shall furnish evidence of their good record and capacity to do works.

CONTRACTOR

18. A tenderer submitting a quotation which the tender accepting authority considers excessive and / or indicative of the insufficient knowledge of current prices or definite attempt of profiteering will render himself liable to be debarred permanently from tendering or for such period as the tender accepting authority may decide. The tender rates should be based on the controlled price for materials, if any fixed by Government or the reasonable price permissible for the tenderer to charge a private purchaser under the provision of Clause-8 of the Hoarding and Profiteering Prevention Ordinance, 1943 as amended from time to time and on similar principles to labour and supervision in the construction.

19. The fact of submitting the tender implies that the tenderers have actually inspected the site of work and have examined before tendering, the nature and extent of various kinds of soil at various depths and have based their tender on such examination by them and no future representation in this regard will be considered.

20. The SIPCOT reserves to itself the right of allotting the different sub works to the different contractor or to one and the same contractor as it may decide after the receipt of tenders.

21. **PERFORMANCE SECURITY AND ADDITIONAL PERFORMANCE SECURITY**

a. Within 15 days from the date of the Letter of Acceptance, the successful tenderer shall deliver to the Employer a Performance Security as specified in Clause-9 of Pre-qualification Tender Notice accompanying the Tender Documents (Section-II of Technical Bid Documents).

b. On evaluation of tender, if it is found that if the overall quoted amount of the tender is less than 5% to 15% of the value put to tender, the contractor shall pay additional performance security at 2% of the estimated value strictly in the shape of Demand Draft /Irrevocable bank guarantee for Contract period + One Year+ claim period of 3 months. If the tender savings exceeds 15%, the contractor shall pay an additional performance security of 50% of the difference between quoted amount and estimated amount strictly in the shape of Demand Draft / Irrevocable bank guarantee for contract period + One Year+ claim period of 3 months. Failure to produce Security Deposit additional performance security within 15 days from the receipt of acceptance order and execute the agreement shall entail cancellation of award of tender and forfeiture of EMD.

The Security Deposit and Additional Performance Deposit Amount will not carry any interest and shall be refunded only after one year defect liability period after completion of the entire work and on production of indemnity bond for a further period of four years of defect liability period**.**

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PART-II

PRICE BID

SECTION-III

FORM OF TENDER

PART-II

PRICE BID

SECTION-III

FORM OF TENDER

To

The Managing Director,
State Industries Promotion Corporation of Tamilnadu Limited,
Chennai –600 008.

Sir,

I / WE do hereby tender and, if this tender be accepted, undertake to execute the following work viz. **''**Formation of Approach Road from Km 143/4 of NH-44 to SIPCOT Industrial Park, Dharmapuri" as shown in the drawings and described in the specifications of the State Industries Promotion Corporation of Tamilnadu Limited with such variations by way of alterations or additions to and omission from the said works and method of payment as are provided for in the "Conditions of Contract" for the sum of Rs……..……/- (Rupees ……..……..…… only) or such other sum as may be arrived at under the clauses of the "General Conditions of Contract relating to payment on lump sum basis or by final measurement at unit prices".

I / WE have also completed the priced list of items in Schedule-A annexed (in words and figures) for which I / WE agree to execute the work when the lump sum payment under the terms and conditions of the agreement is varied by payment for measured quantities.

I / WE hereby distinctly and expressly declare and acknowledge that, before the submission of my / our tender I / WE have carefully followed the instructions in the tender notice and have read the TNBP and General Conditions of Contract therein and that I / WE have made such examination of the contract documents and of the plans, specifications and quantities and of the location where the said work is to be done and such investigation of the work required to be done, and in regard to the material required to be furnished as to enable me/us to thoroughly understand the intention of same and the requirement, covenants, agreements, stipulations and restrictions contained in the contract and in the said plans and specifications and distinctly agree that I / WE will not hereafter make any claim or demand upon the State Industries Promotion Corporation of Tamil Nadu Limited based upon or arising out of any alleged misunderstanding or misconception or mistake on my/our part of the said requirements, covenants, agreements, stipulations, restrictions and conditions.

CONTRACTOR

I / WE being a registered in Government Organisations enclose TAX verification certificate in respect of (the particulars of the previous occasion on which the certificate was produced should be given).

I / WE enclose herewith a Demand Draft for the payment of the sum of **Rs.7,07,300/- (Rupees Seven Lakhs Seven Thousand and Three Hundred Only) as Earnest Money Deposit not to bear interest.**

If my/our tender is not accepted, this sum shall be returned to me/us on my/our application when intimation is sent to me/us of rejection or at the expiration of ninety days from the date of this tender whichever is earlier. If my/our tender is accepted, the earnest money shall be retained by the State Industries Promotion Corporation of Tamilnadu Limited, as security for the due fulfilment of the contract. If upon written intimation to me/us by the SIPCOT officers, I/we fail to attend the said office before the end of the period specified on such intimation, the tender will not be considered and if upon intimation being given to me/us by the SIPCOT of acceptance of my/our tender, I / We fail to make the additional security deposit or to enter into the required agreements, as defined in Clause-3 of the tender notice, then I / We agree to the forfeiture of the earnest money. Any notice required to be served on me/us hereunder shall be sufficiently served on me/us if delivered to me/us personally or forwarded to me/us by post to me/us (Registered or ordinary) or left at my/our address given herein. Such notices shall if sent by post be deemed to have been served on me/us at the time when in due course of post it would be delivered at the address to which it is sent.

I / We agree that the time shall be considered as the essence of this contract and to commence the work, as soon as this contract is accepted by the competent authority and the site is handed over to me/us and agree to complete the work within 6 Months from the date of such handing over of the site and to show good progress as defined in the tabular statement "Rate of Progress", furnished under Clause-12 of this tender notice, subject, nevertheless to the provision for extension of time contained in the General Conditions of Contract.

I / We fully understand that the written agreement to be entered into between me/us and the State Industries Promotion Corporation of Tamilnadu Limited, shall be the foundation of rights of both the parties and the contract shall not be deemed to be complete until the agreement has first been signed by me/us and then by the proper officer authorised to enter into contracts on behalf of State Industries Promotion Corporation of Tamilnadu Limited.

CONTRACTOR

I am/we are professionally qualified and my/our qualifications are given below:

NAME	QUALIFICATION

I / We will employ the following technical staff for supervising the work and will see that all of them is always at site during working hours personally checking all items of works and paying extra attention to such works as may require special attention. (Example reinforced concrete work)

Name of Technical Staff proposed to be employed	QUALIFICATION

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PART-II

PRICE BID

SECTION-IV

SPECIAL CONDITIONS

PART-II

PRICE BID

SECTION-IV

SPECIAL CONDITIONS

1. Location of the work site at SIPCOT Industrial Park, Dharmapuri.

2. Attached here to are the tender drawing giving the general layout, details and sections of the proposed works. Further details and working drawings necessary for execution of the construction of work will be prepared and issued by SIPCOT from time to time. All the works shall be carried out in accordance with the instructions and directions given by the SIPCOT Officer in-charge of the work from time to time.

3. Submission of the tender shall means that the contractor has visited the site and studied the site conditions, plans, specifications, conditions and instructions and agree to abide by the same and execute an agreement with the Employer. Before offering tender for the work, the tenderer must satisfy himself to the nature of the soil, facilities for access and storing of materials and other site condition.

4. A schedule of probable quantities is attached herewith but it must be clearly understood that these quantities are liable to alterations, omissions, deductions or additions at the discretion of the SIPCOT and the unit rates quoted by the tenderer shall be valid irrespective of fluctuations in quantities.

5. Withdrawal of the tender when it is once accepted or failure on the part of the successful tenderer to execute the contract agreement within FIFTEEN days after intimation being sent of acceptance of the tender would entail forfeiture of the Earnest Money.

6. In complying with these conditions and the specifications, schedule of quantities and contract agreement, the following works shall have the meaning herein assigned to them except where the subject or context otherwise requires.

a. "Employer" shall mean "MANAGING DIRECTOR", SIPCOT LIMITED, CHENNAI-8 and shall include his representatives / assignees / or successors.
b. "Contractor" shall mean the Person, Firm, Company or the Consortium of Contractors, whose tender is accepted by the Employer and shall include his / their (tenderer's) legal representatives / permitted assignees / or successors.

c. "SIPCOT" shall mean State Industries Promotion Corporation of Tamilnadu Limited and shall include their legal representatives / and assignees / or successors.

CONTRACTOR

d. "Site" shall mean the site of the contract works including any building and erections thereon and any other land (inclusively) as aforesaid allotted by the Employer for the contractor's use.

e. "The contract" or "This Contract" shall mean the tender documents both Technical Bid Documents and Price Bid Documents comprising Notice Inviting Tender, Form of Tender, Information and Instructions to Tenderers, Special Conditions, Additional Conditions, the Drawings, Technical Specifications, Priced Bill of Quantities (Schedule-A), All the Correspondences between the Employer and the Successful Tenderer, the Acceptance Order of Tender (Letter of Indent) and the Articles of Agreement together with the Conditions of Contract with it's Appendix, Special Conditions and also the Specifications, Designs, Drawings and Instructions issued from time to time by the Employer and all these documents taken together are deemed to form one contract and shall be complimentary to each other.

f. "Notice in Writing" or "Written Notice" shall mean a notice in written, typed or printed characters sent (unless delivered personally or otherwise provided to have been received) by registered post to the last known place of abode, private or business address or to the Registered Office of the addressee and shall be deemed to have been sufficiently served / received when in the ordinary course of post it would have been delivered.

g. "Act of Insolvency" shall mean an Act of Insolvency as defined by the Presidency Towns Insolvency Act or the Provincial Insolvency Act or any other Act amending such original Acts.

h. "Net Prices": If in the arriving at the contract amount, the contractor shall have added to or deducted from the total of the items in the tender any sum, either as a percentage or otherwise, then the net price of any item in the tender shall be the sum arrived at by adding to or deducting from the actual figure appearing in tender as the price of that item, a similar percentage or proportionate sum provided always that in determining the percentage or proportion of the sum so added or deducted by the contractor, the total amount of any provisional sums of money shall be deducted from the total amount of the tender. The expression "Net Rates" or "Net Prices" when used with reference to the contract or accounts shall be held to mean "Rates" or "Prices" so arrived at".

i. "Engineer-in-Charge" shall mean the Officer nominated by SIPCOT and made in charge of the project.

j. Words importing persons include Firms and Corporations and Consortium of Contractors. Words importing the singular also include the plural and vice versa where the context so requires.

7. SCOPE OF CONTRACT

The contractor shall carry out and complete the said work in every respect in accordance with this contract and with the directions or and to the satisfaction of Employer viz. the SIPCOT. The SIPCOT may from time to time issue further drawings and / or instructions, details, directions and explanation which are hereafter collectively referred to as instructions, in regard to.

a. The variation or modification of the design, quality or quantity or works or the addition or omission or substitution of any work.

b. Any discrepancy in the drawings in between the schedule of quantities and / or drawings and / or specification.

c. The removal from the site of any materials brought thereon by the contractor and the substitution of any other materials thereof.

d. The removal and / or re-execution of any works executed by the contractor.

e. The dismissal from the works of any persons employed there upon (as per Clause-14 of Special Conditions)

f. The opening up for inspection of any work covered up.

g. The amending and making good of any defect under clause 24, the contractor shall forthwith comply with and duly execute any work comprised in each such SIPCOT instructions, directions and explanations given to the contractor or his representatives upon the works by the SIPCOT shall, if involving a variation, be confirmed in writing by the contractor within seven days.

8. DRAWING AND SCHEDULE OF QUANTITIES

The original Contract Agreement shall remain in the custody of the Employer and a duplicate copy of the Contract Agreement shall remain in the custody of the Project Officer. The contractor on the signing thereof shall be furnished by the Employer free of cost, a copy of the priced, schedule of quantities, one copy of each of the said drawings, the specifications and one copy of all further drawings issued during the progress of the works. Any further copies of such drawings required by the contractor shall be paid for by him. The contractor

shall always keep one copy of all drawings in the works and the Employer/ SIPCOT site officer shall, at all reasonable times have access to the same.

9. CONTRACTOR TO PROVIDE EVERYTHING NECESSARY

The contractor shall provide everything necessary for the proper execution of the works according to the intent and meaning of the drawings, schedule of quantities and specification taken together whether the same may or may not be particularly shown or described therein provided that the same can reasonably be inferred there from and if the contractor finds any discrepancy in the drawings, in between the drawings, schedule of quantities and specification, he shall immediately and in writing refer the same to the project officer / SIPCOT Officers who shall decide in consultation with the Employer which is to be followed.

10. AUTHORITIES, NOTICES AND PATENTS

The contractor shall conform to the provisions of any Act of the legislature relating to the works and to the regulations and bye-laws of any authority and/or any water, lighting and other companies and/or authorities with those system, the structure is proposed to be connected and shall before making any variations from the drawings or specification that may be necessitated by so conforming give to the Employer written notice, specifying the variations from the proposed to be made and the reason for making and apply for instructions thereon. In case, the contractor shall not within the ten days receive such instructions, he shall proceed with the work, conforming the provision, regulations or bye-law in question and any variation so necessitated shall be dealt with under clause No.18. The contractor shall bring to the attention of the Employer any notices required by the said Act/s, Regulations or bye-laws to be given any authority and pay to such authority, or to any public office, all fees that may be properly chargeable in respect of the works and lodge the receipts with the Employer. The contractor shall indemnify the EMPLOYER against all actions arising from such claims and shall himself pay all royalties, license fees, damages, costs and charges of all and every sort/s that may be legally incurred in respect thereof.

11. SETTING OUT

The contractor shall set out the works and shall be responsible for the true and perfect setting out of the same and for the correctness of the position, levels, dimensions and alignment of all parts thereof. If at any time error in this respect shall appear during the progress of the works, the contractor shall at his own expense rectify such error if so required to the satisfaction of the EMPLOYER.

CONTRACTOR

12. MATERIALS AND WORKMANSHIP TO CONFORM TO DESCRIPTION

All materials and workmanship shall so far as procurable be of the respective kinds described in the schedule of quantities and/or specifications and in accordance with the Employer's instructions and the contractor shall upon the request of Employer furnish him with all invoices, accounts, receipts and other vouchers to prove that the materials comply therewith. The contractor shall at his own cost arrange for and/or carry out any test of any materials which the Employer may require.

a. Clean M. Sand / P. Sand shall be used in all cases.

b. Only clean and fresh water shall be used on the work. The contractor shall make his own arrangements for water and power supply required for the execution of the work and shall meet all charges therefore. The special attention of the contractor is drawn to Clause-36 of General Conditions of Contract of TNBP regarding water and lighting.

c. The broken stones for concrete and RCC work should be of hard blue granite and passed by the SIPCOT Officer.

d. The work shall be carried out with least hindrance to the adjoining building and the contractor will be responsible for any damages caused to the existing fixtures, electric fittings etc. in the course of execution and the contractor shall make good to original condition any damage, without any claim for extra.

e. Concrete works: All exposed concrete surfaces will be required to be finished by cement plaster as instructed.

f. Plastering: All external corners, edges of doors and window openings etc. shall be finished sharp using rich mortar and also finished truly vertical or horizontal as the case may be. The rate for plastering shall include the cost of finishing as above and no separate extra for the corners, edges, beams etc. shall be paid.

g. The SIPCOT reserves the right, to split up the work and entrust the spilt up portions to different contractors if found necessary on valid reasons.

h. Projections if any required in the masonry will be measured under the relevant items and no extra will be paid of for finishing the same.

i. The arrangement of R.T.S /M.S. rods for all RCC works shall be in accordance with the working drawing supplied.

(i) Steel Centering using MS Sheets / Angles / Channels / MS Fabricated Spans / Ties / Beams / Adjustable Steel Props shall be used on the work. Wherever it is

impossible to use steel centering, wooden centering will be permitted depending upon the nature and conditions of the works to be executed. In such cases, the planks for forms and centering for RCC works shall be of well seasoned timber approved by the officer according to Clause 10 of TNDSS No.30. They must be made smooth and perfectly level at the top so as to give smooth and even finish to the RCC Ceilings. Mango Planks shall not be used under any circumstances. Centering and formwork shall be provided to the extent and area ordered by the Officer.

(ii) Payment for centering works for all RCC items shall be made only after the concrete is laid.

(iii) All cement concrete for RCC works shall be machine mixed and vibrated.

(iv) All lime mortar shall be ground in mortar mill as per TNDSS.

j. Wherever dewatering of sub soil water is necessary for the execution of works the cost of the same should be borne by the contractor only and no extra claim whatsoever on this account will be admitted.

13. CONTRACTOR'S SUPERINTENDENCE AND REPRESENTATIVE OF THE WORK

The contractor shall give all necessary personal superintendence during the execution of the works and as long thereafter as the Employer may consider necessary until the expiration of the "Defects Liability period", stated in the Appendix hereto. The contractor shall also during the whole time, when the works are in progress employ a competent representative (Project Engineer) who shall be constantly in attendance at the site. Any direction, explanations, instructions or notices given by Employer to such representatives shall be held as given to the contractor.

14. DISMISSAL OF WORKMAN

The contractor shall on the request of the Employer immediately dismiss from the work any person employed thereon by him who may in their opinion be incompetent or misconduct himself and such person shall not be again employed on the worksite without the permission of the Employer.

15. ACCESS OF SIPCOT OFFICER TO WORKS

The Employer/SIPCOT site officers shall, at all reasonable times, have free access to the works and/or to the workshops, factories or other places where materials are lying or from which they are being obtained and the contractor shall give every facility to the Employer/SIPCOT site officers necessary for inspection and examination/test of the material

and workmanship. No person unauthorized by the Employer except the representatives of public authorities shall be allowed on the works at any time.

16. PROJECT OFFICER

The term Project Officer shall mean the person duly authorised to inspect the work in the absence of the Employer. The contractor shall offer the Project Officer / SIPCOT every facility and assistance for inspecting the works and materials and for checking and measuring items and materials. The Project Officer shall have power to give notice to the contractor or to his representatives of non approval of any work or materials and such work shall be suspended or the use of those of such materials shall be discontinued until the decision of the Employer is obtained. The work will from time to time be examined by the Project Officer or any site officer not in any way to exonerate the contractor from the obligation to remedy any defects, which may be found to exist at any stage of the works or after the same is completed. Subject to the limitation of this clause the contractor shall take instructions only from the SIPCOT officer.

17. ASSIGNMENT AND SUB-LETTING

The whole of the works included in the contract shall be executed by the contractor and the contractor shall not directly transfer, assign or underlet/sublet the contract or any share thereof or interest therein without the prior written consent of the Employer and no undertaking shall relieve the contractor from the full and entire responsibility of the contract or from active superintendence of the works during their progress.

18. VARIATION NOT TO VITIATE CONTRACT

No alteration, omission or variation shall vitiate this contract. But in case the Employer thinks proper at any time during the progress of the works to make any alterations and addition to or omissions from the works or any alterations in the kind and quality of the materials to be used therein and shall give notice thereof in writing under his hand to the contractor, shall alter and add to or omit from as the case may be, required in accordance with such notice. But the contractor who shall not do any work extra or any deviation from any of the provisions of the contract, stipulations, specification or contract drawing without the previous consent in writing of the Employer and the value of such extras, alterations, additions or omissions authorised by the Employer shall in all cases be determined by the Employer in accordance with the provisions of Clause-22 thereof and such of the sum shall be added to or deducted from the contract amount accordingly.

19. SCHEDULE OF QUANTITIES

The schedule of quantities unless otherwise stated shall be deemed to have been prepared in accordance with the standard method of measurement of such works as per the Tamilnadu Building Practice.

CONTRACTOR

Any error in description or in quantity or in omission of items from the schedule of quantities shall not vitiate this contract but shall be rectified and the value thereof as ascertained under clause-22 thereof shall be added to or deducted from the contract amount (as the case may be) provided there shall be no rectification of errors in the contractor's schedule of rates.

20. SUFFICIENCY OF SCHEDULE OF QUANTITIES

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 prices stated in the schedule of quantities and/or the schedule of rates and prices which rates and prices shall cover all his obligations under the contract, and all matters and things necessary for the proper completion of the works.

21. TAKING MEASUREMENTS

The Project Officer may from time to time intimate to the contractor that he requires the works to be measured and the contractor shall forthwith attend and send a qualified agent to assist the Project Officer or site officer in taking such measures, measurements and calculations and to furnish the particulars or to give all assistance required by either of them.

Should the contractor fails to attend or neglect or omit to send such Agent then the measurement taken by the Project Officer or site officer shall be taken to be correct measurements of the works. Such measurement shall be taken in accordance with the standard method of measurement for building works.

The contractor or his agent may at the time of measurement take such note and measurements as he may require.

All authorised extra works, omissions and all variations made without the Employer/Project Officer's knowledge, if subsequently sanctioned by the Employer in writing shall be included in such measurements.

22. PRICES FOR EXTRAS ETC / ASCERTAINMENT OF

Should it be found after the completion of the works from measurements taken in accordance with the previous paragraph that any of the quantities or amounts of works thus ascertained are less or greater than the quantities or amounts specified for the works in price-schedule of quantities and (or) tender or that any variation is made, the calculation of such quantities / amounts or variation unless previously or otherwise agreed upon, shall be made in accordance with the Employer's instructions. The measurement and valuation in respect of the contract shall be completed within the 'period of final measurements' stated in appendix.

CONTRACTOR

Materials, when taken into account will be the property of the Employer. Wherein any payment certificate on which the contractor has received payment, the Employer has included the value of any unfixed materials intended for and/or advance payment to the works, such materials shall become the property of the Employer and they shall not be removed except for use upon the works, without the written authority of the Project Officer. The contractor shall be liable for any loss or damage to such materials.

23. REMOVAL OF IMPROPER WORK

The Employer shall during the progress of works, have power to order in writing from time to time removal from the works, within such reasonable times as may be specified in the order, of any materials which in the opinion of the Employer are not in accordance with the specification or the instruction of the Employer, the substitution of proper materials and the removal and proper re-execution of any work executed with materials or workmanship not in accordance with the drawings and specifications or instructions and the contractor shall forthwith carryout such order at his own cost. In case of default on the part of the contractor to carryout such order, the Employer have the power to employ and pay other person etc. to carryout the same and all expenses consequent on incidental thereto shall be borne by the contractor, or may be deducted by the Employer for any money due or that may become due to the contractor.

24. DEFECTS AFTER COMPLETION:

Any defect, shrinkage, settlement or other faults which may appear within the defects Liability period stated in the appendix, arising in the opinion of the Employer and from materials or workmanship not in accordance with the contract shall upon the directions in writing of the Employer and within such reasonable time as shall be specified therein be amended and made good by the contractor at his own cost such defects, shrinkage, settlements or other faults and all damages loss and expenses consequently thereon or incidental thereto shall be made good and borne by the contractor and such damage, loss and expenses shall be recoverable from him by Employer or may be deducted from any money due or that may become due to the contractor the Employer may in lieu of such amending and making good by the contractor, deduct a sum to be determined by the Employer equivalent to the cost of amending such work and in the event of the amount retained under Clause-36 being insufficient recover the balance from the contractor, together with any expense the Employer may have incurred in connection therewith. Should any defective work have been done or materials supplied by any sub-contractor employed on the works who has been nominated or suggested by the Employer, as provided in Clause-26 of the contract shall be liable to make good in the same manner as if such work or materials had been done or supplied by the contractor and been subject to the provision of this clause and clause-26 thereof. The contractor shall remain liable under the provisions of this clause notwithstanding the signing of the Employer or any certificate of the passing of the accounts.

CONTRACTOR

25. CERTIFICATE OF VIRTUAL COMPLETION

The work shall not be considered as completed until the site officer has certified in writing that they have been virtually completed and the defects liability period shall commence from the date of such certificate.

26. NOMINATED SUB-CONTRACTOR

All specialists, Merchants, Tradesman and others executing any work or supplying and filling any goods for which time cost prices or provisional sums are included in the schedule of quantities and / or specifications may be nominated or selected by the Employer are hereby declared to be sub-contractor are employed by the contractor and are therein referred to as nominated sub-contractor. No nominated sub-contractor shall be employed on or in connection with the works against whom the contractor shall make reasonable objection or save where the Employer and contractor shall otherwise agree, who will not enter into a contract provided,

a. That the nominated sub-contractor shall indemnify the contractor against the same conditions in respect of the sub contract as the contractor is under, in respect of his contract.
b. That the nominated sub contractor shall indemnify the contractor against claims in respect of any negligence by the sub-contractor/ his servants or agents or any issues by him or them of any Workmen- Compensation Act in force.
c. Payment shall be made to the nominated sub-contractor within fourteen days of the receipt of the site officer certificate provided that before any certificate is issued, the contractor shall upon request to furnish to the site officer's proof that all nominated sub-contractor accounts included in previous certificates have been duly discharged, in default whereof the Employer may pay the same upon a certificate of the site officer and deduct the amount thereof from any sums due to the contractor. The exercise of this power shall not create privity of contracts as between Employer and sub-contractor.

27. OTHER PERSONS ENGAGED BY EMPLOYER

The Employer with the concurrence of the SIPCOT site officer reserves the right to use the premises and any portion of the site for the execution of any work not included in this contract which he may desire to carry out by other persons and the contractors to allow all reasonable facilities for the execution of such work but is not required to provide any plant or materials for the execution of such work except by special arrangements with the Employer. Such work shall be carried out in such a manner as not to impede the progress of works included in the contract and the contractor shall not be responsible for any damage or delay, which may happen to or be occasioned by such work.

28. INSURANCE IN RESPECT OF DAMAGE TO PERSONS AND PROPERTY

The contractor shall be responsible for all injury to persons animals or things and for all structural and destructive damage to property which may arise from the operation or neglect of himself or of any nominated sub-contractor's employees, whether such injury or damage arise from carelessness, accident or any other cause whatsoever, in any way connected with the carrying out of this contract. This clause shall be held to include inter-alia, any damage to buildings whether immediately adjacent or otherwise, any damage to roads, streets, footpaths, bridges or ways as well as damage caused to the buildings and works forming the subject of this contract by frost or other inclemency of weather. The contractor shall indemnify the Employer and hold him harmless in respect of all and expenses arising from any such injury or damages to persons or property as aforesaid and also in respect of any claim made in respect of injury or damage under any such Acts of Government or otherwise and also in respect of any award of compensation or damages consequent upon such claim. The contractor shall reinstate all damage of every source mentioned in this clause, so as to deliver up the share of the contract works completed and perfect in every respect and so as to make good or otherwise satisfy all claims for damage to the property of third parties. The contractor shall indemnify the Employer against all claims which may be made against the Employer by any number of the public or other third party in respect of anything which may arise in respect of the contract, with an approved office, a policy of insurance in the joint names of the Employer and the contractor against such arise and deposit such policy or policies with the Employer from time to time during the currency of this contract. The contractor shall similarly indemnify the Employer against all claims which may be made upon whether under the workmen's Compensation Act or any other statutes in force during the currency of this contract or in common law in respect of any employees of the contractor or any sub-contractor and shall at his own expenses effect and maintain, until the virtual completion of the contract, with an approved office, a policy of insurance in the joint names of the Employer and the Contractor against such risks and deposit such policy or policies with SIPCOT from time to time during the currency of the contract.

The contractor shall be responsible for anything, which may exclude from the insurance policies above referred to and also for all other damages to any property arising out of and incidental to the negligent or effective carrying out of this contract. He shall also indemnify the Employer in respect of any costs, charges or expenses arising out of any claim or proceedings and also in respect of any award of or compensation of damage arising there from, arising from any such industry or damage to persons or property as aforesaid and also in respect of any claim made in respect of injury or damage under any Acts of Government or otherwise and also in respect of any award of compensation or damages consequent upon such claim.

The Employer with the concurrence of the Site Officer shall be at liberty and is hereby empowered to deduct the amount of any damage, compensation, costs, charges and

expenses and or occurring from or in respect of any such claim or damage from any sum due or to become due to the contractor.

29. The contractor shall at the time of signing the contract insure the works and keep them insured until the virtual completion of the contract against loss or damages by fire in an office, to be approved by the SIPCOT in the joint names of the Employer and contractor (the name of the former being placed first in the policy) for the full amount of the contract and for any further sum if called upon to do so by the Employer, the premium for such further sum being allowed to the contractor as an authorized extra such policy shall cover the property of the Employer only. The contractor shall deposit the policy and receipt for the premium with the Employer within twenty one days from the date of signing the contract. Unless otherwise instructed by the SIPCOT in default of the contractor, insuring as provided above, the Employer on his behalf may so insure and may deduct the premium paid from any amount due or which may become due to the contractor. The contractor shall as soon as the claim under the policy is settled, the work reinstated by Insurance Office should they elect to do so, proceed with all due diligence with the completion of the works in the same manner as though the fire had not occurred and in all respects under the same conditions of contract. The contractor in case of rebuilding or SIPCOT in default of the contractor insuring as provided above, the Employer on his behalf may so insure and may deduct the premium paid from any money due or which may become due to contractor. The contractor shall as soon as the claim under the policy is settled or the work reinstated by the Insurance Office, should they elect to do so, proceed with all due diligence with the completion of the works in the same manner as though the fire had not occurred and in all respects under the same conditions of contract. The contractor in case of rebuilding or reinstatement after fire, shall be entitled to such extension of time for completion as SIPCOT site officer deems fit.

The contractor has to take insurance for the contract value and the coverage should be for the contract period including the EOT period, if any, granted for this work.

30. DATE OF COMMENCEMENT AND COMPLETION

Date of commencement will be reckoned as actual date of handing over of site to the Contractor or 15 days after the receipt of work order whichever is earlier. The contractor shall be allowed admittance to the site on the "Date of commencement" stated above and he shall there upon complete the same on or before the 'Day of completion' stated in the condition 25 subject nevertheless to the provision for extension of time hereinafter contained.

If the contractor fails to commence the work as instructed by SIPCOT or fails to complete the entire work within 6 Months (Six Months) from the date of handing over of the site, he shall be liable for all the damages and consequences arising there from and the same should be rectified by the contractor his own cost.

CONTRACTOR

31. DAMAGE FOR NON-COMPLETION

If the contractor fails to complete the works or part of the works by the due date stated in the appendix or within any extended time under Clause-32 thereof and the SIPCOT site officers certify in writing that in his opinion the same ought reasonable so, to have been completed, the contractor shall pay or allow to the Employer the sums claimed in the appendix as 'Liquidated Damages for the period during which the said works shall so remain incomplete and the Employer and deduct such damages from any moneys due to the contractor.

32. DELAY AND EXTENSION OF TIME

a. If the work is not completed as per the time schedule, a fine not exceeding 5% of the value of the contract will be imposed on the contractor for slow progress of work.

b. If in the opinion of the Employer the works be delayed (a) by force measure of (b) by reason of any exceptionally inclement weather conditions (c) by reasons of proceedings taken or threatened by or dispute with adjoining or neighbouring owners by Public Authorities arising otherwise than through the contractor's own default or (d) by the works or delays of other contractors or tradesmen engaged or nominated by the Employer and not referred to in the schedule of quantities and/or specification of or (e) by reason of site officer(s) instructions as per Clause-2 of (f) by reason of Civil Commotion, local combination of workmen or strike or lockout effecting any of the building trades or (g) in consequences of the contractor not having received confirmation in due time, necessary instructions from the Employer on the recommendation of the Site Officer for which he shall have specially applied in writing, the Employer shall make a fair and reasonable extension of time for completion of the contract shall, as soon as may be given written notice thereof to the Employer the contractor shall nevertheless continue his endeavors to prevent delay and shall do all that may reasonably be required to the satisfaction of Employer to proceed with work.

33. FAILURE BY CONTRACTOR TO COMPLY WITH SIPCOT INSTRUCTIONS

If the contractor after receipt of written notice from the Employer requiring compliance within ten days, fails to comply with such further drawings/and/or SIPCOT officer's instructions, the Employer with the advice of the site officer, may employ and pay other persons to execute any such work whatsoever that may be necessary to the effect thereto and all costs incurred in connection therewith shall be recoverable from the contractor by the Employer on the certificate of the site officer as a debit or may be deducted by him from any money due or to become due to the contractor.

34. TERMINATION / DETERMINATION OF CONTRACT BY THE EMPLOYER

a. If the contractor,

(i) being an individual or firm commit any "act of insolvency" or shall be adjudge insolvent or being an Incorporated Company shall have an order for compulsory winding up made, against with or pass an effective resolution for winding up

voluntarily or subject to the liquidation, such acts of insolvency or winding up shall be liable within seven days after notice to him inquiring him to do so, show to the reasonable satisfaction of the Employer that he is able to carryout and fulfill the contract, and to give security, therefore, if so required by the Employer or if the contract (whether an individual, firm or incorporated company) shall suffer execution to be issued, or shall suffer any payment under this contract to be attached by or on behalf of any of the creditors of the contractor, or shall assign or sublet to this contract without the consent in writing of the Employer/Project Officer first obtained or shall charge or encumber this contract for any payments due or which may become due to the contractor there-under or if the Project Officer shall certify in writing to the Employer that the contractor.

(ii) has abandoned the contract, or

(iii) has failed to commence the works, or had without any lawful excuse under these conditions, suspended the progress of the works for 14 days after receiving from the Employer/Project Officer, written notice to proceed or

(iv) has failed to proceed with the works with such due diligence and failed to make such due progress as would enable the works to be completed within the time agreed upon or

(v) has failed to remove materials from the site or pull down and replace work for seven days after receiving from the Project Officer's written notice that the said materials or work were condemned and rejected by the Employer / Project Officer under these conditions or

(vi) has neglected or failed persistently to observe and perform all or any of the facts, matters or things by this contract to be observed and performed by the contractor for seven days after written notice shall have been given to the contractor requiring the contractor to observe or perform the same or

(vii) has to the detriment of good workmanship or in defiance of the Employer / Project Officer's instructions to the contrary subject any part of the contract.

Then and in any of the said cases the Employer with the written consent of the Project Officer, may notwithstanding any previous waiver, after giving seven days notice in writing to the contractor determine the contract, but without hereby affecting the functions of the Project Officer or the obligations and liabilities of the contractor, the whole of which shall/continue in force as fully as if the contract had not been so determined and as if the work subsequently executed had been executed by or on behalf of the contractor, and further the Employer on the recommendation of the Project Officer may enter upon and take possession of the works and all plant, tools, scaffoldings, sheds, machinery, steam and other power utilities and materials lying upon the premises or the adjoining lands or roads, and use the same as his own property nor may employ the same by means of his own servants and workman-in-carrying "on" and completing the works or by employing any other contractor or other

person or persons to complete the works and the contractor shall not in any way interrupt or do any act, matter or thing to prevent or hinder such other contractor or other person or persons employed for completing the finishing or using the materials and plant for the works. When the Employer/Project Officer shall give a notice in writing to the contractor to remove his surplus materials, tools and plant, and should the contractor fails to do so within a period of 14 days after receipt thereto by him, the Employer shall sell the same by public auction and shall give credit to the contractor for the amount realized. The Project Officer shall thereafter ascertain and certify in writing under his hand what (if anything) shall be due or payable to or by the Employer for the value of the said plant and materials so taken possession of by the Employer and the expense or loss which the Employer shall have been put to, in procuring the works to be completed and the amount, if any, owing to the contractor and the amount which shall be so certified shall thereupon be paid by the Employer, as the case may be and the certificate of the Project Officer shall be final and conclusive between the parties.

b. After, determining the contract, SIPCOT shall have the right to give any part or whole of the unexecuted balance work to any other contractor, in which case any expenses which may be incurred in excess of such amount which would have been paid to the original contractor if the whole work had been executed by him, will be recovered from him. For this purpose, the amount will be deducted from the money due to him from SIPCOT on any account whatsoever. But if the expenses incurred by SIPCOT are less than the amount works out as per original agreement rate, than the difference will not be paid to the Contractor, as he is a defaulter.

35. PRIME COST AND PROVISIONAL SUMS

a. Where 'Prime Cost' (PC) prices or Provisional Sums of money are provided for any goods or work in the specification or schedule of quantities the same are exclusive of any trade discounts or allowances, discount for cash, or profit which the contractor may require and of carriage and fixing.

b. All goods or works for which prime cost prices or provisional sums of money are provided may be selected or ordered from any manufacturers or firms at the discretion of the Project Officer or Employer and the Employer reserves to himself the right of paying direct to any such goods, or work and deducting the said prices or sums, from the amount of contract. Should any goods or work for which prime cost prices or provisional sums are provided or portions of same be not required, such prices or sums, together with the profits allowed for the same and such additional amounts as the contractor may have allowed for carriage and fixing will be deducted in full from amount of the contract whether the goods be ordered by the contractor or otherwise, the contractor shall, at his own cost fix the same if called upon to do so and the contractor shall also receive and sign for such goods

and be responsible for their safe custody as and from the date of their delivery upon the works.

c. In cases in which provisional quantities of materials are contained in the contract, the contractor shall provide such materials to such amounts or to greater or less amounts as the Project Officer shall direct in writing as the net rates at which he shall have priced such items in his schedule of quantities. Should however any such item be entirely omitted which omission shall be at the Employer / Project Officer's discretion, no profit on such items shall be allowed to the contractor.

d. If the contractor neither produces the receipt nor gives authority to the Employer to issue a certificate in favour of such sub-contractor direct, the SIPCOT officer may upon giving the contractor seven days notice in writing of his intention to do so, issue to the sub-contractor such certificate direct. The Employer may obtain the receipt from the sub-contractor which receipt shall be deemed as a discharge for the amount of such certificate as though given by the contractor. In the event of such default on the part of the contractor, he shall not be allowed any profit he may have added in the schedule of quantities upon such sub-contract.

e. The exercise of the option before referred to by the contractor and the issue of certificates as before described to sub-contractor upon the contractors request of the issue to the sub-contractor director of certificate by the Employer shall not, however relieve the contractor from any of the liabilities in respect of insufficient/faulty or in-completed work of the sub-contractor for which he may be liable under the terms of contract.

f. If any provisional items provided for work of a nature usually carried out by the contractor in the ordinary course of his business, the Employer shall give the contractor an opportunity of tendering for the same without prejudice to the right to accept the lowest or any tender.

36. CERTIFICATE AND PAYMENTS

The contractor shall be paid by the Employer from time to time in installments under interim certificates to be issued by the Project Officer to the contractor on account of the works executed when in the opinion of the site officer, work to the approximate value of work for interim certificates or less at the reasonable discretion of the Employer has been executed in accordance with this contract, subject, however, to retention of 5% of bill amount from each bill. The Project Officer shall with the concurrence of the Employer include in the interim certificate such amount as he may consider proper on account of materials delivered upon the site by the contractor for use in the work. And when the works have been critically completed and the Project Officer should have certified in writing that they have been completed, the contractor shall be paid by the MANAGING DIRECTOR in accordance with the certificate to be issued by the Project Officers the sum of money named in the Appendix as 'Installment after virtual completion' being 50% of the said total retention money. The balance 50% of the retention amount, EMD and Security Deposit will be released, after one

year from the completion of entire work, to the contractor on receipt of indemnity bond for a further period of four years, provided always that the issue by the Project Officer of any certificate during the progress of the works or their completion shall not relieve the contractor from his liability under Clause 2 and 25 nor relieve the contractor of his liability in the cases of all defects and insufficiencies in the works or materials which a reasonable examination would have disclosed. New certificate of the Project Officer shall be the conclusive evidence that any works or materials to which it relates are in accordance with the contract. The Employer shall have full power on the advice of the Project Officer withhold any certificate if the works or any parts thereof are not being carried out to his satisfaction. The Project Officer may by any certificate make any correction in any previous certificate, which shall have been issued by him.

Payments upon the Project Officer's certificates shall be made within 15 days named in the Appendix as period for honouring of Certificates' on such certificates have been delivered to the Employer.

37. FORFEITURE OF PERFORMANCE SECURITY

The performance security is liable to the forfeited in case, where the contractor fails to carry out the work in accordance with the specifications, terms and conditions of the Contract, leading to termination of the contract.

38. Notwithstanding anything contained in the agreement, instructions of the Employer shall be final and binding on the contractor and in respect of all or any of the matter under clauses 2 to 32 above and the clauses stipulated shall not contradict the TNBP.

39. SETTLEMENT OF DISPUTES

In case of any difference or dispute shall arise between the parties here to in respect of any of the matter comprised in this contract, the jurisdiction of the court shall be at Chennai.

40. The contractor shall be responsible for the safe custody and storage of the materials under dry condition at the place of the work spot approved by the Officer.

41. No royalty shall be charged, where due for materials quarried from the Public Works Department or District Board or other Government quarries. No plot rent will be charged for materials stacked on the SIPCOT land during the course of construction provided all such materials are removed within a month after the work is completed.

42. Royalty charges due for the use of private quarries and private land shall be paid by the contractor.

43. The contractor shall form his own approach road in the works site for which no extra will be due to him. On completion of work, the contractor shall not be permitted to remove the materials laid for formation of road. If the contractor is allowed to use the existing roads, he shall maintain them in good condition at his own cost throughout the period of the contract.

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44. Any surplus materials remaining at the site, will not generally be taken over by SIPCOT, whether before or after the completion or determination of contract. Such materials which were originally procured by the contractors are the property of the contractors and can however be taken over by the SIPCOT if required, for use on other works which are in progress only by special arrangements and at the prevailing market rates viz. the rates at which the articles or articles of a similar description can be procured at a given time at the storage godown from public market suitable in the division for obtaining supply thereof.

45. The contractor's special attention is invited to the General Conditions to the Contract of TNBP and he is requested to provide shed, latrine and urinal for his workmen at his own expenses.

46. If night work is required to fulfill the agreed rate of progress, all arrangements shall made by the contractors inclusive of lighting without any claim for extra.

47. The contractor shall not employ the labour below the age 14 years and shall also note that he must offer employment to ex-servicemen, ex-toddy tapers and unemployed agricultural labourers as far as possible.

48. Any of the items in the schedule may be omitted or radically altered. No variation in a rate shall become payable to contractors on account of such omissions or variation in quantities.

49. Reference to TNBP Nos. in the schedule of quantities or as per the re-print 1988 and Addenda and Corrigenda issued thereafter.

50. The formation of roads will be deemed to be completed only if all the items of works including finishing items contemplated herein are executed.

51. The contractor shall abide by the contractor's labour regulations of the PWD framed by the Tamilnadu Government.

52. The contractor shall at his own expenses provide arrangements for the provision of footwear for any labour doing cement mixing work and all other similar type of work involving the use of tar, mortar, etc. to the satisfaction of Employer's / Officer and on his failure to do so the SIPCOT shall be entitled to provide the same and recover the cost from the contractor.

53. When there are complaints of non-payment or wages to the labour, bills of the contractor may be withheld pending a clearance certificate from the labour Department.

54. RULES FOR THE PROVISION OF HEALTH AND SANITARY FOR WORKERS EMPLOYED BY THE SIPCOT CONTRACTORS

The contractor's special attention is invited to clause 37, 38, 39 and 51 of the General Conditions to contract in Tamilnadu Building Practice and he is requested to provide at his own expenses, the following amenities to the satisfaction of the officer.

CONTRACTOR

a. FIRST AID

At the work site, there shall be maintained in a readily accessible place, first aid appliances and medicines including adequate supply of sterilized dressings and sterilized cotton wool. The appliances shall be kept in a good order. They shall be placed under the charge of a responsible person who shall be readily available during working hours.

b. DRINKING WATER

(i) Water of good quality fit for drinking purpose shall be provided for the work people on a scale of not less than a gallon per head per day.

(ii) Where drinking water is obtained from an intermittent public water supply, each work place shall be provided with storage tank where such drinking water shall be stored.

(iii) Every water supply and storage shall be at a distance not less than 50 feet away from any latrine, drain or other existing well which is within such proximity of latrine, drain or any other source of pollution. The well shall be properly closed, if water is drawn from it for drinking. All such wells shall be entirely closed and be provided with a trap door and shall be dust and water proof.

A reliable pump shall be fitted to each covered well. The trap door, shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

c. WASHING AND BATHING PLACES

Adequate washing and bathing places shall be provided separately for men and women. Such places shall be kept in clear and drained condition. Bathing or washing should not be allowed in or near the drinking water well.

d. LATRINE AND URINALS

There shall be provided within the premises of every work place and accommodation for labourers latrines and urinals in an accessible place separately for each of them. The number of seats to be provided shall not be less than the following in any particular case.

i.	Where the number of persons employed does not exceed 50	-	2 seats
ii.	Where the number of persons employed exceed 50 but does not exceed 100	-	3 seats
iii.	For every additional 100 persons	-	3 seats

If women are employed, separate latrine and urinals screened from those for men shall be provided on the same scale. Except in work places provided with water flushed latrine connected with a water borne sewerage system, all latrines shall be provided with receptacle dry earth system which will be cleared at least four times daily and at least twice during working hours and kept in a strictly sanitized conditions.

CONTRACTOR

The latrine and urinals shall be tarred inside and outside at least once a year. The excreta from the latrines shall be disposed off at the contractor's expenses in outside pits approved by the local Public Health Authority. The contractor shall also employ adequate number of scavengers, conservancy staff to keep the latrine and urinals in a clear condition.

e. SHELTER DURING REST

At the work site there shall be provided, at free of cost, two suitable sheds one for meals and another for rest for the use of labour.

f. CRECHES

At every work place at which 25 or more women are working there shall be provided two huts of suitable size for the use of children under the age of 6 years belonging to such women. One hut shall be used for infant's games and play and the other as their bed room. The huts shall not be constructed on a lower standard than the following:

i. Thatched roofs
ii. Mud floors and walls
iii. Planks spread over the mud floor and covered with matting

The size of the crèches should vary according to the number of women workers. The crèches should be properly maintained and necessary equipment like toys, etc. should be provided and huts shall be provided with suitable and sufficient sweepers to keep the place clean. There shall be two Ayas in attendance. Sanitary facilities shall be provided to the satisfaction of the Health Officer of the area concerned. Two numbers of huts shall be constructed to children and attendants of the children.

g. CANTEEN

A cooked food canteen on a moderate scale shall be provided for the benefit of the workers, if it is considered expedient.

h. SHEDS FOR WORKSMEN

The contractor should provide at his own expense, shed for housing the workmen. The sheds be on a standard not less than the clean shelter type to live in which the workers pertaining to the locality are accustomed to. A floor area of about 6' x 5' for 2 persons shall be provided. The sheds are to be in a row with 5' clear space between sheds and 80' clear space between row if conditions permit. The work people's camp shall be laid out in units of 400 persons each. Each unit to have clear space of 48' alround.

55. GENERAL RULES TO SAFETY EQUIPMENT AND FIRST AID:

ARTICLE – 10

1. All necessary personal safety equipments shall be kept available for the use of the persons employed on the site and be maintained in a condition suitable for immediate use.

2. The workers shall be required to use the equipment thus provided and the Employer shall take adequate steps to ensure proper use of the equipment by those concerned.

ARTICLE – 11

When work is carried on in proximity to any place where there is a risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps shall be taken for the prompt rescue of any person in danger.

ARTICLE – 12

Adequate provision shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

ARTICLE – 13

Where large work places are situated in cities, town or in their suburban and no beds are considered necessary owing to the proximity of city or town hospital, suitable transport shall be provided to facilitate removal of urgent cases to the hospitals. At the work places, some conveyance facilities such as car, shall be kept readily available to the injured person or persons suddenly taken seriously ill to the nearest hospital.

56. SPECIAL CONDITION FOR GST

The unit rates offered shall be inclusive of **All Taxes and levies by the Central or State Governments or Local Authority as applicable except GST** including any variation during contract period and any agreed extension of time. No claim in respect of Tax and levies by the Central or State Governments or Local Authority whether existing or future shall be entertained. **Rates shall also be inclusive of all incidental charges and charges for taking all Insurance Policies, such as CAR Policy, Workmen's Compensation, Third Party Liability, Transport Policy, etc.**

The GST value as mentioned in Schedule – A is the applicable GST at the time of execution of the agreement. Any changes in the value of the GST in the future will be applicableand the contractor is bound to pay the same as and when demanded.

"All duties, taxes, and other levies except GST, payable by the contractor under the cont ract,or for any other clause shall be included in the rates, prices and total Bid Price submitted by the bidder".

GST will be charged on the amount collected from the tenderer on account of rent, electricity, water charges etc., if availed by them.

CONTRACTOR

57. RECOVERY OF MONEY FROM CONTRACTOR IN CERTAIN CASES:

In every case in which provision is made for recovery of money from the contractor, Government shall be entitled to retain or deduct the amount thereof from any money, that may be due or may become due to the contractor under these presents and or under any other contract or contracts or any other account what so ever.

58. RECOVERY/UNDER REVENUE RECOVERY ACT

Whenever any amount has to be paid by the contractor in view of determination of the contract by virtue of Clause 57.4 of General Conditions of Contract (TNBP Volume-II) or any amount that may be due or may become due from the contractor under these presents and the contractor is not responding, the SIPCOT shall be entitled to recover the said amount under the provision of the Tamil Nadu Revenue Recovery Act 1864 (Tamil Nadu Act V of 1864).

59. CONTRIBUTION TO WORKERS WELFARE FUND:

Towards contribution of fund for the benefit of manual workers employed in the construction works an amount equivalent to 1.00% of estimate amount will be paid by the Employer direct to the Labour Welfare Board as per G.O. Ms. No. 283 / MA & WS Dept / Dated: 11.11.2010 & G.O. Ms. No. 295/ Labour and Employment(I2) Dept/ Dated:17.12.2013.

60. The Contractor should facilitate the Project Officer, **SIPCOT Industrial Park, Dharmapuri** for compliance under EPF & MP Act, 1952 for this work. The contractor has to produce documentary proof for Minimum Wages Act, PF, ESI etc., without violation of labour law in connection with the labour employed for the execution of this work.

61.The Govt. of India has notified vide notification No:20/2017-Central Tax (Rate) dated:22nd August 2017 and Notification:21 No.24/20017-Central Tax (Rate) dated21st September 2017, the concessional rate of the Goods and Services Tax(GST)at 12% (CGST6%+SGST6%) is leviable for any Government Contract, whether Civil or Electrical, irrespective of the Goods and Service Tax(GST) rate applicable on purchase of goods used in the execution of Government contract.

And GST amount will be calculated at 18% from the sum of total tendered value quoted by the tenderer for construction cost (excluding GST) specified in the BOQ, subject to GST rate applicable from time to time as recommended by the GST Council.

"All duties, taxes, and other levies except GST, payable by the contractor under the contract, or for any other clause shall be included in the rates, prices and total Bid Price submitted by the bidder".

CONTRACTOR

62. Bonus to the contractors in advance:

Bonus as incentive for advance completion of works to the contractors and any work completed in advance by not less than 10% of agreement period can be considered and Bonus of 1% on the value of actual quantum of works executed at tendered rate may be paid, by adopting G.O (MS.). No.60 Public works (G2) Department, dr.14.03.2008 and the procedure laid down in PWD/Buildings Organisation memorandum No. H.D.O(A)/24179/2002-1, dt.22.04.2002"

63. Procurement of cement: Arasu Cement from TANSEM or its equivalent brand should be used in the construction works.

64. (i) Appropriate charges will be received for any materials supplied by SIPCOT to the contractor for the execution of work (ii) Necessary charges will be recovered from the contractor for the usage of water, electricity and rent, if availed by the contractor from SIPCOT. (iii) Necessary GST will be charged extra on the above.

CONTRACTOR

PART-II

PRICE BID

SECTION-V

ADDITIONAL CONDITIONS

PART-II

PRICE BID

SECTION-V

ADDITIONAL CONDITIONS OF CONTRACT

1. The works should be carried out strictly in accordance with the relevant BIS / MORT & H / TNBP / TWAD / CEIG / TNEB Rules / Standard / Specifications, and also as per the conditions of contract.

2. The materials used for this work is inclusive of all taxes and duties. If any exemption is claimed at a later date, the amount so claimed should be passed on to SIPCOT.

3. The tender conditions should also be returned along with the tender duly signed by the tenderer in all pages.

4. The contractor shall be liable to set right all defects arising out of his faulty execution (or) substandard work noticed during defects liability period of five year at his cost.

5. This is an ITEM RATE LUMPSUM CONTRACT.

6. If required before the payment of final bill, the contractor shall also produce a certificate from the income tax authority that all the income tax payable by him upto date had been paid.

7. The contractor engaging the labourers for the work is wholly responsible for any accidents or death occurring to the labour while carrying out the work awarded by the SIPCOT and the SIPCOT shall not be held responsible for such occurrence and also for payment of compensation to labourers.

8. **Risk Insurance:** The work under the contract shall be maintained at the contractor's risk until the work is taken over by the P.O. The contractor shall accordingly arrange his own insurance against all natural calamities, fire and other acts of GOD during such period and the SIPCOT shall not be liable for any loss or damage (vide Clause 47.1 of General Conditions to Contract as amended).

9. **Safety code:** The safety measures and all amenities for the labourers shall be made by the contractors at their cost as indicated in the safety code vide appendix to General conditions to contract and Clause 34, 35 and 42-1 to 42-8 of General conditions to contract.

10. **Recovery of dues under Revenue Act:** Any amount fallen due from the contractor on account of this contract, even after recovering from the bills for this work and any other contract awarded to the contractor then the amount is liable to be recovered under the provision of Revenue Recovery Act.

CONTRACTOR

PART-II

PRICE BID

SECTION-VI

PRICE ADJUSTMENT CLAUSE

PART-II

PRICE BID

SECTION-VI

PRICE ADJUSTMENT CLAUSE IS APPLICABLE FOR THIS WORK

PRICE ADJUSTMENT

Price variation clause is applicable for this work as per G.O.Ms.No.101/Public Works (G2) Department/ Dated 10.06.2009.

Contract price shall be adjusted for increase or decrease in rates and price of labour, materials, fuels and lubricants in accordance with the following principles and procedures and as per formula given in the contract data:

a. **The price adjustment shall apply for the work done from the start date given in the contract data upto end of the initial intended completion date of extensions granted by the Engineer and shall not apply to the work carried out beyond the stipulated time for reasons attributable to the contractor.**
b. **The price adjustment shall be determined during each quarter from the formula given in the contract data.**
c. **Following expressions and meanings are assigned to the work done during each quarter:**

R = Total value of work done during the quarter. It would include the amount of secured advance for materials paid for (if any) during the quarter, less the amount of the secured advance recovered, during the quarter. It will exclude value for works executed under variations for which price adjustment will be worked separately based on the terms mutually agreed.

To the extent that full compensation for any rise or fall in costs to the contractor is not covered by the provisions of this or other clauses in the contract, the unit rates and prices included in the contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.

2. Calculation of price adjustment

1.2. Adjustment for Cement component

i. Price adjustment for increase or decrease in the cost of cement procured by the contractor shall be paid in accordance with the following formula:

Vc = 0.85 x Pc/100 x R x (Ci-Co)/Co

CONTRACTOR

Vc = Increase or decrease in the cost of work during the quarter under consideration due to changes in rates of cement.

Co = The All India Average Wholesale Price Index for Cement for the quarter preceding the date of opening of bids as published by the Ministry of Industrial Development, Government of India, New Delhi).

Ci = The All India Average Wholesale price Index for cement for the quarter under consideration as published by RBI (Source-EA-Ministry of Industrial Development, Government of India, New Delhi).

Pc = Percentage of cement component of the work.

2.3. Adjustment for Steel Component

i. Price adjustment for increase or decrease in the cost of steel procured by the contractor shall be paid in accordance with the following formula:

Vs = 0.85 x Ps/100 x R x (Si-So) / So

Vs = Increase or decrease in the cost of work during the quarter under consideration due changes in rates of steel.

So = The All India Average Wholesale Price Index for Steel (bars and rods) for the quarter preceding the date of opening of bids as published by the Ministry of Industrial Development, Government of India).

S1 = The All India Average Wholesale Price Index for steel (bars and rods) for the quarter under consideration as published by RBI (Source-EA Ministry of Industrial Development, Government of India,l New Delhi)

Ps = Percentage of steel component of the work

Note: For the application of this Clause, the index of bars and rods has been chosen to represent the steel group.

2.5 Adjustment for POL (fuel land lubricant) component

(i) Price adjustment for increase or decrease in the cost of POL (fuel and lubricant) shall be paid in accordance with the following formula:

Vf = 0.85 x Pb/100 x R x (fi-Fo)/Fo

Vf = Increase or decrease in the cost of work during the quarter under consideration due to changes in rates of fuel and lubricants.

Fo = The Average official retail price of High speed diesel (HSD) at the existing consumer pumps of IOC at Chennai on the day thirty days prior to the date of opening of bids.

F1 = The average official retail price of HSD at the existing consumer pumps of IOC at Chennai for the 15h day of the middle calendar month of quarter under consideration.

Pf = Percentage of fuel and lubricant component of the work

Note: For the application of this Clause the price of High Speed Diesel oil has been chosen to represent the fuel and lubricant group.

The following percentages will govern the price adjustment for the work under this contract.

PRICE ESCALATION – ABSTRACT

Construction of Roads, Side Drains and Foot Path:

Sl. No	Description	Schedule-A
1	Cement	
2	Steel	
3	POL	
	TOTAL	

CONTRACTOR

PART-II

PRICE BID

SECTION-VII

APPENDIX

(CONTRACT DATA)

PART-II

PRICE BID

SECTION-VII

APPENDIX

[CONTRACT DATA]

Sl. No.	Details	Reference to NIT / Conditions of Contract / Special Condition	Data
1.	Date of commencement of the work	Clause-30 of Special Conditions	Date of handing over of site to the contractor or 15 days after the receipt of the work order whichever is earlier.
2.	Period of completion	Clause-30 of Special Conditions	6 Months from the date of commencement. (including monsoon period)
3.	Liquidated damages (Not as penalty)	Clause-31 of Special Conditions	**Rs. 33,000/- per day**
4	Defects Liability Period	Clause-10 of Pre-qualification Tender Notice (Section-II to accompany the Technical Bid)	Five years
5	Earnest Money Deposit	Clause-8 of Pre-qualification Tender Notice (Section-II to accompany the Technical Bid)	**Rs.7,07,300/- In the form of DD in the name of tenderer's / Firm Only.**
6	Security Deposit (Performance Security)	Clause-9 of Pre-qualification Tender Notice (Section-II to accompany the Technical Bid)	An amount equivalent to 2% (Two Percent) of the contract value less EMD paid.
7	Retention Money	Clause-10 of Pre-qualification Tender Notice (Section-II to accompany the Technical Bid)	5% (Five Percent) of each running account bill.
8	Interim Payment	Clause-36 of Special Conditions	Within 21 days from the date of receipt of Project Officer's Certificate of Payment or when the value of work excluding deductions to be made exceeds Rs.50.00 lakhs whichever is earlier.
9	Period of Final measurement and certification of final payment.	Generally as per Clause-36 of Special Conditions	Within "TWO" months from the date of completion of works.
10	Payment of Final bill by the Employer.	Clause-36 of Special Conditions	Within "ONE" month from the date of certification by the Engineer-in-charge.

CONTRACTOR

Sl. No.	Details	Reference to NIT / Conditions of Contract / Special Condition	Data
11	Rate of Interest for delayed payment	--	"NIL"
12	Release of Security Deposit and Performance Security Deposit (if any)	Clause-10 of Pre-qualification Tender Notice (Section-II to accompany the Technical Bid)	1. 50% of the total withheld amount shall be refunded after completion of work, along with final bill. 2. Remaining 50% of the total withheld amount along with the Earnest money deposit security deposit & additional performance security deposit shall be refunded after one year from the date of completion on receipt of indemnity bond for a further period of 4 years.

CONTRACTOR

PART-II

PRICE BID

SECTION-VIII

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS FOR
(A). BUILDING (CIVIL) WORKS

NOTE:

The General Technical Specifications shall be those confirming to the INDIAN STANDARD SPECIFICATIONS as published by BUREAU OF INDIAN STANDARDS (BIS) from time to time with all amendments published up to the date of submission of Tenders. In the absence of any definite provision in the afore said specifications, reference may be made to the specifications prescribed in the Tamil Nadu building practice and where even these are

Silent, the construction shall confirm to sound Engineering practice as approved by the Engineer. In case of any dispute arising out of the interpretation of the above, the decision of the Engineer shall be final and binding on the contractor.

SECTION -1
GENERAL SPECIFICATIONS

The term Indian Standard Specifications herein after referred to as IS means the relevant Indian Standard Specifications with all Amendments published up to the date of submission of tenders.

A Statement of relevant IS applicable to this context, is enclosed.

LIST OF INDIAN STANDARDS

Sl. No.	Short Title	IS Number	TNBP Number
I.	**Cement** (e) Specifications for ordinary and Low heat Portland Cement (f) Specification for Portland Pozzolana Cement	 269-1976 1489-1976	 10 10 A
II.	**AGGREGATES** 1. Specification for coarse and fine Aggregate from natural source for concrete 2. Specification for sand and Masonry Mortars 3. Method of Tests for aggregates for concrete	 383-1970 2116-1980 2386-1963 (Part I to VII)	 5 & 7 7 7
III.	**BUILDING STONES** 1. Method of test for Determination of strength properties of natural building stones. Part - I Compressive Strength Part - II Transverse Strength Part - III Tensile Strength Part - IV Shear Strength 2. Method of Measurement of buildings and civil engineering works 3. Specification for fly-ash for use as Pozzolana and admixure 4. Method of Measurement of building and Civil Engineering Works Part – XII plastering and pointing	 1121-1974 (Part I to IV) 1200-1976 (Part – IV) 3812-1981 (Part I) 1200-1976 (Part – XII	 35
IV.	**CONCRETE** 1. Method of Measurement of building and Civil engineer works Part-II concrete works 2. CONCRETE WORKS Code of practice for plain	 1200-1974 (Part II) 456-2000	

	and reinforced concrete 3. Method of test for strength of concrete 4. Code of practice for laying in situ cement concrete lining on canals 5. Method of sampling and analysis of concrete 6. General requirements for concrete Vibrators – immersion type. 7. Specification for Concrete Vibrating tables 8. Method of Test for permeability or cement mortar and concrete 9. Specifications for flyash for use as Pozzolana as admixture for concrete 10. Specification for Portable swing weigh batch for concrete (Single and double bucket type)	516-1959 3873-1978 1973 (Part I to IX) 1199-1976 1791-1968 2505-1980 2514-1963 3085-1965 3812-1966 (Part II)	28,30
V.	**EARTH WORK** 1. Method of Measurement of building and Civil Engineer Works Part-I Earth work, 2. Safety code for excavation works, 3. Method of test for soils Part II determination of water content, 4. Method of test for soils Determination of moisture content Dry density relation using light compaction 5. Method of test for soils Determination of Dry density of soils in place by sand replacement method 6. Method of test for soils Determination of dry density of soils in place by the core cutter method	1200-1974 (Part I) 3764-1966 2720-1973 (Part II) 2720-1980 (Part VII) 2720-1975 (Part XXVIII) 2720-1975 (Part XXIX)	20, A, B, C, 23, 24, 25 19, 26
VI.	**OTHER SUBJECTS** 1. Safety code for scaffolds and Ladders Part I Scaffolds 2. Safety code for scaffolds and ladders Part II Ladders 3. Recommendations on stacking and storage of construction materials at site	3696-1966 (Part I) 3696-1966 (Part II) 4082-1977	
VII.	**PILES:** 1.Code of practice for design and construction of pile foundation – driven cast-in-situ piles 2.Code of practice for design and construction of pile foundation – Load test on piles	IS: 2911(Part I/Sec I) - 1979 IS: 2911(Part 4) - 1985	

In addition to the Indian Standard Specifications, the specifications prescribed in Tamil Nadu Building Practice (TNBP) shall also be followed, where IS specification are not available.

CONTRACTOR

SECTION - 2
SITE OF WORK

2.1 Clearing and Grubbing

2.1.1 Clearing and leveling Site

The portion of the right-of-way where required for constructing the work under these specifications shall be cleared of all trees, bushes, rubbish and other objectionable matter. Trees designated by the Engineer-in-charge shall not be cut and shall be protected fro injury. Such cleared material shall be disposed of, as provided in sub- paragraph 'c' below or removed from the site of work before the date of completion of the contract as approved by the Engineer in-charge. The clearing operation shall be in accordance with clauses 4.1, 4.1.1, 4.2 and 4.3 of I.S. 4701-1982 Indian code of practice for earth work in canals. Surface boulders either loose or partly embedded in the ground will have to be removed and stacked as directed.

b. Grubbing

The area described or shown on the relevant site plan shall be cleared of all obstructions, loose stones, non-required materials and rubbish of all kinds. All brushwood shall be cleared and the roots grubbed up. No trees shall be cut down and removed without the instructions of the Engineer-in-charge. Those which are cut down shall be grubbed up. The same remarks apply to jungle clearance. Trees to be preserved will be designated by the Engineer-in-charge. Those which are cut down shall be grubbed up. The same remarks apply to jungle clearance. Trees to be preserved will be designated by the Engineer-in-charge.

The products of the clearing shall be stacked in such place and manner as may be ordered by the Engineer in-charge and the ground shall be left in a perfectly clean condition; all products of the clearing shall be the property of Government and shall be disposed of as the Engineer-in-charge may direct. All holes or hollows, whether originally existing or produced by digging up roots shall be carefully filled up with earth, well rammed to the design density and levelled off, as may be directed.

C. Disposal of Cleared and Grubbed Material

The disposal of cleared and grubbed material shall be in accordance with clause 4.1.1 of I.S. 4701-1982 code of practice for earth work on canals. All waste materials to be burnt

shall be piled neatly and when in suitable condition shall be burnt completely to ashes. Piling of waste material for burning shall be done at such a location and in such a manner as would not cause any fire risk. Necessary precautions shall be taken to prevent spreading of fire to areas beyond the limits of cleared site. Suitable materials and equipment for prevention and suppression of fire shall be kept available at all times.

The material to be disposed of may be buried for which Para 1.2 and 2 of specification 16 of TNBP shall apply.

2.1.2 Payment

For the clearance of scrub jungle, light jungle, heavy jungle with or without uprooting etc., payment will be made as provided for in the tender documents. The contractor shall include the cost of clearing of site and grubbing in the prices bid in the bill of quantities of the contract for the relevant finished item of work for which clearing and grubbing as mentioned in the above para are required unless otherwise it is given as a separate item in the contract. No payment towards removal of small stones and boulders of size less than 0.01 cubic metre will be made, and the rate Quoted for excavation will be considered to include this item. However, payment will be made for the removal of surface boulders of sizes greater than 0.01 cubic metre but less than 3 cubic metres, either loose or partly embedded in the ground, at the rate quoted in bill of quantities for the actual quantity to removed, based on stack measurement applicable for the relevant strata classification after deducting 40% towards voids.

Benching will be paid as separate item, per 1 (one) running metre of bench at the rate provided for in the tender documents.

2.2.1 Setting out of the work

Monsoon Damages

Damages due to rain or flood shall have to be made good by the contractor till the work is handed over to the department.

The responsibility for desilting and making good the damages due to rain or flood rests with the contractor. No extra cost is payable for such operations and the contractor shall, therefore, have to take all necessary precautions to protect the work done during the construction period.

Removal of Silt and Water

Accumulated silt and water in the structures for the works partly done by the Contractor in this or previous seasons should be removed and no extra payment will be made, for such removal of silt and water. The unit rate of excavation is deemed to include cost for removal of such silt and water.

Section – 3

3. Filling

3.1 The portion of the area where filling is proposed, is to be cleared off all trees, bushes, rubbish and other objectionable matter if anything is deposited there without any extra cost by the contractor.

3.2 During the course of filling if any boulders or non – specified earth is brought to the site it should be removed from the site before levelling.

3.3 During the course of filling if any layer does not conform to test as specified in the bid document, shall be removed and relaid to meet out the standard.

Payment will be made for only the difference in the final and initial levels based on the empirical formula furnished by the Executive Engineer. Pre-levels as taken by the Executive Engineer will be handed over to the contractors for verification and acceptance before commencement of work. If the contractor represents that the firm is not satisfied with the computation of levels, levels will be taken by Executive Engineer in presence of the contractor. The contractor has to bear the charges. The levels furnished by Executive Engineer is final. After filling, final level will be taken by Executive Engineer. The contractor should sign the final levels also. Payment will be made based on the difference between the pre and final levels for the filled-up portions with filling earth at different stages. The payment will be made as per the quantity computed by Executive Engineer.

If any intermediate payment is desired by the contractor, levels at that stage will be taken and quantity arrived. Deductions in the quantity will be made based on the consolidation achieved. The decision of the Executive Engineer is final and binding for proposing the quantity to be deducted for interim bills. Pre final payment shall however be restricted only to 90% of the total value of work satisfactorily completed and finally measured for. Pre-final payment will be assessed based on the consolidated final levels. Release of the remaining

10% shall be effected only after an immediate monsoon period of 3 months (October to December). Shortfall if any should be made good by the contractor. The contractor shall make his own arrangements for the machineries, power roller, clean fresh water etc., for use on the works and shall meet all charges there for.

The contractor shall employ at his cost necessary watch and ward to safeguard his machineries, plants etc., including barricading and danger lighting where ever the machineries are stationed as well as for the works turned out by him and paid for from time to time till completion including those hired if any. The tenderer is requested to specially note that if any incidental pumping is opted by the tenderer to facilitate for filling all incidental charges including pumping shall be borne by him.

Before commencing the work and also during the progress, the contractor shall give notice to the concerned authorities. Viz the Panchayats / Municipalities, the Railway department, Police and other departments or company as may be required to the effect that the work is being taken up in particular locality and necessary diversion of traffic may be arranged for. The contractor shall co-operate with the department concerned and provide for necessary barricading of roads, protection to existing cables, wires etc., during the operation. The contractor shall provide at his own expenses watching and lighting arrangements during the day and night times and put the required notice board such as "CAUTION-ROAD CLOSED" for traffic etc.,

He should also provide and maintain at his own cost, the necessary supports for underground cables etc., to afford best protection to them in consultation with the authorities in-charge of the properties and to their best protection.

No payment will be made for the excess earth brought by the contractor and such surplus earth brought to the site shall be disposed off by the contractor at his own cost in the places shown. The seignorage and other charges payable to the District Collector are to be borne by the contractor. The contractor should handover all the receipt of full payment made to the District Collector towards seignorage charges paid by him to the Executive Engineer. If the seignorage charges part or full payment is not made to the District Collector, the amount due to the District Collector will be recovered from the bills and paid to be concerned authorities.

Only materials capable of giving on compaction in field, a dry density of more than 15.00

KN/m3 shall be used for the filling. For assessment of suitability of the materials for use in the work, the contractor may get the materials duly tested, for compact ability in the laboratory indicated by the Executive Engineer (at the cost of the contractor) in accordance with Proctor's Procedure.

Notionally given a dry density of 16.50 KN/m3 or more on compaction at optimum moisture content in the laboratory are suitable for the work. Although the laying of materials shall proceed in 15cm layers and further consolidated, dry density tests will be carried out only when a consolidated thickness of 15cm is achieved. One set of two core samples for every 3000 square meter area of each layer shall be taken and tested. The average dry density shall not be less than 15.00 KN/m3. The contractor shall bear the expenses of the above tests, which shall be carried out in Highways research laboratory or any other lab as directed by the Executive Engineer.

It is hereby made clear that for any stagnation of water or inundation of water due to any reason whatsoever in the filling site or at the commencement of work at the time of handing over of site, for the execution of work or during execution of work, the contractor should make his own arrangement to bail-out the water at his own cost. The department will not accept or entertain any plea for bearing this cost or allowing extension of time on this score to complete the work.

SECTION – 5

5.1 Excavation

5.1.1 Classification of Excavation

Except as otherwise provided in these specifications material excavated will be measured in excavation to the lines shown on the drawings or as provided in these specifications and all materials as required to be excavated will be paid for at the applicable price bid in the schedule for excavation. No additional allowance above the price bid in the schedule will be made on account of any of the material being wet. Bidders and the contractors must assume all responsibility for deducing and concluding as to the nature of the materials to be excavated and the difficulties of making and maintaining the required excavation. The Government does not represent that the excavation can be performed and maintained at the paylines described in these specifications as shown on the drawings.

5.1.2 Excavation for Structures

a. General

Excavation for the foundation of structures shall be to the elevation shown on the drawer or as directed by the Engineer-in-Charge. In so far as practicable the material removed in excavation for structures shall be used for backfill and embankments.

b. Foundations for Structures

All trenches in soil other than rock or hard compact soil more than 1.5m deep, into which men enter shall be securely shored and strutted and timbered. All trenches in soil soft or fissured rock or hard soil exceeding 2 m in depth, into which men enter shall be securely shored and tinkered. Notwithstanding anything said above, it shall be understood that the need for shoring shall receive careful and frequent consideration even in trenches of less than 1.5 or 2m in depth (as the case may be). When there is doubt as to the safety of the work without shoring, no further, excavation or other work shall be continued until adequate shoring is provided. Where the sides of trenches are sloped but not to within 1.5m of the bottom the vertical sides shall be shored and the shoring shall extend at least 30 cm above the vertical sides.

When open spaced sheathing is used, a toe board shall be provided to prevent material rolling down the slope and failing into the part of the trench with vertical walls. Shoring and timbering shall be carried along with the opening of the trench but when conditions permit protection work, such as sheet piling may be done before the excavation commences. All loose stones, projecting clumps of earth, pockets of unsuitable material which might come down on the workers in the trench or any condition which is a hazard, shall be either removed or the excavated sides adequately braced and the trench suitably guarded. On steps slopes workmen shall not be permitted to work one above the other.

The contractor shall prepare the foundations at structure sites by methods which will provide firm foundation for the structures. The bottom and side slopes of common excavation upon or against which the structure is to be placed shall be finished to the prescribed dimensions and the surfaces so prepared shall be moistened and tamped with suitable tools to form firm foundation upon or against which to place the structure. The contractor shall prepare the foundation for the structures as shown on respective drawings. The natural foundation

material beneath the required excavation shall be moistened if required and compacted in place.

If the Engineer-in-Charge considers it necessary to consolidate the foundation strata by grouting cement slurry, the drilling and grouting or any other foundation treatment shall be done by the contractor as directed by the Engineer-in- Charge and the payment will be as per the general contract document in respect of extra items. Densities of the compacted foundation materials and the testing thereof shall be in accordance with paragraph 5.1.2. Separate payment will not be made to the contractor for moistening and compacting the foundation of structures.

The contractor shall include cost thereof in the prices bid per cubic metre of the item of the bill of quantities for preparation of foundations. When unsuitable material is encountered in the foundation for structure the Engineer-in-Charge will direct additional excavation to remove the unsuitable material.

The additional excavation shall be refilled as follows. In excavation in soils, the over excavation shall be filled in by selected bedding material and compacted. In excavation in rock it shall be filled by cement concrete 1:5:10 (One cement, five sand and ten aggregate of maximum size 40mm by volume). No separate payment for excavation backfill will be made as per clause 5.2.2(a).

C. Extra Excavation and Over Excavation

Should remains of old building, be met with the material shall be removed with wedges and levers. Blasting will not be allowed, without the permission in writing of the Engineer-in-Charge.

If bad ground or loose soil is met with. the contractor, will be responsible for reporting the to the Engineer-in-Charge who will issue such orders as may be necessary. For extra, concrete and masonry arising from bad ground, the contractors shall be paid treating this as additional quantity as per the contract data of contract documents.

All excavated earth, which is unfit or surplus to requirements for filling in, shall be spread as instructed by the Engineer-in-Charge at the contractor's expense.

If at any points in common excavation the foundation material is excavated beyond the lines required to receive the structure or if at any point in common excavation the natural foundation material is disturbed or loosened during the excavation process, it shall be compacted in places or where directed, it shall be removed and replaced as follows.

In excavation in soil and in rock it shall be filled by cement concrete 1:5:10 (one cement five sand and ten aggregate of 40 mm size by volume). Any excess excavation or over excavation performed by the contractor for any purpose or reason except for additional excavation as may be prescribed by the Engineer-in-Charge and whether or not due to the fault of the contractor shall be at the expense of the contractor. Filling for such excess excavation or over excavation shall be at the expense of the contractor.

d. Measurement for Payment

Excavation for structures will be measured for payment, for box cutting with vertical sides, of foundation dimensions. The contractor will have to make his own arrangements for shoring, strutting provision of adequate slopes for the sides to prevent slips etc. and no separate charge will be paid for any incidental charges arising either during excavation of foundation or construction of the structure.

The quantity for payment of excavation in soils and rock will be arrived at by taking pre levels and finished levels of respective strata. Block levels will be taken at one meter or closer intervals. The levels will be plotted on a graph sheet and average levels arrived at for purpose of determining the quantity of excavation. The contractor's signature in token or his acceptance has to be recorded in the cross section sheets. Final payment will be based on levels only.

The contractor shall expose the surface of the strata for the inspection of Engineer-in-Charge for taking levels whenever the classification in strata gets changed.

e. Payment

Payment for excavation for structures will be made at the unit price per cubic meter bid therefor in the bill of quantities for excavation for structures shall include the cost of all labour and materials for coffer dam and other temporary construction, of all pumping and dewatering, of all other work necessary to maintain the excavation in good order during construction, of removing such temporary construction where required shall include the cost of disposal of the excavated material except that required overhaul will be paid for.

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SECTION-6

MATERIALS

6.1.1 to 6.1.2 deleted

6.1.3 Stone for Masonry

a. General

The stones used for stone masonry shall conform to the relevant specification of clause 4.1 of I.S. 1597 (part-1) 1967 and I.S. 1123-1975 code of practice for construction of stone masnory part-1 Rubble stone Masonary.

Stone Masonary Using Granite

The stone of the required quality shall be obtained from the quarries specified in tile lead chart appended to the bill of quantities. The common types of natural stones which are generally used are Granite and other igneous rocks, and shall be sound, free from defects like decay, cavities, cracks, flaws, sand, holes, soft seams, veins, patches of soft or loose materials or any other deleterious materials like Iron Oxide, organic impurities etc. They should be free from rounded, worn or weathered surface or skin or coating which prevents the adherence of mortar. All stones used shall be clean of uniform colour and texture, strong, hard and durable.

The stone shall be supplied from the specified quarry and shall have abrasion value of 45% and specific gravity of about 2.6. The crushing strengths of the stones shall be determined in accordance with I.S.1121-1974. (Part 1 to a) The strength shall be as detailed below in Table 4(A).

Table - 5(A)

Sl. No.	Types of stone	Minimum Crushing strength
1.	Granite	1000 Kgs/ Sq.m

The percentage of water absorption by the stones when immersed in water for 24 hours shall not exceed 5% of their dry as determined in accordance with IS 1124-1974. Samples of the stones collected from the stacks by the contractor will be tested for the standards specified above and other relevant Indian Standards and stone stacks not conforming to the standards will be rejected and their cost shall be borned by the contractor. The contractor shall obtain these stones form the approved portions of the approved quarries only.

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Cost

The cost of collecting the stones for masonry will not be paid separately and their cost including the cost of quarrying, transporting, stacking, royalties charges shall be included in the unit price per cubic metre bid therefore in the relevant item on the bill of quantities.

6.1.4 Sand for Masonry

General

The term sand is used to designate fine aggregate with maximum size of particle 43.75 mm. The sand shall be of course category conforming to the Indian Standard Specifications IS-2116-1980. Sand for masonry mortars' as revised from time to time. Where sand from different sources are being used at one xer at the same time, these shall be blended to ensure uniform grading in successive batches. Variations in the grading of sand being obtained from the same source shall be controlled by means of the fineness modulus test. The following control limits shall be used. Controlled to limits of plus and minus 0.25 of running average of ten consecutive test samples.

For natural sand, fineness modulus shall be greater than 2.30 and less than 3.10. For manufactured sand, the specifications should be the same as in relevant section under specifications for concrete.

Quality of sand

The sand shall consist of natural sand, crushed stone or crushed gravel sand, or a combination of any of these. The sand shall be hard, durable, clean and free from adherence coatings and organic matter and shall not contain more than permissible limit of clay balls or pelletts as specified further below.

The sand shall not contain any harmful impurities, such as iron pyrites, alkalis, salts, coal, mica shale or similar laminated or other materials in such form or in such quantities as to affect adversely the hardening, the strength, the durability or the appearance of the mortar applied or to attack ary reinforcement used in the masonry work. Unless found satisfactory, as a result of further tests as may be specified by the Engineer in charge of the work, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine slit, fine dust and organic impurities in the sand shall not exceed the following, limits.

a.	Clay, fine silt and fine dust (determined in accordance with Appendix C of I.S.383-1963 and also I.S.2386 (part 11) 1963.	Not more than 5 per cent by weight.
b.	Organic impurities (Determined in accordance with I.S.2386 (Part 11) Specified in specified in 1963.	Below that indicated by comparison with the standard solution 6.2.2 of I.S.2386 (Part 11) 1963.

Sand shall generally conform to specifications given in paragraph 6.3.6 except that the sand for mortar shall conform to the grading of sand given in clause 4 of I.S.2116-1980 as detailed below, in Table 3(B).

Table 3 (B)
Grading of sand for use in Masonry Mortars

I.S Sieve designation	Percentage passing by mass
4.75mm	100
2.36mm	90 to 100
1.18mm	70 to 100
600 micron	40 to 100
300 micron	5 to 70
150 micron	0 to 15

A sand whose grading falls out-side the specified limits due to excess or deficiency or course or fine particles may be processed to comply with the standard by screening through suitably sized sieves and/or blending with required quantities of suitable sized sand particles. If the sand brought to site is not clean, it must be washed clean in water. Fine dirt sand, or sea sand, or sand containing saline impurities shall on no account be used.

b. Cost

The cost of sand for masonry will not be measured and paid separately and the cost of sand including the cost of stripping and transporting and storing and royalty charges shall be included in the unit price per cubic metre bid therefore in the relevant item of work in the bill of quantities for which this sand is required.

6.1.5 Cement

The contractor has to make his own arrangement for procurement of cement of required specifications. The specifications and conditions specified for supply of cement is given in paragraph 6.3.3 shall be applicable here also. Ordinary Portland cement conforming to I.S.269-1989 shall be used for Masonry work. Portland Pozzolana cement conforming to I.S.1489-1991 may also be used for masonry work, in the event of non-availability of ordinary Portland cement with the approval of Engineer-in-charge.

6.1.6 Water

The specifications and conditions specified for procuring water in paragraph 6.3.5 shall be applicable here also.

6.2 Mortar

6.2.1 Preparation of Mortar

Unless otherwise specified the cement mortar used in masonry works shall be cement mortar mix 1:4 (one cement four sand by volume). Mixing shall be done thoroughly preferably in a mechanical mixer. In such case, the cement and sand in the specified proportion shall be mixed dry thoroughly in the mixer operated manually or by power. Water shall be added gradually and wet mixing continued at least for 2 minutes. Water should not be more than that required for bringing the mortar to the required working consistency of 90 to 130 millimeters as required in clause 9.1.1 of IS 22501-19891. The mix shall be clean and free from injurious kind of soil, acid, alkali, organic matter or deleterious substances.

6.2.2 Time of use of Cement Mortar

Cement mortar shall be used as soon as possible after mixing before it has begun to set, within 30 minutes after the water is added to the -dry mixture. Mortar unused for more than 30 minutes should not be used and shall be removed from the site or work. The cost of such wasted mortar shall be borne by contractor. The use of re-tampered mortar will not be permitted to be used for the masonry.

6.2.3 Tests of Mortar

Mortar test cubes shall be cast for the mortar used on the work and shall be tested in accordance with Appendix-A of IS 2250-1965 code of practice for preparation and use of Masonry mortars.

Such cubes shall develop a compressive strength of at least 50 Kgs. Sq.cm for cement mortar mix, 1:5 and 75 kgs / Sq cm for mortar mix 1:4. Mortar not conforming to the specifications will be ejected and the cost of such wasted mortar shall be borne by the contractor.

6.2.4 Measurement and Payment

Cement mortar will not be measured and paid separately and its cost including cost of materials, mixing, transporting and placing shall be included in the unit price per cubic metre bid here for in the bill of quantities of the contract for the relevant finished item of work for which cement mortar mix mentioned in the above paragraph is required.

6.3. Curing

All masonry surfaces shall be treated as specified to prevent loss of moisture from mortar until the required curing period is elapsed or until prior to placement of other masonry or concrete or backfill against surfaces. The contractor shall make his own arrangements to procure and convey water for curing. All masonry built with cement Mortar shall be kept watered continuously for a minimum period of two weeks from the date of construction. Watering shall be done carefully so as not to wash out the mortar, joints or disturb the masonry in any manner.

If the contractor fails to do curing to the satisfaction of the officer in charge of the work, the latter will either make arrangement to our the masonry at the risk and cost of the contractor or order the masonry to be pulled down.

The masonry so pulled down should be rebuilt by the contractor at his own cost.

SECTION – 7

PLASTERING AND POINTING

7.1 Materials

7.1.1 Sand for Mortar for plastering and Pointing

a. General

Sand shall generally conform to specification given in paragraph 7.1.6 except that the sand for preparation of Mortar for plastering and pointing shall conform to the following gradition, shown in Table 6 (A) as per IS 1542-1977.

Table 6 (A)

Requirement of Grading for sands for External Plastering and Rendering

I.S Sieve designation	Percentage by weight passing I.S. Sieve
10.00mm	100
4.75mm	95 to 100
2.46mm	95 to 100
1.10mm	90 to 100
600 micron	80 to 100
300 micron	20 to 650
150 micron	0 to 50

The procurement of sand for mortar for plastering and pointing shall conform to the specifications given in paragraph 6.3.8.

b. Cost

The cost of sand for mortar for plastering and pointing will not be measured and paid separately and the cost of sand including the cost of stripping and transporting and storing and royalty charges shall be included in the unit price per cum bid therefore in the relevant item of work in the bill of quantities for which this sand is required.

7.1.2 Cement

The specification and conditions specified for supply of cement in paragraph 7.1.3. shall be applicable here also. Ordinary Portland cement conforming to IS 269-1976 shall be used for preparation of mortar for plastering, pointing and for masonry work. In the event of non-availability of ordinary Portland cement, Portland Pozzolana cement conforming to IS 1489-1976 may be used with the approval of Engineer-in-charge.

7.1.3 Water

The specification and condition specified for procurement of water in Paragraph 7.1.5 shall be applicable here also.

7.2 Mortar

7.2.1 Preparation of Mortar for plastering work

Unless otherwise specified the cement mortar used in plastering work shall be in cement mortar 1:3 (one cement, three sand by volume). The other specifications and conditions enunciated in paragraph 5.2.1 shall apply for this mortar for plastering work also.

7.2.2 Preparation of Mortar For Pointing

The cement mortar used in pointing work shall be cement mortar mix 1:4 (One Cement four sand by volume). The other specifications and conditions enunciated in paragraph 4.2.1. Shall apply for this mortar for pointing of work also.

7.3 Plastering with cement Mortar (1:4 One Cement three sand by volume) 2Omm thick

7.3.1 Preparation of surface

The roughening of the background improves the bond of plaster. All joints shall be thoroughly raked. After roughening the surface, care shall be taken to moisten the surface sufficiently before plastering as otherwise freshly exposed surface may tend to absorb considerable amount of water from the plaster. The surfaces shall be wetted evenly before applying the plaster. Care shall be taken to see that the surface is not too dry as this may cause lack of adhesion or excessive suction of water from the plaster. A fog spray may be used for this work. As far as possible, the plaster work shall not be done under hot sun.

7.3.2 Laying of plastering with cement mortar 1:3 (one cement three sand by volume) 2Omm thick

The mortar used for plastering shall be stiff enough to cling and hold when laid. TO ensure even thickness and true surface, plaster shall be applied in patches of 150 mm x 150 mm of the required 20 mm thickness at not more

than 2 metres intervals horizontally and vertically over the entire surface to serve as guides. The surface of these guides shall be truly in the plane of to be finished plaster surface and truly plump.

The mortar shall then be applied to the surface to be plastered between the guides with a trowel. Each trowel full of mortar shall overlap and sufficient pressure shall be used to force it into thorough contact with the surface. On relatively smooth surfaces, the mortar shall be dashed on with the trowel to ensure adequate bond. The mortar shall be applied to a thickness slightly more than that specified, using a string, stretched out between the guides. This shall then be brought to a true surface by working with a long wooden float with small-motion. The surface shall be periodically checked with a string stretched across it. Finally the surface shall be rendered smooth with a small wooden float, over working shall be avoided. All corners arises and junctions shall be brought truly to a line with the necessary rounding or chambering. If it is necessary to suspend the work at the end of the day it shall be left in a clean horizontal or vertical line not nearer than 150 mm from any corner or arises or on parapet tops or on cooing etc. when recommencing the work, the edges of the old work shall be scraped clean and treated with cement slurry before the new plaster is laid adjacent to it. After the first coat is done it shall be kept undisturbed for the next 24 hours and thereafter kept moist and not to be permitted to dry until the final rendering is applied. After the plaster has sufficiently hardened cement slurry with cream like consistency shall be applied as thinly and evenly and rubbed to a fine condition.

The finished surface shall be cured with winter for a minimum period of 14 days. Should the mortar crack or perish, the work shall be removed and redone at the contractors expense or should contractor fails to cure the work to the satisfaction of the Engineer-in-charge the later may cure the work at the risk and cost of the contractor. All portions which sound hallow when tapped or found to be soft or otherwise defective shall be cut out in regular shape and redone as directed by the Engineer in charge.

7.4 Measurement and payment

a. Plastering

The measurement of plastering will be in units of square meters and it shall be paid at the relevant unit prices bid per one square meters of plastering in the bill of quantities which unit price shall include the cost of materials, their conveyance, charges for preparation of mortar including mixing charges and charges for performing the plastering work as illustrated in this division including curing.

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b. pointing

Unless specified in the contract document, no separate payment will be made for pointing random rubble masonry and coursed rubble masonry and the unit prices for the rubble masonry in the bill of quantities, shall include the cost of materials, their conveyance, charges for preparation of mortar including mixing charges and charges for performing the pointing work as illustrated in this division including curing.

SECTION - 8

8.1 General concrete Requirements

8.1.1 Composition

a. General

The I.S. 456- 2000 code of practice for plain and reinforced concrete shall be followed. Concrete shall be composed of cement, sand, coarse aggregate water and admixtures (if any) as specified and all well mixed in batching plant by weight or in concrete mixer and brought to the proper consistency. The contractor shall provide such means and equipments as are required to accurately determine and control the relative amounts of various material required for the concrete. Such means, the equipment and its operation shall be subject, at this time, to the approval of the Engineer-in-charge. The measuring and weighing equipment shall operate with the degree of accuracy specified by the Engineer in charge.

For works in which water tightness is required the specification in I.S.3370 (part 1 & Part 11) 1965 para 1 to 10 shall be applied.

Mixing

Concrete shall be mixed in a mechanical mixer and shall be as dense as possible, plastic enough to consolidate well and stiff enough to stay in place on the slopes. Mixing shall be continued until there is a uniform mixing of the materials and the concrete is uniform in colour and consistency.

The time of mixing shall be as shown in table of IS 457-1957 reproduced below:

Capacity of Mixer	Minimum time of Mixing	
	Natural Aggregates	Manufactured Aggregates
All mixers	2 minutes	2 ½ minutes

Concrete classification

It is related to the specified 28 days compressive the Table below:-

Classification of Concrete (JS.456-2000)	Max. size Aggregates	Characteristic Compressive Strength N/mm2 for 15 cm Cube at 28 days
1. M-10	40	10
2. M-15	40/20	15
3. M-20	20	20

A minimum of 3 test specimens shall be made for each 120 m3 of each class of concrete for given age. There shall be at least 3 test specimens for each day of concreting even if only a few cubic metres of the particular concrete is manufactured in a day.

The test shall satisfy the following criteria

3 The average strength of any 3 consecutive samples shall be greater than the specified strengths;

4 The overall coefficient of variation for any ten consecutive sample strength shall be less than 15%;

5 Not more than 10% of the specimen strengths shall be less than 85% of the specified strength.

Note: The mix shall be designed to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in above table.

b. Nominal maximum size of aggregates

For sizes of aggregates IS 383-1970 shall apply. The coarse aggregate to be used in concrete shall be as large as practicable, consistent with required strength, starting of reinforcement and embedded items, and placement thickness.

The size of the coarse aggregate to be used will be determined by the Engineer-in-charge and may vary incrementally according to the conditions encountered in each concrete placement. Nominal maximum size of aggregate for concrete in structures shall be as indicated in the relevant drawings appended to the contract documents.

Smaller coarse aggregate than specified shall be used where the opinion of the Engineer-in-charge that proper placement of concrete is impracticable with the size of the aggregate specified in the drawings.

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Designation of size	Nominal size range
20 mm aggregate	4.75 to 20 mm
40 mm aggregate	20 mm to 40 mm

generally coarse aggregate of maximum nominal size of 40 mm shall be used in M 7.5 and of 20 mm size in M 10 grade concrete bed.

C. Mix proportions

The proportions of various ingredients to be used in the concrete for different items of the work are given in the bill of quantities. In proportioning concrete, the quantity of both cement and aggregate should be determined by mass. Water shall be either measured by volume in calibrated tanks or weighed. Wherever the quantity of concrete involved in a particular work is small, nominal mix concrete may be allowed with the specific approval of the Engineer-incharge who may also allow volumetric batching/proportioning for the restricted quantity. The proportion of materials for nominal size concrete shall be in accordance with Table.3, page 50 of IS 456-2000. All measuring equipment shall be maintained in a clean serviceable condition and their accuracy periodically checked. Adjustments shall be made as directed to obtain concrete having suitable workability, impermeability, density, strength and durability without the use of excessive cement. The acceptance of rejection of concrete shall be as per the acceptance criteria laid down in clause 15 of I.S.456-2000. The net water cement ratio exclusive of water absorbed by the aggregae shall be sufficiently low to provide adequate durability in concrete. The water cement ratio for various grades of concrete shall be as determined and ordered by the Engineer-in-charge.

Admixtures of pozzolana, if ordered, shall confirm to the requirements specified in IS 9103-1979 (Indian Standard Specification for admixtures for concrete).

Test Strength of samples

The test strength of sample shall be the average of the strength of three specimen. The individual variation should not be more than 56% of the average.

Standard Deviation

i) Standard deviation based on test result

a) Number of test results:-

The total number of the results required to constitute an acceptable regard for the calculation of standard deviation shall be not less than 30 attempts shall be made to obtain the 30 test results, as early as possible, when mix is used for the first time.

(ii) Determination of standard deviation:-

(a) Concrete of each grade shall be analyzed separately to determine its standard deviation

(b) The standard deviation of concrete of a given grade shall be calculated using the following formula from the results of individual test of concrete of that grade

Estimated standard deviation = Root of $\frac{\square\square\square^2}{n - 1}$

Where T = deviation of the individual test strength from the average n = number of sample test results Where sufficient test results for a particular grade of concrete are not available the value of standard deviation given in the following table may be assumed.

Table

Grade of Concrete	Assumed standard Deviation-(N/mm2)
M10	2.3
M15	3.5
M20	4.6
M25	5.3

Acceptance Criteria

The Concrete shall be deemed to comply with the strength requirements if:

a. every sample has a test strength not less than the characteristic value; or

b. the strength of one or more samples though less than the characteristic value, is in each case not less than the greater of:

1. the characteristic strengthening minus 1:35 times the standard deviation: and

2. 0.80 times the characteristic strength; and the average strength of all the samples is not less than the characteristic strength plus

1.65 = (1.65 / number of samples) = times the standard deviation

The concrete shall be deemed not to complete with the strength requirements if:

a. the strength of any samples is less than the greater of:

1. The characteristic strength minus 1.35 times, the standard deviation; and

2. 0.80 times the characteristic strength; or

b. the average strength of all the samples is less than the characteristic strength plus

1.65 = (3 / number of samples) = times the standard deviation.

Concrete is liable to be rejected if it is porous or honeycombed; its placing has been interrupted without providing a proper construction joint. However, the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the Engineer-in-charge.

d. Consistencies

The slump of concrete at the placement shall range from 25 mm to 50 mm with vibrations achieved through the vibrators to the satisfaction of Engineer-in-charge. The slump test shall conform to IS 1199-1959.

1. Reinforced cement concrete

S. No.	Place Condition	Degree of workability	value of work ability
1.	Correcting of lightly reinforced sections without vibration or heavily reinforced sections with vibrations.	Medium	25mm to 75 mm slump for 2Omm
2.	Concreting of heavily reinforced sections without Vibration	High	75mm to 125 mm slump for 2Omm aggregate

ii. For plain concrete work. Slump requirements mentioned in item 1 above are applicable.

ii. Lining with slip form machine-60 to 70 mm and 50 mm for concrete paver finisher.

If the specified slump is exceeded at the placement, the concrete is unacceptable. The Engineer-in-charge reserves the right to require lesser slump whenever concrete of such lesser slump can be consolidated readily into place by means of vibration specified by the Engineer-in-charge. The use of any equipment which will not readily handle and place concrete of the specified slump will not be permitted.

To maintain concrete at proper consistency, the amount of water and sand batched for concrete shall be adjusted to compensate for any variation in the moisture content or grading of the aggregates as they enter the mixture. Addition of water to compensate for stiffening of the concrete after mixing but before placing will not be permitted. Uniformity in concrete consistency from batch to batch will be required.

8.1.2. Concrete quality Control Measures and concrete quality Assurance Test Programme

a. Concrete quality Control Measures

The contractor shall be responsible for providing quality concrete to ensure compliance of the contract requirements.

b. Making and curing concrete test specimens in the field: will confirm to I.S. 516-1959.

c. Capping cylindrical concrete specimens will conform to I.S.516-1959.

d. Compressive strength of concrete specimens will conform to I.S., 516-1959 and para 16 (16.1, 16.2 & 16.3) of I.S. 456-2000-core testing.

a. Sampling Procedure and Frequency

A random sampling procedure shall be adopted to ensure that each concrete batch has a reasonable chance of being tested. i.e. the sampling should be spread over the entire period of concreting and should cover all mixing units.

c. Frequency

The minimum frequency of sampling of concrete of each grade shall be in accordance with the following:

Quantity of concrete M3	Number of samples
1 to 5	1
6 to 15	2
16 to 30	3
31 to 50	4
51 and above	4 plus one additional sample for each additional 50 M3 or part thereof.

Note: At least one sample shall be taken during each shift.

Test Facilities

The Samples shall be collected and the tests conducted in the presence of the engineer or his authorized representatives. Alternatively the contractor may test the materials during execution of works at the laboratories approved by the Engineer at the contractors own cost provided that the samples are collected and given proper identification marks in the presence of the engineer or his authorized representative.

8.1.3. Cement

a. General

Cement shall conform to clause 4 of I.S. 456-2000 for the purpose of specifications. Cement used shall be one of the following two types with prior approval of the Engineer-in- charge.

1. ordinary or low heat portland cement conforming to I.S.269-1967 (I.S. Specification for ordinary and low heat portland cement third revision).

2. The provisions of this paragraph apply to cement for use in cast-in-place concrete required for items such as concrete pipes, precast concrete structural members and other precast concrete products, for grout and mortar and for other items is provided for in the applicable paragraphs of these specifications covering the items for which such portland cement is required.

The contractor shall make his own arrangements for the procurement of cement for the work either bagged or in bulk as required by specification of the works. Each shipment of bagged cement shall be stored separately so that it may readily be distinguished from other shipment and shall be stored in a dry enclosed area protected from moisture.

Storage of materials shall be as described in I.S.4082-1977 (I.S. Recommendation on stacking and storage of construction materials at site). To prevent undue aging of bagged cement after delivery, the contractor shall use bags of cement in the chronological order in which they were delivered to the job site.

All storage facilities shall be subject to approval of the Engineer-in-charge and shall be constructed to prevent easy access for inspection, and identification.

b. Acceptancy of cement

Tested cement will be supplied by the contractor according to clause 1 0. 1 of I.S. 269-1976.

c. Recovery of Cost of cement in waste - concrete etc.

The cost of cement used in wasted concrete, in replacement of damaged or defective concrete, in extra concrete required as a result of over excavation, and in concrete placed by the contractor's operations shall be borne by the Contractor himself. No extra payment will be made to contractors for such additional quantity.

8.1.4. Admixtures

The contractor shall use Air Entraining admixtures as directed by the Engineer-in-charge.

Admixtures shall be of uniform consistently and quality and shall be maintained at the job site at uniform strength of solution. Admixtures shall be batched in liquid form in containers capable of measuring at one time the full quantity of each admixture required for each batch chemical admixtures which harm the quality and strength of concrete shall not be used in the concrete. Admixtures to be used in concrete shall confirm to I.S. 9103-1979 Indian Standard Specifications for Admixtures for concrete.

8.1.5. Water

The water used in making a curing of concrete, mortar and grout shall be free from objectionable quantities of silt, organic matter injurious amounts of oils, acids, salts and other impurities etc. as per I.S. specification No.456-2000.

The Engineer-in-charge will determine whether or not such quantities of impurities are objectionable.

Such determination will usually be made by comparison of compressive strength, water requirement, time of set and other properties of concrete made with distilled or very clean water concrete made with the water proposed for use. Permissible limits for solids when tested in accordance with I.S. 3025-1964 shall be as tabulated below.

PERMISSIBLE LIMITS FOR SOLIDS IN WATER

1.	Organic	Maximum permissible limit 200 mg/liitre
2.	Inorganic	300 mg/liter
3.	Sulphate (as So4)	500 mg/liter
4.	Chlorides (as CL)	2000 mg/liter for plain concrete work and 1000 mg/liter for RCC work.
5.	Suspended matter	2000 mg/liter

If any water to be used in concrete, mortar, or grout is suspected by the Engineer-in-charge of exceeding the permissible limits for solids, samples of water will be obtained and tested by the Engineer-in-charge in accordance with I.S. 3025-1964.

8.1.6. Sand (Fine Aggregate)

a. General

The term sand is used to designate aggregate most of which passes 4.75 millimeter I.S. sieve and contains only so much coarser materials as permitted in clause 4.3 of I.S.383-1970. Sand shall be predominantly natural sand which may be supplemented with crushed sand to make up deficiencies in the natural sand gradings.

All sand shall be furnished by the contractor from any approved sources specified in the contract.

Sand as delivered to the batching plant. Shall have a uniform and stable moisture content. Determination of moisture content shall be made as frequently as possible, the frequency for a given job being determined by the Engineer-in-charge according to weather conditions (I.S. 456-2000).

b. quality

The sand shall consist of clean, dense, durable, uncoated rock fragments, as per I.S. 383-1979.

Sand may be rejected if it fails to meet any of the following quality requirements.

Organic Impurities in sand

Color no darker than the specified standard in clause 6.2.2 of I.S. 23286 part 11 1963. (Indian Standard method of test for aggregates for concrete parts estimation of deleterious materials and organic impurities).

Sand shall be screened before use. If sand brought to site is not clean it must be washed clean in water. Fine drift sand or sea sand or sand containing saline impurities shall on no account to be used.

Sodium Sulphate Test for Soundness

The sand to be used shall pass a sodium or magnesium sulphate accelerated test as specified in I.S. 2386 (Part-V) 1963 for limiting loss of weight.

Specific Gravity: 2.6 Minimum

Deleterious substances

The amounts of deleterious substances in sand shall not exceed the maximum permissible limits prescribed in table 1 clause 3.2.1 of I.S.383-1970 and shall be described as Fine aggregates, grading zones – I,II,III and IV, sand complying with the requirements of any of

the four grading zones is suitable for concrete. But, sand conforming to the requirements of grading zone-IV shall not be used for reinforced cement concrete work.

8.1.7 Coarse Aggregate

a. General

For the Purposes of these specifications the term "coarse Aggregate" designate clean well graded aggregate most of which is retained on 4.75 mm t.S. Sieve and containing only so such finer material as permitted for various types described under clause 2.2 of I.S. 383-1970. Coarse Aggregate for concrete shall consist of uncrushed stone, or crushed stone and partially uncrushed and crushed stone.

Coarse Aggregate for concrete shall be furnished by the Contractor from the approved quarries specified in the contract documents. The contractor shall unless otherwise specified in the tender notice and subsequently on this basis in contract be responsible for payment of seignorages, quarry fees etc., on all materials.

Coarse Aggregate as delivered to the building plant shall generally have uniform and stable moisture content. In case of variations, clause 9.2.3 of I.S. 456-2000 shall govern during batching.

b. Quality

The coarse aggregate shall consist of naturally occurring (crushed or uncrushed) stones, and shall be hard, strong, durable clear and free from veins and adherent coating, and free from injuious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious materials. Coarse aggregate will be rejected if it fails to meet any of the following requirements.

1. Los-Angeles Abrasion Test

The abrasion value of Aggregates when tested in accordance with the method specified in I.S. 2386 (Part IV) using Los-Angles machine shall not exceed 30% for Aggregate to be used in concrete for wearing surface and 50% for aggregate to be used in other concrete.

2. Aggregate Crushing Strength Test

Aggregate crushing value, when determined in accordance with I.S. 2386 (Part IV) 1963. The aggregate impact value shall not exceed 45% by weight for aggregates used for concrete for other than wearing surfaces, and 30% by weight for concrete for wearing surfaces such as runways, roads and payments.

3. Soundness Test

The coarse aggregate to be used for all concrete works shall pass a sodium or magnesium sulphate accelerated soundness test specified in I.S. 2381 (Part V) 1963 and the average loss of weight after 5 cycles shall not exceed

the limits specified in clause 3.6 of I.S. 383- 1970.

4. Specific Gravity: should be 2.60 Minimum

5. Deleterious Material

The maximum quantity of deleterious materials in coarse aggregates shall not exceed the limits specified in Table 1 of I.S. 383-1970 when tested in accordance with I.S. 2386-1963.

c. Separation

The coarse aggregate shall be separated into nominal sizes during production of the aggregate. Just prior to batching the coarse aggregate shall be rewashed by pressure spray and finish screened on multidisc vibrating screen capable of simultaneously removing undersized and oversized aggregate from each of the nominal aggregates entering the batches occurred during intermittent and batching then a dewatering screen will be required after the finished screens to remove the excess free moisture. Finish screen shall be mounted over the batching plant or on the ground adjustant to the batching plant. Finished screen shall be so mountered that the vibration of this screen will not be transmitted to batching bins or scales and will not affect the accuracy of the weighing equipment in any other manner.

The method and rate of feed for finish screening shall be such that the screen will not be overloaded and will result in a finished product which meets the grading requirements of these specifications. Coarse aggregate shall be fed to the finished screen in a combination of alteration of nominal sizes which will not cost noticeable accumulation of poorly graded coarse aggregate in any bin. The finish screened aggregate shall pass directly to the individual batching bin in such a manner has to minimize breakage. Below 2.36 mm materials passing through the finish screens, shall be wasted unless it is tooted back through a sand classifier in a manner which causes uniform blending with the natural sand being processed. Water from finish screening shall be drained in such a manner as to prevent aggregate wash

water from entering the batching bins and weighing hoppers. Washing and finish screening requirements shall be subject to approval by the Engineer-in- charge.

Coarse aggregate for concrete shall be separated into various nominal maximum sizes specified in the relevant drawings. Separation of the coarse aggregate into the specified sizes after finish screening shall conform to the grading requirements specified in table - 2 of I.S. 383-1970, when tested in accordance with I.S. 2386--(Part-1) 1963 (Method of test for aggregate for concrete part -1) particle size and shape.

Coarse aggregate for mass concrete may be separated as previously herein specified. Separations of the Coarse aggregate into the various sizes shall be sure that when tested in accordance with I.S. 386 (part-]) 1963 shall conform to the requirements specified in Table-3 of I.S. 383-1970.

Sieves used in grading tests will be standard mesh sieves conforming to I.S. 460 (part-]) 1978 (specification for test sieves part-1 wire cloth test sieves).

8.1.8 Production of sand and Coarse Aggregate

a. General

Sand and Coarse aggregate for concrete, and sand for mortar and grout, may be obtained by the Contractor from the approved source shown in the contract documents.

Tests performed on samples of sand and coarse aggregate obtained from the approved sources mentioned in the contract documents indicated that they are generally suitable. Well in advance of their usage on the works, the contractor shall have his own testing of materials and satisfy himself that they conform to the specification mentioned herein for use in the works.

No separate payment will be made for such tests. If sand and coarse aggregate are to be obtained from a deposit not previously tested and approved by the Engineer-in-charge. the Contractor shall submit representative samples for pre-construction test and approval. not less than 60 days before the sand and coarse aggregates are required for use. Each, sample shall approximately consist of 100 kg. of material. In addition to pre-construction tests, the approval of deposits, the Engineer-in-Charge may test the aggregates for their suitability during their processing. The Contractor shall provide such facilities as may be necessary for procuring representative samples free of cost at the aggregate processing plant at the batch

plant. Final acceptance of aggregates will be based on the samples taken from the batch plant or mixing platform.

But use and development of any such deposit shall be subject to the approval by the Engineer-in-charge. Any royalties (senior age or other charges) required for materials taken from deposits not owned by the State Government and controlled by the Department of Mines and Geology, Government of India shall be paid by the Contractors.

b. Developing Aggregate Deposits

If the Deposit is owned by the State Government and controlled by the Department of Mines and Geology, the portion of the deposit used shall be located and operated so as not to detract the usefulness of the deposit or any other property of the Government, and so as to preserve, in so far as practicable. the future usefulness on value of the deposit. The Contractor shall carefully clear the area of deposit, from which the aggregates are to be produced, of trees, roots, bush sod, solid, unsuitable sand and gravel and other objectionable matter. Materials including stripping, removed from deposits owned by the Government and controlled by the Director of mines and Geology, Government of India and not used in the work covered by these specifications shall be disposed off as directed.

Due to the overall construction programme. it is quite likely that more than one contractor may elect to use one of the sources named in the contract document. The Contractor shall be responsible for coordinating his work such that it does not interfere with the operations of other contractors who are also using any given source.

c. **Processing Raw Materials**

Processing of the raw materials shall include screening and washing as necessary to produce sand and coarse aggregate conforming to the requirements of paragraphs 7.1.6 and 7.1.7 processing of aggregates produced from any source owned by the State Government and controlled by the Department of Mines and Geology shall be done at an approved site. Water used for washing aggregate shall be free from objectionable quantities of salts, organic matter and other impurities.

Oversize metal may be crushed to correct aggregate particle size, and excess material in individual coarse aggregate size fractions may be crushed to give the largest practical yield of usable concrete aggregate.

Suitable types of crushers shall be used with the prior approval of the Engineer-in-charge for producing coarse aggregates. Crusher fines produced in the manufacture of coarse aggregates may be used in sand. Crushed stone, sand, crushed gravels and crusher fines if used shall be predominantly cubical in shape and shall be blended uniformly with natural sand by routing them together through sand classifier. Crusher coarse aggregate shall be blended uniformly with coarse aggregate by routing both together through the classifying screens.

In the process of developing and producing aggregates from approved sources for work under these specifications, the provisions of Environmental quality protection shall apply.

d. Cost

This shall be included in the applicable prices bid in the schedule for concrete filler road works in which the aggregates are used, which prices shall include the cost of stripping and transporting and storing materials. The Contractor shall not be entitled to ;any additional compensation for materials wasted from a deposit. including crushed fines, excess materials of any of the sizes into which the aggregates are required to be separated by the contractor, and materials which have been discarded by the reasons of being above the maximum sizes specified for use.

8.1.9 Mixing

a. General

The Concrete ingredients shall be thoroughly mixed in mechanical mixers designed to positively ensure uniform distribution of all the component materials through out the concrete at the end of the mixing period. Mixing shall be done as per clause 9.3 of I.S.456-2000. The mixer should comply with I.S. 1791-1985 (I.S. Specifications for batch type concrete mixers). The concrete as discharged from the mixer shall be uniform in composition and consistent from batch to batch. Workability shall be checked at frequent intervals as per I.S. 1199-1959. Mixers will be examined regularly by the Engineer-in-charge or his authorized Engineer for changes in condition due to accumulation of hardened concrete or mortar or to wear of blades. The mixing shall be continued until there is a uniform distribution of the materials so that the mass is uniform in colour and consistency and to the satisfaction of the Engineer-in-charge. If there is segregation after unloading the concrete should be remixed.

Any mixer that at any time produces unsatisfactory mix, shall not be used until repaired. If repair attempts are unsuccessful, a defective mixer shall be replaced. Batched size shall be at least 10% of, but not in excess of the rate capacity of the mixer unless otherwise authorized by the Engineer-in-charge.

8.1.10 Forms

a. General

Form shall be used wherever necessary, to confine the concrete and shaping it to the required lines. If a type of form does not consistently perform in an acceptable manner, as determined by the Engineer-in-charge, the type of

form shall be changed and method of creation shall be modified by the contractor subject to approval of the Engineer in-charge.

Plumb and string lines shall be installed before, and maintained during concrete placement. Such lines shall be used by the contractor's personnel and by the Engineer-in-charge and shall be in sufficient number and properly installed as determined by the Engineer-in-charge. During concrete placement, the contractor shall continuously monitor plumb and string lines, form positions and immediately correct deficiencies.

Forms shall have sufficient strength to with-stand the pressure resulting from placement and vibration of the concrete and shall be maintained rigidly in position. Where form vibrators are to be used, forms shall be sufficiently rigid to effectively transmit energy from the form vibrators to be concrete. While not damaging or altering the positions of forms. Forms shall be sufficiently tight to prevent loss of mortar from the concrete.

Chamfer strips shall be placed in the corners of forms and at the top of wall placement to produce beveled edges on permanently exposed concrete surfaces. Interior angle of inter-setting concrete surfaces and edges of construction joints shall not be beveled except where indicated on the drawings.

Suitable struts of stiffeners of ties shall be used for the form work wherever necessary. All supports shall be braced and cross braced into two directions. All splices and braces shall be secured by bolting unless specially intended otherwise. All struts shall be firmly supported against settlement and sliping, by suitable means as directed. All supports shall be cut square at both ends and firmly supported against settlement and slipping. When the formwork is

supported on soils, planks. sleepers etc., shall be used to properly disperse the loads. In case, the supports rest on already completed beam or slab, suitable props shall be provided under the latter.

a. The joint between the form work and existing concrete shall also be 'grant tight'. Forms shall over lap the hardened concrete in the lift previously placed by not more than 75mm and shall be tightened against the hardened concrete so that when concrete placement is resumed the forms will not allow loss of mortar at the construction joint.

b. The form work shall be of well seasoned timber or steel. When timber forms are used, they shall be lined, with mild sheet or other suitable smooth faced non-absorbent materials as specified. Supports may be of timber or steel. Suitable wedges in pairs to facilitate adjustment and subsequent releasing of forms shall be provided preferably at the upper end of the support. The details of the proposed form work and supports shall be submitted to the Engineer- in-Charge and got approved before erection.

c. In case of columns, retaining walls of deep vertical component the height of the column shall facilitate any placement and compact in of concrete and suitable arrangement may be made for securing the form to the already poured concrete for placing the subsequent lifts. No steel ties or wires used for securing this form work shall be left exposed on the face of the finished work.

d. Suitable inserts for blackouts for electrical and other service fixtures where necessary shall be provided in the required locations as specified.

e. Cleaning and oiling of forms at the time the concrete is placed in forms, the surfaces of the forms shall be free from encrustations of mortar, grout or other foreign material. Before concrete is placed, the surface of the forms shall be oiled with commercial forms of oil.

f. Removal of Forms

The stripping of form work shall conform to clause 10.3 of I.S. 456-2000. The contractor shall be liable for damage and injury caused by removing forms before the concrete has gained sufficient strength. Forms on upper sloping faces of concrete such as forms on the water sides of warped transitions, shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping surfaces shall be performed at once and be followed immediately by the specified curing.

To avoid excessive stresses in concrete that might result from swelling of forms. Wood for wall openings shall be loosened as soon as the loosening can be accomplished damages to the concrete. Forms for the openings shall be constructured so as to such loosening. Forms shall be removed with care so as to avoid injury to and any concrete so damaged shall be repaired in accordance with paragraph 7.3.21.

g. Cost

The cost of furnishing all materials and performing all work for constructing forms, including any necessary treatment or coating of forms are to be included at applicable prices bid in the schedule.

8.1.11 Tolerances for Concrete Constructions

a. General

Tolerances are defined as allowable variations from specified lines, grades, and dimensions and as the allowable magnitude of the surface irregularities. Allowable variations from specified lines, grades and dimensions are listed in table given under sub paragraph (b) below.

The intent of this paragraph is to establish tolerances that are consistent with modern construction practice that the governed by the effect that permissible variation may have upon a structure.

The Government reserves the right to diminish the tolerances set-forth herein if such tolerances impair the structural action, operational function or architectural

appearance of a structure or portion thereof.

Concrete shall be within all stated tolerances even though more than one tolerance may be specified for a particular concrete structure. Provided that the specified variation for one element of the structure to exceed its allowable variation. Where tolerances are not specified for a particular structure, tolerances shall be those specified for a similar work. As an exception to clause 2 of the general provisions, specific tolerances shown herein in connection with any dimension shall govern. The Contractor shall be responsible for finishing the concrete forms with in the limits necessary to insure that the completed work will be within the tolerances specified. Concrete work that exceeds the tolerance limits specified shall be remedied in accordance with the sub paragraphs (d and e).

b. Variations From Specified Lines, Grades And Dimension

Hardened concrete structures shall be checked by the contractor and will be subject to such inspection and measurement as needed to determine that the structures are within the tolerance specified in the table below.

Variation is defined as the distance between the actual position of the structure or any element of the structure and the specified position in plan for the structure or the particular element. Plus or minus variations shown as (+) indicate a permitted actual position up or down and in or out from the specified position in plan. Variations not designated as plus or minus indicate the maximum deviation permitted between designated successive points on the completed element of construction.

Specified position in plan is defined as the lines, grade and dimensions described in these specifications or shown on the drawings or as otherwise prescribed by the Engineer-in-charge.

NOTE: Tolerances apply to concrete dimensions only, but not for positioning of vertical reinforcing bars or dowels.

C. Concrete surface Irregularities

1. General

Bulges, depressions and offsets are defined as concrete surface irregularities. Concrete surface irregularities are classified as "abrupt" or gradual and are measured relative to the actual concrete surface.

2. Abrupt surface Irregularities

Abrupt surface irregularities are defined herein as offsets such as those cause be misplace or loose forms, loose knots in form number, or other similar, forming faults. Abrupt surface irregularities are measured using a straight irregularity and the magnitude of the offset is determined by direct measurement.

3. Gradual Surface Irregularities

Gradual surface irregularities are defined herein as bulges and depressions resulting in gradual changes on the concrete surface. Gradual surface irregularities are measured using a

suitable template conforming to the design profile of the concrete surface being examined. The magnitude of the gradual surface irregularities is defined herein as a measure of the rate of change in slopes of the concrete surface. The surface irregularities shall not exceed 6mm for bottom slab and 12 mm for side slopes when tested with a straight edge of 1.5 metre in length. The magnitude of gradual surface irregularities on concrete shall be checked by the contractor to ensure that the surfaces are within the specified tolerances. The Engineer-in-charge will also make such checks of hardened compliance with such specifications.

d. Repair of Hardened Concrete Not within Specified Tolerances

Hardened concrete which is not within specified tolerances shall be repaired to bring it within those tolerances. Such repair shall be in accordance with paragraph 6.3.21 and shall be accomplished in a manner approved by the Engineer-in-Charge. Concrete repair to bring concrete with the tolerances shall be done only after consultation with a representative of Engineer-in-Charge regarding the method of repair. The Engineer-in-Charge shall be notified as to the time when repair will be performed. Concrete shall be finished in a manner which will result in a concrete surface with a uniform appearance.

The tins and any rough projections can then be rubbed down and the whole surface brought to an even finish by rubbing with an wooden float using a mortar of one part cement by two parts of coarse sand as an abrasive, the mortar at the same time filling the voids. A neat cement work shall then be applied to give a smooth surface. If the concrete has set hard, the tins and rough projections, if any, shall be removed by using corborandum brick or a paved grinding machine by chipping, before finishing off with the smoothing wash. If the work of chipping is not done with care or if the surface exposed after removal of the forms cannot be satisfactorily dealt with in this manner due to bad form work or for other reasons, a coat of cement plaster of 1:2 of thickness as ordered by the Engineer-in-charge shall be applied. No extra payment will be given for finishing concrete surface as instructed above in this clause.

e. Prevention of Repeated Failure To Meet Tolerances

When concrete placements result in hardened concrete that does not meet the specified tolerances, the contractor shall submit to the Engineer-in-Charge an outline of all preventive actions such as modification to forms, modified procedure for setting screeds, and different finishing techniques to be implemented by the contractor to avoid repeated failures. The

Engineer-in-Charge reserves the right to delay concrete placement until the contractor implements such preventive actions which are approved by the Engineer-in-Charge.

8.1.12 Reinforcing Bars

a. General

Reinforcing bars shall be placed in the concrete as shown in the drawings or as directed. For anchoring the concrete to the Hard rock provision of Anchor rods is made in the Drawing and the contractor shall place these anchor rods to the spacing and depth shown in the drawings.

b. Materials

Unless shown otherwise on the drawings the reinforcement to be used shall be High yield strength deformed (H.Y.S.D.) bars of grace F.E.415 conforming to I.S.1786-1985 (I.S. specification for high yield strength deformed steel bars and wires for concrete reinforcement.

c. Placing

Reinforcement shall be bent and fixed in accordance with the procedure specified in I.S. 2502-1963 (code of practice for bending and fixing of bars for concrete reinforcement). All reinforcement shall be placed and maintained in the position shown in the drawings splices shall be located where shown in the drawings, provided that the location of the splices may be altered subject to the written approval of the Engineer-in-Charge.

Subject to the written approval of the Engineer-in-Charge, the contractor may for his convenience, splice bars at additional locations other than those shown on the drawings. All additional splices allowed shall be at the expense of the contractor. In order to meet design and space limitation on splicing, some bent bars may exceed usual clearance cutting and bending of such bars from select lengths may be required at the site.

Unless otherwise prescribed, placement dimensions shall be to the centre lines of the bars. Reinforcement will be inspected for compliance with requirements as to size, shape, length, splicing, position, and amount after it has been placed, but before being laid with concrete. Before reinforcement is embedded in concrete the surface of the bars and the surfaces shall be cleaned of heavy flaky rust, loose mill scale, dirt, grease or other foreign substances which in the opinion of the Engineer-in-Charge are objectionable. Heavy flaky rust that can be removed by firm rubbing with burlap, or equivalent treatment is considered objectionable. As

specified in clause 11.3. of I.S. 456-2000 unless otherwise specified by the Engineer-in-Charge, reinforcement shall be placed with the following tolerances.

a. For effective depth 20Omm or less = ± 10 mm

b. For effective depth more than 20Omm = ± 15 mm

c. The cover in no cases be reduced by more than one third of specified cover or 5mm whichever is less.

Reinforcement shall be securely held in position so that it will not be displaced during the placing of the concrete and special care shall be exercised to prevent any disturbances of the reinforcement in concrete that has already been placed.

Welding of bars shall be done as directed by the Engineer-in-Charge and in conformity with the requirements of clause 11.4 of I.S. 456-2000. Chairs, hangers, spacers and other supports for reinforcement shall be of concrete, metal or other approved material. Concrete cover shall be as shown on the drawings.

d. Reinforcement Drawings

The Engineer-in-Charge will supply drawings of reinforcement details and bar bending schedules for adoption.

e. Measurement and Payment

Measurement for payment of reinforcement bars will be based on the weight of the bars placed in the concrete in accordance with the drawings supplied by the Engineer-in-Charge in conformation with those specified drawings has been determined at the time of embedment. Except as otherwise provided below payment for furnishing and placing reinforcing bars will be made at the unit price per one quintal bid in the bill of quantities for furnishing and placing reinforcing bars, which unit price shall include the cost of reinforcing bars, attaching, wire ties or other approved supports and of cutting, bending cleaning securing and maintaining in position reinforcing bars as shown on the drawings.

The total weight of bars placed as reinforcement in concrete shall be arrived at by adding the products of lengths of each size and mass per meter (vide Table 1 and para 6.2.1. of IS 1786-1985) of that size of rod.

8.1.13 Dowels

The dowels shall be of same H.Y.S.D. bars of grade Fe 415 conforming to I.S. 1786-01985 as used for reinforcement.

Details for dowels shall be as shown on the drawings or as directed by the Engineer-in-Charge.

Dowels shall be placed in the concrete where shown on the drawings or where directed and will be accepted for compliance with requirements as to size, shape, length, position, and amount after they have been placed but before being covered by concrete. Before the dowels are embedded in concrete, the surfaces of dowels shall be cleaned of all dirt, grease or other foreign substances which in the opinion of the Engineer-in-Charge are objectionable.

The dowels shall be accurately placed and secured in position so that they will not be displaced during the placing of the concrete. Measurement for payment of dowels will be made only on the weight of the dowels placed in.the concrete in accordance with the drawings or as directed.

Payment for furnished and placing of dowels will be made at the unit price per one quintal bid in the bill of quantities for furnishing and placing of reinforcing bars which unit price shall include the costs of furnishing all the materials and for placing the dowels as required.

8.1.14 Preparation for Placing

a. General

No concrete shall be placed until all form work installation of items to be embedded and preparation of surface involved in the placement have been approved. The Contractor shall supply concrete placement checkout cards (Placement Register) satisfactory to the Engineer-in-Charge and shall provide a water tight container for such cards at the convenient location near each individual concrete placement site. The cards shall list all the various work items for example "cleanup" and "embedded items" required prior to placement of concrete. After each work item for an individual placement has been completed that item on the cards shall be signed by contractor or his representative signifying completion of the required work. Engineer authorized by the Engineer-in-Charge will inspect the work during and after completion of each phase of the preparation and if the work is satisfactory will sign the check-outward placement register. Approval of preparation to placement will not be complete

units the contractor or his representative and above authorized Engineer have approved by signature all applicable items for that placement. All surfaces of forms and embedded materials shall be free from curing compound, dried mortar for previous placements, and other foreign substances before the adjacent or surrounding concrete placement is begun. Prior to beginning concrete placement, the contractor shall make ready a sufficient number of properly operating vibrators and operators and shall have readily available additional vibrators to replace defective one during the progress of the placement. The Engineer's representatives at the placement may require that the contractor delay the start of the concrete placement until the number of working vibrators available is acceptable.

b. FOUNDATION SURFACES

All surfaces upon or against which concrete is to be placed shall be free from frost, ice, water, mud and debris.

1. Rock surfaces shall be free from oil, objectionable coatings, and, loose semi-detached and unsound fragments. Immediately prior to placement of concrete, surfaces of rock shall be washed with an air water jet and shall be

brought to a uniform surface dry condition.

2. Earth foundation surfaces shall be wet to a depth of 15cm, or to impermeable material whichever is less before concrete is placed.

c. Construction Joints

Construction joints are defined as concrete surfaces upon or against which concrete is to be placed and to which new concrete is to adhere but which have become so rigid that the new concrete cannot be incorporated integral

with that previously placed. The provision of construction joints shall conform to clauses 12.4.1 and 12.4.2 of I.S. 456 - 2000. When the work has to be resumed on a surface which has hardened such surface shall be roughened. It shall then be swept clean and thoroughly wetted. For vertical joints neat cement slurry shall be applied on the surface before it is dry. For horizontal joints the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixed and applied immediately before placing of the concrete.

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Where the concrete has not fully hardened ail laitance shall be removed by scrubbing the wet surface with writ or bristle brushes, care being taken to avoid dislodgement of particles or aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface, a layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots, and work thereafter shall proceed in the normal way.

Preparation of Proper Construction Joints

Preparation of proper construction joints must be ensured by the contractor through the following guidelines. The contractor must use such air water guns.

GUIDELINES ON PREPARATION OF CONSTRUCTION JOINTS (LIFT JOINTS)

Objective

The objective in concrete placement in walls 1 cross drainage structures, etc., is to be absolutely sure of achieving a good bond at the joints between the successive concrete "lifts". The surface of each lift has to be thoroughly cleaned of all laitance, grout, and dirt before concrete for the next lift is placed.

Green Cutting

2. The surface of the respective lift shall be thoroughly green-cut with an air water jet. Green cutting is usually done 8 to 12 hours after the top surface of a concrete lift had been completed and sufficiently hardened. The actual time for taking up the green cutting operation shall depend upon the following factors:

- Concrete placement temperature;
- atmospheric temperature;
- concrete mix; and
- Slump.

The air-water jet will remove the thin surface film of laitance and grout to expose clean surface.

3. Green cutting, if done at the proper time, shall Yield very good results. When started too early, it shall result in oversetting and removing too much mortar. It is also liable to loosen the aggregate particles and leaving too poor a surface to bind the fresh concrete. On the

other hand, if green-cutting is delayed to long, the cutting action of the air and water jet would be ineffective for proper removal of laitence. It, therefore, requires much greater care and judgment for proper use at the proper time.

4. Skill of Jet Operator Besides determining the proper time for initiating green-cutting, the process will require constant attention on the part of the air-water jet operator.

By correct manipulation of the high velocity air-water jet, a trained operator can ensure the removal of the thin surface film of laitance and grout effectively and at the same time leaving the aggregate stones, already embedded in the mortar, undistributed.

5. Proper Air - Water Gun : In addition to the skill of the jet operator, a proper air-water gun is also a vital requirement for effective green-cutting. The issuing nozzle must be about 460 mm (18 inches) long to ensure the requisite cutting force close to the concrete surface.

6. Quantum of Compressed Air and Water, For effective green cutting, it is essential that the air pressure should be around 6.33 to 7.03 Kg/Cm2 (90 to 100 lbs. per square inch). It should not be allowed to fall below 90 lbs per square inch. The water pressure, of course, should be sufficient to bring the water into effective influence of the air pressure. As an approximate estimate, the quantity of compressed air required by the Breen-cutting gun is 2 cubic meters per minute (70 cbm) and the quantity of water 60 gallons (273 liters) per minute.

7. An Important Aspect. An important aspect to be taken note of is that 'Green Cutting" as an exclusive operation shall be fully useful only if the next lift of concrete is placed within 3 to 4 days (or a maximum of 5 days) of the placement of the previous lift. If there be a delay in concrete placement beyond this period, the laitance will come up to the concrete surface again at some places. Removal of such laitance shall then be not possible by the ordinary green-cutting operation alone. Legit sand blasting of even the green-cut lint shall need to be resorted to. However, if there is excessive delay in concrete placement, it will require either "wet sand blasting" or the application of high pressure 'water blaster' to remove the laitance for effective binding with the fresh concrete. The effort to achieve this will be considerably less if green cutting has already been done.

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8. Sand Blasting

Sand blasting is the process of roughening and cleaning the surface of old and set concrete by means of coarse sand and air applied under pressure of 90 to 100 pounds per square inch (6.33 to 7.03 kilograms per square centimeter) through the nozzle, so as to erode the laitance and grout from the old and fresh concretes monolithic. Sand blasting of rock is also done so that concrete may be placed on or against a clean surface as required according to specifications.

9. There are two types of sand blasting, namely "wet sand blasting' and "dry sand blasting". In wet sand blasting water is also used along with sand and air under pressure, while in the latter, only sand and air under pressure are used. Normally the concrete and rock surface etc., are wet sand blasted to keep down the dust.

The percentages of different sizes of sand particles for efficient sand blasting shall be as follows

Size	Percentage
8 mesh per inch (25.40 millimeters)	26
16 mesh per inch (25.40 millimeters)	30
30 mesh per inch (25.40 millimeters)	23
50 mesh per inch (25.40 millimeters)	21

11. For effective sand blasting it is essential that pressure of air should be between 90 to 1000 pounds per square inch (6.33 to 7.03 kilograms per square centimeter). If pressure fails below 90 pounds per square inch (6.33 kilograms per square centimeter), sand blasting becomes ineffective. If sand having large percentage of fines is used, it will not provide the requisite cutting power and the whole effort goes waste. A good quality well graded "Sand-blast sand" is needed for achieving the objective of sand blasting.

11. High Pressure Water Blasters.

Green cutting is far cheaper than sand blasting, Proper quality sand (known as sand-blast sand) is the most expensive item and special efforts are needed to arrange such sand. A high pressure water blaster offers a workable alternative to sand blasting, On the Sardar Sarovar Project, indigenously manufactured water blaster are being used which can develop pressures

in the range of 50-150 bars, with their water jet capacity adjustable to 880-1760 litres per hour (viz 15 liters/minute - 30 liters/minute). The equipment has a very small sand blasting attachment as well.

12. Summary:

Green - cutting offers the most economical methodology in the preparation of good construction joints. It has, however, to be initiated at the proper time and with a proper air - water gun (as per enclosed dimensional sketch) to yield the best results. It is far cheaper than sand blasting. If a delay of more than 3 to 5 days is anticipated in placing the concrete over the previous lift, the concrete surface of the lifts should be properly 'green-cut" and thereafter (say one day prior to placement of concrete) it should be light sand-blasted or water blasted in order to remove the "re-appeared" laitance.

D. Contraction Joints

Contraction joints serve to provide for volumetric shrinkage of monolithic concrete and for movement between monolithic unit at established joints, thus preventing formation of objectionable shrinkage cracks elsewhere in concrete. Prior to application of wax based curing compound to contraction joints, the surfaces of all joints shall be cleaned thoroughly oc accretion of concrete or other foreign material by scraping, chipping or other means approved by the Engineer-in-Charge. Water stops, reinforcing bars and other embedded items shall be free of curing compound when adjoining concrete is placed.

8.1.15 Placing

a. General

The contractor shall notify the Engineer-in-Charge before batching begins for placement of concrete. Placing shall be performed only in the presence of an authorized Engineer's representative. Placement shall not begin until after preparations are complete and the concrete placement check out card has been signed by the contractor or his representative and the authorised representative of the Engineer-in-Charge substantiating completion of all preparation for that placement. All surface upon or against which concrete is to be placed shall be prepared in accordance with paragraph 7.3.16. Re-tempering of concrete will not be permitted. Any concrete which has become so stiff that proper placing cannot be assured shall be wasted.

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Concrete shall not be placed in standing water except with written permission of the Engineer-in-Charge and the method of placing shall be subject to approval.

Concrete shall not be placed in running water and shall not be subjected to running water until after the concrete has hardened. Concrete shall be deposited as nearly as practical in its final position and shall not be allowed to flow in such a manner that the lateral movement will cause segregation of the coarse aggregate from the concrete mass. Methods and equipment employed in depositing concrete in forms shall minimize clusters of coarse aggregate clusters that occur shall be scattered before the concrete is vibrated. Forms shall be constantly monitored and their position adjusted as necessary during concrete placement in accordance with paragraph 6.3.12. All concrete shall be placed in approximately horizontal layers. All construction joints which intersect exposed concrete surfaces all be made straight and level to plumb except as shown otherwise on the drawings. The placing of concrete shall be in accordance with clause 12.2 of I.S. 456-2000. If concrete is placed monolithically around openings having vertical dimension greater than 60 cm, or if concrete in decks, floor slabs, or other similar parts of structures is placed monolithically with supporting concrete, the following requirements shall be strictly observed.

1. Concrete shall be placed up to the top of the formed openings at which point further placement will be delayed to accommodate settlement of fresh concrete. If levels are specified beneath nearly horizontal structural members such as decks, floor slabs beams and girders such levels being between the nearly horizontal members and the vertical supporting concrete below. Concrete shall be placed to the bottom of the bevels before delay of placement.

2. The last 60 cm or more of concrete placed below horizontal members or bevels shall be placed with a 50 mm or less slumps and shall be thoroughly consolidated.

In placing concrete or unformed slopes so steep as to make internal vibration of the concrete impractical without forming, the concrete shall be placed ahead of non-vibrating slip form screed extending approximately 0.75 meters back from its leading edge. Concrete ahead of the slip form screed shall be consolidated by internal vibrations so as to ensure complete filling under the slip form.

A cold joint is an unplanned joint resulting when a concrete surface harden before the next batch is placed against it cold joints would be allowed only in the event of equipment breakdown or other unavoidable prolonged interruption of continuous placing. If such unavoidable delays in placing occur which make it appear that unconsolidated concrete may harden to the extent that later vibration will not fully consolidate it. The contractor shall immediately consolidate such concrete to a stable and uniform slope. If delay of placement is then short, enough to permit penetration of the under lying concrete placement shall resume with particular care being taken to thoroughly penetrate and re-vibrate the concrete surface placed before the delay.

If concrete cannot be penetrated with vibrator the cold joint shall be then treated as a construction joint. Care shall be taken to prevent cold joints when placing concrete in any part of the work. The concrete placing rate shall ensure concrete is placed with the previously placed adjacent concrete in plastic so that the concrete can be made monolithic by normal use of vibrators/tamping. Concrete shall not be placed in rain sufficiently heavy or prolonged to wash mortar from concrete. A cold joint may necessarily result from prolonged heavy rainfall. The Contractor shall not be entitled to any additional payment, over the unit prices bid in the schedule for concrete, by reason of any limitation in the placing of concrete, required under the provisions of this paragraph.

b. Transportation

The transportation of concrete still confirm to clause 12.1 of I.S. 456-2000. The methods and equipment used for transporting concrete from the batch plant to its final position in to placement and the time that elapses during transportation shall not cause measurable segregation of coarse aggregate or slump loss during transportation exceeding 5 centimeters. Concrete shall be deposited as near as practical to its final position. The use of Aluminum pipe or Aluminum chutes for delivery of concrete will not be permitted. Concrete buckets shall be capable of promptly discharging concrete of the specified mix design and the dumping mechanism shall be capable of discharging at one location shall portions of concrete from a full bucket.

If used to transport concrete, the truck mixers shall meet the applicable requirements of paragraph 6.3.10. If used to transport concrete, the truck mixers shall meet the applicable

requirements of paragraph 6.3.10. The transporting equipment for placing concrete shall readily handle the place concrete of the specified slump, The Contractor shall when directed, replace in-adequate transporting equipment with acceptable equipment.

C. Compaction

The compaction of concrete shall conform to clause 12.3 to I.S. 456-2000. Concrete shall be consolidated by vibrators 1 tampers. The vibrations shall be sufficient to removal all undesirable air voids from the concrete, including the air voids trapped against the forms. After consolidation, the concrete shall be free of rock pockets and honeycomb areas and shall be closed tightly against all surfaces of forms and embedded materials. All concrete shall be properly consolidated before it hardens. Except as herein after provided, consolidation of all concrete shall be by immersion-type vibrators. Immersion type vibrators shall be operated in nearly vertical position and the vibrating head shall penetrate and re-vibrate the concrete in the upper portion of the underlying layer. Care shall be exercised to avoid contact of the vibrating head with embedded items and with formed surfaces which will later be exposed to view.

Concrete shall not be placed upon either plastic concrete until the previously placed concrete has been thoroughly consolidated. Form vibrators shall be used in conjunction with slip form lining machines to consolidate concrete in canal linings. Such vibrators shall be arranged for effective uniform consolidation of the concrete. The Engineer-in-Charge or his representative may remove samples of the hardened concrete for testing and examination, and the contractor shall repair, at no cost to the Government, concrete from which such samples are removed. Immersion type vibrator shall be operated at speeds at 7000 revolutions per minute when immersed in concrete. Form vibrators shall operate at speeds of atleast 6000 revolutions per minute when being used to consolidate concrete. The contractor shall immediately replace improperly operating vibrators with acceptable vibrators.

8.1.16. FINISHES AND FINISHING

The requirements for finishing of concrete surface shall be as specified in this paragraph or as otherwise indicated on the drawings. The contractor shall notify the Engineer-in-Charge before finishing concrete. Unless inspection is waived, in each specific case, finishing of concrete shall be performed only when on Engineer's representative is present. General

surfaces will be tested by the 'Engineer-in-Charge in accordance with paragraph where necessary to determine whether the concrete surface is within the specified tolerances shall be repaired. Interior surfaces shall be sloped for drainage where shown on the drawings or as directed. Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Floating may be performed by use of hand on power driven equipment. Floating shall be started as soon as the screened surface has stiffened sufficiently by and shown to the minimum necessary to produce a surface what is force from screened mark and in and uniform in texture. Joints and got shall be tooled where shown on the drawing or as directed. After the surfaces of road way slabs of concrete bridges, have been wood floated, the surfaces shall be given a broom finish. The finish shall be applied when the water sheet has practically disappeared. The broom shall be drawn transversely across the pavement with adjacent strokes slightly overlapping. The brooming shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operation. The finished surface shall have a uniform appearance and shall be free of corrugations exceeding 1.5 millimeters in depth. Broom shall be of quality, size and construction and be so operated as to produce a surface finish satisfactory to the Engineer-in-Charge.

8.1.17 PROTECTION

The contractor shall protect all concrete against damage until final acceptance by the Engineer-in-Charge. The Contractor shall provide protection to prevent erosion to fresh concrete whenever precipitation either periodic or sustaining is imminent or occurring. When precipitation appears imminent, the contractor shall immediately make ready at the placement site all materials which may be required for protection of fresh concrete.

The Engineer-in-Charge may delay placement of concrete until adequate provisions for protection against weather are made.

All fresh concrete surfaces shall be protected from contamination and from foot traffic until the concrete has hardened. Hardened concrete surfaces which have to receive finish shall be protected against damage from foot traffic and other construction activity by covering with protective iiiats, plywood or by other effective means. Methods of protection shall be subject to approval by the Engineer-in-Charge.

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8.1.18 Curing

a. General

The contractor shall furnish all materials and perform all work require for curing concrete. The uniformed top surfaces of concrete shall be cured for 28 days with a damp sand cover or curing mat over. The sand or curing mats shall both be kept so wet as to allow alter to drain from them and stain other concrete. The sand or curing mats shall be removed after the expire of the during period. All concrete surfaces shall be treated as specified to prevent loss of moisture from the concrete until the required curing period elapsed or until immediately prior to placement of other concrete or backfill against those surfaces. Only sufficient time to prepare construction joint surfaces and to bring them to a surface dry condition shall be allowed between discontinuance of curing and placement of adjacent concrete. Forms shall be removed within 24 hours after the concrete has hardened sufficiently conforming to clause 10.3 of I.S. 456-2000 to prevent structural collapse of other damage by careful form removal. Where required, repair of all minor surface imperfections shall be made immediately after form removal and prior to curing. Minor surface repair shall be completed within 2 hours after form removal and shall be immediately followed by the initiation of curing by the applicable method specified herein. Concrete surfaces shall be kept continuously moist after form removal uniti initiation of curing.

b. Material

Concrete cured with water shall be kept wet for at least 28 days from the time the concrete has attained sufficient set to prevent detrimental effect to the concrete surfaces. The concrete surfaces to be cured shall be kept wet by covering them with water - saturated material by using a system of perforated pipes mechanical sprinklers or porous hose, or by other methods which will keep all surface continuously (not periodically) wet. All curing methods are subject to approval of Engineer-in-Charge.

c. Cost

The cost of furnishing all materials and performing all work for curing concrete shall be included in the price bid in the bill of quantities for the concrete on which the particular curing methods are required.

8.1.19 Repair of Concrete

a. General

Concrete shall be repaired in accordance with clause 5.7 of I.S. 3873-1978. Imperfections and irregularities on concrete surface shall be corrected in accordance with paragraph 6.3.13 and clause 5.7 of I.S. 3873-1978.

b. Types of Repair

All repairs shall be made with concrete. Repairs to concrete surfaces and addition where required shall be made by cutting regular opening into the concrete and placing fresh concrete to the required lines. The chipped openings shall be sharp and shall not be less than 70 mm in depth. The fresh concrete shall be reinforced and chipped and toweled to the surface of the openings. The mortar shall be placed in layers not more than 2Omm in thickness after being compacted and each layer shall be compacted thoroughly. All exposed concrete surfaces shall be cleaned of impurities, lumps of mortar or grout unsightly stains.

c. Cost

The cost of furnishing all materials and performing all work required in the repair of concrete shall be borne by the contractor.

8.1.20 Measurement of Concrete

Measurement for payment of concrete required to be placed directly upon or against surfaces of excavation will be made to the lines for which payment for excavation is made. In measuring concrete for payment, the volume of all openings, arises, embedded pipes and metal work, each of which is large than 0.1 square meter in cross section will be deducted.

8.1.21 Payment for Concrete

Payment for concrete in the various parts of the work will be made at the applicable unit prices therefore in the bill of quantities, under unit price shall include the cost of furnishing all materials and performing all works required for the concrete construction, except that payment for furnishing and placing reinforcing bars will be made at the respective unit price's bid therefore in the schedule.

SECTION - 9

BRICK WORK

9.1 Brick Masonry

9.1.1 Specification for Building Bricks and classification are covered by I.S. 1077/1970 and 3102/1971.

9.1.2 Bricks are to be well soaked in water before use for a period sufficient for the water to penetrate the whole depth of the bricks. For further instructions regarding soaking and size of bricks to be used IS 2212/1962 and IS 1200 part 111/1970 shall apply. Wetting the bricks assists in removing the dirt, sand and dust from them and also it prevents the suction of water from the wet mortar, as otherwise the mortar is likely to dry out soon and crumble before attaining any strength. Bricks shall not be too wet at the time of use as they are likely to slip on the mortar and proper adhesion of bricks to mortar will not be possible.

9.1.3 Regarding making of bricks IS 2117/1967 shall apply. Specification for facing brick is covered by IS 2691/1972.

9.1.4 Mortar : Specification is covered by IS 2212/62 should the mortar perish, i.e, become dry white or powdery through neglect of watering, the work shall be pulled down and rebuilt at the Contractor's expense, or should the Contractor fail to watch the work to the satisfaction of the Engineer-in-Charge of the work the later may supply the requisite men to watch the work properly and charge the cost to the Contractor.

9.1.5 All masonry shall be washed down on completion and all strains - lime or otherwise removed from the face.

9.2 No bats or out bricks shall be used except where absolutely required for obtaining the dimensions of the different courses for obtaining the specified bond and where in the opinion of the Engineer-in-charge of the work is of too pretty a nature to warrant the special moldings of bricks of the shape required.

9.2.1 Setting bricks in mortar, bond and making of joints are covered by IS 2212/1962.

9.2.2 No extra payment will be made for the manner of finishing brick work face joints and it shall be included by the Contractor in his unit rate for brick work.

9.2.3 Raking back, when circumstances render it necessary on the same section. of the structure in uneven course the bricks shall be raked back so as to maintain an uniform and effective bond.

9.3 Openings: This is covered in para 10.2, 10.4 of IS 2212/1962.

9.4 Contract unit rate for brick work are inclusive of Queen and Joints.

9.5.1 Measurement of brick work is covered by IS 1200

9.5.2 Brick work shall generally be measured in cubic meters or otherwise specified.

9.5.3 Walls half brick in width and less shall be measured in square meters stating thickness.

9.5.4 Brick walls of width over half brick shall be measured in multiples of half brick which shall be deemed to be inclusive of mortar joints, irrespective of excess of executed width. Wall exceeding one brick thick by not exceeding three bricks in thickness shall be measured in multiples of half brick which shall be deemed to be inclusive of the mortar joints where fractions of half brick occur due to architectural or other reasons the measurements shall be taken as follows:

a. up to 3/4 brick - actual measurement

b. Exceeding 3/4 brick - full half brick for walling more than three bricks in thickness the actual thickness of wall shall be measured.

9.5.5 The following shall be taken as half brick measurements

For metric bricks

For bricks 1 9 x 9 x 9 cm - 10.00 cm

For bricks 19 x 9 x 5.7 cm – 10.00 cm

For Bricks other than metric bricks

For Brick of size 9" x 4 ½" x 3" (23 x 11.5 x 7.5 cm) - 11.50 cm

For Brick of size 8 ¾" x 4 ¼" x 2 ¾" (23 x 11 x 7 cm) - 11.00 cm

For Brick of size 8 ¾" x 4 1/4" x 2 ¼" (23 x 11 x 5.7cm) - 11.00 cm

For Brick Of Size 8 ¾" x 4 ¼" x 2" (23 x 11 x 5 cm) - 11.00 cm

9.6 Handling bricks:

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Bricks shall not be handled in baskets or in other manner which will destroy the sharpness of their edges.

9.7 Rounding corners: Corners of rooms or pillars whether interior (or) projecting shall not be rounded by in exceptional cases where it is so desired to round the corners shall be done in plaster for the reentrant corners but will require chiseling of projecting angles before plastering.

9.8 Brick on edge coping etc. Para 10 of IS 2212/1962 shall apply. No extra payment will be made for this work, over the Contract rate for brick work. The contract rate shall include the same.

9.9 Plinth offsets: Plinth off-sets on the interior faces only should be kept 15cm below floor level (unless finished thickness of floor to be laid will determine, instead of the 15 cm) to allow for the floor paving which is done subsequently coming upon the face of the superstructure. Similarly retaining wall of verandahs etc must be built with due regard to the slope allowed for the floors.

9.10 Parapets: All parapets will be measured under the masonry below them and which they are continuous in a floor, the parapet has to be reckoned with the lower floor.

9.11 Bricks forming skew back joints shall be specially mould or cut, so as to radiate truly, and defects in this particular shall not be remedied by the extravagant use of mortar nor shall patching up by chips etc. be permitted.

9.12.1 Bricks shall not be dumped at site. They shall be stacked in regular tiers as and when they are unloaded to minimize breakage and defacement of bricks.

9.12.2 In the case of bricks made from clays containing lime Kankar the bricks in stack should be thoroughly soaked in water (docked) to prevent lime plastering.

9.12.3 Brick stacks shall be placed close to the site of work so that least effort is required to unload and transport the bricks again by loading pallets or in barrows. Building bricks shall be loaded or unloaded a pair at a time unless palletized.

Unloading of Building bricks or handling in any other way likely to damage the cornets or edges or other parts of bricks shall not be permitted.

9.12.4 Bricks shall be stacked on dry firm ground. For proper inspection of quality and ease in counting the stacks shall be 50 bricks long and 10 bricks high, the bricks being placed on

edge and preferably the width of each stack shall be two bricks. Clear distance between adjacent stacks shall not be less then 0.8m.

9.12.5 Bricks of different type and classification shall be stacked separately.

9.13 Specification for common burnt clay Building Bricks as per IS 1077:1970

9.13.1 The common burnt clay bricks shall be classified on the basis of their minimum compressive strength. The bricks of compressive strength 5OKg/cm2 shall be classified as 50. The bricks of classification 50 shall have sub-classification 50A and 50B based on tolerances and shape.

9.14 General Quality

9.14.1 Bricks shall be hard-or machine molded, they shall be free from cracks and claws and modules of free lime. Bricks of 9cm height shall be molded with a frog 1 or 2 cm deep on one of its flat side. Bricks of 4 cm height and those made by an extrusion process may not be provided with frogs.

9.15 Dimensions and tolerances

9.15.1 The standard size of common building bricks shall be as follows:

	Length	Width	Height
	Cm	cm	cm
a) Metric bricks	19	9	9
	19	9	4
b) For bricks other than Metric bricks	9″	4 ½″	3"

9.15.2 Tolerances: The dimensions of bricks when tested in accordance with 7.15.3 shall be within the following limits:

Sub Clause - A	(a) Length	368 to 392 cm
	(b) Width	174 to 186 cm
	(c) Height	174 to 186 cm (in the case 9 cm high bricks), 77 to 83 cm (in the case 4 cm high bricks)
Sub Clause - B	(a) Length	350 to 410 cm
	(b) Width	165 to 195 cm (in the case 9 cm high bricks)
	(c) Height	74 to 86 cm (in the case 4 cm high bricks)

9.15.3 Twenty (or more according to the size of stack) whole bricks shall be selected at random. All blisters, loose particulars of clay and small projects shall be removed. They shall then be arranged upon a level surface successively in contact with each other and in a

straight line. The overall length of the assembled bricks shall be measured with a steel tape or other suitable in extensible measure sufficiently long to measure the whole row at one stretch. Measurements by repeated application of a short rule or measure shall not be permitted. If for any reason it is found impractible to measure bricks in one row, the sample may be divided into all the rows of 10 bricks, which shall be measured separately to the nearest millimeter. All these dimensions shall be added together.

9.16 Physical properties:

9.16.1 Compressive strength: Common building bricks shall have a minimum compressive strength of 50 Kg/cm2 when tested in accordance with procedure laid down in table 1 of IS: 3495 - 1966 (See also note under 1.1)

9.16.2 The compressive strength of any individual brick shall not fall below the average compressive strength specified for the corresponding class of bricks by more than 20 percent.

9.16.3 Water absorption: When tested in accordance with the procedure laid down in Table 2 of IS : 3495 – 1966 (method of sampling and testing of clay building bricks) the average water absorption of common building bricks shall not be more than 20 percent up to class 125 (see 30-1 below) and 15 percent for higher class, by weight after immersion in cold water for 24 hours.

9.16.4 Efflorescent: When common building bricks are tested in accordance with the procedure laid down in Table 3 of IS: 3495 - 1966 (method of sampling and testing of clay building bricks) the rating of efflorescence shall not be more than "moderate" upto class 125 and "slight" for higher classes.

9.17 Classification of burnt clay solid bricks (as per IS: 3102=1971):

9.17.1 Classes and sub-clause fo burnt clay solid bricks shall be as detailed below:

Type of brick	Class designation (see note below)	Compressive strength Kg/ Cm2 min. immersion	Water absorption (24 hrs. %) Max	Efflorescence
1	2	3	4	5
Heavy duty (see IS 2180-1970)	450	450	10	Nil
Common burnt clay building bricks (see IS 1077-1970)	400	400	10	Nil
	350	350	15	Slight
	300	300	15	Slight
	250	250	15	Slight
	200	200	15	Slight

	175	175	15	
	150	150	20	Moderate
	125	125	20	Moderate
	100	100	20	Moderate
	75	75	20	Moderate
	50	50	20	Moderate

Note: Each class of bricks shall further be divided into subclasses A, B etc. based on the following.

Sub Clause A - Tolerance limit shall be ± 3 percent and shall have smooth rectangular faces with sharp corners and emit clear ringing sound.

Sub Clause B - Tolerance limit shall be ± 8 percent and shall be permitted to have slight distortion and rounded edge, provided no difficulty shall arise in laying of uniform courses.

9.17.2 Specification for burnt clay facing bricks as per IS 291-1972. The facing bricks shall be of two classes - (a) Class 1 & (b) Class 11

9.17.3 General quality: The facing bricks shall be made of clay, shale or mixture of these materials with or without admixtures and burnt to meet the requirements of this standard. The coloring material added to be clay shall be of suitable ceramic, materials and shall be well distributed throughout the body. The bricks shall be of uniform color.

9.17.4 Bricks shall be free from cracks, flows and modules of free lime and of even texture. These shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right angled edge.

9.17.5 The standard sizes of the facing bricks shall be 19 x 9 x 9 cm and 19 x 9 x 4 cm. The permissible tolerances shall be as under.

Dimension	**Tolerance**	
	Class I CM	**Class II CM**
19	± 3	± 3
9	± 3	± 3
4	± 1.5	± 2

9.17.6 The average compressive strength obtained in accordance with the procedure laid down in Table 1 of IS 3495 - 1966 (Method of Sampling and testing clay building bricks) shall not be less than 75 Kg/CM2 for class II and 100 KG/cm2 for Class I.

9.17.7 Water absorption requirement when tested in accordance with the procedure laid down in Table 2 of IS: 3495 - 1966 for 24 hours immersion shall not exceed 15 percent.

9.17.8 When tested in accordance with the method specified in Table 3 of IS: 3495 - 1966 efflorescence requirements shall be 'Nil' for both cases.

9.18 When measured in accordance with the method specified in Table 4 of IS: 3495 - 1966 the war page for both classes shall not exceed 2.5mm.

9.19 Nominal thickness of wall. This is the thickness of wall that is stated in the estimates for calculation of quantities. It is a fictitious dimension, which is neither the actual thickness of wall excluding surface finishes like plaster, rendering etc. for necessarily the overall thickness, including such finishes. The following example will illustrate this point.

For traditional bricks of 8 inch length (with allowance of 114 inch for mortar joint)	Nominal Thickness	Actual Thickness
1 Brick wall	9 inch	8-1/2 to 8-3/4 inch
1-1/2 Bricks wall	13-1/2 inch	13 to 13-1/4 inch
2 Bricks wall	18 inch	17-1/2 to 17-3/4 inch
For modular brick (with allowance of 1cm for mortar joint)		
1 Brick wall	20 cm	19 cm
1-1/2 Bricks wall	30 cm	29 cm
2 Bricks wall	40 cm	39 cm

9.20 Bricks - unless otherwise specified, burnt clay bricks shall confirm to the requirement of IS : 1077-1957 specification

for common burnt clay building bricks and shall be of the specified class.

9.21 Mortar - Mortar for masonry shall be prepared in accordance with IS: 2250 code for practice for preparation and use of masonry mortars. The selection of mortar will also be governed by the strength required for masonry and reference may be made to IS: 1905-1961 code of practice for structure safety of buildings. Mortar shall be well mixed and shall be transported from the mixing plate form to the site of work in such a manner to prevent formation of laitance or segregation.

9.22 Cement - Cement used for brick masonry shall be of ordinary or rapid - hardening portland cement conforming to IS 269:1958 specification for ordinary. Rapid - hardening and low heat Portland Cement (Revised) or blast furnace slag cement conforming to IS:455-1962, specification for Portland Blast - furnace slag cement (Revised).

9.23 Fine aggregate: Sand shall confirm to IS: 2116 specification for sand for masonry mortar.

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9.24 Water: Water used for masonry mortar shall be clean and free from injurious amounts of deleterious materials.

9.25 Bonds and joints: The primary object of bond is to give strength to masonry but is may also be employed to create artistic effects when the brick work is exposed to view.

In brick work the cross joints in any course shall not be nearer than a quarter of a brick length from those in the course below or above it.

The thickness of bed joints shall be such that four courses and these joints taken consecutively shall measure as follows:

a. In the case of traditional brick : Equal to four times to actual thickness of the brick plus 3 cm

b. In the case of modular : Equal to 39 cm brick conforming to IS:1077-1957

9.25.1 The face joints of brick may be finished by jointing or by pointing. In jointing, either the face joints of the mortar shall be worked out while still green to give a finished surface flush with face of the brick work, or the joints shall be squarely raked out to a depth of 1 cm while the mortar is still green for subsequent plastering. The face of the brick work shall be cleaned with wire brush so as to remove any splashes of mortar during the course of raising the brick work. In pointing, the joints shall be squarely raked out to a depth of 1.5cm while mortar still green and raked joint shall be well brushed to remove dust and loose particles and well wetted, and shall be later refilled with mortar to give the required finish. Some such finishes are "flush", "weathered", "tucked" and "ruled".

9.25.2 Laying of brick work: Bricks shall be laid on a full bed of mortar. When laying the bricks shall be slightly pressed so that the mortar can get into ail the pores of tile brick surface to ensure proper adhesion. Cross joints and wall joints shall be properly flushed and packed with mortar so that no hollow spaces are left. In case of thick walls (two – brick thick and over) the joints shall be grouted at every course in addition to budding and flushing with mortar. The course at the top of the plinth and sills at the top of the wall just below the roof slab or floor slab and at the top of the parapet shall be laid with bricks on edge(applicable only in the case of traditional bricks) and at corners arid at dead ends the bricks shall be properly radiated and keyed into position by using cut bricks. Brick with 2 cm deep frog shall be used frog down.

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Bricks with 1 cm deep frog shall be used either frog up or frog down. The course shall be aligned and care, shall be taken to keep the pretends.

The brick work shall be built in uniform layer corners and other advanced work shall be racked back. No part of a wall during its construction shall rise more than one meter above the general construction levels, to avoid unequal settlement and also in proper jointing. Tooting may be done where future extension is contemplated but shall not be used as an alternative to racking back. All quoins shall be accurately constructed and the height of the course checked with storey rods as the work proceeds. In general, quoin-bricks shall be headers and stretchers in alternative courses,

the bond being established by placing a quoin closer next to the queen header. Acute and obtuse quoin closer next to the queen header. Acute and obtuse quoins shall be bonded. Where practicable, in the same way as square quoins. Obtuse quoins shall be formed with squints showing a three- quarter brick on one face and a quarter brick on the other. The arrangement of bond at jambs of openings shall be symmetrical.

9.26. Pilasters: These shall be so set out to avoid broken bond.

9.27. Partitions: For half brick partitions to be keyed into main walls, indents shall be left in the latter.

9.28 Fixing of frames: When doors or window frames of timber are fixed in the openings, the fixing shall be done generally with hold fasts of adequate size and strength securely embedded in the brick work or in chases later filled up by cement mortar or concrete. Hold fasts shall be fixed into the brick work for a sufficient length and then turned up at end into across joint, thus avoiding indiscriminate cutting of bricks. Iron hold fasts shall be given a protective coat of bitumen to avoid rusting. Wood work faces in contact with brick work shall be treated with wood preservative to prevent attack from insects and termites. Fixing of Steel doors and windows shall be done in accordance with IS: 1081 - 1960. Code of practice for fixing and glazing of metal (Steel and Aluminum) Doors, Windows and Ventilator. The frame shall preferably be fixed simultaneously and the masonry work proceeds, as this construction will ensure proper bond without gaps between the masonry and the framer.

9.29. Curing: In hot and dry weather, the mortar is likely to dry up before it has attained its final set and crumble.

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This shall be prevented by keeping the brick work constantly wet for at least seven days, except in the case of brick work with mud mortar, for which no such curing shall be done.

9.30. Workmanship: The following shall be strictly followed:

(a) All loose materials, dirt and set lumps of mortar which may be lying over the surface over which the brick work is to be freshly started shall be removed with a wire brush.

(b) All the bricks shall be thoroughly shaken in clean water before use.

(c) The surface over which the brick work is to be started shall be slightly wetted.

(d) The first course itself shall be made horizontal by providing enough mortar in the bed joint to fill up any undulations in the bed course.

(e) Care shall be taken to see that the required quantity of water is added to the mortar at the mixing platform itself and not over the course.

(f) Care shall be taken to see that there is no through joint and the lap is not less than half the width of the brick and that all the vertical joints are properly filled with mortar.

(g) The vertically of the walls and horizontality of the courses shall be checked very often with plumb bob and spirit level respectively.

(h) No portion of the brick work shall be left more than 1 meter lower than the other. Where the masonry of one part has to be delayed work shall be "racked back" suitably at an angle not exceeding 40O according to bond and not toothed.

(i) Where plastering is required to be done the joints shall be raked to a depth of 1 cm while the mortar is wet to facilitate satisfactory adhesion between the plaster and brick work.

R.R. MASONRY WORKS: This specification covers the general requirement for stone masonry, which is required to be carried out. The work under this specification shall consist of furnishing of all tools, plants, labour and materials any and everything necessary for carrying out the work.

Applicable codes and specification:

All general codes and specification applicable to stone masonry work shall apply the latest edition of IS codes shall apply. IS: 1597 – Code of practice for construction of stone masonry (Part-I)

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2. R.R. MASONRY WORK FOR FOUNDATION AND BASEMENT:

a) Stones for this work shall be hard durable rock, close or find grained and uniform in color, free from veins, floors and other defects and shall conform to IS: 1597 (Part-I). The masonry works are to be done will stones from rocks available at sites and approved quarry stones. Stones with good corners are to be selected from the dumping yard for this work. The unit of measurement shall be Cum.(or) part thereof. The sides of the stones are to be neatly dressed to form a neat even surface.

b) The stones shall be laid in mortar proportions specified for the particulars items of work stones shall be got approved, if desired by Engineer. All courses shall be of the same height unless (or) otherwise specified. Height of each course in the masonry shall not be less than 150mm. All stones shall be set in full cement mortar. The quality and size of the rubbles shall be subject to the approval of the Engineer.

c) Sprawls and pinning shall not be allowed on the face. All bed joints shall be Horizontal and side joints vertical. Two bond stones each of minimum area of 500 Sq.cm. for every 1.0 Sq.m. of each wall face shall be provided. These shall be through stones in walls of 60mm. thick and under. In walls thicker than 600 mm.

The length of bond stones shall be 2/3 times the thickness of walls. The stones for hearting of the wall shall not be less than 150mm. In any direction. Chips and spawls shall be wedged in to avoid thick mortar beds and joints. Care should be taken so that no dry work or hollow spaces shall be left anywhere in the masonry.

d) The exposed face of the work shall be carefully and neatly pointed with mortar in all joints. On the other side, the joints shall be neatly struck with trowel while the mortar is fresh.

e) Curing of masonry shall continue for a minimum of ten days.

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(C)TECHNICAL SPECIFICATIONS FOR ROAD WORKS

The Technical Specifications for the work is the "Specifications for Road and Bridge Works (Third Revision – April 1995) issued by Ministry of Surface Transport (Road Wing), Government of India and Published by Indian Roads Congress.

This volume contains specifications for only selected items of work. For other clauses mentioned in Bill of Quantities, the MORTH specifications mentioned above should be referred to.

2.0 SPECIFICATIONS FOR SELECTED ITEMS OF WORK

305.1.1 General Description

These specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous back fills with approved material obtained from road way and drain excavation, borrow pits or other sources. All embankments, sub-grades, earthen shoulders and miscellaneous back fills shall be constructed in accordance with the requirements of these specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

305.2 Materials and General Requirements.

305.2.1 Physical Requirements

305.2.1.1 The materials used in embankments, sub-grades, earthen shoulders and miscellaneous back fills shall be soil, murrum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate of affect the stability of the embankment / sub-grade.

The following types of material shall be considered unsuitable for embankment.

a) Materials from swamps, marshes and bogs., Peat, log, stump and perishable materials, any soil that classifies as OL, OI, OH or Pt in accordance with IS:1499.Materials susceptible to spontaneous combustion

b) Materials in a frozen condition and

c) Clay having liquid limit exceeding 70 and plasticity index exceeding 45 and

d) Materials with salts resulting in leaching in the embankment.

305.2.1.2 Expansive clay exhibiting marked swell and shrinkage properties (free swelling index exceeding 50 percent when tested as per IS:2720 – part 40) shall not be used as a fill material. Where an expansive clay with acceptable "free swelling index" value is used as a fill material, sub-grade and top 500 mm portion of the embankment just below sub-grade shall be non-expansive in nature.

305.2.1.2 Any fill material with the soluble sulphate content exceeding 1.9 grams of sulphate (expressed as S03) per litre when tested in accordinance with BS:1377 Test 10, but using a 2:1 water –soil ratio shall not deposited within 500mm or other

distance described in the contractor, of concrete, cement bound materials or other cementitious materials forming part of the permanent works.

Materials with a total sulphate content (expressed as SO)3 exceeding 0.5 per cent by mass, where tested in accordance with BS:1377 Test 9, shall not be deposited within 500mm or other distance described in the contract of metallic items forming part of the Permanent Works.

305.2.1.4 The size of the coarse material in the mixture of earth shall or ordinarily not exceed 75mm when being placed in the embankment and 50 mm when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill materials and its compaction to the requirements of these specifications. The maximum particle size shall not be more than two-thirds of the compacted layer thickness.

305.2.1.5 Ordinarily, only the materials satisfying the density requirements given in Table 300-1 shall be employed for the construction of the embankment and the sub-grade.

TABLE 300–1: DENSITY REQUIREMENTS OF EMBANKMENT AND SUBGRADE MATERIALS.

Sl. No.	Type of work	Maximum Laboratory dry unit weight when tested as per IS:2720 (part 8)
1	Embankments up to 3 meters height, not subjected to extensive flooding.	Not less than 15.2 kN/Cum
2	Embankments exceeding 3 meters height or embankments of any height subject to long periods of inundation.	Not less than 16.0 kN/Cum
3	Sub-grade and earthen shoulders / verges / back fill.	Not less than 17.5kN/Cum

Note:

1. This table is not applicable for light weight fill material e.g. cinder, fly ash, etc.
2. The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors
3. The material to be used in sub-grade should also satisfy design CBR at the dry unit weight applicable as per Table – 300 -2.

305.2.2. General Requirements

305.2.2.1 The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby road way excavation or any other excavation under the same contract.

The work shall be so planned and executed that the best available materials are saved for the sub-grade and the embankment portion just below the sub-grade.

305.2.2.2 Borrow Materials Where the materials are to be obtained from designated borrow areas, the location, size and shape of these areas shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow areas are not designated by the Employer / the Engineer, arrangement for locating the source of supply of material for embankment and sub-grade as well as compliance to environmental requirements in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8m width should be left at intervals not exceeding 300m. Small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of one vertical to four horizontal depth in any case being, limited to 1.5m. Also no pit shall be dug within the offset width from the toe of the embankment required as per the consideration of stability with a minimum width of 10M.

Haulage of material to embankments or other area of fill shall proceed only when sufficient spreading and compaction plants is operating at the place of deposition.

No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Should the contractor be permitted to remove acceptable material from the site to suit his operational procedure, then he shall make good any consequent deficit of material arising there from.

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stock pilled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stock piling materials, use of plants or silting of temporary buildings or structures.

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing program approved by the Engineer. It shall be ensured that the sub-grade material when compacted to the density requirements as in Table 300-2 shall yield the design CBR value of the sub-grade.

Table 300-2: Compaction Requirements for Embankment and Sub-grade.

Sl. No.	Type of work / Material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (part 8)
1.	Sub-grade and earthen shoulders	Not less than 97
2.	Embankment	Not less than 95
3.	Expansive Clays sub-grade and	Not allowed

	500 mm portion just below the sub-grade	
4.	Remaining portion of embankment	Not less than 90

The Contractor shall submit the following to the Engineer for approval at least seven working days before commencement of compaction.

i. The values of maximum dry density and optimum moisture content obtained in accordance with IS:2720 (Part 8) as the case may be appropriate for each of the fill materials he intends to use.

ii. A graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

iii. The dry density moisture content CBR relationships for light, intermediate and heavy compactive efforts (light corresponding to IS 2720 (part 7), heavy corresponding to IS : 2720 (Part 8) and intermediate in between the two) for each of the fill materials he intends to use in the sub-grade. Once the above information has been approved by the Engineer, it shall form the basis for compaction.

305.3 CONSTRUCTION OPERATIONS

305.3.1.3. Setting Out

After the site has been cleared the work shall be set out. The limits of embankment / sub-grade shall be marked by fixing better pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment / sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conform to the specified side slopes.

305.3.2.3. Dewatering

In the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair / restore it to original condition or compensate the damage at his own cost.

If the embankment is to be constructed under water, Clause 305. 4 .6 shall apply.

305.3.3.3. Stripping and storing top soil

In localities where most of the available embankment materials are not conducive to plant growth, or when so directed by the Engineer, the top soil from all areas of cutting and from

all areas to be covered by embankment foundation shall be stripped to specified depth not exceeding 150mm and stores in stock piles of height not exceeding 2 M for covering embankment slopes, cut slopes and other disturbed area where re-vegetation is desired. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpiles. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

305.3.4.3 Compacting ground supporting embankment / Sub-grade:

Where necessary, the original ground shall be leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in Table 300-2.

In case where the difference between the sub-grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 M and the ground does not have 97 per cent relative compaction with respect to the dry density as given in Table 300-2, the ground shall be loosened upto a level 0.5m below the upgrade level, watered and compacted in layers in accordance with clauses 305.3.5 and 305.3.6 not less than 97 per cent of dry density as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

Embankment or sub-grade work shall not proceed until the foundations for embankment / sub-grade have been inspected by the Engineer for satisfactory condition and approved.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by bore hole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in clause 305.2.1 at least 500mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

305.3.5 Spreading material in layers and bringing to appropriate moisture content.

305.3.5.1 The embankment and sub-grade material shall be spread in layers of uniform thickness not exceeding 200 m compacted thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted as per Clause 305.3.6/ the motor grader blade shall be hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slop and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 300.2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross section of the embankment.

305.3.5.2 Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made

good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformity with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, discing or harrowing until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedures, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS : 2720 (part 2) and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction, it is in the range of 1% above to 2% below the optimum moisture content determined in accordance with IS : 2720 (Part 7) or IS 2720 (Part 8) as the case may be. Expansive clays shall however be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be proceed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub-grade.

305.3.5.3 Embankment and other areas of fill shall, unless otherwise required in the contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

Embankments and other areas of unsupported fills shall not be constructed with sleeper side slopes or to greater widths than those shown in the contract, except to permit adequate compaction at the edges before trimming back, to obtain the final profile following any settlement of the fill and the underlying material.

Whenever, fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments cuttings, other fills and excavations steeper than '1' vertical on 4 horizontal, such faces shall be Benched as per Clause 305.4.2.3 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill formed shall subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer on the slope or any other method approved by the Engineer.

305.3.6.3 Compaction

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types…encountered during construction. Smooth wheeled, vibrator, pneumatic tyred, sheep foot or pad foot rollers, etc. of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of vibratory roller of 80 to 100 KN static weight with plain or pad foot drum or heavy pneumatic tired roller of adequate capacity capable or achieving required compaction.

The contractor shall demonstrate the efficiency of the equipment he intends to use by carrying out compaction trials.

The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 300-2. Subsequent layers shall be placed only after the finished layer has been and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture / density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identical to that obtained from tests in accordance with IS : 2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment / sub-grade earthen shoulders, further compensation shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material compacted to the density requirements and satisfaction of Engineer.

305.3.7.3 **Drainage**

The surface of the embankment / sub-grade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

305.3.8.3. **Repairing of damages caused by rain / spillage of water:**

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller. Plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6 If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. These shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages

including widening of the cut, if any shall be carried out by the Contractor at his own cost, including the arranging of machinery / equipment for the purpose.

305.3.9.3 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders / verge / road bed and side slopes to conform to the alignment, levels, cross sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause 902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The top soil, removed and conserved earlier (Clause 301.3.2. and 305.3.3.) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding and mulching of slopes is prescribed, this shall be done to the requirement of Clause 308.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

305.4 CONSTRUCTION OF EMBANKMENT AND SUB-GRADE UNDER SPECIAL CONDITIONS:

305.4.1.3. Earthwork for widening existing road embankment.

When the existing embankment and / or sub-grade is to be widened and its slopes are steeper than 'l' vertical on 4 horizontal, continuous horizontal benches, each at least 300mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment / sub-grade material to be added. The material obtained from cutting of benches could be utilized in the widening of the embankment / sub-grade. However, when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal, the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of small vibratory rollers / plate compactors power rammers or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

305.4.2.3 Earthwork for embankment and sub-grade to be placed against sloping ground.

Where an embankment /sub-grade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed / scarified as required in Clause 305.4.1 before

placing the embankment /sub-grade material. Extra earthwork involved in benching or due to ploughing / scarifying etc., shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings before the fill is placed against sloping ground.

Where the Contract requires construction of transverse sub-surface drain at the cut-fill interface, work on the same shall be carried out to Clause 309 in proper sequence with the embankment and sub-grade work as approved by the Engineer.

305.4.3.3 Earthwork over existing road surface

Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:

i) If the existing road surface is of granular or bituminous type and lies within 1m of the new sub-grade level, the same shall be scarified to a depth of 50mm or more if specified, so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new sub-grade level is compacted to the desired density.

ii) If the existing road surface is of cement concrete type and lies within 1m of the new sub-grade level the same shall be removed completely.

iii) If the level difference between the existing road surface and the new formation level is more than 1 M, the existing surface shall be permitted to stay in place without any modification.

305.4.4.3 Embankment and sub-grade around structures

To avoid interference with the construction of abutments, wing walls or return walls or culvert / bridge structures, the contractor shall, at points to be determined by the Engineer suspend works on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures upto a distance of twice the height of the road from the back of the abutment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and sub-grade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index liquid limit more than 20 and 40 respectively when tested according to IS: 2720 (Part 5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in Appendix 6 of IRC:78 (Standard Specifications and Code of Practice for Road Bridges – Section VII) in respect of the type of material, the extent to back fill, its laying and compaction, etc. The fill material shall be deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of Table 300-2.

Where the provisions of any filter medium is specified behind the abutment the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium, spelt out in Clause 2502/309-32(B) unless otherwise specified in the contract. Where it may be impracticable to use conventional rollers the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or provider ramming Care shall be taken to see that the compaction equipment does not hit or come too close to any structure member so as to cause any damage to them or excessive pressure against the structure.

305.4.5 Construction of embankment over ground incapable of supporting construction equipment

Where embankments to be constructed across ground which was not support the weight of repeated heavy loads of construction equipment the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor if so desired by him may also use suitable geosynthetic material to increase the bearing capacity of the foundation. The exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3.

305.4.6 Embankment construction under water

Where filling or back filling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall consist of graded, hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity co-efficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

305.4.7 Earthwork for high embankment

In the case of high embankments, the contractor shall normally use the material from the specified borrow area. In case he desires to use different material for his own convenience, he shall have to carry out necessary soil investigations and redesign the high embankment at its own cost. The contractor shall then furnish the soil test data and design of high embankment for approval of the Engineer, who reserves the right to accept or reject it.

If necessary, stage construction of fills and any controlled rates of filing shall be carried out in accordance with the Contract including installation of instruments and its monitoring. Where required, the Contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the Contract. If settlement of fill results in any surcharging material, which is unacceptable for use in fill being surcharged, lying below

formation level, the Contractor shall remove the unacceptable material and dispose it as per direction of the Engineer. He shall then bringing the resultant level up to formation level with acceptable material.

305.4.8 Settlement period

Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wing wall, retaining wall, footings, etc. or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the Contractor as directed by the Engineer.

305.4 Plying of Traffic

Construction and other vehicular traffic shall not use the prepared surface of the embankment and / or sub-grade without the prior permission of the Engineer. Any damage arising out of such use shall, however, be made good by the Contractor at his own expense as directed by the Engineer.

305.5 Surface finish and quality control of works

The surface finish of construction of sub-grade shall confirm to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

305.6 Sub – grade strength

305.7.1. It shall be ensured prior to actual execution that the borrow area material to be used in the sub-grade satisfied the requirements of design CBR.

305.7.2. Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on undisturbed samples cut out from the compacted sub-grade in CBR mould fitted with cutting shoe or on re molded samples compacted to the field density at the field moisture content.

305.7 Measurements for payment

Earth embankment / sub-grade construction shall be measured separately by taking cross sections at intervals in the original position before the work starts and after its completion and computing the volumes of earth work in cubic metres by the method of average end areas.

The measurements of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net quantities of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cum. Of suitable material brought to site from road and drainage excavation forms one cum of compacted fill and all bulking or shrinkage shall be ignored.

Construction of embankment under water shall be measured in cum. Construction of high embankment with specified material and in specified manner shall be measured in Cum.

Stripping including storing and reapplication of top soil shall be measured in Cum.

Work involving loosening and re-compacting of ground supporting embankment / sub-grade shall be measured in Cum Removal of unsuitable measures in Cum.

Scarifying existing granular / bituminous road surface shall be measured in squire metres.

Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6

Filter medium and back fill material behind abutments, wing walls and other retaining structures shall be measured at finished work in position in Cum.

305.8 Rates

305.9 The contract unit rates for the items of embankment and sub-grade construction shall be payments in full for carrying out the required operations including full compensation for

iv. Cost of arrangement of lands as a source of supply of material of required quantity for construction unless provided otherwise in the Contract.

v. Setting out.

vi. Compacting ground supporting embankment / sub-grade except where removal and replacement of unsuitable material or loosening and re-compacting is involved.

vii. Scarifying or cutting continuous horizontal benches 300 mm wide on side slopes of existing embankment and sub-grade as applicable.

viii. Cost of watering or drying of material in borrow areas and or embankment and sub-grade during construction as required.

ix. Spreading in layers, bringing to appropriate moisture content and compacting to Specification requirements.

x. Shaping and dressing top and slopes of the embankment and sub-grade including rounding of corners.

xi. Restricted working at sites of structures.

xii. Workings on narrow width of embankment and sub-grade.

xiii. Excavation in all soils from borrow pits / designated borrow areas including clearing and grubbing and transporting the material to embankment and sub-grade site with all lifts and leads unless otherwise provided for in the contract.

xiv. All labour, materials, tools, equipment and incidentals necessary to complete the work to the specifications.

xv. Dewatering, and

xvi. Keeping the embankment / completed formation free of water as per Clause 311.

305.9.2 In case the contract unit rate specified is not inclusive of all leads, the unit rate for transporting material beyond the initial lead, as specified in the Contract for construction of embankment and sub-grade shall be inclusive of full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the specified initial lead.

Clause 301.9.5 shall apply as regards contract unit rates for items of stripping and storing and re-compacting the embankment / sub-grade topsoil.

305.9.4 Clause 301.9.2. shall apply as regards Contract unit rate for the items of loosening and re-compacting the embankment / sub-grade foundation.

305.9.5 Clause 301.9.1 and 305.8 shall apply as regards contract rates for items of removal of unsuitable material and replacement with suitable material respectively.

305.9.6 The Contract unit rate for scarifying existing granular / bituminous road surface shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. This will also comprise of handling, salvaging, stacking and disposing of the dismantled materials within all lifts and upto a lead of 1000 m or as otherwise specified.

305.9.7 Clause 202.7 shall apply as regards Contract unit rate for dismantling and removal of existing cement concrete pavement.

305.9.8 The contract unit rate for providing and laying filter material behind abutments shall be payment in full for carrying out the required operations including all material, labour, tools, equipment and incidentals to complete the work to specifications.

305.9.9 Clause 305.4.6 shall apply as regards contract unit rate for construction of embankment under water.

305.9.10 Clause 305.4.7 shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instrumentation, its monitoring and settlement period, where specified in the Contract or directed by the Engineer.

306 SOIL EROSION AND SEDIMENTATION CONTROL

306.1 Description

This work shall consist of measures as shown on plans or as directed by the Engineer to control soil erosion, sedimentation and water pollution, through use of berms, dikes, sediment basins, fibre mats, mulches, grasses, slope drains and other devices.

306.2 Materials

All materials shall meet commercial grade standards and shall be approved by the Engineer before being used in the work.

306.3 Construction Operations:

Prior to the start of the relevant construction, the Contractor shall submit to the Engineer for approval his schedules for carrying out temporary and permanent erosion / sedimentation control works as are applicable for the items of clearing and grubbing, roadway and drainage excavation, embankment / sub-grade construction, bridges and other structures across water courses, pavement courses and shoulders. He shall also submit for approval his proposed method of erosion / sedimentation control on service road and borrow pits and his plan for disposal of waste materials. Work shall not be started until the erosion / sedimentation control schedules and methods of operations for the applicable construction have been approved by the Engineer.

The surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations shall be limited to the extent practicable. The Contract may be directed to provide immediate permanent or temporary erosion and sedimentation control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage to adjacent properties, or cause contamination of nearby streams or other water courses, leaks, reservoirs, etc. Such work may involve the construction of temporary berms, dikes.

306.4 Carted earth for the filling

Liquid limit shall be less than 50

Plasticity index shall be less than 25

Free swell index shall be less than 50 percent

The size of the coarse material in the carted earth shall not exceed 50 mm

The soil shall be compacted at minimum 97 percent of maximum dry density

4 days soaked CBR shall be minimum 8

306.5 Carted earth for the subgrade layer

The size of the coarse material in the carted earth shall not exceed 50 mm

The soil shall be compacted at minimum 97 percent of maximum dry density

Liquid limit shall be less than 50

Plasticity index shall be less than 25

Free swell index shall be less than 50 percent

4 days soaked CBR shall be minimum 8

401.1 GRANULAR SUB-BASE

401.1. Scope

401.2. This work shall consist of laying and compacting well – graded material on prepared sub-grade in accordance with the requirements of these specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross sections shown on the drawings or as directed by the Engineer.

401.3. Materials:

402.2.1. The material to be used for the work shall be natural sand, murrum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 400-1. While the gradings in Table 400-1 are in respect of coarse graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5mm, the corresponding gradings for the coarse graded materials for each of the three maximum particle sizes are given at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

402.2.2. Physical requirements

The material shall have a 10 percent fineness value of 50 KN or more (for sample in soaked condition) when tested in compliance with BS : 812 (Part 111). The water absorption value of the course aggregate shall be determined as per IS : 2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 383. For grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 percent.

TABLE 400-1: GRADING FOR CLOSE – GRADED GRANULAR SUB-BASE MATERIALS.

IS Sieve Designation	Percent by weight passing the IS Sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	80-100	100	-
2635 mm	55-90	70-100	100
9.50 mm	35-65	50-80	65-95
1.75 mm	25-55	40-65	50-80
1.76 2.36 mm	20-40	30-50	40-65
1.77 0.425 mm	10-25	15-25	20-35
1.78 0.075 mm	3-10	3-10	3-10
CBR value (minimum)	30	25	20

SUB-BASE MATERIALS

IS Sieve Designation	Percent by weight passing the IS Sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm		100	-
2635 mm	55-75	50-80	100
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm	<10	<10	<10
0.075 mm			
CBR (minimum) value	30	25	20

Note: The material passing 425 micro (0.425 mm) sieve for all the three grading when tested according to IS : 2720 (part 5) shall have liquid limit and plasticity index not more that 25 and 6 percent respectively.

401.3 Strength of sub-base:

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfied the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remolded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

401.4 Construction Operations:

401.4.1 Preparation of sub-grade:

Immediately prior to the laying of sub-base, the sub-grade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

401.4.2 Spreading and Compacting:

The sub-base material of grading specified in the Contract shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mix-in place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small sized jobs. The equipment used for mix-in-place construction shall be rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work. Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or Trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS : 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators, until the layer is uniformly wet. Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibrator roller of minimum 80 to 100 kN static weight with plain drum or pad foot drum of heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7MN / m2 or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super elevation and shall commence at the edges and progress towards the centre for portions having cross fall on both sided.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5km per hour.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of

material on completion of compaction shall be well closed free from movement under compaction equipment and from compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

401.5 Surface Finish and Quality Control of work:

The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

401.6 Arrangements for Traffic

During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112.

401.7 Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

401.8 Rate

The contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compaction for:

i) making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions.

ii) furnishing all materials to be incorporated in the work including all royalties, fees, trees where necessary and all leads and lifts.

iii) all labour, tools, equipment and incidentals to complete the work to the specifications.

iv) carrying out the work in part widths of road where directed; and

v) carrying out the required tests for quality control.

401.9 Granular drainage layer

The material for granular sub-base-cum-drainage layer shall be of Grading V – (Grading for Granular Sub base material-MORTH Revision)

Table 400-1

IS Sieve Designation	75.0 mm	53.0 mm	26.5 Mm	9.50 mm	4.75 mm	2.36 Mm	0.85 mm	0.425 mm	0.075 mm
Percentage by weight passing the IS sieve	100	80-100	55-90	35-65	25-50	10-20	2-10	0-5	-

The GSB drainage layer shall be formed end to end of side drain.

401.10 The Physical requirements for materials for granular sub base

Table 400-2

Aggregate Impact value (AIV)	IS:2386(part 4) or IS:5640	40 maximum
Liquid limit	IS:2720 (part 5)	Maximum 25
Plasticity Index	IS:2720 (part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-part 9)	IS:2720(part 5)	Minimum 30
Water absorption	IS:2386(part 3)	< 2 percent

If the water absorption of the aggregates determined as per IS 2386 (part 3) is greater than 2% the aggregate shall be tested for wet aggregate impact value (AIV) (IS 5640)

402. LIME TREATED SOIL FOR IMPROVED SUB-GRADE/SUB-BASE.

402.1 Scope:

This work shall consist of laying and compacting an improved sub-grade / lower sub-base of soil treated with lime on prepared sub-grade in accordance with the requirements of these specifications and in conformity with the lines, grades and cross sections shown on the drawing or as directed by the Engineer. Lime treatment is generally effective for soils which contain a relatively high percentage or clay and silty clay.

402.2 Materials

402.2.1 Soils:

Except when otherwise specified, the soil used for stabilization shall be the local clayey soil having a plasticity index greater than 8.

402.2.2 Lime

Lime for lime-soil stabilization work shall be commercial dry lime slaked at site or pre-slaked lime delivered to the site in suitable packing. Unless otherwise permitted by the Engineer, the lime shall have purity of not less than 70% by weight of quick time (CaO) when tested in accordance with IS:1514. Lime shall be properly stored to avoid prolonged exposure to the atmosphere and consequent carbonation which would reduce its binding properties.

402.2.3 Quantity of lime in stabilized mix:

Quantity of lime to be added as percentage by weight of the dry soil shall be as specified in the Contract. The quantity of lime used shall be related to its calcium oxide content, which shall be specified. Where the lime of different calcium oxide content is to be used, its quantity shall be suitably adjusted to the approval of the Engineer so that equivalent calcium oxide is incorporated in the work. The mix design shall be done to arrive at the appropriate quantity of lime to be added, having due regard to the purity of lime, the type of soil, the moisture density relationship, and the design CBR/Unconfined Compressive strength (UCS) value specified in the Contract. The laboratory CBR/UCS value shall be at least 1.5 times the minimum field value of CBR/UCS stipulated in the contract.

406. WET MIX MACADAM SUB-BASE/BASE

406.1 Scope

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water to a dense mass on a prepared subgrade/sub-base/base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be increased to 200mm upon approval of the Engineer.

406.2 Materials

406.2.1 Aggregates

406.2.1.1. Physical requirements: Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-10 below.

TABLE 400-10. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUB-BASE/BASE COURSES

Sl.No.	Test	Test Method	Requirements
1	*Los Angeles Abrasion value or *Aggregate Impact value	IS:2386(Part-4) IS:2386(part-4) Or IS:5640	40 per cent (Max.) 30 per cent (Max.)
2	Combined flakiness and Elongation indices (Total)	IS:2386(Part-1)	30 per cent (Max.)

***Aggregate may satisfy requirements of either of the two tests.

**To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (part-5)

406.2.1.2 Grading requirements: The aggregates shall confirm to the grading given in Table 400-11.

TABLE 400-11. GRADING REQUIRMENTS OF AGGREGATES FOR WET MIX MACADAM

IS Sieve Designation	Per cent by weight passing the IS
53.00 mm	100
45.00 mm	95-100
22.40mm	60-80
11.20mm	40-60
4.75mm	25-40
2.36mm	15-30
600.00 micron	8-22
75.00 micron	0-8

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

406.3 Construction Operations

406.3.1.Preparation on base : Clause 404.3.1. shall apply

406.3.2. Provision of lateral confinement of aggregates: While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 407.4.1.

406.3.3. Preparation of mix: Wet mix macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers. Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

406.3.4. Spreading of mix: Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub-grade/sub-base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The paver finisher shall be self-propelled, having the following features.

i)Loading hoppers and suitable distribution mechanism

ii)The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.

iii) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during constructions. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

406.3.5. Compaction: After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall / super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added materials shall not be permitted.

Rolling should be done when the subgrade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outline in IS:2720(Part-8).

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After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

406.3.6. Setting and drying: After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

406.4 Opening to Traffic

Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

406.5. Surface Finish and Quality Control of Work

406.5.1. Surface evenness: The surface finish of construction shall conform to the requirements of Clause 902.

406.5.2.Quality control: Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

406.6 Rectification of Surface Irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to subgrade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, reshaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompacted in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5m long and 2m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

406.7. Arrangements for Traffic

During the period of construction, arrangement of traffic shall be done as per Clause 112.

406.8 Measurements for Payment

Wet Mix macadam shall be measured as finished work in position in cubic metres.

406.9 Rates

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8.

406.10 Wet Mix-Macadam Layer (WMM)

The material for Wet Mix Macadam layer shall be given below (Grading for Wet Mix Macadam material-MORTH V Revision) Table 400-13

IS Sieve Designation	53.0 mm	45.0 mm	26.5 mm	22.40 Mm	11.2 mm	4.75 Mm	2.36 mm	600 Micron	75 Micron
Percentage by weight passing the IS sieve	100	95-100	-	60-80	40-60	25-40	15-30	8-22	0-5

* Materials finer than 425 microns shall have Plasticity index (PI) not exceeding 6

* The final gradation approved within these limits shall be graded from

coarse to time and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa

406.11 Physical Requirements of Coarse aggregates for WMM (Table 400-12)

1. Los Angeles Abrasion Value –IS:2386(part 4)-40 percent (max)or
   Aggregate Impact Value – IS:2386(part 4)or IS:5640-30 Percent (Max)
2. Combined Flakiness and Elongation indices (Total)-IS:2386(part 1)-35 percent (max)
   If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386(part 5)

Binder – Viscosity Grade 30 (VG30- Conforming to IS:73)

503 Tack Coat

503.1 Scope:

This work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction over it.
The plant shall have the following essential features.

503.2 Materials:

503.2.1 Binder:

The binder used for tack coat shall be a bituminous emulsion or cutback as specified in the Contract.

503.3 Construction Operation:

503.3.1 Preparation of base:

The surface on which the tack coat is to be applied shall be cleaned of dust and any extraneous material before the application on the binder, by using a mechanical broom or any other approved equipment / method as specified by the Engineer.

503.3.2 Application on binder:

Binder may be heated to the temperature appropriate to the grade of cut back used and approved by the Engineer and sprayed on the base at the rate specified in Table 500-2. The normal range of spraying temperature for a bituminous emulsions shall be 20 C 60 C and for a cutback 50 C-80 C if RC-70 / MC-70 grade is used. It shall be the responsibility of the Contractor to carefully handle the inflammable bituminous cutback material so as to safeguard against any fire mishap. The binder shall be applied uniformly with the aid of either self-propelled or towed bitumen pressure sprayer with self-heating arrangement and spraying bar with nozzles having constant volume or pressure system, capable of spraying bitumen at specified rates and temperatures so as to provide a uniformly unbroken spread of bitumen work should be planned so that no more than the necessary tack coat for the day's operation is placed on the surface. After application and prior to succeeding construction

allow the tack coat to cure, without being disturbed, until the water / cutter has completely evaporated, as determined by the Engineer.

	Type Surface	Quality of liquid bituminous Material in kh/10sqm area
i)	Normal bituminous surfaces	2.0 to 2.5
ii)	Dry and hungry bituminous surfaces	2.5 to 3.0
iii)	Granular surfaces treated with primer	2.5 to 3.0
iv)	Non bituminous surfaces	
a)	Granular base (not primed)	3.5 to 4.0
b)	Cement concrete pavement	3.0 to 3.5

Note: There is no need to apply a tack coat on a freshly laid bituminous course if the subsequent bituminous course is overlaid the same day without opening it to traffic.

503.4 Quality Control of Work:

Control on the quality of materials and work shall be exercised by the Engineer in accordance with Section 900.

503.5 Arrangement for Traffic:

During the period of construction, the arrangement of traffic shall be done to clause 112.

503.6 Measurement for payment:

Tack coat shall be measured in terms of surface area of application in square metres.

503.7 Rate:

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (1) to (v) as applicable to the work specified in these Specifications.

BITUMINOUS CONCRETE:

512.1 Scope:

This work shall consist of constructing in a single layer, bituminous concrete (asphalt i.e. concrete) of thickness 25-100 mm as previously prepared bituminous course to the requirements of these specifications.

512.2 Materials:

512.2.1 Bituminous : Clause 507.2.1 shall apply.

512.2.2 Coarse Aggregate : Clause 507.2.2 shall apply. The stone polishing valve as measured by B.S: 812 (Part 114) shall not be less than 55. the aggregate shall satisfy the

physical requirements as given in the Table 500.8 except that the maximum value for the water absorption should be 1 percent.

512.2.3 Fine aggregate : Clause 507.2.3 shall apply.

512.2.4 Filler : Clause 507.2.4 shall apply.

512.2.5 Aggregates gradation : The mineral aggregates including mineral filler shall be graded or combined as to conform to the grading set forth in Table 500.23.

TABLE 500.23. AGGREGATES GRADITION FOR BITUMINOUS CONCRETE.

IS Sieve Designation	Percent passing the sieve by weight
26.5 mm	100
19 mm	90-100
9.5 mm	58-80
4.75 mm	35-65
2.36 mm	23-49
300 micron	5-19
75 micron	2-8

512.3 Mix Design

512.3.1 Requirement of mix:

Apart from conformity with the grading and quality requirement of individual ingredients, the mix shall meet the requirements set forth in Table 500.24

Sl. No.	Description	Requirements
1	Marshall stability (ASTM Designation :	820 kg (1800 kb) Minimum
	D-1559) determined on Marshall specimens Compacted by 75 compaction blows on each end.	
2	Marshall flow (mm)	2-4
3	Percent air voids in mix	3-4
4	Percent voids in mineral aggregate (VMA)	Minimum 11-13 percent
5	Percent voids in mineral aggregates filled by bitumen (VFB)	65-75
6	Binder content, percent by weight of total mix	Minimum 4-5
7	Water Sensitivity (ASTM D 1075)Loss of stability on immersion in water at 60 C	Minimum 75 percent retained strength.
8	Swell Test (Asphalt Instt. MS-2 No.2)	1.5 percent maximum.

512.3.2 Binder content :

The binder content shall be so fixed as to achieve the requirement of the mix set forth in Table 500-24. Marshall method for arriving at the binder content shall be adopted.

512.3.3 Job mix formula:

Clause 507.3.3 shall apply except that the requirement of Bituminous Concrete mix shall be as per Table 500-24.

512.3.4 Permissible variations from the job mix formula:

The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. The permissible variations of individual percentages of various ingredients in the actual mix from the job mix formula may be within the limits as specified in Table 500-11. These variations are intended to apply to individual specimens taken for quality control tests vide section 900.

512.3. Construction Operations

512.4.1 Weather and seasonal limitations: Clause 504.3.1 shall apply.

512.4.2 Preparation of base:

The base on which bituminous concrete is to be laid shall be prepared, shaped and conditioned to the specified levels, grade and cross fall (camber) in accordance with Clause 501 or as directed by the Engineer.

The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed by mechanical means or blown off by compressed air, In portions where mechanical means cannot reach, other approved method shall be used.

512.4.3 Tack Coat:

A tack coat complying with Clause 503 shall be applied over the base.

512.4.4. Preparation of mix : clause 507.4.4 shall apply.

512.4.5 Spreading : Clause 507.4.5 shall apply.

512.4.6 Rolling : clause 507.4.6 shall apply.

512.5 Opening to Traffic:

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

512.6 Surface finish and quality control of work:

The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

512.7 Arrangements for Traffic:

During the period of construction, arrangement of traffic shall be done to Clause 112.

512.8 Measurements for Payment:

Bituminous concrete shall be measured as finished work in cubic meters or tones as provided in the Contract.

512.9 Rate:

The contract unit rate for bituminous concrete shall be paid in full for carrying out the required operations including full compensation for all components listed in clause 504.8 (i) to (vi). The rate shall cover the provision of bitumen in the mix at 5.0 percent of the weight

of the total mix with the 7provision the variation of quantity of bitumen will be assessed and the payment adjusted as per the rate of bitumen quoted.

512.10 Bituminous Concrete (BC)

The material gradation for BC layer shall be as given below (composition of Bituminous concrete pavement – MORTH V Revision)

Table 500-17

IS Sieve Designation	45.00 mm	37.50 mm	26.50 mm	19.00 mm	13.20 mm	9.50 mm	4.75 mm	2.36 mm	1.18 mm	0.60 mm	0.30 mm	0.15mm	0.075 mm
Cumulative % by weight of total aggregate passing	-	-	-	100	90-100	70-88	53-71	42-58	34-48	26-38	18-28	12-20	4-10

Bitumen content %by mass of total mix-Min 5.4%

512.11Physical requirements for coarse aggregate for Bituminous concrete

Table 500-16

Property	**Test**	**Specification**	**Method of Test**
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS 2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max 35%	IS 2386 Part II
Strength	Los Angeles Abrasion value or Aggregate impact value	Max 30% Max 24%	IS 2386 Part IV
Durability	Soundness either: Sodium Sulphate of Magnesim Sulphate	Max12% Max 18%	IS 2386 Part V
Polishing	Polished Stone value	Min.55%	BS 812-114
Water absorption	Water Absorption	Max 2%	IS 2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS 6241
Water Sensitivity	Retained Tensile Strength	Min 80%	AASHTO 283

507 DENSE BITUMINOUS MACADAM:

507.1 Scope:

507.2.1 Bitumen

The bitumen shall be paving bitumen of Penetration Grade VG30 as per Indian Standard Specifications for "Paving Bitumen" IS:73. Guidance to selection of the grade of bitumen may be taken from Appendix-4.

507.2.2 Coarse Aggregates:

The coarse aggregates shall consist of crushed stone, crushed gravel / shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall be treated with anti-stripping agents of approved quality in suitable doses. The aggregates shall satisfy the physical requirements set forth in Table 500-8.

If crushed gravel / shingle is used, not less than 90 percent by weight of the gravel / shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The portion of the total aggregate passing 4.75 mm sieve shall have a sand equivalent value of not less than 50 when tested in accordance with the requirements of IS:2720 (Part).

The plasticity index of the fraction passing the 425 micro sieve shall not exceed 4.

TABLE 500-3. PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM.

S. No.	Test	Test Method	Requirements
1.	Los Angeles Abrasion value *	IS : 2386 (Part-4)	40 percent maximum
2.	Aggregate Impact Value	IS : 2386 (Part -4)	30 percent maximum
3.	Flakiness and Elongation Indices (Total)**	IS:2386 (Part-1)	30 percent maximum
4.	Coating and Stripping of Bitumen Aggregate Mixture	AASIITO T 182	Minimum retained coating 95 percent
5.	Soundness	IS;2386 (Part-5)	
	i) Loss with Sodium Sulphate 5 cycles		12 percent maximum
	ii) Loss with Magnesium Sulphate 5 cycles		18 percent maximum
6.	Water absorption	IS:2386 (Part – 3)	2 percent maximum

* Aggregates may satisfy requirement for either of the two sets.

Note: If crushed slag is used, Clause 404. 2.3 shall apply.

507.2.3 The aggregate for bituminous macadam shall conform to one of the two grading in Table 500-4, depending on the compacted thickness, the actual grading shall be as specified in the Contract.

507.2.4 Proportioning of Materials.

The bitumen content for premixing shall be 3 to 3.5 percent by weight of the total mix except when otherwise directed by the Engineer.

THE FILLER SHALL BE GRADED WITHIN THE FOLLOWING LIMITS:

IS Sieve	Percent passing by weight
600 micron	100
300 micron	95-100
75 micron	85-100

The filler shall be free from organic impurities and have a Plasticity Index not greater than 4. the Plasticity Index requirement shall not apply if filler is cement or lime. When the coarse aggregate is gravel 2 percent by mass of total aggregate of Portland cement or hydrated lime shall be added and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the gravel is limestone.

507.2.5 Aggregate gradation:

The combined coarse and fine aggregates filler (when used) shall produce a mixture to conform to the grading set forth in Table 500-9.

TABLE 500-9. AGGREGATE GRADATION FOR DENSE BITUMINOUS MACADAM.

Sieve Designation	Percentage passing the sieve by weight
37.5 mm	10
26.5 mm	90-100
13.2 mm	56-80
4.75 mm	29-59
2.36 mm	19-45
300 micron	5-17
75 micron	1-7

The aggregate mix, as used in work, shall not vary from the low limit on one sieve to the high limit on the adjacent sieve but shall be well graded.

507.3.1 Requirement of mix:

Apart from conformity with grading and quality requirements of individual ingredients, the mix shall meet the requirements set out in Table 500-10.

TABLE 500-10 REQUIREMENTS OF DENSE BITUMINOUS MACADAM MIX.

Sl. No.	Description	Requirements
1	Marshall stability (ASTM Designation D-1559) determined on marshal specimens compacted by 75 compaction blows on each end	820 kg (1800 lb) minimum

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2	Marshal flow (mm)	2-4
3	Percent Air voids	3-5
4	Minimum voids in mineral aggregates (VMA)	10 percent – 12 percent
5	Percent voids in mineral aggregate filled by bitumen (VFB)	65-75
6	Binder content percent by weight of total mix	Not less than 4.0 percent.

507.3.2 Binder content:

The binder content shall be so fixed as to achieve the requirement of the mix set out in Table 500-10. Marshall method for arriving at the binder content shall be adopted, replacing the aggregates retained on 26.5 mm sieve by the aggregates passing 26.5 mm sieve and retained on 22.4mm sieve.

507.3.3 Job mix formula.

The contractor shall intimate to the Engineer in writing, at least 20 days before the start of the work, the job mix formula proposed to be used by him for the work and shall give the following details.

i) Source and location of all materials.

ii) Proportions of all materials expressed as follows where each is applicable.

a) Binder as percentage by weight of total mix.

b) Coarse aggregate / fine aggregate / Marshall filler as percentage by weight of total aggregate including mineral filler.

iii) A single definite percentage passing each sieve for the mixed aggregate.

iv) The results of tests enumerated in Table 500-10 as obtained by the Contractor.

v) Test results of physical characteristics of aggregate to be used.

vi) Mixing temperature and compacting temperature.

While working out the mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for who samples of all ingredients of the mix shall be furnished by the Contractor as required by the former. The approved job mix formula shall remain effective unless and until modified by the Engineer. Should a change in the source of materials be proposed a new job mix formula shall be established and got approved from the Engineer before actually using the materials.

507.3.4 Permissible variation from job mix formula.

It shall be the responsibility of the Contractor to produce a uniform mix conforming to the approved job mix formula subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used within the limits as specified in Table 500-11. These variations are intended to apply to ndividual specimens taken for quality control tests vide section 900.

TABLE 500-11 PERMISSIBLE VARIATIONS FROM THE JOB MIX FORMULA

Sl. No.	Description of ingredients	Permissible variation by weight of total mix in percent
1	Aggregate passing 13.2 mm sieve and larger sieves.	+ / - 8
2	Aggregate passing 11.2 mm sieve and 5.6 mm sieve.	+ / - 7
3	Aggregate passing 2.80 mm sieve and 1.4 mm sieve.	+ / - 6
4	Aggregate passing 710 micron sieve and 355 micron sieve.	+ / - 5
5	Aggregate passing 180micron sieve.	+ / - 4
6	Aggregate passing 90 micron sieve.	+ / - 2
7	Binder	+ / - 0.3
8	Mixing temperature	+ / - 10^0 C

507.4 Construction Operations:

507.4.1 Weather and seasonal limitations

Clause 504.3.1 shall apply.

507.4.2. Preparation of base.

The base on which Dense Bituminous Macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross sections in accordance with Clause 501 or as directed by the Engineer. The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed or blown off by compressed air. In portions where mechanical means cannot reach, other approved method shall be used. A priming coat where needed, shall be applied in accordance with Clause 502 or as directed by the Engineer.

507.4.3 Tack Coat:

A tack coat over the base shall be applied as per Clause 503.

507.4.4. Preparation of mix:

Clause 504.3.4. shall apply.

507.4.5 Spreading

The mix transported from the hot mix plant to the site shall be spread by means of a self propelled pavers with suitable screeds capable of spreading, tamping and finishing the mix to specified grade, lines and cross section. Paver finisher shall have the essential features as spelt out in Clause 504.3.5. However, in restricted locations and in narrow widths where the available equipment cannot be operated in the opinion of the engineer, he may permit manual laying of the mix. Similarly for smaller jobs, mechanical paver may be used with the approval of the Engineer.

The temperature of mix at the time of laying shall be in the range 120^0 C – 160^0C.

Mixes with a temperature of less than 120^0C shall not be put into paver spreader. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal and transverse joints shall be offset by a least 250 mm from those in the lower courses and the joint on the top most layer shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter and the surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be preferably heated with joint heater to attain a suitable temperature of about 80^0 C before laying of adjacent material.

507.4.6 Rolling

After spreading the mix by paver, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not more than 5 km/h immediately following close to the paver. Generally the initial or breakdown rolling shall be done with 80-100 kN static weight smooth wheeled roller. The intermediate rolling shall be done with 80-100 kN static weight vibratory roller or with a pneumatic tyred roller of 150-250 kN weight having a tyre pressure of at least 0.7 MPa. The finish rolling shall be done with 60-80 kN weight smooth wheeled tandem roller. All rolling can be accomplished after trial compaction as approved by the Engineer. Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and or removed and made good. The rollers shall not be permitted to stand on pavement which has not been fully compacted and where temperature is still more than 70^0 C. Necessary precautions shall be taken to prevent dropping of oil, grease, petrol other foreign matter on the pavement either when the rollers are operating or standing.

The wheels of roller shall be kept moist to prevent the mix from adhering to them. But in not case shall fuel / lubricating oil be used for this purpose nor excessive water poured on the wheels. Rolling shall commence longitudinally from edges and proceed towards the centre except that on super elevated and unidirectional cambered portions, it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller shall proceed on the fresh material with rear or front wheel leading so as to minimize the pushing of the mix and each pass of the roller shall overlap the preceding one by half the width of the rear wheel.

Rolling shall be continued till the density achieved is at least 98 percent of that of laboratory Marshall specimen (compacted as defined in Table 500-10) and all roller marks are eliminated. Skin patching of an area that has been rolled will not be permitted. Rolling operations shall be completed in all respects before the temperature of the mix falls below 100^0 C.

507.5 Opening to Traffic

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. The Dense Bituminous macadam shall be provided with an

appropriate wearing course as early as possible prior to regular opening to normal traffic and / or impending rain.

507.6 Surface finish and Quality control of work:

The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

507.7 Arrangements for Traffic:

During the period of construction, arrangements for the traffic shall be done to Clause 112.

507.8 Measurement of Traffic:

Dense Bituminous Macadam shall be measured as finished work in cubic meters or tones as directed by the Engineer.

507.9 Rate:

The contract unit rate for Dense Bituminous Macadam shall be payment in full for carrying out the required operations including full compensation listed in Clause 504.8 (i) to (vi). The rate shall cover the provision of bitumen in the mix at 4.5 percent of the weight of the total mix, with the provision that the variation of quantity of bitumen will be assessed and the payment adjusted as per the rate of bitumen quoted.

507.10 Dense Graded Bituminous Macadam (DBM)

The thickness of the Dense Bituminous Macadam Exceeds 100mm then the following Two gradation as Tabulated below shall be provided.

The material gradation for DBM top layer shall be as given below (Composition of Dense Graded Bituminous Macadam-MORTH V Revision)

I)Table 500-10 (Top Layer)

Nominal aggregate size 26.5mm

Layer thickness 50-70 mm

IS Sieve Designation	45.00 mm	37.50 mm	26.50 mm	19.00 mm	13.20 mm	9.50 mm	4.75 mm	2.36 mm	1.18 mm	0.60 mm	0.3 mm	0.15mm	0.075 mm
Cumulative % by weight of total aggregate passing	-	100	90-100	71-95	56-80	-	38-54	28-42	-	-	7-21	-	2-8

Bitumen content %by mass of total mix-Min 4.5%

II) The material gradation for DBM Bottom Layer shall be as given below (Composition of

Dense Graded Bituminous Macadam –MORTH V Revision)

Table 500-10 (DBM Bottom Layer)

Nominal aggregate size 37.5 mm

Layer thickness 75-100 mm

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IS Sieve Designation	45.00 mm	37.50 mm	26.50 mm	19.00 mm	13.20 mm	9.50 mm	4.75 mm	2.36 mm	1.18 mm	0.60 mm	0.3 mm	0.15mm	0.075 mm
Cumulative % by weight of total aggregate passing	100	95-100	63-93	-	55-75	-	38-54	28-42	-	-	7-21	-	2-8

Bitumen content %by mass of total mix-Min 4%

507.11 The Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam

Table 500-8

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS 2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max 35%	IS 2386 Part II
Strength	Los Angeles Abrasion value or Aggregate impact value	Max 35% Max 27%	IS 2386 Part IV

509 OPEN GRADED PREMIX CARPET:

509.1 Open graded Premix Carpet using Bitumen:

509.1.1 Scope:

This work shall consist of laying and compacting an open-graded carpet of 20mm thickness in a single course composed of suitable small-sized aggregates premixed with a bituminous binder on a previously prepared base, in accordance with the requirements of these specifications, to serve as a wearing course.

509.1.2 Materials:

509.1.2 Binder:

The binder shall be bitumen of a suitable grade appropriate to the region, traffic, rainfall and other environmental conditions, as directed by the Engineer and satisfying the requirements of IS : 73, 271, 454 or other approved cutback as applicable. Guidance in this regard may be taken from Appendix-4.

509.1.2.2 Aggregated

The coarse aggregates shall conform to clause 504 2.2.1. the Stone polishing value as measured by BS:812 (Part 114 shall not be less than 55.

The aggregates shall satisfy the quality requirements set forth in Table 500-3 except that the water absorption shall be limited to a maximum of 1 per cent.

509.1.2.3 Proportioning of materials:

The materials shall be proportioned as per quantities given in Table 500-16.

TABLE 500-16 QUANTITIES OF MATERIALS REQUIRED FOR 10 M^3 OF ROAD SURFACE FOR 20MM THICK OPEN-GRADED PREMIX CARPET USING BITUMEN.

Aggregates for Carpet:

a)	Stone chipping 13.2mm size, passing 22.4mm sieve and retained on 11.2mm sieve.	0.18 m3
b)	Stone chipping 11.22 mm size, passing 13.2 mm sieve and retained on 5.6 mm sieve.	0.06 m3
	Total	**0.24 m3**
	Binder for premixing (quantities in terms of straight run Bitumen)	
a)	For 0.18 m3 mm size stone chippings at 52kg per m3.	9.5 kg
b)	For 0.09 m3 mm 11.2 mm size stone chippings	5.1 kg
	Total	**14.6 kg**

Construction Operations

509.1.3.1 Weather and seasonal limitation

Clause 504.3.1 Shall apply.

509.1.3.2 **Preparation of base**

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with Clause 501. A prime coat needed shall be applied in accordance with Clause 502 as directed by the Engineer.

509.1.3.3 Tack Coat

A tack coat complying with Clause 503, shall be applied over the base preparatory to laying of the carpet.

509.1.3.4 Preparation of Premix

Hot mix plant of appropriate capacity and type shall be used for the preparation of mix material. The hot mix plant shall have separate dryer arrangement for heating aggregates and pug mill for mixing aggregates as binder.

The temperature of binder at the time of mixing shall be in the range of 150^0 C to 163^0 C and that of the aggregates in the range of 155^0 C provided that the difference in temperature between the binder and aggregates at no time exceeds 14^0C. Mixing shall be thorough to ensure that homogenous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall between 130^0 C to 160^0 C.

The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and the mix being transported covered in transit if so directed by the Engineer.

509.1.3.5 Spreading and rolling:

The mixed material shall be spread by suitable means. As soon as sufficient length of bituminous materials has been laid, rolling shall commence with 80-100 NK rollers, preferably of smooth wheel tandem type, or other approved equipment. Rolling shall begin at the edge and progress toward the centre longitudinally, except that on the super elevated and unidirectional cambered portions, it shall progress from the lower to upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions, which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued till the entire surface has been rolled to compaction and all the roller marks eliminated. In each pass of the roller, preceding track shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel / lubricating oil be used for this purpose. Excess use of water for this purpose shall be avoided.

Roller shall not stand on newly laid material while there is a risk that it will be deformed thereby. Rolling operations shall be completed in every respect before the temperature of the mix fall below 100^0C.

508. Semi - Dense Bituminous Concrete.

508.1. Scope.

This clause specified the construction of Semi - Dense Bituminous Concrete, foruse in wearing courses. This work shall consist of construction in a single of multiple layers of Semi - Dense Bituminous Concrete on a previously prepared bituminous bound surface. A single layer shall be 25mm to 100mm thickness.

508.2 Materials:

508.2.1 Bitumen: The Bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS:73 and of the penetration indicated in Table 500-15, for semi dense bituminous concrete, of this bitumen as modified by one of the method specified in Clause 521, or as otherwise specified in the contract. Guidance on the selection if an appropriate grade of Bitumen is given in the manual for construction and Supervision of Bituminous work.

508.2.3 Coarse Aggregate : The course aggregates shall be generally as specified in Clause 507.2.2, except that the aggregate shall satisfy the physical requirements of Table 500-14.

508.2.4 Fine aggregate: the Fine aggregates shall be all as specified in Clause 507.2.3.

508.2.5 Filler : filler shall be generally as specified in Clause 507.2.4. where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-

14 then 2 Percent by total weight of aggregate, of hydrated lime shall be added without additional cost.

508.2.6 **Aggregates gradation and Binder content :** When testing in accordance with IS:2386 Part-I (Wet Sieving method), the combined grading of the course and fine aggregates and added filler shall fall within the limits shown in Table 500-15 for gradings 1 or 2 as specified in the Contract.

Mix Design

508.3.1 Requirement of mix: Apart from conformity with the grading and quality requirement of individual ingredients, the mix shall meet the requirements set forth in Table 500.16

508.3.2 Table 500-14.PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR SEMI DENSE BITUMINOUS CONCRETE PAVEMENT LAYERS.

Property	Test	Specification
Cleanliness	Grain size analysis	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation index (combined)	Max.30%
Strength*	Los Angeles Abrasion value Aggregate impact value	Max.27%
Polishing	Polished stone value	Min.55
Durability	Soundness* Sodium sulphate Magnesium sulphate	 Max.12% Max 18%
Water Absorption	Water absorption	Max 2%
Stripping	Coating and stripping of bitumen aggregate mixtures*	Minimum retained Coating 95%
Water Sensitivity**	Retained tensile strength*	Min 80%

Notes: 1. IS.2386 Part 1
2. IS.2386 Part 1
(the elongation test may be done only on non-flaky aggregates in the Sample).

3. IS.2386 Part 4*

4. IS.2386 Part 4*

5. BS.812 Part 114

6. IS.2386 Part 5

7. IS. 2386 Part 3

8. AASHTOT283**

9. IS.6241

* Aggregate may satisfy requirements of either of these two tests.

**The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

508.3.2. Binder content: The binder content shall be optimized to achieve the requirements of the mixture set out in Table 500-16 and the traffic volume as specified in the contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.
Base and surface courses (Bituminous)

Table 500-15 COMPOSITION OF SEMI DENSE BITUMINOUS CONCRETE PAVEMENT LAYERS.

Grading	1	2
Nominal aggregate size	13mm	10mm
Layer thickness	35-40mm	25-30mm
IS Sieve (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5		
19	100	
13.2	90-100	100
9.5	70-90	90-100
4.75	35-51	35-51
2.36	24-39	24-39
1.18	15-30	15-30
0.6	-	-
0.3	9.19	9-19
0.15	-	-
0.075	3.8	3.8
Bitumen content % by mass of total mix[2]	Min 4.5	Min.5.0
Bitumen grade (pen)	65*	65*

Notes: 1 . The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method

*Only in exceptional circumstances 80/100 penetration grade may be used as approved by the Engineer.

Table 500-16 REQUIREMENTS FOR SEMI DENSE BITUMINOUS PAVEMENT LAYERS.

Minimum stability (KN at 60°C)	8.2
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-5
Per cent voids in mineral aggregate (VMA)	See Table 500-12
Per cent voids filled with bitumen (VFB)	65-78

508.3.3. **Job mix formula:** The procedure for formulating the job mix formula shall be generally as specified in Clause 507.3.3 and the results of tests enumerated in Table 500-16 as obtained by the Contractors.

508.3.4 **Plant trials – permissible variation in job mix formula:** The requirements for plant trials shall be all as specified in Clause 507.3.4 and permission limits for variation as shown in Table 500-13.

508.3.5. **Laying trials :** The requirements for laying trials shall be all as specified in Clause 507.3.5.

508.4 **Construction Operations**

508.4.1 **Weather and seasonal limitations**: The provisions of Clause 501.5.1 shall apply.

508.4.2. **Preparation of base :** The surface on which the Semi Dense Bituminous material is to be laid shall be prepared in accordance with Clause 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot access other approved methods shall be used as directed by the Engineer.

508.4.3. Geosynthetics : Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements sated in Clause 70.3.

508.4.4. Stress absorbing layer: Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 522.

508.4.5. Tack coat: Where specified in the contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Clause 503.

508.4.6. Mixing and transportation of the mixture: The provision as specified in Clauses 501.3 and 501.4 shall apply.

508.4.7. Spreading: The general provisions of Clauses 501.5.2 and 501.5.4 shall apply.

508.4.8. Rolling: The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

508.5. Opening of Traffic : The newly laid surface not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of Engineer in writing.

508.6. Surface Finish and Quality Control: The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of this specification.

508.7. Arrangements for Traffic : During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

508.8 Measurement for payment: The measurement shall be all specified in Clause 507.8.

508.9. Rate: The contract unit rate shall be as specified in Clause 507.9. except that the rate shall include the provision of bitumen at 4.75 per cent. By weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down accordingly.

901. GENERAL

901.1 All materials to be used, all methods adopted and all works performed be strictly in accordance with the requirements of these specifications. The Contractor shall setup laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out all required tests and Quality Control work as per Specifications and / or as directed by the Engineer. The internal layout of the laboratory shall be as per Clause 1221 and / or as directed by the Engineer. The list of equipments and the facilities to be provided shall be got approved from the Engineer in advance.

901.2 The contractors laboratory should be manned by a qualified Materials Engineer / Civil Engineer assisted by experience technicians, and the set up should be got approved by the Engineer.

901.3 The contractor shall carry out quality control tests on the materials and work to the frequency stipulated in subsequent paragraphs. In the absence of clear indications about method and or frequency of tests for any item, the instructions of the Engineer shall be followed.

901.4 For satisfying himself about the quality of the materials and work, quality control tests will also be conducted by the Engineer (by himself, by his quality control units or by any other agencies deemed fit by him), generally to the frequency set forth herein under. Additional tests may also be conducted where, in the opinion of the Engineer, need for such tests exists.

901.5 The contractor shall provide necessary co-operation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This may include provision of labour, attendants, assistance in packing and dispatching and any other assistance considered necessary in connection with the tests.

901.6 For the work of embankment, sub-grade and pavement, construction of subsequent layer of same or other material over the finished layer shall be done after obtaining permission

from the engineer. Similar permission from the engineer shall be obtained in respect of all other items of works prior to proceedings with the next stage of construction.

901.7 The Contractor shall carry out modifications in the procedure of work, if found necessary, as directed by the engineer during inspection. Works falling short of quality shall be rectified / redone by the Contractor at his own cost, and defective work shall also be removed from the site of works by the Contractor at his own cost.

901.8 The cost of laboratory building including services, essential supplies like water, electricity, sanitary services and their maintenance and cost of all equipment, tools, materials, labor and incidentals to perform tests and other operations of quality control according to the specification requirements shall be deemed to be incidental to the work and no extra payment shall be made for the same. If, however there is a separate item in the Bill of quantities for setting up of a laboratory and installing testing equipment, such work shall be paid for separately.

901.9 For testing of samples of soils / soil mimes, granular materials and mixes, bituminous materials and mixes, aggregates, cores, etc. samples in the required quantity and form shall be supplied to the Engineer by the Contractor at his own cost.

901.10 For cement, bitumen, mild steel, and similar other materials where essential tests are to be carried out at the manufacturer's plants or at laboratories other than the site laboratory, the cost of samples, sampling, testing and furnishing of test certificates shall be borne by the Contractor. He shall also furnish the test certificates to the Engineer.

901.11 For testing of cement concrete at site during construction, arrangements for supply of samples, sampling, testing and supply of test results shall be made by the Contractor as per the frequency and number of tests specified in the Handbook of Quality control for construction of Roads and Runways (IRC:SP:11) and relevant IS Codes or relevant clauses of these specifications, the cost of which shall be borne by the Contractor.

901.12 The method of sampling and testing of materials shall be as required by the "Handbook of Quality Control for Construction of Roads and Runways" (IRC:SP:11), and these MOST specifications shall be followed. Where they are silent, sound-engineering practices shall be adopted. The sampling and testing procedure to be used shall be as approved by the Engineer and his decision shall be final and binding on the Contractor.

901.13 The materials for embankment construction shall be got approved from the Engineer. The responsibility for arranging and obtaining the land for borrowing or exploitation in any other way shall rest with the Contractor who shall ensure smooth and uninterrupted supply of materials in the required quantity during the construction period. Similarly, the supply of aggregates for construction of road pavement shall be from quarries approved by the Engineer. Responsibility for arranging uninterrupted supply of materials from the source shall be that of the Contractor.

901.14 **Defective Materials:**

All the materials which the Engineer / his representative has determined as not conforming to the requirements of the contract shall be rejected whether in place or not; they shall be

removed immediately from the site as directed. Materials, which have been subsequently corrected, shall not be used in the work unless approval is accorded in writing by the Engineer. Upon failure of the contractor to comply with any order of the Engineer / his representative, given under this Clause, the Engineer / his representative, shall have authority to cause the removal of rejected material and to deduct the removal cost thereof from any payments due to the Contractor.

901.15 **Imported Materials:**

At the time of submission of tenders, the contractor shall furnish a list of materials / finished products manufactures, produces or fabricated outside India, which he proposes to use in the work. The Contractor shall not be entitled to extension of time for acts or events occurring outside India and it shall be the Contractor's responsibility to make timely delivery to the job site of all such materials obtained from outside India.

The materials imported from outside India shall conform to the relevant specifications of the Contract. In case where materials / finished products are not covered by the Specifications in the Contract, the details of Specifications proposed to be followed and the testing procedure as well as laboratories / establishment where tests are to be carried out shall be specifically brought out and agreed to in the Contract.

The Contractor shall furnish to the Engineer a certificate of compliance of the tests carried out. In addition, certified mill test reports clearly identified to the lot of materials shall be furnished at the Contractor's cost.

902. CONTROL OF ALIGNMENT, LEVEL AND SURFACE REGULARITY:

902.1 General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer, subject to the permitted tolerances described herein-after.

902.2 Horizontal Alignment:

Horizontal alignments shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of +- 10mm there from. The corresponding tolerance for edges of the roadways and lower layers of pavement shall be +- 25mm.

902.3 Surface Levels:

The levels of the sub-grade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross profile of the road shown on the drawings or as directed by the Engineer beyond the tolerance mentioned in Table 900-

Table 900 – 1. Tolerance in surface levels.

1.	Sub Grade		+ 20 mm - 25 mm
2.	Sub-base + 10mm		
	a) Flexible pavement		- 20 mm
	b) Concrete pavement		+ 6 mm
	(Dry lean concrete or Rolled concrete)		
3.	Base-course for flexible pavement		
	a)	Bituminous course	+ 6 mm - 6 mm
4.	b)	Other than bituminous	
	i)	Machine laid	+ 10 mm - 10 mm
	ii)	Manually laid	+ 15 mm - 15 mm
5.	Wearing course for flexible pavement		
	a)	Machine laid	+ 6 mm - 6 mm
	b)	Manually laid	+10 mm - 10mm
6.	Cement concrete pavement		+ 5 mm - 6 mm

This may not exceed – 8mm at 0.30 from the edges.

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction wit the positive tolerance for base course, if the thickness of the former is thereby reduced by more than 6mm for flexible pavements and 5mm for concrete pavements.

For checking compliance with the above requirement for sub grade, sub base and base course, measurement of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above. The one measurement being not in excess of 5mm above the permitted tolerance. For checking the compliance with the above requirement for bituminous wearing courses and concrete and pavements, measurements of the surface levels shall be taken on a grid of points spaced at 6.25m along length and at 0.5m from the edges and at the centre of the pavement. In any length of pavement, compliance shall be deemed to be met for the final road surface, only if the tolerance given above is satisfied for any point on the surface.

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902.4. Surface Regularity of Pavement Courses.

The longitudinal profile shall be checked with a 3 metre long straight edge / moving straight - edge as desired by the Engineer at the middle of each traffic lane along a line parallel to the centre line of the road.

The maximum permitted number of surface irregularities shall be as per Table 900-2.

Table 900-2 MAXIMUM PERMITTED NUMBER OF SURFACE IRREGULARITIES

	Surfaces of carriage ways and paved shoulders.				Surface of laybys, service areas and all bituminous base courses.			
Irregularity	4 mm		7 mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75
Roads of lower category	40	18	4	2	60	27	6	3
National Highways / Express ways	20	9	2	1	40	18	4	2

Category of each section of road as described in the Contract.

The maximum allowable difference between the road surface and underside of a 3m straight-edge when placed parallel with, or at right angles to the centre line of the road at points decided by the Engineer shall be.

For pavement surface

(bituminous and cement concrete) .. 3 mm

for bituminous base course .. 6 mm

for granular sub-base / base- course .. 8 mm

for sub-base under concrete pavements .. 10 mm

902.4 Rectification

Where the surface regularity of sub-grade and the various pavement courses fail outside the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer.

i. **Sub-grade:**

Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and re compacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of Clauses 305.

ii. **Granular sub-base:**

Same as at (i) above, except that the degree of compaction and the type of material to be used conform to the requirements of Clause 401.

iii. **Lime / Cement stabilized soil sub-base:**

For lime /cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below:

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material is less than 2 hours the surface shall be scarified to a depth of 50mm supplemented with freshly mixed materials as necessary and re compacted to the relevant specification. When this time is more than 2 hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material to specification. This shall also apply to lime treated material except that the lime criterion shall be 3 hours instead of 2 hours.

iv. Water Bound Macadam / Wet Mix Macadam Sub-base / Base:

Where the surface is high or low, the top shall be scarified, reshaped with added material as necessary and re-compacted to Clause 404. this shall also apply to wet mix macadam to clause 406.

v. **Bituminous Constructions:**

For bituminous construction other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material over a suitable tack coat if needed and re-compacting to specification. Where the surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications.

For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5m in length and not less than 3.5m in width.

vi. **Dry Lean Concrete sub-base / Rolled Cement Concrete:**

The defective length of the course shall be removed to full depth and replaced with material conforming to clauses 601 or 603 as applicable. The area treated shall be at least 3m long not less than 1 land wide and extend to the full depth. Before relaying the course, the disturbed sub grade or layer below shall be corrected by leveling, watering and compacting.

vii. **Cement Concrete Pavement:**

The defective areas having surface irregularity exceeding 3mm but not greater than 6mm may be rectified by bump cutting or scrapping or grinding using approved equipment. When required by the Engineer, areas which have been reduced in level by the above operation(s) shall be retextured in an approved manner either by cutting groves (5mm deep) or roughening the surface by hacking the surface. If high areas in excess of 6mm or low area in excess of 3mm occur, exceeding the permitted numbers are if the contractor cannot rectify the slab shall be demolished and reconstructed at the Contractor's expense and in no case the area removed shall be less than the full width of the lane in which the irregularity occurs and full length of the slab.

If deemed necessary by the Engineer, any section of the slab which deviates from the specified levels and tolerance shall be demolished and reconstructed at the contractor's expenses.

903.Quality Control Tests during Construction:

903.1.General:

This materials supplied and the works carried out by the contractor shall conform to the specifications prescribed in the preceding clauses.

For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control tests, as described hereinafter, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to carryout additional tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. However, the number of tests recommended in table 900-3 and 900-4 may be reduced at the discretion of the Engineer if it is felt that consistency in the quality of materials can still be maintained with the reduced number of tests.

Test procedures for the various quality control tests are indicated in the respective sections of these specifications or for certain tests within this section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Engineer.

903.2 Tests on Earthwork for Embankment, Sub-grade construction and cut formation:

903.2.1 Borrow material:

Grid the borrow area at 25 m c/c (or closer, if the variability is high) to full depth of proposed working. These pits should be logged and plotted for proper identification of suitable sources of material. The following test on representative samples shall be carried out.

a) Sand content (IS:2720 (part -4) : 2 tests per 3000 cubic meters of soil.

b) Plasticity Test (IS :2720) (part -5) : Each type to be tested 2 tests per 3000 cubic meters of soil.

c) Density Test (IS:2720 (PART-6) : Each soil type to be tested, 2 tests per 3000 cubic meters of soil.

d) Deleterious content test (IS 2720 (part-2) : One test for every cubic meters of soil.

e) CBR test on materials to be incorporated in the sub-grade or soak / un- soaked samples (IS 2720 (part -16): One CBR test for every 3000 cubic meter at least or close as and when required by the Engineer.

903.2.2 Compacting Control:

903.2.2.1 Control shall be exercised on each layer by taking at least one measurement of density for each 1000 square of compacted area, or closer as required to yield the minimum number of test result for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS:2720 (part-28). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-10 density determinations. The number of

test in one set of measurements shall be 6) if non-destructive tests are carried out, the number of tests shall be double) as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance criteria shall be subject to the condition that the mean density is not less than the specified density plus:

$$\frac{1.65 - 1.65}{(\text{No. of samples})^{0.5}}$$

However, for earth work in shoulders (earthen) and in the sub-grade, at least one density measurement shall be taken for every 500 square meters for the compacted area provided further that the number of tests in each set of measurements shall be at least 10. In other respects, the control shall be similar to that described earlier.

Cut formation:

Tests for the density requirements of cut formation shall be carried out in accordance with Clause 903.2.2.1.

903.3 Tests on sub-bases and bases (excluding bitumen bound bases). The tests and their frequencies for the different types of bases and sub-bases shall be as given in Table 900-3. The evaluation of density results and acceptance criteria for compaction control shall be on lines similar to those set out in clauses 903.2.2.

903.3.1 Acceptance Criteria:

The acceptance for tests on the strength of cement / lime stabilized soil and distribution of stabilizer content shall be subject to the condition that the mean value is not less than the specified value plus.

$$1.65 \; (-) \; \frac{1.65}{(\text{No. of samples})^{0.5}} \text{ times the standard deviation.}$$

TABLE -01. Frequency of Test for Borrow Material

Test No.	Description	Test Method	Frequency
EW-1	Sand content	IS:2720 (Part-4)	One tests per 4000 cum of soil
EW-2	Plasticity index	IS:2720 (Part-5)	One tests per 4000 cum of soil
EW-3	Natural moisture content	IS:2720 (Part-2)	One test for every 500 cum of soil
EW-4	Compaction test	IS:2720 (Part-7)	One test per 4000 cum of soil
EW-5	CBR test on materials to be used in the sub-grade.	IS:2720 (Part-16)	One CBR test for every 5000 cum of soil

TABLE 10.2. Frequency of Test for Earth Work

Test No.	Description	Test Method	Frequency
EW-6	Moisture content prior to compaction.	IS:2720 (Part-2)	One test for every 250 m3 of soil subject to minimum of 4 test / day.
EW-7	Thickness of layer		Regularly.
EW-8	Degree of the compaction	IS:2720 (Part-28)	One test of the test per 2000 m2 area comprising 5-6 measurement.

TABLE -10.3. Frequency of Test for Granular and Stabilised (Mechanical) sub-base and gravel roads

Test No.	Test	Test Method	Frequency
SB-1	Gradation	IS:2720 (Part-4)	Two tests per 500 cum or per day.
SB-2	Attler berg limits	IS:2720 (Part-5)	Two tests per 500 cum or per day.
SB-3	Moisture content prior to compaction	IS:2720 (Part-2)	Two tests per 500 cum or per day.
SB-4	Density of compacted layer	IS:2720 (Part-28)	One set of test per 2000 Sqm.
SB-5	Thickness		Regularly

TABLE -10.4 Frequency of Test for Stabilised (Lime/Cement/Lime-GBFS/Lime-Fly ASH) Sub-base

Test No.	Test	Test Method	Frequency
SB-6	Purity o lime / cement Gradation	IS:15145/IS:269/ 455/ IS:1489	One test per 500 kg or lot.
SB-7	Degree of pulverization	--	Regularly
SB-8/9	CBR or unconfined compressive strength test on a set of 3 specimens.	IS:2720 (Part-16) IS:4332 (Part-5)	One test per 100 cum of mix.
SB-3	Moisture content prior to compaction	IS:2720 (Part-2)	Two tests per 500 cum or per day.
SB-4	Density of compacted layer	IS:2720 (Part-28)	One set of test per 2000 Sqm.
SB-5	Thickness		Regularly

TABLE -10.5 Frequency of Test for Water Bound Mecadam (Sub-base, Base Course and Surface Course)

Test No.	Test	Test Method	Frequency
GB-1	Aggregate impact value	IS:2386 (Part-4)	One test per 250 cum or source.
GB-2	Grading of aggregate and screening.	IS:2386 (Part-1)	Two tests per 250 cum or per day.
GB-3	Flakiness – index and	IS:2386 (Part-1)	One test per 250 cum or

	elongation index		per day.
GB-4	Attlerberg limits of binding material.	IS:2720 (Part-5)	One test per 50 cum or per day.
GB-5	Water absorption	IS:2386 (Part-3)	One test per source
GB-6	Thickness	--	Regularly

TABLE – 10.6 Frequency of Test for Prime Cost and Tack Coat

Test No.	Test	Test Method	Frequency
BL-1	Quality of binder	IS:73/217/8887	One test per lot or per 10 tonne.
BL-2	Temperature of binder	Appendix 10.6	Regularly.
BL-3	Rate of spread of binder	Appendix 10.7	Two tests per day or per 1000 sqm.

TABLE – 10.7 Frequency of Test for Bituminous Macadam

Test No.	Test	Test Method	Frequency
BL-1	Quality of binder	IS:73/217/8887	1 test per lot or per 10 tonne.
BL-2	Temperature of binder	Appendix 10.6	Regularly.
BL-4	Aggregate impact value	IS:2386 (Part-4)	1Test per 250 cum/source
BL-5	Flakiness index	IS:2386 (Part-1)	1 Test per 250 cum
BL-6	Stripping of aggregate	IS:6241 – 1971	1 Test per source
BL-7	Water absorption	IS:2386 (Part-3)	1 Test per source
BL-8	Grading of aggregates	IS:1286 (Part-1)	1 Test per 100 cum
BL-9	Binder content	Appendix- 10.8	2 test per day.
BL-10	Thickness		Regularly
BL-11	Density of compacted layer	Appendix 10.9	1 Test per 1000 sqm. Area or per day.

(B). TECHNICAL SPECIFICATIONS AND SPECIAL CONDITIONS FOR ELECTRICAL WORKS

1. The work shall be carried out in accordance with the General specification for Electrical works and the code of practice for electrical wiring installing I.S:8732/1963 and I.S.3045/1965 and as amended upto date. All installation shall comply with the requirement of Indian Electricity Rules 1956 and Act and IS Code amendment up to date.

2. Approval of the Engineer-in-charge shall be taken well in advance for all materials and brand of materials to be used on works by the contractor based on the description of the Executive Engineer-in-charge and his decision will be final.

3. Bad workmanship is liable to be rejected in total.

4. The Contractor shall supply on completion of work, completed plan along with insulation, polarity and earth test reports before the installation is to be handed over to the Executive Engineer-in-charge in good condition in triplicate. The tests should be carried out in the presence of Engineer-in-charge at contractor's cost.

5. All repairs and patch works shall be neatly carried out to match the original finish and to the entire satisfaction of Engineer-in-charge.

6. The Contractor shall make his own arrangements at his own cost for all general Tools and Plants and special Tools and Plants required on the job.

7. The Contractor shall make his own arrangements for storage of materials and watch and ward at his own cost till installation (completed works) is handed over to the Department for obtaining the service connection from Electricity Board and testing the line. Any loss and tampering of materials for which the payment was made by the department, shall be made good by the Contractor at his own cost.

8. Issue of the materials to the Contractor wherever stipulated shall be regulated to the needs from time to time depending upon the progress.

9. Materials stipulated for issue shall be taken over to the site of works and the safe custody till completion of the job is the responsibility of the contractor.

10. All debris due to electrical works shall be removed from site by thecontractor as soon as the work is completed.

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11. Electrical works shall be progressed by the contractor side by side with the progress of the building work, carrying of conduits for recessed portion shall be planned together with the building progress so that there is no hindrance to the building progress at any stage.

12. The internal electrical installations shall be ordinarily carried out according to the drawing supplied with the schedule of work subject to change made by the Executive Engineer-in-charge.

13. The wiring routes shall be marked at site first and get approval from the Executive Engineer-in-charge before commencement of actual work. The work must be carried out as directed by the Executive Engineer-in-charge.

14. In place, where electrical conduit is required to place through wall/RCC column/beam etc., the conduit shall be laid during the execution of work in consultation with the Engineer-in-charge so as to avoid the need for cutting the structure at a later stage.

15. The teak wood materials such as fillets specials T.W. bodes and all materials shall be got approved from the Engineer-in-charge before use to ensure the quality of materials.

16. In the case of recessed conduit works, the M.S. Boxes shall also be recessed and covered with 1/8" (3mm) hylem bake lite sheet. The thickness of M.S. Box sheets shall not be less than 3mm thick.

PROVISION OF FITTINGS

17. All switch boards shall be placed such that the bottom is normally 1.22 meters above floor level or such height as decided by the Engineer-in-charge.

18. All fittings shall be provided at 2.6 meter from the floor level or such height as decided by the Engineer-in-charge.

19. The convenient 5/15 amps plug socket shall be 23 cm above floor level or such height as decided by the Engineer-in-charge.

20. Wiring shall run normally at 2.6 meters from the floor level or such height as decided by the Engineer-in-charge.

21. The materials issued if any by the department to the contractor the cost will be recovered at the stores issue rates.

If the contractor fails to return the surplus materials after completion of work, the cost will be recovered at double the stores issue rate or market rate whichever is higher.

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22. Tools and Plants generals and special as required on the work is to be arranged by the contractor at his own cost.

23. Brass tinned link/joint clips of0.32mm (30 gauge) thick up to 40mm length and 0.40mm (28 gauge) thick above 40mm length and of 8mm width shall be used on the work.

24. Brass hinges brass hooks and eyes, single plank teak wood board 60mm minimum depth in case of open wiring and minimum depth of 100mm in the case of concealed wiring and not less than 6mm thickness shall be used on the works.

FIXING OF WOODEN BATTENS

25. The screws shall be used for fixing the wooden batten and accessories at an interval not exceeding 50cm. The thickness of battens shall not be less than 10mm.

26. The clips are provided on the wooden batten with screw/pins and spaced at intervals of 15cm both in the case of horizontal and vertical run.

27. The round block shall not be less than 75mm and 40mm deep and fixed by means of 2 Nos. of screws.

28. Plona type switches, sockets outlets of approved make wherever needed shall be used for recessed boards after getting the approval of Engineer-in-charge.

29. Only brass screws shall be used for fittings, switches, plug and sockets main boards and distribution boards and teak wood accessories etc., required for wiring.

30. All conduct pipe shall be of approved gauge (not less than 16 SWG 14 SWG) solid drawn or lap welded finished with galvanized stone enameled finish. The saddles used shall not be less than 24 gauge up to 25mm dia pipes and not less than 20 gauge for longer dia pipes.

31. The main earthing load shall not be less than 8 SWG copper (4.06mm). In case of copper wire earthing of 6 SWG G.I. Wire (4.96 mm) in case of G.I. wire earthing separate earthing shall be provided for all mountings of main boards, distribution boards, 5/15 amps C.S. plugs sockets with not less than 14 SWG of copper (2.03mm.)

32. Earthing shall confirm to the relevant I.S. code 303/1966. The G.I. pipes earth electrode system is adopted. G.I. pipes shall be of medium class 38/40 mm dia 3.75 meters long. The electrode shall be buried in the ground vertically with its top not less than 20 cm below ground level. Normally an earth electrode shall provide 1.5 meters away from any building. In case of providing twin earthing the distance between the earth pits shall be 10’-0”

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alternative layers of charcoal or coke and salt of minimum 15cm thick are to be provided from the bottom of earth pit up to 1.00 meter below ground level and the masonry work is to be carried out in brick with cement mortar 1:4 (one of cement and four of sand) above the last layer and the top is to be covered by suitable cast iron frame and cover.

33. The staircase light point wiring must be done by looping or piece wire system and switch must control phase or line wire only.

34. Looping in system is to be adopted for wiring normally the looping of neutral to light fan plug points etc., shall be restricted to 3 points for a single wire from the switch board.

35. The wooden batten and specials shall not be butt jointed and joints should be lap jointed.

36. The wiring must be done using bend and corners wherever necessary sharp banding or cabling must be avoided.

37. The lighting circuit shall not have more than 10 points or a load of 800 watts which ever is less. In exceptional cases the lighting circuit shall not have more than 8 points.

38. Power wiring shall be kept separate and distinct from the lighting wiring.

39. The contractor should be present at the premises at the time of effecting service connection by the Electricity Board authority and afford all facility for testing and commissioning the installations.

40. The apartment main switches and the main switches at the Electricity Board Service connection should be numbered in paint for easy identification and the damager boards should be provided wherever necessary according to the Indian Electricity rules and indications.

41. The contractor should provide sufficient leads for connecting the main switches to meters and cuts provided by the Electricity Board at his own cost.

42. Looping of neutral and connection wires in the switch boards must be carried out through mechanical connectors and proper insulation shall be provided inside the switch boards wherever necessary to avoid short circuiting the system.

43. The scaffolding and the shed required for the Electrical installation works should be put up by the contractor at his own cost.

44. The run off mains relates to the mains run from the buss bar to distribution board or buss bar main switches as the position indicated in the electrical layout. The point wiring shall

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includes mains taken from distribution board or main switch to board. The main for this shall not be measured and paid.

The run off mains relates to the mains run from the main switches provided inside the apartments to the Electricity Board authorities. The earthing for the main switches provided in the service connection board should be properly inter connected and connected to the main earthing system.

45. Each circuit has to be taken from the Distribution Board by separate independent conductor/separate group of wires from Distribution Board and they could be distinctly visible. The wiring must be done if there is no Distribution Board with distributed circuits as directed by the field staff.

46. For temporary supply if any required by the contractor himself should apply to Madras Electricity System and obtain the supply at his own cost.

47. PVC pipes and specials, M.S. Boxes etc. if available with the department the same may be supplied for works at recovery.

48. The contractor should prepare necessary electrical systematic layout drawing at this own cost and get approval from the Chief Electrical inspection to Government, Madras-2 and the permission to enlarge the same from the CEIG (Madras-2)

49. The contractor shall use only the brand of materials that are approved by the Engineer-in-charge.

50. The Electrical installation to be carried out as per the specification and it confirmed to I.E. rule.

51. GST:- Clause (2) of General conditions of contract "The contractors shall be solely responsible to the payment of GST under the provisions of the Tamil Nadu GST Act as in force for the time being and the rates for the various items of the work shall remain unaffected by any change that may be made from time to time in the rate which the sales tax is payable.

52. All rates quoted in the tender shall be inclusive of payable under GST Tax as amended from time to time (Including Amendment Act) 28/84 and that the contract or responsible to file the sales tax returns and may be the tax as demanded by the Commercial Tax Department. No request for payment of sales tax separately, in addition to tendered rates due to any subsequent levy increase in tax, will be entertained vide also clause 38 (x) or General conditions of contract.

53. The Electrical contractors should hold either "A" grade license (or) "B" grade license issued by the Electrical wireman and supervisor contractor licensing Board.

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