

Request for Bids Works

(One-Envelope Bidding Process)

Procurement of:
**Rehabilitation of Yasser Arafat Square
in the city center**

Volume I: Bidding Procedures
Volume II: Conditions of contract
Volume III: Technical Specification
Volume VI: Bill of Quantity
Volume V: Drawings

RFB No: RamMun/RM/2021/025

Employer: Ramallah Municipality

Funded by: Government of India - Ramallah Municipality

Country: Palestine

Issued on: March, 2021.

Volume I: Bidding procedures

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Section I - Invitation to Bid

Bid No. (RamMun/RM/2021/025)

To Whom it May Concern

1. Introduction:

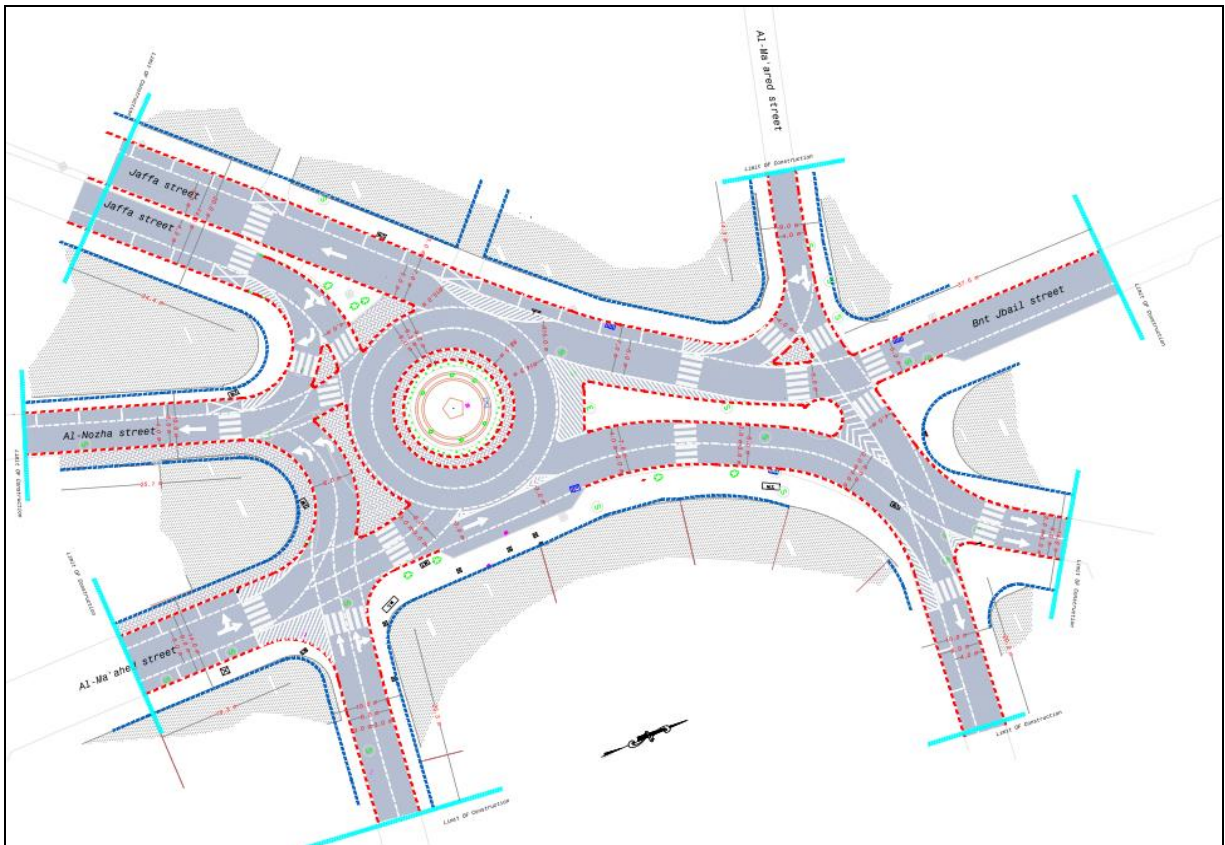
Ramallah Municipality has received funding from the Government of India to support quick impact project in Palestine. This fund is approved to be used for the **Rehabilitation of Yasser Arafat Square in the city center** under the Contract No. **(RamMun/RM/2021/025)**. You are hereby invited to submit your offer for the above-mentioned Bid.

2. Name of the Bid:

Rehabilitation of Yasser Arafat Square in the city center.

3. Subject of Bid:

The Bid consists of the rehabilitation of Yasser Arafat Square roads; The Square is located in a busy area in the city center. This project work is to be executed according to the general specification of Roads, and the attached specifications and conditions. The bid works mainly contains milling and overlay of Existing asphalt, in addition to the rehabilitation of roads/medians/sidewalks where required according to drawings so as to regulate the traffic flow smoothly and safely. Further details concerning the subject of the bid are provided in the Bid documents.



4. Eligible Bidders:

The Bid is open for Palestinian Contractors who are qualified and classified as **Road** by the *National Committee for Contractors' Classification*. (*Certificate of Classification* to be presented upon the purchase of the Bid documents). The Bid is also open for **Indian companies registered in Palestine or Indian contractor** enter into a consortium, Joint Venture or other form of legally binding association with a Palestinian contractor. Bidders must meet the post qualifications requirements (criteria) stipulated section II: ITB-Eligible bidders, in order to ensure his financial and technical capability to execute project works.

5. Bid Document:

A complete set of Bidding Documents in English may be purchased by interested bidders upon a cash payment of a nonrefundable fee **100US\$**. The Bidding Documents will be available **at Citizen Service Center (CSC) - Ramallah Municipality**.

6. The price quoted will be exclusive of VAT

7. Site Visit and Pre-Bid Meeting:

Contractors are invited to attend the site visit, which will be held **on 29/03/2021 at 10:00AM**, the pre-bid meeting shall be held at **Ramallah Municipality, meeting Hall**.

8. Place and Date of Bid Submission:

Bids must be delivered to the address shown below on or before **07/04/2021 at 12:00 noon**. Electronic Bidding **will not** be permitted. Late Bids will be rejected. Bids will be publicly opened in the presence of the Bidders' designated representatives and anyone who chooses to attend at this address: **Ramallah Municipality, Municipality hall**.

9. Validity of Bids:

The quoted prices will be in US\$ and exclusive of VAT. Bids shall be valid for a period of **120 days** from the deadline for submission of bids and must be accompanied by a Bid Security of **2,000US\$ valid for 148 days after bid closing date**.

10. Attached Forms and Construction Programs:

In a separate letter accompanying their bid, Bidders shall submit the forms enclosed in this Volume under Section V. Failure to provide the required documents or the duly completed forms might be sufficient ground to disqualify and reject the bid.

11. Newspaper advertising fees:

The fees of the newspaper advertising is to be paid by the contractor who has been awarded the bid.

Section II - Instructions to Bidders

A. General

- 1. Scope of Bid**
- 1.1** The Employer, as defined in *Section III: Appendix to Bid* hereunder, invites bidders for the construction of the works as described in these Bid Documents. The name and identification number of the Contract is provided in the Invitation to Bid.
- 1.2** The successful Bidder will be expected to complete the Works within the Time for Completion as specified in the *Appendix to Bid*.
- 2. Eligible Bidders**
- 2.1** Bidders may submit bids if none of the following reasons for exclusion apply:
- Participation of a bidder is ruled out by sanctions issued by the Borrower country laws;
 - The bidder is or was involved as a consultant in the preparation or implementation of the project.
 - The same applies to an enterprise or an individual that is closely connected to the bidder under a company group or a similar business link, or to several enterprises or individuals associated correspondingly.
 - The bidder is legally barred from the procurement process in the Palestinian Territories on the grounds of previous violations of regulations on fraud and corruption.
 - The bidder or sub-contractors to be contracted for considerable portions of the contract are enterprises economically intertwined with the contracting agency in the host country and/or state controlled enterprises that are not legally or financially independent.
- 2.2** In accordance with the paragraph (2.1) above, the bid is open for Palestinian Contractors who are qualified and classified as **Road sector-** by the *National Committee for Contractor's Classification*. (*Certificate of Classification* to be presented upon the purchase of the Bid Documents) and the Bid is also open for **Indian companies registered in Palestine or Indian contractor** enter into a consortium, Joint Venture or other form of legally binding association with a Palestinian contractor. Bidders must meet the post qualifications requirements (criteria) referred to under **Para. 2.3** below.
- 2.3** The post qualification criteria includes the assessment of the technical, financial and administrative capacity, past implementation experience and the register of judicial disputes relating to work on a successful/failed basis and according to the criteria of qualification and evaluation set out below, which include the main following issues: **All supporting document should be attached and must be filled according to section V” Annexes –Information about the bidder”.**
- 2.3.1** Company General information and related experience which includes:
- Legal address in Palestine and company’s legal supporting certificates “certificate of classification, craft certificate-رخصة مهنة, company registration certificate.
 - The number of similar projects executed over the past 5 years shall not be less than 3. “Execution certificates,-shows the project name, client, description of project and year on execution, the financial value of the executed work-, should be attached”.
 - Ongoing projects for the company.

2.3.2 Evidence of financial resources should include the following audited documents, -from the external Auditor of the company- for at least two previous years. Moreover, **the firm's minimum average annual turnover should not less than 100,000 US\$,-** calculated as total certified payments received for contracts in progress and/or completed within the last 3years, divided by 3 years-, shown as certificates of achievement or certified payments for road projects.

- **Balance sheet.**
- **Income statement.**
- **Cash flow.**
- **With the exception of the previous two years, a recent commitment certificate from a licensed bank to provide unconditional banking facilities for the tender with 20% of the contract value and for the actual project duration.**

2.3.3 Technical capacity includes:

- The name of the qualified technical staff assigned for the execution of project work as shown in Volume II, part III: additional requirement, item 2.
- List of the major equipment and tools available at the company and required for the execution of work.
- Method statement and project work plan with required resources during the execution period of project work.
- Any judicial disputes in courts and the contractor is part of it" showing the other part, reason for dispute, financial value of dispute, etc"

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| 3. One Bid per Bidder | 3.1 Each Bidder shall submit only one bid, either individually or as a partner in a joint venture for this specific project. A Bidder who submits or participates in more than one Bid will cause all the proposals with the Bidder's participation to be disqualified. |
| 4. Cost of Bidding | 4.1 The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible or liable for these costs. |
| 5. Site Visit | 5.1 The Bidder, at the Bidder's own responsibility and risk, shall visit and examine the Site of Works and its surroundings and become acquainted with it and shall obtain, upon his own responsibility and at his own expense, all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.
5.2 The Bidder shall be deemed to have understood the nature of the works and the circumstances pertaining to the project, as well as all local customs, the required type of labor and labor conditions, and all other conditions related to this Bid or which affect his Bid prices.
5.3 The Bidder shall acquaint himself with the conditions of: <ul style="list-style-type: none">a) Existing access roads or other means of communication and access to the site of works, including police regulations concerned therewith.b) Available land for storage.c) Available connections to electricity and water for construction, & the soil and subsoil to be excavated, stored or removed.d) The availability of local labor at the site / location; local materials and other local resources shall also be considered. |

B. Bid Documents

- 6. Content of Bid Documents** 6.1 The set of Bid documents comprises the documents listed in the table below and addenda issued in accordance with **Para. 7** below and any other documents that may be issued by the employer prior to the submission of the bid:

Volume I:	I. Invitation to Bid. II. Instructions to Bidders (including the advertisement for Invitation to Bid). III. Appendix to Bid IV. Letter of Bid V. Annexes (Forms of Bid 1 – 13; 14 – 21) VI. “ <i>Target Contract</i> ” Labor Contents
Volume II	Part I: General Conditions of Contract (FIDIC 1999) Part II: Particular Conditions of Contract Part III: Additional Requirements
Volume III	Technical Specifications
Volume IV	Bills of Quantities
Volume V	Drawings

- 6.2 Contractors who are invited by the advertisement for this Bid and wish to participate in bidding may obtain a copy of the Bid Documents distributed as mentioned in the *Invitation to Bid* upon payment of the price quoted for the said documents.
- 6.3 If, in the Bidder’s opinion, the Bid documents contain ambiguities, which might influence the calculation of the prices, the Bidder shall indicate this to the Employer in the pre-bid meeting referred to under **Para. 7** of the *Invitation to Bid*. Necessary clarification will be made by Circular Letter(s) to be sent by the Employer to all Bidders.
- 7. Amendment of Bid documents** 7.1 Before the deadline for submission of Bids, the Employer may modify the Bid documents by issuing Addenda.
- 7.2 Any addendum thus issued shall be part of the Bid documents and shall be communicated in writing by facsimile to all purchasers of the Bid documents. Prospective Bidders shall acknowledge receipt of each addendum by facsimile to the Employer.

C. Preparation of Bids

- 8. Language of Bid** 8.1 All documents relating to the Bid shall be in the language specified in the **Particular Conditions**.
- 9. Documents Comprising the Bid** 9.1 The Bid submitted by the Bidder shall comprise the following and as described under **Para. 2.2-2.3 above**:
- (a) The Bid;
 - (b) Bid Security;
 - (c) Priced Bill of Quantities;
 - (d) Minutes of the pre-bid meeting and related required documents.
 - (e) Qualification Information Forms and Documents to be completed. Failure to complete any of these forms will be sufficient grounds to reject the Bid.

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- (f) Evidence of financial resources.
 - (g) Any other materials that may be required for completing and submitting the Bid and as specified in the *Particular Conditions* and *Additional Requirements*.

10. Bid Prices

- 10.1 The Contract shall be for the whole Works, as described under **Para. 1.1** above, based on the priced Bills of Quantities to be submitted by the Bidder.
- 10.2 The Bidder shall fill in rates and prices for all items of the Works described in the Bills of Quantities. Items for which no rate or price is entered by the Bidder and/or unit rate or total is written unclearly and this form ambitious in computing the total prices of the Bid, the following actions will be taken:
 - A. The highest price entered by the other participated bidders will be applied so as to obtain the total price of the bid.
 - B. If the bid offer **to which item A** above is applied remains the lowest bid offer, and the bid is to be awarded to him, the lowest price entered from the other participated bidder will be applied so as to determine the total value of the bid to be awarded.
- 10.3 The prices quoted by the Bidder against the items in the Bills of Quantities shall cover all his obligations under the Contract and all matters and things necessary for the proper execution & maintenance of the Works, including profits, duties, taxes, and other levies payable by the Contractor under the Contract, the law, or for any other cause. However, the prices quoted will be **exclusive of VAT**.

11. Currencies of Bid & Payment

- 11.1 The unit rates and prices shall be quoted by the Bidder entirely in **Dollar “US\$”**.

12. Bid Validity

- 12.1 The submitted bid shall be considered binding on the Bidder, and shall not be withdrawn after its submission, and shall remain binding for a period of **(120) days** from submission, unless a longer period is specified in the Invitation to Bid.
- 12.2 In exceptional circumstances, the Employer may request that the Bidders extend the period of validity for a specified additional period. The request and the Bidders' responses shall be made in writing. A Bidder may refuse the request without forfeiting the Bid Security. A Bidder agreeing to the request will not be required or permitted to otherwise modify the Bid, but will be required to extend the validity of Bid Security for the period of the extension, and in compliance with **Para. 16** (below) in all respects.

13. Prohibited Agreements

- 13.1 Agreements restricting competition are not permitted, specially arrangements and negotiations with other Bidders in respect of:
 - submitting or not submitting a bid
 - the prices to be demanded and profit rates
 - binding arrangements for other compensation
 - processing cost margins and other price components
 - terms of payment and delivery and other conditions of contract

		insofar as they influence the prices directly or indirectly.
		- Indemnity or compensation payments for non-participation or limited participation in the competition.
		- Profit-sharing.
14. Sub-Contractors	14.1	If parts of the Works are intended to be executed by subcontractor(s), the Bidder shall indicate nature and scope of such parts of the works and state name and address of the subcontractor(s) considered.
15. Joint Venture	15.1	Bids submitted by Joint Ventures or other Bidding Combinations shall be accepted only if the following information is provided with the Bid.
		(a) A list of the members of the Joint Venture / Bidding Combination designating the duly authorized representative(s).
		(b) A declaration, signed by duly authorized representatives of all members, stating that the duly authorized representatives shall represent the members specified in the list in a legally binding manner vis-à-vis the Employer, and that all members are jointly and severally liable for the performance of the Contract with the Employer.
16. Bid Security	16.1	The Bidder shall furnish, as part of the Bid, a <u>Bid Security</u> in the amount specified in the <i>Invitation to Bid</i> .
	16.2	The Bid Security shall be in the form of a bank guarantee issued by a reputable bank located in the country of the Employer. The format of the Bid Security should be in accordance with the form of Bid Security included in this document (Section V) or another form acceptable to the Employer. Bid Security shall be valid for 28 days beyond the validity of the Bid or any other period as specified in the Invitation to Bid. The Bid Security provided in currencies other than the one specified in the Invitation to Bid(ITB) shall be converted to the currency specified in the (ITB)using the exchange rates of the Palestinian Monetary Authority at the bid submission deadline date.
	16.3	The Employer shall reject any Bid not accompanied by an acceptable Bid Security.
	16.4	The Bid Security of unsuccessful Bidders will be returned upon the end of the Bid validity period specified in Para. 12.1 (above), or upon signing the Contract with the successful Bidder.
	16.5	The Bid Security of the successful Bidder will be discharged when the Bidder has signed the Agreement and furnished the required Performance Security.
	16.6	The Bid Security may be forfeited
		(a) if the Bidder withdraws the Bid after Bid opening during the period of Bid validity;
		(b) If the Bidder does not accept the correction of the Bid price, pursuant to Para. 26 (below); or
		(c) in the case of a successful Bidder, if the Bidder fails within the specified time limit to
		(i) Sign the Agreement; or
		(ii) Furnish the required Performance Security.

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| 17. Format and Signing of Bid | 17.1 The Bidder shall prepare one original of the documents, comprising the Bid as described in Para. 6 of the <i>Instructions to Bid</i> , bound with the volume containing the Form of Bid. |
| | 17.2 The Bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder, as the case may be. All pages of the Bid shall be signed. Where entries or amendments have been made these shall be initialed by the persons signing the Bid. |
| | 17.3 The Bid shall contain no alterations or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the Bidder, in which case such corrections shall be initialed by the persons signing the Bid. |

D. Submission of Bids

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| 18. Sealing and Marking of Bids | 18.1 The Bidder shall seal the Bid in one inner envelope and one outer envelope. |
| | 18.2 The inner and outer envelopes shall, <ul style="list-style-type: none">(a) Be addressed to the Employer at the address provided in the Bid documents;(b) Bear the name and identification number of the Contract as defined in the Bid documents and <i>Appendix to Bid</i>;(c) Provide a warning not to open before the specified time and date for Bid opening as defined in the Bid documents. |
| | 18.3 In addition to the identification required, the inner envelopes shall indicate the name and address of the Bidder to enable the Bid to be returned unopened in case it is declared late, pursuant to Para.20 . |
| | 18.4 If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the Bid. |
| 19. Deadline for Submission of Bids | 19.1 Bids shall be delivered to the Employer at the address specified in the Bid documents no later than the time and date specified in the Invitation to Bid. The Bidder shall deposit his bid in the Bid Box at the above mentioned address. |
| | 19.2 The Employer may extend the deadline for submission of Bids - in which case all rights and obligations of the Employer and the Bidders previously subject to the original deadline will then be subject to the new deadline. |
| 20. Late Bids | 20.1 Any Bid received by the Employer after the deadline prescribed in Para. 19 (below) will be returned unopened to the Bidder. |
| 21. Modification and Withdrawal of Bids | 21.1 Bidders may modify or withdraw their Bids by giving notice in writing before the deadline prescribed in Para. 19 . |
| | 21.2 Each Bidder's modification or withdrawal notice shall be prepared, sealed, marked, and delivered in accordance with Paras. 17&18 , with the outer and inner envelopes additionally marked "Modification" or "Withdrawal," as appropriate. |
| | 21.3 No Bid may be modified after the deadline for submission of Bids. |
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- 21.4 Withdrawal of a Bid between the deadline for submission of Bids and the expiration of the period of Bid validity specified in the Bid documents or as extended pursuant to **Para.12.2** will result in the forfeiture of the Bid Security pursuant to **Para. 16**.
- 21.5 Bidders may only offer discounts to or otherwise modify the prices of their Bids by submitting Bid modifications in accordance with this Para., or included in the original Bid submission.

E. Bid Opening and Evaluation

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| 22. Bid Opening | 22.1 The Employer will open the Bids, including modifications made pursuant to Para. 21 , in the presence of the Bidders' representatives who choose to attend at the time and in the place specified in the Bid documents. |
| | 22.2 Envelopes marked "Withdrawal" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Para. 21 shall not be opened. |
| | 22.3 The Bidders' names, the Bid prices, the total amount of each Bid and of any alternative Bid (if alternatives have been requested or permitted), any discounts, Bid modifications and withdrawals, the presence or absence of Bid Security, and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening. |
| | 22.4 The Employer will prepare minutes of Bid opening, including the information disclosed to those present in accordance to Para. 22.3 . |
| 23. Process to Be Confidential | 23.1 Information relating to the examination, clarification, evaluation, and comparison of Bids and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any effort by a Bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of his Bid. |
| 24. Clarification of Bids | 24.1 To assist in the examination, evaluation, and comparison of Bids, the Employer may, at the Employer's discretion, ask any Bidder for clarification of the Bidder's Bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by facsimile, but no change in the price or substance of the Bid shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Bids in accordance with Para. 26. |
| 25. Examination of Bids and Determination of Responsiveness | 25.1 Prior to the detailed evaluation of Bids, the Employer will determine whether each Bid:
(a) Meets the eligibility criteria defined in Para. 2;
(b) has been properly signed;
(c) is accompanied by the required securities; and
(d) is substantially responsive to bid documents requirements |

	25.2	A substantially responsive Bid is one, which conforms to all the terms, conditions, and specifications of the Bid documents, without deviation or reservation.
	25.3	If a Bid is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.
26. Correction of Errors	26.1	Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows: (a) Where there is a discrepancy between the amounts in figures and in words, the amount in words will govern; (b) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern. (c) Should there be any error in mathematical operations, then the sums shall be corrected and the corrected Bid sum shall be binding to the Bidder.
	26.2	The amount stated in the Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, with the concurrence of the Bidder, shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount, the bid will be rejected and the Bid Security will be forfeited.
27. Evaluation and Comparison of Bids	27.1	The Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with Para. 25.
	27.2	In evaluating the Bids, the Employer will determine for each Bid the evaluated Bid price by adjusting the Bid price as follows: (a) Making any correction for errors pursuant to Para. 26; (b) Excluding provisional sums and the provision, if any, for contingencies in the Bill of Quantities, but including Day work where priced competitively; (c) Making appropriate adjustments to reflect discounts or other price modifications offered in accordance with Sub-Para. 21.5.
	27.3	The following Bids shall be excluded: (a) Bids received after opening date and time. (b) Bids submitted by Bidders who have entered into an agreement, which constitutes a prohibited restriction of competition. (c) Bids not enclosing a duly completed signed and stamped Bid Security.
	27.4	In selecting the Bids to be considered for the award of contract, only those Bidders who offer the necessary security for the performance of the contractual obligations will be taken into account. This shall entail the necessary expertise and experience, performance capacity and capability, the reliability as well as technical and financial means and resources.
	27.5	Bids, of which the prices are obviously disproportionate to the Works concerned, will be disregarded. Only such Bids from which

proper execution and covering of the defects liability period can be expected with due regard to rational and thrifty construction operations and efficient management will be considered. From those Bids the award will be made to the one which appears to be the most acceptable with regard to all technical, functional, environmental, and economical aspects.

- 27.6** Any arithmetical error by the Bidder in pricing the Bill of Quantities or in the additions or in carrying forward subtotals to the summary or to the Bid shall be corrected during the evaluation of the Bids. In such cases the Bid sum shall be adjusted accordingly and the Bidder shall be informed. It shall be assumed that the unit price rates entered in the Bill of Quantities are correct.
- 27.7** Proposals for modifications and additional offers which the Employer has admitted or requested for the bidding action shall be evaluated in the same way as the base bid. Other proposals for modifications and additional offers may be considered.
- 27.8** The Employer does neither bind himself to accept the lowest Bid or any Bid, nor will he be responsible or pay for expenses or losses which may be incurred by any Bidder with the preparation of his Bid.
- 27.9** The Employer reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors, which are in excess of the requirements of the Bid documents or otherwise result in unsolicited benefits for the Employer will not be taken into account in Bid evaluation.

28. Standstill Period

- 28.1** The Contract shall be awarded not earlier than the expiry of the Standstill Period. The duration of the Standstill Period is **5 working days**. Where only one Bid is submitted, the Standstill Period shall not apply.

29. Notice of Intention to Award

- 29.1** When a Standstill Period applies, it shall commence when the Employer has transmitted to each Bidder the Notification of Intention to Award the Contract to the successful Bidder. The Notification of Intention to Award shall contain, at a minimum, the following information:
- (a) The name and address of the Bidder submitting the successful Bid;
 - (b) The Contract price of the successful Bid;
 - (c) The names of all Bidders who submitted Bids, and their Bid prices as readout, and as evaluated;
 - (d) The expiry date of the Standstill Period;
 - (e) Instructions on how to request a debriefing and/or submit a complaint during the standstill period.

F. Award of Contract

30. Award Criteria

- 30.1** The Employer will award the Contract to the Bidder whose Bid has been determined to be substantially responsive to the Bid documents and who has provided the best evaluated offer.
- 30.2** Up to 2 contracts (simultaneously) may be awarded to a single contractor, provided his operational and financial situation has been assessed and was found to be adequate.

31. Employer's Right to accept any Bid and to reject any or all Bids	31.1 The Employer reserves the right to accept or reject any Bid, and to cancel the Bidding process and reject all Bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for the Employer's action.
32. Notification of Award and Signing of Agreement	32.1 The Bidder whose Bid has been accepted will be notified of the award by the Employer prior to expiration of the Bid validity period by facsimile confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "<i>Letter of Acceptance</i>") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "<i>Contract Price</i>") and place of signing the Agreement. 32.2 The notification of award will constitute the formation of the Contract, subject to the Bidder furnishing the Performance Security in accordance with Para. 31 and signing the Agreement in accordance with Sub-Para. 30.3. 32.3 The Agreement will incorporate all agreements between the Employer and the successful Bidder. The successful Bidder shall sign the Agreement within 14 days following the notification of award a long with the letter of acceptance. 32.4 Upon the furnishing by the successful Bidder of the Performance Security, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful.
33. Performance Security	33.1 Upon signing the contract after receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance Security in the amount stipulated in the Appendix to Bid and in the form of Bank Guarantee as per the enclosed form drawn on an approved registered bank in Palestine. Failure of the successful Bidder to comply with the requirements of Sub-Para's 30.3 and 28.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Bid Security without resort to the Court, and the Bidder shall have no right to claim for the said Bid Security or any compensation thereof.
34. Bribery and Corruption	34.1 Bid, offer being rejected and the contract being cancelled in case any illegal or corrupt practices have been connected with the award or execution of the contract. 34.2 No offer, gift, payment or benefit of any kind, which could or would be construed as an illegal or corrupt practice, shall be accepted, either directly or indirectly, as an inducement or reward for the award or execution of the procurement contracts. Any such practices will be grounds for cancellation of this agreement and or the procurement contract concerned.

Section III: APPENDIX TO BID

Project: Rehabilitation of Yasser Arafat Square in the city center

Bid No: RM/59/2018

No.	Item	Sub – Para.	Data
1	The Donor	IT	Government of India and Ramallah Municipality.
2	The Employer's Name: Address:	1/1/2/2 and 1/3	Ramallah Municipality – Ramallah.
3	The Engineer's Name: Address:	1/1/2/4	Eng. Osama Misleh Ramallah Municipality.
4.	The Contractor's Name: Address:	1/1/2/3 and 1/3	
5.	Bid Security	IT	2,000 US\$.
6.	Defects Liability Warranty	IT	(5%) of the value of the actual Completed works.
7.	Time for Completion of the Works	1.1.3.3	14 calendar days from Commencement Date.
8.	Defects Liability Period	1.1.3.7	(365) days.
9.	Governing Law	1.4	Palestinian State or those prevailing in the Palestinian Territories.
10.	Ruling language	1.4	English.
11.	Language for communications	1.4	English.
12.	Time for access to the Site	2.1	(7) days after Commencement Date
13.	Amount of Performance Security	4.2	(10%) of the Accepted Contract Amount.
14.	Normal working hours	6.5	6:00AM-9:00PM and according to the approved work plan "which may include night working hours".
15.	Time for Commencement of Works after Commencement Date	8.1	(14) Days , this period is considered included in the Time for Completion.
16.	Amount of Liquidated damages	8.7 and 14.15b	(0.05 * contract value/ Time for Completion of the Works) per day.
17.	Maximum Amount of Liquidated damages.	8.7	(10%) of the Accepted Contract Amount.

No.	Item	Sub – Para.	Data
18	Taking Over of the Works	10.1	(28) days after the elapse of the period granted to the committee for the inspection of the works.
19.	Total advance payment	14.2	(25%) of the accepted contract price upon formal commencement of work on site.
20.	Percentage of retention	14.3	(10%) of the Interim Payment Amount.
21.	Limit of Retention Money	14.3	(10%) of the Accepted Contract Amount.
22.	Minimum Amount of Interim Payment Certificate	14.6	(25%) of the accepted contract price upon execution and acceptance of 60% of the works. (50%) of the accepted contract price upon initial taking over of the project work.
23.	Legal interest rate (Financing Charges)	14.8	(9%) yearly.
24.	Currencies of payment	14.15	Dollar “US\$”.
25.	Periods for submission of insurance	18.1	Before commencement order
26.	Amount of insurance for Works and Contractor's Equipment	18.2	(115%) of the Accepted Contract Amount
27.	Minimum amount of Third Party insurance	18.3	(150,000) USD for each accident and without determining the No. of accidents.
28.	Amount of insurance for Contractor's Staff	18.4	(15%) of the Accepted Contract Amount.
29.	The DAB members shall be	20.2	(1) Member.
30.	Date by which the DAB shall be appointed	20.2	(28) days after Commencement date.
31.	The appointing society of DAB	20.3	Engineering Association / Jerusalem Center
32.	Arbitration procedural rules	20.6	According to the Palestinian Arbitration law.
33.	The Arbitration members shall be	20.6	(1) Member.
34.	Arbitration fees	20	Paid Equally by the Employer and Contractor.

Section IV: LETTER OF BID

LETTER OF BID

Name of Bid:

Bid No:.....

To:

Ramallah Municipality

Ramallah

We have visited the project locations and have acquainted ourselves with its conditions and the surrounding environment. We have examined the Conditions of Contract, Specifications, Drawings, Bill of Quantities, Appendix to Bid, additional requirements, the other Schedules and Addenda Nos.----- for the execution of the above-named Works.

We, the undersigned, offer to execute, complete, hand-over and remedy any defects therein in conformity with this Bid which includes all the above-mentioned documents, for a total sum ----- of or such other sum as may be determined in accordance with the *Conditions of Contract*.

We accept, if necessary, the appointment of the *Dispute Adjudication Board* in accordance to 'Chapter Twenty' of the *Conditions of Contract* and we shall reach an agreement on assigning its members according to *Section III: Appendix to Bid*.

We agree to abide by this Bid for a period of (.....) days, starting from the Bids' submission date and it shall remain binding upon. We acknowledge that the *Appendix to Bid* forms part of this *Letter of Bid*.

If this offer is accepted, we will provide the specified *Performance Security* in accordance with Clause (4/2) of the *Conditions of Contract*, commence the Works at the Commencement Date, and complete the Works, hand it over and remedy any defects therein in conformity with requirements of the Bid documents within the Time for Completion.

Unless and until a formal Agreement is prepared and executed, this "*Letter of Bid*" together with the "*Letter of Acceptance or Decision of Award*" shall constitute a binding contract between us.

We also understand that you are not bound to accept the lowest or any bid you may receive.

This offer is edited on day ----- month ----- year-----

Bidder's signature: -----

Witness: -----

Bidders name: -----

Name of Witness: -----

Section V: ANNEXES

Forms of Bid

Form (1)	Letter of Acceptance
Form (2)	Bid Security
Form (3)	Contract Agreement
Form (7)	Performance Security
Form (8)	Defects Liability Security
Form (9)	Advance Payment Security
Form (10)	Discharge of Payment at Completion (at the Taking Over)
Form (11)	Discharge Statement

Information about the Bidder and his Bid

Form (13)	Works of Similar Nature and Volume
Form (15)	Major Items of Contractor's Equipment
Form (16)	Key Personnel
Form (18)	Works under Way (Ongoing Works)
Form (19)	General Information about the Bidder
Form (20)	Standard Curriculum Vitae
Form (21)	work plan.

Form (1): Letter of Acceptance

[On letterhead paper of the Employer]

[Date].....

To:.....**[name and address of the Contractor]**

Subject:..... **[Notification of Award Contract No.]**

This is to notify you that your Bid dated **[insert date]** for execution of the

.....

[insert name of the contract and identification number, as given in the Appendix to Bid]

for the Accepted Contract Amount of the equivalent of

.....

[insert amount in numbers and words and name of currency], as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by our Agency.

You are requested to furnish the Performance Security within 14 days in accordance with the *Conditions of Contract*, using for that purpose the *Performance Security Form* included in *Section IX: Contract Forms* of the Bidding Document.

Authorized Signature:

Name and Title of Signatory:

Name of Agency:

Attachment: Contract Agreement

Form (2) : Bid Security

Address of guarantor bank:

.....
.....
.....

Address of beneficiary (Ramallah Municipality):

.....
.....
.....

We, the undersigned..... (Guarantor), in order to enable.....to bid for (Project, object of contract), hereby irrevocable and independently guarantee to pay to you an amount up to a total of, waiving all objections and defenses.

We shall effect payments under this guarantee on your first written demand, which must be accompanied by your confirmation that you have accepted the above-mentioned bid and that the firm is no longer prepared to abide by its bid.

This security shall expire not later than by this date we must have received any claims for payment by letter or encoded telecommunication.

It is understood that you will return to us this security on expiry or after payment of the total amount to be claimed hereunder.

This security is governed by the laws of the Palestine State.

.....
Place, date

.....
Guarantor

Form (3) : Contract Agreement

Project Name:

Bid No.:

This Agreement made the day of the (month) (year)

Between

The Employeras the First Party

And

The Contractor as the Second Party

Whereas the Employer desires that the Works known as should be executed by the Contractor,..... and he has accepted the Bid submitted by the Contractor for the execution and completion of these Works and remedying of any defects there in and to hand it over in accordance with the Conditions of Contract.

The two Parties agree as follows:

1. In this Agreement words and expressions shall have the same meanings as respectively assigned to them in the *Conditions of the Contract* hereafter referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement:
 - a. The Letter of Acceptance
 - b. The Letter of Bid
 - c. The Addenda nos
 - d. The *Conditions of Contract* (Particular and General)
 - e. The Specifications
 - f. The Drawings
 - g. The Priced schedules (Bills of Quantities and other Schedules)
3. The Accepted Contract Amount:
Time for Completion:
Note: The municipality due fees registered on the contractor will be deducted from the due payments of the projects.
4. In consideration of the payments to be made by the Employer to the Contractor as per the *Conditions of Contract*, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein and to hand it over in conformity with the provisions of the Contract.
5. The Employer hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price at the times and in the manner prescribed by the Contract.

In Witness whereof the Parties hereto have caused this Agreement to be executed the day and year first before written in accordance with laws in force.

The Second Party (the Contractor)	The First Party (the Employer)
Signature:	Signature:
Name:	Name:
Occupation:	Occupation:
Witnessed by:	Witnessed by:

Form (7) : Performance Security

Address of guarantor bank:

.....
.....
.....

Address of beneficiary (Ramallah Municipality):

.....
.....
.....

To Messrs.' (The Employer).....

We are pleased to inform you that our Bank:
has agreed to give a Financial Guarantee to the Contractor.....

In pursuance of Bid No..... related to the Project:.....
for An amount of: (US\$)

As a security for the execution of the Bid awarded to him in accordance with the Conditions listed in the Contract Agreement Documents.

We undertake to pay you right after receiving your first written demand the said amount or any part you demand notwithstanding any reservation or stipulation, provided that you mention the reasons for this demand that Contractor refused or failed to execute any of his duties in accordance to the Contract without any consideration to any objection or prosecution from the Contractor on the payment.

This guarantee shall remain valid from the date of its issuance until Taking-Over the completed Works in accordance with the Contract, which is initially to be on theday of the month of of the year of..... unless extended or renewed upon the Employer's request.

This Security is governed by the laws of the Palestine State.

Guarantor's signature / Bank:

Authorized to sign:

Date:

Form (8): Defects Liability Security

Address of guarantor bank:

.....
.....
.....

Address of beneficiary (Ramallah Municipality):

.....
.....
.....

To Messrs.' (The Employer).....

We are pleased to inform you that our Bank:
has agreed to give a Financial Guarantee to the
Contractor.....

In pursuance of Bid No..... related to the
Project:.....

for An amount of: (US\$)

As a security for his commitment to execute all his obligations regarding remedy and
maintenance in accordance with the provisions of the Contract Agreement.

We undertake to pay you right after receiving your first written demand the said amount or any
part you demand, notwithstanding any reservation or stipulation, provided that you mention the
reasons for this demand that the Contractor refused or failed to execute his duties regarding
remedying and maintenance works in accordance with the Contract, without any consideration
to any objection or prosecution by the Contractor on the payment.

This guarantee shall remain valid from the date of issuance until the final Taking-Over of the
Works in accordance with the Contract and the completion of the defects and required
remedies by the Contractor, unless extended or renewed upon the Employer's request.

This Security is governed by the laws of the Palestine State.

Guarantor's signature / Bank:

Authorized to sign:

Date:

Form (9) : Advance Payment Security

Address of guarantor bank:

.....
.....
.....

Address of beneficiary (Ramallah Municipality):

.....
.....
.....

To Messrs.' (The Employer).....

We are pleased to inform you that our Bank:
Guarantees the Contractor.....
for An amount of: (US\$)
Against the Advance Payment Guarantee in pursuance of Bid No. related to
the project: to
guarantee payment by the Contractor of the Advance Payment in accordance with the Bid
Conditions.

We undertake to pay you the above-mentioned amount or the due balance at your first written
demand not withstanding any objection or reservation by the Contractor.

This guarantee shall remain valid from the date of its issuance until repayment of the Advance
Payment installments by the Contractor. The guarantee shall be automatically extended until
the full recovery of the Advance Payment.

Guarantor's signature / Bank:

Authorized to sign:

Date:

Form (10): Discharge of Payment at Completion (at the Taking Over)

I, the undersigned and fixing my seal below
.....

We, the undersigned and fixing our seals below
.....

declare that we have received from an amount of
.....
as a Payment at Completion at the Initial Taking-Over of the Project: -
.....; Bid number RM/59/2018.

Now therefore we hereby discharge
and the Government of Palestine from the foresaid amount and from all amounts that we
previously received on the account of the above-named Project with our reservation and
undertaking to submit all details of the claims to
within a period of (84) eighty four days from the date of this discharge, supported by the
documentary evidence (this shall not be a statement of trueness of these claims). In the event
that we do not submit these claims within the foresaid duration, we hereby waive our right to
claim, whatever the type and the value of this claim, and we discharge
..... and the Government of Palestine from any
right or relation to the above mentioned Project prior to *Initial Taking Over* of the project.

Issued on:

Contractor's name:

Name of authorized person to sign:

Signature of authorized person to sign:

Seal:

Form (11): Discharge Statement

I, the undersigned and fixing my seal below

.....

We, the undersigned and fixing our seals below

.....

Declare that we have received from an amount ofas a Final Payment in pursuance of the provisions of the Paras (14/11, 14/12, 14/13) of the *General Conditions of Contract* for construction of the Project
Bid number RM/59/2018.

Now therefore we hereby declare by this statement that we have submitted all our claims regarding this Contract; hence we discharge

.....

and the Government of Palestine from any right or relation to the above-mentioned Project, a general comprehensive, absolute and irrevocable discharge.

Issued on:

Contractor's name:

Name of authorized person to sign:

Signature of authorized person to sign:

Seal:

Form (13): Works of Similar Projects (last five years)

No.	Project name	Name of client and contact person	Type of work performed and year of completion	Final Value of Executed Works (...)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Note: The Bidder shall enter in this Schedule all works he performed as Prime Contractor over the last five years and similar in nature and volume to the Works of the Bid. The value should be indicated in (...).

Form (15): Major Items of Contractor's Equipment

Description(Type, Model, Make)	No. of each	Year of Manufacture	New or Used	Owned (O) or Leased (L)	Estimated Value, (...)

Note: The Bidder shall enter in this Schedule all major items of Contractor's Equipment, which he proposes to bring on Site, both owned and leased (rented).

Form (16): Contractor Key Personnel & Project Staff

Designation	Name of Nominee	Nationality	Summary of Qualifications, Experience and Personnel Occupation
Headquarters			

1. Director			
2. Other Key Staff			
(give designation)			
...			
...			

Project Site Staff

According to Volume: PART III: Additional Requirements- 2.Contractor's Superintendence.

1. Contractor's Representative			
2. Certified Surveyor			
3. Civil Engineers- full time, "Site Engineer" NO.1			
4. Others			

Other Key Staff

Expected Total Number of **Expatriate** Staff to be Employed on Site =

Note: The Bidder shall list in this Schedule the key personnel he will employ at headquarters and on Site, to direct and execute the Works, together with their qualifications, experience, positions held and their nationalities.

**Form (18): Works Underway Committed Works
(Ongoing Works)**

No.	Project name	Name of client and contact person	Date of Commencement	Target Time of Completion	Contract Value @	Value of Remaining works, @	Expected date of completion
-----	--------------	-----------------------------------	----------------------	---------------------------	------------------	-----------------------------	-----------------------------

1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Form (19): General Information about the Bidder

1. Name of company:.....

2. Registered address:

.....

Telephone:

Fax: E-mail:

3. Type of company (natural person, partnership, corporation, or other):

.....

4. Description of company (e.g. Road contractor)

.....

.....

.....

5. Country where Company is based / registered:

.....

7. Number of years' experience as contractor:.....

8. Registration details

.....

.....

Please attach copy of the registration certificate

10. Name(s) and address(es) of companies involved in the project and whether parent / subcontractor / other:

.....

.....

.....

.....

12. Foreign companies must state whether they are established in the Palestinian Territories in accordance with applicable regulations And submit appropriate evidence.

Signature:

Name:

Function:

Company Seal:

Date:

Form (20): Standard Curriculum Vitae

Proposed position in the contract:

1. Surname:
2. Name:
3. Date and place of birth:
4. Nationality:
5. Address (phone/fax/e-mail):
-
-
- Email:

6. Education:

Institutions:	
Date: From (month/year) To (month/year)	
Degree:	

7. Language skills

Indicate on a scale of 1 to 5 (1 – excellent; 5 – basic):

Language	Level	Passive	Spoken	Written
	Mother tongue			

8. Membership of professional bodies:

9. Other skills (e.g. computer literacy, etc.):

10. Present position:.....

11. Years of professional experience:.....

12. Key qualifications:.....

13. Professional experience

Date: from (month/year) to (month/year)	
Place	
Company/organisation	
Position	
Job description	

Signature:

Name:

Function:

Company Seal:

Date:

Form (21): work plan

No.	Main and sub main activities	duration	human resources	Required equipment	² days														notes
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1																			
1.1																			
1.2																			
2																			
2.1																			
2.2																			
3																			
3.1																			

Volume II: Conditions of contract

PART I

GENERAL CONDITIONS

(FIDIC 1999)

INTERNATIONAL FEDERATION OF CONSULTING ENGINEERS
FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS
INTERNATIONALE VEREINIGUNG BERATENDER INGENIEURE
FEDERACION INTERNACIONAL DE INGENIEROS CONSULTORES



PART II: PARTICULAR CONDITIONS JERUSALEM 2006

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PART II : Particular Conditions

1. General Provisions

Clause (1/1/2) - Parties and Persons:

Add to Sub-Clause (1/1/2/2) the following: *"The Employer shall be the First Party in the Contract".*

Add to Sub-Clause (1/1/2/5) Contractor's Representative the following: *"Naming the Contractors Representative shall be in writing."*

Sub-Clause (1/1/2/11)-(Additional):

Government Official: Means any official employee or any person employed by the Employer including persons working in the governmental institutions and companies that the Government has shares in.

Clause (1/1/4) - Money and Payments:

Add the following two Sub-Clauses to the end of this Clause:

Sub-Clause (1/1/4/13) - (Additional) Other Payments:

Means all direct or indirect commissions, consulting fees, agent fees or other, and anything of a value that the Contractor paid or agreed to pay to others. This statement shall include without limitation a detailed description of these other payments and the basis therefore, whether made or to be made directly or indirectly by or on behalf of the Contractor, or by or on behalf of his Subcontractors, or by their employees, agents or representatives in connection with the Invitation to submit Bids for the execution of this Contract or the Bidding/ Auctioning process itself or the award to the Contractor or the negotiations to sign the Contract for its execution.

Sub-clause (1/1/4/14)-(Additional) Prohibited Payments:

Means all moneys whether it is commissions, consulting fees, agent fees or others paid directly or indirectly or anything of a value or promises or commitments to pay such moneys or to give these things either directly or indirectly regardless if this was done by or on behalf of the Contractor, or by or on behalf of his Subcontractors or by any of their employees, agents or representatives who paid to any "Government Official" in connection with the invitation to submit Bids for the execution of this Contract or the Bidding/ Auctioning process itself or the award to the Contractor or the negotiations to sign the Contract for its execution.

Sub- Clause (1/1/6/1) Country

Add the following at the end of the sub-clause: Country: *Palestine*

Sub- Clause (1/1/5/6) Laws

Add the following at the end of the sub-clause: *Means all laws, legislations and regulations of the Palestinian National Authority or those prevailing in the Palestinian Territories.*

Clause (1/2) - Interpretation:

Add the following paragraph to the end of this Clause: *"In all these Conditions of Contract, provisions including the expression "Cost plus reasonable profit" implies that the profit represents 5% of this cost.*

Clause (1/6) - Contract Agreement:

Delete the last paragraph of the main text and replace it by the following paragraph: *"The Contractor shall pay the stamp duties and other similar charges resulting from entry into this Agreement as required by the applicable laws in force."*

Clause (1/8) Care and Supply of Documents

Second paragraph: at the end of the sentence *".....and the documents of the contractor (if any)"* add *"*, including the contractor's plants and types."

2. The Employer

Clause (2/3) - Employer's Personnel:

Add the following paragraph to the end of this Clause: *"If there are other Contractors working on the Site for the Employer, their contracts should include similar provisions for cooperation and commitment to comply with the safety regulations, furthermore, Employer should notify the Contractor about the presence of these other Contactors.*

Clause (2/4) - Employer's Financial Arrangements:

Add the following paragraph to the end of this Clause: *"The Employer financial arrangement to be notified to the Contractor shall be in the form of a letter of commitment to finance the Project during*

the project intended completion period unless otherwise agreed upon between the two parties depending on the Project's conditions; its method of financing and its other special circumstances."

3. The Engineer

Clause (3-1) Engineers Duties and Authority:

For clarity purposes, the following shall be taken into consideration: The Engineer shall exercise the authorities entrusted to him in the Contract, or those implicitly understood from the Contract, provided that he shall obtain the prior approval of the Employer on the following matters:

1. Issuing Variation Orders.
2. Issuing extension of time for completion and applying the liquidated damages provisions.
3. Approving the appointment of Subcontractors.
4. Issuing the order to suspend the Work.

Clause (3/4) Replacement of the Engineer:

Delete the original Clause and replace with the following: "If the Employer intends to replace the Engineer, he shall notify the Contractor not less than (28) days prior to the intended date of replacement. This notice shall also include the name, address and experience of the replacement Engineer. If the Contractor has reasonable objection to the proposed replacement Engineer, he shall notify the Employer within (14) days from the receipt of the Employer's said notice, the objection should be accompanied with the supporting particulars. The Employer shall upon the receipt of such notice and the relevant particulars, make his decision which shall be conclusive and final."

Clause (3/6) (Additional) Administrative Meetings:

"The Engineer or the Contractor's representative may call each other for administrative meetings to discuss Work issues, and in this case the Engineer shall prepare minutes of the meeting and dispense copies to all attendants and the Employer, taking into consideration that the actions required from any party shall be in line with the responsibilities stipulated in the Conditions of the Contract."

4. The Contractor

Clause (4/1) General Obligations of the Contractor:

At the end of Paragraph 'D', add the below paragraph:

The As-Built drawings shall be submitted in four copies (including the original copy) in addition to one soft copy saved on a UBS hard disk of 120GB capacity.

At the end of this clause add paragraph e as follows: (e) *All the documents required under paragraph (a) and (d) above shall be subjected to the approval of the Engineer.*

Clause (4/2) - Performance Security:

Delete the 2nd, 3rd and 4th Paragraphs from the original Clause and replace with the following:

"Unless otherwise stated, the Contractor shall deliver the Performance Security to the Employer within (14) days from the date of receiving the "Letter of Acceptance " and shall send a copy of the Security to the Engineer, otherwise the Contractor shall be considered as withdrawing his Bid and the Employer shall be entitled to forfeit the Bid Guarantee previously submitted by the Contractor.

The Performance Security shall be issued from within a country approved by the Employer and shall be in accordance with the form annexed to Volume I (Example Form of Performance Security Demand Guarantee). If the Performance Security is in the form of a Bank Guarantee, then it shall be issued by a licensed local bank, and any Security issued by a foreign bank shall be endorsed by a licensed local bank.

If the Performance security is not in the form of a Bank Guarantee, then it shall be issued by a financial establishment registered and licensed to work in Palestine and approved by the Employer.

After issuing the Taking-Over Certificate, the Performance Security may be reduced to be 5% of the actual Contract Amount or be replaced by a Defect Liability Security (Defect Liability Guarantee) for 5% of the actual Contract Amount.

The Contractor shall ensure that the Performance Security remains valid in its full value stated in the Appendix to Bid until the Contractor has completed the Works. If the terms of the Performance Security specify an expiry date and it is determined that the Contractor shall not be entitled to receive neither the Taking Over Certificate nor the Performance Certificate by the (28th) day prior to the final date of Security validity, then the Contractor shall extend the validity of the Performance Security until the completion of the Works and/or the remedying of defects as the case may be."

Delete the last paragraph and replace by the following:

The Employer has, within (21)days from the date of issuing the Taking-Over certificate (Completion Certificate) to return the Performance guarantee to the Contractor provided that the latter has furnished the Employer with the Defect Liability Guarantee.

Clause (4/4) - Subcontractors:

Add the following paragraph at the beginning of this Clause: *"The Contractor shall hire local Contractors as Subcontractors".*

At the end of this Clause add the following: *"The maximum limit of subcontracted works is (33%) of the Accepted Contract Amount unless the Subcontractor is nominated in the Contract. The Contractor shall attach to his Bid a statement list indicating the works he intends to subcontract and specifying the percentage of each subcontracted work from the Accepted Contract Amount. During the course of execution, the Contractor shall submit to the Engineer and the Employer's copies of all the Subcontract Agreements."*

The Engineer shall make sure that the above-mentioned percentage is not exceeded and shall report any breach to the Employer.

6. Staff and Labour

Clause (6/1) - Engagement of Staff and Labour:

Add the following paragraph to the end of this Clause:

"The Contractor should respect the laws and regulations related to the engagement of foreign labour, and shall comply with the local laws with respect to their residency and work permits."

Clause (6/5) Working Hours:

Add the following paragraph to the end of this Clause: *"The working days during the week shall be from Saturday thru Thursday and from dawn to dusk."*

Clause (6/8) Contractor's Superintendence:

At the end of this Clause add the following paragraph: *"In order to ensure proper command of the Language for Communication, the percentage of the Contractor's staff with fluent command of this language may be specified or the Contractor shall employ a sufficient number of interpreters."*

Clause (6/9) Contractor's Personnel:

The numbers and qualifications of the Contractor's Project Staff shall be as stated in the Supplementary Particular Conditions.

Clause (6/12) - (Additional):

- A. Pests and Rodents Control:** *The Contractor shall at all times take the necessary precautions to protect all staff and labour working on the Site against Pests and Rodents nuisance and to reduce their danger to health. The Contractor shall provide suitable prophylactics for the Contractor's Personnel and shall comply with the regulations of the local health authorities including the use of appropriate pesticides.*
- B. Drugs and Alcoholic Beverages:** *The Contractor shall not bring to the Site any Drugs or Alcoholic Beverages, nor permit or disregard the use of such by his staff and labour or the Subcontractor's staff and labour at the Site.*
- C. Arms and Ammunition:** *The Contractor shall not bring or use on Site, any arms, ammunition or explosive materials prohibited by the law and shall prevent his labour and employees and the Subcontractors labour and employees from keeping or using such arms and ammunition at Site.*
- D. Religious Rituals and Official Holidays:** *The Contractor shall comply with the official holidays, and respect the customary religious rituals.*

7. Plant, Materials and Workmanship
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Clause (7/2) Samples:

At the end of this Clause add the following paragraph:

"The Engineer shall issue his approval on the contractor's samples within a reasonable time in order not to delay the completion of the works."

Clause (7/4) Testing:

To clarify what is stated in this Clause, the Contractor shall bear the costs of the tests specified in the Contract (including the General and Particular Specifications) during the course of execution and on completion.

8. Commencement, Delays and Suspension

Clause (8/3) – Program of Works:

At the end of this Clause add the following paragraph:

"The Contractor shall submit the revised program of Works within (14) days from the receipt of the Engineer's notice requesting such submission."

Clause (8/7) - Liquidated Damages:

"The amount of Liquidated Damages for each section of the work and the method of its accumulative calculation shall be as stated in the Appendix to Bid or in the Supplementary Particular Conditions."

9. Tests on Completion

Clause (9/1) - Contractor's Obligations:

At the end of this Clause add the following paragraph:

"All tests and inspections shall be carried out by a neutral and impartial laboratory. This laboratory shall be classified by the Engineer's Association and accredited by the Palestinian Standards Institute

Unless otherwise stated, all Costs pertinent to those tests and inspections shall be born by the Contractor.

The testing laboratory shall study, analyze and compare the tests results and inspections with the provisions of the General and Particular Specifications and should show (in tables) the upper and lower limits (if any) for those results according to the Technical Specifications. At the end of the report, the laboratory shall clearly indicate the success or failure of the tests and give his recommendations."

10. Employer's Taking Over

Clause (10/1) - Taking Over of the Works and Sections:

Delete the 3rd paragraph from (*The Engineer shall...*) to the end of the Clause and replace with the following:

- a. *When the whole of the Works or any part of it are completed by the dates specified in the Appendix to Bid and can be used for its intended purpose and determined to have passed the required Tests At Completion as per the Contract, the Contractor may give the Engineer a notice to that effect (with a copy to the Employer) accompanied by an written undertaking to complete any remedies or any outstanding Works as soon as possible during the Defects Notification Period. This said notice and the attached written undertaking shall be deemed to be a request by the Contractor to the Engineer to issue the Taking-Over Certificate.*
- b. *The Engineer shall, within (14) days from receiving the Contractor's notice, inspect the Works and submit a report about his findings to the Employer (with a copy to the Contractor). The Engineer may certify that the Works have been completed and can be Taken-Over or give written instructions to the Contractor specifying the Works required to be completed by the Contractor before Taking-Over the Works and specify the time required to complete the remaining Works and remedy defects in an acceptable manner to the Engineer. If the Contractor deems that the Engineer's report is not accurate, he may notify the Employer, in such a case the Employer shall, within (14) days from the date of the Contractors notice, investigate the situation, in the ways he deems appropriate, to ascertain the findings mentioned in the Engineer's report or decide to form a Taking-Over Committee.*
- c. *The Employer shall, within (14) days from the receipt of the Engineer's report (in which he states that Works have been completed and are in a state ready to be Taken-Over), form a Taking Over Committee (the Engineer shall be one of its members)- provided that its members shall not exceed (7) members. The Contractor shall be notified about the time and date for carrying out the inspection of the Works. In the meantime, the Engineer and the Contractor shall prepare all necessary statement lists, data, schedules and drawings needed to facilitate the work of the Taking-Over Committee.*
- d. *The Taking-Over Committee shall, within (14) days from the date of its formation, conduct, in the presence of the Contractor or his authorized representative, an inspection of the Works and prepare the Taking-Over minutes to be signed by the Taking-Over Committee members and the Contractor or his authorized representative. Copies of which shall be handed over to the Employer, Contractor and the Engineer. If the Taking-Over Committee fails to conduct the inspection of the Works and*

prepare the report within a period not more than (28) days after the elapse of the above-mentioned period, then the Taking-Over date shall be the date specified in the Engineer's report.

- e. The Engineer shall, within (7) days of the date of signing the minutes of Taking Over the Works, issue a Taking-Over Certificate specifying the completion date for the Works pursuant to the Contract. This date is deemed to be the date for commencing the defects remedying period. The Engineer shall attach to the Taking-Over Certificate a list of the uncompleted works and the remedies to be completed by the Contractor within a certain period of time from the commencement of the Defects Notification Period.
- f. The Contractor is entitled to comment or object on the Taking-Over Committee's report provided that he submits such objection in writing to the Engineer within (7) days from signing the Taking-Over report. In such a case, the Engineer shall study this issue and report his recommendations to the Employer.

12. Measurement and Evaluation

Clause (12/3) -Evaluation:

Delete paragraphs (a) and (b) from this Clause and replace by the following:

- a. If the measured quantity for this item is changed by more or less than 25% from the relevant quantity stated in the Bill of Quantities or other priced Schedule and this change in quantity multiplied by the relevant unit rate specified in the Contract exceeds (1%) of the Acceptable Contract Amount and this item is not specified in the Contract as a fixed rate item, or
- b.
 - 1. Instructions has been issued to vary this work in accordance to Clause "13.Variations and Adjustments", and
 - 2. No unit rate or price is specified in the Contract for this item, and.
 - 3. No specific unit rate is appropriate because its nature of work is not similar to any other Contract item, or the work is not executed under similar working conditions.

The new unit rate or price shall be derived from relevant Contract rates, with reasonable adjustments to account for the issues described in paragraphs (a and/ or b) above, whichever is applicable. If no rates or prices are relevant to derive the new unit rate, it shall be derived from reasonable cost of executing the work plus reasonable profit whilst taking into consideration any other relevant issue.

Until an appropriate rate is agreed upon or determined, the Engineer shall determine a provisional unit rate for the purposes of preparing Interim Payment Certificates.

In all cases, the new unit rate shall be applied as follows:

- a. In case of increase, the new rate shall be applied to the quantity which exceeds the quantity stated in the Bill of Quantities, and
- b. In case of decrease, the new rate shall be applied to the quantities remaining from that stated in the Bill of Quantities."

13. Variations and Adjustments

Clause (13/8) - Adjustment for Changes in Cost:

The cost adjustment will be as per the **Decision of the Palestinian Council of Ministries No. (06/46/12/ف.م.و.س.ف.)**.

The following are for clarification:

1- Currencies

- a) In case that bid currency not in NIS, the total bid value will be converted into NIS, with the exchange rate prevailing at the deadline of bid submission date.
- b) The prevailing exchange rate will be according to Palestinian Monetary Authority.

2- Adjustment for Changes in Cost

No compensation for any party will be granted, in case of fluctuations in price index of construction inputs on the date of the payment has increased or decreased with less than 3%, from the price index of construction inputs on the date of bid opening.

Compensation for any party will be granted, in case of fluctuations in price index of construction inputs on the date of the payment has increased or decreased with more than 3%, from the price index of construction inputs on the date of bid opening.

Formula to be used:

$Pr = Pi \frac{Ir}{Io}$	<i>same formula presented differently</i>	$Pr = Pi \times Ir/Io$
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Where:

Pr: reviewed payment to be calculated; Pi: initial payment;
 Ir: price index of construction inputs for the month in which the reviewed prices take effect;
 Io: the initial price index of construction input on the date of opening the bids.
 x: multiplication; /: division The price index for construction inputs is published by the Palestinian Central Bureau of Statistics.
 The price revision is applied on payment of installments.

14. Contract Price and Payments

Clause (14/2) - Advance Payment:

This Clause shall be applied to the Projects in which the Appendix to Bid allows for giving the Contractor an Advance Payment.

Add to the third paragraph *"issued by a financial institution licensed to work in Palestine"*.

Delete the 5th paragraph which starts with *"The Advance Payment shall be repaid"* and ends with *"until such time as the Advance Payment has been repaid"* and replace by the following:

"The Advance Payment shall be repaid by the Contractor as follows: The amount of the Advance Payment shall be repaid in installments of 10 % of the due amount of each Interim Payment Certificate".

Add the following paragraphs to the end of this Clause:

"The second installment of the Advance Payment shall be paid in the amount of 5% of the Accepted Contract Amount within two weeks from the date the Contractor completes supplying the Site with the equipment, plants and materials required to actually start the works and based on a relevant statement from the Engineer".

"If it is proven to the Employer that the Contractor has used the Advance Payment for purposes outside the scope of the Contract, the Employer shall then have the right to immediately forfeit the Advance Payment Guarantee notwithstanding any objection from the part of the Contractor."

Clause (14/7) – Payment to Contractor:

Add to the end of this Clause the following: *"The due payments will be paid in the specified Contract currency and shall be disbursed to Contractor's bank account in Palestine"*.

Clause (14/8) - Delayed Payments:

Delete the 2nd paragraph of this Clause and replace it by the following: *"The financing charges shall be calculated at a percentage of (9%) and shall be adjusted either by increase or decrease in accordance to the modifications enacted on the Civil Procedure Law. The Financing charges shall be paid in the currencies identified for them."*

Clause (14/9) - Payment of Retention Money:

Delete the main text of this Clause and replace it by the following:

"Upon the Employer's consent and when the amount of Retention Money reaches (60%) of its maximum amount specified in the Appendix to Bid, (50%) of the retained money may be paid against a special Guarantee."

If the aforementioned paragraph is applied, the entire amount of the Retention Money shall be disbursed and the special Guarantee shall be returned after Taking-Over the Works and submitting the Defects Liability Guarantee.

Clause (14/10) - Statement on Completion (upon Taking over):

The Contractor shall submit, upon receipt of this payment, a Discharge Statement in accordance to the form attached to Volume I, Form (11) Discharge of Interim Payment at the Taking-Over.

Clause (14/11) - Application for Final Payment Certificate (Final Statement):

Paragraph (b) of the hereinabove mentioned Clause is amended to read as follows:

b- *Any other sums which the Contractor considers himself entitled to under the Contract or those amounts that generate from issues arisen after issuing the Taking-Over Certificate (Initial Taking Over).*

Clause (14/12) -Discharge:

Add the following after the term (Performance Security): *"or Defects Liability Guarantee as the case might be"*

16. Suspension and Termination by Contractor

Clause (16/1) - Contractor's Entitlement to Suspend Work:

To the end of this Clause add the following paragraph:

"The Contractor shall, within (3) days from the date of submitting the Application for Interim Payment Certificate in accordance with Clause (14/3) of the Contract, notify the Employer about the date of submitting the said Application to the Engineer".

17. Risk and Responsibility

Add the following Clauses to the end of the Chapter:

Clause (17/7) - (additional): The Structural Insurance for the Project: *"The Contractor shall be liable for a period of ten years for the Structural Insurance of the Project according to the relevant provisions of the Palestinian Civil Law."*

Clause (17/8) - (additional):

Use of Explosive Materials:

The Contractor shall take all the necessary measures and precautions and comply with the Engineer's instructions, regulations and laws issued by the concerned authority in connection to the use of explosive material; its transportation and storage and any other requirements that may be needed to execute his obligations under this Contract. This applies too to all combustible material or materials whose use, transport and storage is dangerous.

The Contractor shall obtain the necessary permits, make all contacts with the related authorities and sources before starting any explosion work and shall abide by the official instructions given to him in this regard. He shall also inform the Engineer or his representative about his arrangements and procedures for storing and transporting and handling the explosion works. Keeping in mind that such arrangements and procedures shall not relieve the Contractor from any of his responsibilities and commitments according to the laws, regulations and instructions pertinent explosive material.

Clause (17/9) - (additional):

Urgent Repairs: *If as a result of any accident, failure or any other event pertinent to the ongoing work or any part of it either during the execution of the works or during the defect liability period, there becomes (in the opinion of the Engineer) a need for urgent repairs to assure the safety of the works or the public safety and the contractor is unable or not willing to remedy these repairs, then the employer shall have the right to execute these repairs on the contractor's expenses after notifying the contractor in writing about the intended repairs.*

18. Insurance

Clause (18 / 1) - General Requirements for Insurances:

Add the following to the end of this Clause:

- *The Contractor shall be the insuring party, and the insurance policy shall include a provision to identify the liabilities of both the Employer & the Contractor as two separate entities in the insurance policy (Cross liabilities).*
- *The currency of the insurance is that specified in the Contract.*

Clause (18 /2) - Insurance for Works and Contractor's Equipment:

Add the following to the end of this Clause: *"The replacement value and additions to it shall be equal to (115%) of the Accepted Contract Amount."*

20. Claims, Disputes and Arbitration

Clause (20/6) - Arbitration

Delete the first paragraph which starts with (unless settled amicably) and ends with (language for communication defined in Sub-Clause 1 / 4) and replace with the following: *"Unless the dispute is settled amicably", any dispute about the decision of "Dispute Adjudication Board-DAB" which did not yet become final and binding, shall be settled by Arbitration as follows:*

- a. *The dispute shall be finally settled in accordance with the Palestinian Arbitration Law in force (unless otherwise agreed upon between both parties).*
- b. *The arbitration board shall be formed from one or three members appointed in accordance with the law in force and;*
- c. *The arbitration procedures shall be conducted in the language of communication defined in Clause (1/4).*

Article (20/8) - Expiry of Dispute Adjudication Board's Appointment:

Paragraph (b) of this clause is amended to read as follows: b. *"The dispute shall be referred directly to Arbitration pursuant to the provisions of Clause (20/6)".*

PART III: ADDITIONAL REQUIREMENTS

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PART III: Additional Requirements

The following requirement/conditions prevail over relevant similar requirement/conditions wherever mentioned in the Bid Documents:

1. Engineer and Engineer's Representative

- 1.1 The Engineer may exercise the authority specified in or necessarily to be implied from the Contract, provided, however, that the Engineer shall obtain the specific approval of the Employer before taking any of the following actions:
1. approving assignment of any part of the Works;
 2. certifying additional cost determined;
 3. determining any extension of time;
 4. issuing variations;
 5. issuing orders for the suspension of works;
- 1.2 The Engineer has the power to issue instructions related to the control of quality and quantity at any time and to remove from the site any rejected materials.
- 1.3 The Engineer has the power to reject unreasonable claims submitted by the Contractor. Any extra quantities implemented by the Contractor or the Contractor's employee at his own responsibilities and not included in the drawings, the Engineer has the authority to reject and cancel these quantities from the Contractor's payments without any claim by the Contractor.
- 1.4 The Engineer has the power to exercise his duties in accordance with his contract and in all cases the Engineer shall control the project implementation from the start date of the project up to the completion date. The Engineer shall act with transparency and impartially in the acceptance, rejection or evaluation of any act which may affect directly or indirectly the rights of the Employer or the Contractor. It's deemed to be understood that any act may be subject to revision or modification at any time.
In all cases the Engineer cannot change specifications or drawings except where mistakes are found and the Engineer never can relieve the Contractor from any of his contractual obligations and responsibilities.
- 1.5 The Contractor should also provide the following services needed for their operation and maintenance throughout the execution of the project:
1. **The Contractor shall** provide the Site at his own expense with all required services necessary for work as water, electricity etc.
 2. **Measuring and Inspection Devices:** The Contractor shall, at his own expense provide all necessary measuring and inspection devices such as tapes in different lengths, surveying instruments requested by the Engineer. These devices shall be available on-site throughout the Contract and shall be under the control of the Engineer.
 3. **Temporary Project Signs:** The Contractor shall at his own expense install (2) signs at the different sites during construction, which shows the name of the Project, the Employer, and the donor, which will be referred to, as in the following text (Funded by the India representative office), the Engineer, and the Contractor. Materials, size, text and shape shall be to the approval of the Engineer. All of these signs (materials, size, text, covers, etc.) should be approved by The Employer and the donor.
 4. **Final project sign "Plague" to be erected on site according to the donors requirement "material and dimensions to be determined later"**
 5. **Failure of the Contractor to Comply:** If the Contractor fails to provide any of the above-mentioned items, then the Employer will provide at the expense of the Contractor and the cost will be deducted from payments due to the Contractor whatever reaches, plus 25% of whatever it costs as managerial costs. The Contractor is deemed to have allowed for all the above expenses in his Bid Price.

2. Contractor's Superintendence

- A. The Contractor shall assign qualified consultant registered at engineering associations as consultant in roads sector with the full-time staff engineers having adequate experience in similar projects. The minimum staff profile shall be as follows:

Site staff	Minimum qualifications	Years of Experience in similar works
▪ Site Engineer	▪ Civil engineer with relevant professional experience of at least (7) years.	▪ 5 years
▪ Certified Surveyors	▪ Professional experience of at least (5) years	▪ 3 Years

The Contractor shall submit the names and qualifications of the above mentioned staff members in Form (2) Proposed Personnel with the bidder technical offer.

The assignment, as well as future replacement of staff will require the approval of the Engineer and the Employer.

- B. Penalty for the Absence of any of the Superintendents:

The Contractor shall get the approval of the Engineer on the program for provision of his superintendents. If any of the Contractor's superintendents being absent without excuse, then the Employer will deduct the amount of **50US\$** per day, for every superintendent being absent, from due amounts to the Contractor. For absence in part the deduction will be done proportionally.

- C. If the Contractor fails to appoint any of his staff, then the Employer will appoint such staff and deduct their salaries from the payments due to the Contractor. This appointment shall not release the Contractor from any of his obligations and responsibilities and the Contractor shall compensate the Employer for any damage that might be incurred to the Project as a result of the absence of any of the Contractor's superintendents.

3. Materials, Samples and Tests

- All materials shall be certified by the Palestinian Standard Institute (PSI).
- The Engineer will approve an authorized laboratory-testing firm by (PSI) and the assigned firm should be approved by the Employer as it is the owner of the project. Moreover, all samples shall be taken on site by the laboratory staff.
- Material Tests: The Employer will carry out the laboratory tests required for the project and at the expense of the contractor. However, the cost of these tests shall be paid by the Employer, then these dues are to be recovered from the due payments of the contractor, i.e these costs are deducted from the due interim claims to the contractor.
- If and when the Contractor proposes an alternative material suitable for its required use, then he shall notify the Engineer in writing of its specifications, before its import, for approval.
- The Contractor shall within one month from the date of the Order to Commence provide the Employer with detailed information regarding the suppliers of the required materials supported by samples, catalogues, certificates of origin and testing and approval certificates.
- The Engineer has the right to conduct any test, either on the samples or on the delivered materials.
- Laboratory firm shall submit a report contains studies and analysis and evaluation of results and the consequent recommendations in accordance with present specifications.

4. Ownership of Plant and Materials

a) All contractor's Equipment, Temporary Works Plant and materials owned by the Contractor or by any company in which the Contractor has a controlling interest, shall when present on the Site, be deemed to be the property of the Employer.

b) If the Contractor fails to remove equipment, plant, materials or Temporary Works from the Site within a reasonable period after the Completion of the Works or Termination of Contract, in accordance with the instructions of the Engineer, then the Employer may remove either by sale or returning them to their original owners, If hired, at the expense of the contractor, then the settlement of account shall be made with the Contractor, and if any amount is due to him, he shall be paid such sum. However, if the result of such settlement did not cover the cost of removal, then such amounts shall be deducted from payments due to the Contractor.

5. Programme

The Contractor shall take into consideration the Engineer's comments, and amend his programme to a suitable technical standard. The amended Programme shall be submitted within (7) days from the date of receipt of the Engineer's comments.

The Contractor shall submit to the Engineer, for his approval, an updated programme at the end of each calendar month. If the Contractor does not submit an updated programme, the Engineer may retain up to **20%** from the Contractor's payment due for that month.

6. Supply of Employer to Contractor

The Employer shall supply to the Contractor the forms, models and guidelines identifying the required attachments to be submitted by the Contractor with the drawings and documents for approval.

Instructions given by the Engineer shall be in writing, provided that if for any reason the Engineer considers it necessary to give any such instruction orally, the Contractor shall comply with such instruction. Confirmation in writing of such oral instruction given by the Engineer, whether before or after the carrying out of the instruction, shall be deemed to be an instruction within the meaning of this Sub-Clause. Provided further that if the Contractor, within 7 days confirms in writing to the Engineer any oral instruction of the Engineer and such confirmation is not contradicted in writing within 7 days by the Engineer, it shall be deemed to be an instruction of the Engineer.

7. Assistance with Local Regulations

The Employer will not provide any services or assistance to the Contractor in obtaining copies of laws, regulations and information on local customs, orders or bye-laws of the country where the works are located which may affect the Contractor in the execution of his obligations under the contract and they are included within the responsibilities of the Contractor.

8. The Contractor's Obligations

Additional obligations for the Contractor:

1. Prior to the commencement of the levelling and excavation of the site, the contractor must obtain the written approval of the Engineer on the survey plan, site management plan and the shop drawings, longitudinal and cross-sectional sections of the roads with levels, dimensions in addition to calculating the amount of excavation and embankment amounts.
2. **Aadjustment of all service manholes and grills to Asphalt finish level.**
3. All necessary measurements on the site at his own risk and cost.
4. Verify the consistency between drawing and site conditions.
5. Warn the Engineer if he has noticed any present defect or defect to arise in the future due to design and materials prescribed.
6. Liability for any theft that occurs on the site.
7. Provide sufficient number of safety clothes and helmets, as they are obligatory at site.
8. protect his works during the entire period of execution
9. It's not permitted to work during the night unless approved by the Employer and the Contractor should respect the religious and public holidays and weekends.
10. Provide all safety facilities and security measures on site according to specifications and **site management plan approved by the Engineer**, which includes, at a minimum, the following issues. In case the contractor does not perform safety and security measures under the approved site plan before starting the work On site, a fine will be deducted for each preventive measure that has not been performed, and if the delay fines for the project amount reached 5% of the contract value, The Employer is entitled to take the necessary action, including the suspension of work on the site.

Preventive action "includes providing the procedures and keep them on site"	Min. penalty for failure to perform any preventive measure
▪ Provide all traffic warning and regulatory road sign reflective of lights, in addition to directing the traffic flow, lighting flash, reflectors, flagman etc. ▪ Install all warning signals and lights in their proper locations to ensure fixity "i.e not to fall or move as a result of weather or traffic, and always inspect signals at work site"	100US\$/day/warning sign. 100US\$/day/regulatory sign 100US\$/day/flagman 100US\$/day/flash
▪ Wearing reflective clothing (vest, Jacket) on-site and basic personal protective issues such as protective boots and solid hats, for workers on site or for inspector visitors.	100US\$/day/capita
Note: In the event of any violation of any preventive measure found by the supervising engineer, the engineer shall hand over to the contractor or site engineer a notification explaining the preventive measures not implemented on the site under the approved site management plan, and shall execute them within the time limit specified in the notification and up to a maximum of 24hours from the date of notifying. In case the situation is not corrected, a fine will be levied for each non-performing/day preventive measure automatically, and such fines shall be deducted from the contractor's interim claims. It is the responsibility of the contractor to document the actions taken to correct the procedure with images and to send it to the supervising engineer.	

9. Contractor's Drawings

The Contractor shall submit to the Engineer for his approval shop drawings showing the methods and details to be used in the execution of all items of the works.

Within (10) days after commencement the work, the Contractor should prepare and submit to the Engineer the grid topography map of the site existing levels (natural ground levels) for the Engineer's review and recheck directly in site before commencing any mobilisation in order to be signed and documented. All Drawings produced by the Contractor have to be approved by the Engineer.

10. Interference with Traffic

All operations necessary for the execution and completion of the Works and the remedying of any defects therein shall, so far as compliance with the requirements of the Contract permits, be carried on so as not to interfere unnecessarily or improperly with:

- The convenience of the public, or
- The access to, use and occupation of public or private roads and footpaths to or of properties whether in the possession of the Employer or of any other person.

The Contractor shall save harmless and indemnify the Employer in respect of all claims, proceedings, damages, costs, charges and expenses whatsoever arising out of, or in relation to, any such matters insofar as the Contractor is responsible therefore.

11. Demolished/excavated Materials

- All materials and articles shall be the property of the Employer.
- The Contractor shall at his expense, remove all rubble, unsuitable and extra excavations and other demolition materials and debris from site to authorized places approved by the Employer and according to the engineer's direction. If these materials are required by the Employer it must be handled to them properly with complete cooperation.
- Removal of existing trees in the working area and planting them in places designated by the Employer and at his own expense.

12. Discoveries

The Contractor shall not be compensated for any special efforts during excavations carried out on land belonging to the Employer.

14. Patents and Licences

The Contractor shall pay all patents, licenses and royalties.

15. Extension of the Period of Implementation of the Works

The Contractor should notify the Engineer, in written, of each event likely to cause a delay of the works within 7 days of its arisen. Upon receiving the written notification of the Contractor, the Engineer shall assess the impact of the arisen event on the progress of the works and the Contractor shall be, accordingly and based on the Engineer's evaluation, granted an extension of time.

The Employer is not liable for any delay in the work of the contractor caused by other parties, such as service enterprises, "the water company, the electricity company, the telecommunications company, etc.", and the contractor is not entitled to claim any damages as a result of their delay, and the duration of the delay will be considered-if it affects the critical path of the project under the approved work plan-an extension of the time period included in the tender only.

16. Variations and Modifications

All Variations shall grant a prior written approval of the Employer. The Employer will not pay for any variation, which the Contractor has executed without the prior written approval of the Employer. Just in cases of urgency of decision is required; the Engineer is empowered to issue variation orders, upon obtaining provisional approval from the Employer.

17. Work Register

17.1 Reporting Requirements:

- (a) Contractor shall promptly submit the schedules and reports set forth below and in addition, those schedules and reports as requested by the Engineer.
- (b) Critical path schedule/bar chart schedule shall show manpower required by the items interval and reflect percent of schedule completion by time interval.
- (c) A weekly detailed schedule, of day-to-day operation showing planned manpower loading for major activities.
- (d) A weekly report showing schedule progress versus actual progress giving details of how the Works will be completed in relation to the schedule.
- (e) A daily report that contains the following information:
 - Major construction equipment schedule correlated to works schedule.
 - Construction equipment, Manpower by crafts.
 - Labour alert if Contractor's available manpower is not sufficient to meet the schedule for performance of the Works.
 - Procurement schedule for the procurement and receipt of material and equipment and subcontract services by Contractor and a monthly status report of such materials/equipment.
- (f) During the later stage of accomplishing Works, and prior to delivering of notice of Works, Contractor shall submit his plans for demobilization at Site to the Engineer for approval and shall comply within such demobilization plans as approved by the Engineer.

17.3 The Contractor shall provide a work register, keep a neat and accurate Work Register in accordance with the forms, requirements and guidelines of the Employer and the donor. These forms, requirements and guidelines will be provided to the Contractor upon issuing the order to commencement.

18. Quality of Works and Materials

Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Engineer's notice. If the Contractor has not corrected a Defect within the time specified in the Engineer's notice, the Engineer will assess the cost of having the Defect corrected, and the Contractor will pay this amount.

The materials used in the works should be in accordance with the specifications of the contract. Appropriate deduction will be applied for bad performance or materials quality.

If the handover committee or the municipal engineer refuses to handover any item/s of the executed work, which is found to be deficient or in breach of specification, the Contractor shall be notified in writing of the reasons for the refusal and to amend the executed work within 7 days of the day following the notification. Moreover, the contractor shall remove any unacceptable material at his own expense, and the necessary repairs are to be carried out for the entire road width and according to the supervisor's instructions.

19. Inspection and Testing

If any test is ordered by the Engineer which is

- a) Not so intended or provided for, or
- b) (In the cases above mentioned) no so particularized, or
- c) (though so intended or provided for) required by the Engineer to be carried out at any place other than the site or the place of Manufacture, fabrication or preparation of the materials or Plant tested.

And the results show the materials, Plant or workmanship not to be in accordance with the provisions of the contract or to the satisfaction of the Employer, and then the cost of such test shall be borne by the Contractor.

20. Measurement

- a) Measuring the executed works will be done according to the preambles attached to the Bill of Quantities or according to the description of the items of works stated in the BOQ.
- b) No item, type of work or part of work will be measured under more than one item.

21. Interim Payments

- A. The contractor due payment for the executed work interim payment, final payment or any other payment shall, as a minimum include the following documents:
 - 1- Payment request signed by the Contractor: Interim Payment Certificate or Final Payment Certificate form (the form is to be provided by the Employer)
 - 2- Payment Summary Form which shows all items of work of the BOQ performed and requested for payment under this application and those previously paid and their quantities (format to be provided by the Employer).
 - 3- Measurement sheets for all items of work previously paid and those requested to be paid under this application.
 - 4- Test Certificates of all materials, components and workmanship incorporated in the performance of the items requested for payment.
 - 5- All shop drawings that illustrate and explain the execution, dimensions and measurement of certain items.
 - 6- Weekly Report in accordance with the guidelines of the Employer.
 - 7- All the above shall be submitted in (2) copies.
 - 8- For (a), (b), (c) and (d) above, the Contractor shall also submit an electronic copy on Excel to the Engineer.
 - 9- The Contractor shall provide a **zero VAT** certificate.
 - 10- The Engineer's confirmation is of grand importance for the items question to pay and ensuring that these items are implemented in accordance with contract specifications, Bid, drawings and the Engineer satisfaction.
 - 11- The approval of the Engineer and proceed the payments do not relieve the Contractor from any of his responsibilities or obligations.
 - 12- Valid insurance as per General and Particular Conditions.
- B. The payments will be made from the donor to the contractor by direct disbursement transferred to their bank account according to the approved payment request from the supervising engineer.
- C. A value of 10% of each due payment is to be retained until all project works are completed, and the entire amount is to be paid at the initial handover of the project.

22. Taking-Over

The Contractor shall, within one month from the date of issuing the Taking-Over Certificate submit the following "hard and soft copy":

- 1- Two copies of As-Built Drawings (including the original copy).
 - 2- Two copies of the Final payment including all measurement sheets and the final BOQ.
 - 3- Final Report showing all works activities and details for all stages, using a set of photographs that shall be signed by the Contractor and approved by the Engineer.
 - 4- If the Contractor fails in fulfilling all or any of the above mentioned, then the Engineer or the Employer will perform the missing on the account of the Contractor.
-

23. Insurances

For clarification only, the following are the insurances required for the Project:

- (a) Insurance of the Permanent and Temporary Works to include materials and Plant to values specified in the Contract.
- (b) Insurance of the Equipment.
- (c) Third Party Insurance - property and persons.
- (d) Insurance against accident or injury to workmen and employees.

Use of Insurance Compensation: "In case of any damage to the Works or any part thereof or to materials or Plant or Temporary Works due to risks covered by the insurance, the Contractor shall, as rapidly as possible, carry out the repairs and making good of the defects. The insurance company shall pay the insurance compensation to the Employer who will in turn pay any amount he receives to the Contractor in installments in accordance with the Engineer's recommendations. If the value of the compensation is greater than the amounts to be paid to the Contractor, then these amounts shall be paid to the Contractor, and if it is less than the cost of repair, then the Contractor shall bear the difference"

Accident or Injury to Workmen: "The Contractor shall immediately notify the Engineer in writing about any accident which occurs on Site if it results of an injury to any of the labourers or employees or damage to property, and he shall provide him with the details and the affidavits of witnesses. Also, the Contractor shall inform the concerned authorities about such accidents when and if the laws and regulations so require".

24. Further Additional Clauses

The Contractor shall give due regard and responsibility to the following matters:

(a) General Obligations

- 1. The contractor shall decrease noise and environmental pollution as much as possible.
- 2. The contractor shall not use the Site for purposes other than the execution of the work.

(b) Control of Work Management

- 1. The Contractor shall co-operate with the Engineer in arranging the time and dates of Site meetings, and in the preparation of Minutes of Meetings.
- 2. He shall co-operate with the Engineer in taking photographs for the presentation of reports about the progress of the Work.
- 3. He shall keep a special record, registering the climatic conditions of maximum and minimum temperatures, humidity, and the average rainfall in millimetres, and the number of hours of rainfall, for each day.
- 4. In case of repair work, he shall tabulate the requirements therefore, and inform the Engineer's Representative of his completion of each item, one by one.
- 5. In case of the Engineer or his Representative may reject any material or works, the Contractor shall, before starting to rectify such condition, submit his proposals for such rectification to alleviate the repetition of the error.

(c) Contractor's Professional Conduct and Execution of Duties in Connection with Contract.

- 1. Good Practice: If a full description of any material, product or workmanship was not specified, then it is nevertheless understood, that this material or work shall be suitable for the purposes of the Contract or what may be needed to execute the item in conformity with good practice and whatever is mentioned for the relevant item, in the Bill of Quantities, the General Technical Specifications and the Standard Specifications being used.
- 2. Standard Specifications: If Standard Specifications are specified, then the Contractor shall submit a Certificate of Origin certifying that the item purchased is in conformity with such standard Specification, and submit the same for the Engineer's approval.
- 3. The Contractor shall place, clear signs wherever services are concealed, in order to facilitate relocation of the said services, during testing, maintenance, repair or operation of the same.

Volume III: Technical Specification
Road Specifications

Attached as electronic copy on CD

Volume VI: Bill of Quantity

Preambles

- A.
1. These Bills of Quantities are to be read in conjunction with the Tender Conditions of Contract, agreement, Specifications, and Drawings. The various documents making up the contract shall be deemed to be mutually explanatory. The method of measurement followed shall be the “principles of measurement (international) for works of construction “amended to suit local practice.
 2. Quantities stated in the Bill of Quantities are approximate and not to be considered as limiting for extending the amount of work to be carried out and/or materials to be supplied by contractor.
 3. Payments due under the contract shall be determined by applying the unit rates to the quantities executed for the respective items, in accordance with the BOQ and contract.
 4. The Units of Measurements symbols:
 - m which refers to linear meter.
 - m² which refers to square meter.
 - m³ which refers to cubic meter.
 - No. which refers to number.
 - L.S. which refers to lump sum.
 5. The municipality is not be responsible for any delay in work caused by other parties, such as service enterprises, "water Authority, electricity company, telecommunications company, etc.", and the contractor is not entitled to any due claim as a result of their delay, and the duration of the delay will be considered-if it affects the critical path of the project according to the approved work plan-as an extension of time for the contracted project duration only.
- B.
- The contractor shall be deemed to have:
1. Revised all the tender documents, inspected and examined the site and it's surroundings. He shall also be deemed to have taken into account the form and nature of the site, the extent and nature of the work and materials necessary for the completion of the works, the means of communication with and access to the site, the accommodation he may require and in general to have obtained for himself all necessary information as to the risks, contingencies and any other circumstances influencing and affecting his tender.
 2. Satisfied himself before submitting his tender as to the correctness and sufficiency of the tender and of the rates and prices stated in the bill of quantities or price schedule, where shall, save where otherwise provided, cover all his obligations under the contract.
 3. Determined his price on the basis of his own calculations, operations and estimates. And he shall, at no additional charge, carry out any work that is the subject of any item whatsoever in his tender for which he indicates neither a unit price nor a lump sum.
- C.
- The Bill of Quantities tendered rates **include** the costs of all works carried out for the following items -with no claim of separate payment for this work-:
1. Transport.
 2. Providing all required safety measures on site and maintain all necessary diversions, temporary roads signs with posts, fencing, and lighting especially at night hours working all according to project supervisor.
 3. **The adjustment of all service manholes and grills to Asphalt finish level.**
 4. Selecting sites outside the right-of-way for the use of his plant, equipment, if required, residences, Temporary Works or any other uses which are essential during the execution of the Contract. The Contractor shall take the necessary measures for using these sites and shall be

responsible for all expenses that may become due in return for such use.

5. Safely maintaining traffic during construction.
6. Protecting from damage the existing utilities below and above ground such as water lines, drains, sewer pipes, service connections, cables, valve boxes, light poles, pylons, telephone poles and any other services within the project limits.
7. Keeping the site and the adjacent roads/ surrounding areas clean from project waste “i.e all waste/surplus materials and other rubbish resulting from the works shall be transferred outside the site to authorized locations approved from the Municipality and as directed by the project supervisor.

D. The item Unit price shall include the following issues, noting that the work is to be constructed according to an approved plan from project Supervisor within the contractual execution period, “working hours could be at night for some activities”.

1. Road works:
 - All activities needed to execute the work according to the approved plan as method of work, time frame and resources / per activity, No. of machines, tools, etc.
 - Submitting a recent job mix design for the Asphalt from an approved lab –to be approved from project supervisor.
2. Patching Work:
 - All related work -like cutting, excavation, adjusting/replacing existing basecoarse level to required level, applying prime coat.
 - Item Unit rate to be measured is for Asphalt work only (Measurement will be for asphalt weight only)

Project Name : Rehabilitation of Yasser Arafat Square- City Center

Bill of Quantity 1-1 : Road Work

Item	Item Description	Unit	Quantity	Unit Price US\$	Amount US\$
1.1	<u>Asphalt Milling:</u> Milling of existing asphalt up to 2-3cm depth. The price includes: milling around existing manholes and beside existing curb stone, removal and disposal of all milled asphalt, debris, unsuitable and surplus materials to places authorized by the municipality and as approved by the Supervisor Engineer. All according to specifications, drawings, and directions of Project Supervisor.	m ²	4,000		
1.2	<u>Excavation/Embankment:</u> Excavation in any sort of earth, rock, or asphalt from natural ground level to the finished sub grade level "with a depth ranges from 35-40cm". The price includes: *Embankment with suitable materials "imported from outside the site, depth of 35-40cm" for fill areas in layers not to exceed 25cm after compaction), *removal of excess/unsuitable excavated materials to dumpsite places approved by Municipality. All according to specifications, drawings, and directions of Project Supervisor.	m ³	80		
1.3	<u>Base course:</u> Furnishing crushed aggregate base course material class A, 20cm thick after compaction (CBR=100), (degree of compaction =100%) the price includes: mixing, spreading on sub-grade, compacting and finishing, all tests required. All according to specifications, drawings, and directions of Project Supervisor.	m ²	150		
1.4	<u>Asphalt Works:</u> Furnishing, spreading and compacting 6cm thick after compaction bituminous wearing course (3/4 inch). The Price includes: *furnishing and applying bituminous tack coat (RC-70 or RC-250) or equivalent (rate of application 0.50 kg/m2). Between asphalt layers, *mechanical trimming and cleaning of existing pavement, also The price include Furnishing and applying bituminous prime coat (MC-70) or equivalent (rate of application 1.2 kg/m2) to previously constructed sub grade, sub-base or aggregate base course road paved shoulders All tests required. All according to specifications, drawings and directions of Project Supervisor. (degree of compaction =98%).	m ²	4,000		
1.5	<u>Asphalt patching:</u> Replace damaged areas in existing asphalt using manual and/or mechanical machine, the price includes: *cutting, excavation, adjusting /compacting existing base coarse level to required level, replacing existing base coarse layer with 20cm layer after compaction, prime coat, 5-6cm hot asphalt mix wearing course (3/4 inch) ,disposal of unsuitable and surplus materials. All according to specifications, drawings and directions of Project Supervisor.	Ton	170		
	Total to be carried to next page				

Bill of Quantities 1-2 : Road Work

Item	Item Description	Unit	Quantity	Unit Price US\$	Amount US\$
	Subtotal from previous page				
1.6	<u>Asphalt Levelling course</u> : with varying thickness not exceeding 4cm of hot asphalt mix bituminous thin course (1/2 inch),to be placed above the existing Asphalt -to compensate for irregularities in the Asphalt surface- prior to placing the top Bituminous wearing course surface, or to any places as directed by the Project Supervisor.	ton	85		
1.7	<u>Side walk and Medians Curbstone:</u> Supplying and erecting pre-cast concrete curbstone for sidewalks and medians (100x25x17/20/10) with all related works of excavations, leveling, embankment, laying of concrete under the curbstones (10x27cm –B250) and a rear (10x10cm) concrete box, including also expansion taints and all necessary works, all according to specification, drawings and directions of the project supervisor.	m.r	250		
1.8	<u>Interlock Tiles:</u> Supplying and erecting precast concrete interlock Tiles 20*10*6cm thick “compressive strength of 50N/mm ² ” for sidewalks, mediums and roundabout aprons, the price includes: *leveling "Excavationa/embankement" to the design level, *treating with water to achieve a field density of 98% of Modified proctor *spreading simsemia bedding layer of 50mm -after compaction-, *Pointing with sea sand, *200mm thick basecourse layer -after compaction , all as specification, drawings and instructions of Project Supervisor.	m ²	280		
Total Amount including VAT (US\$)					
Discount in % (if any) =					
Total Amount in numbers including VAT (US\$) =					
Total amount in Words including VAT (US\$):					

Authorized Signature:

Name and Title of Signatory:

Name of Bidder:

Address:.....

Tel: **Jawwal:** **Fax:**.....

Request for Bids Works

(One-Envelope Bidding Process)

Procurement of:
**Rehabilitation of Yasser Arafat Square
in the city center**

Volume III

Technical Specification
Road and Electrical Specifications

RFB No: RamMun/RM/2021/025

Employer: Ramallah Municipality

Funded by: Government of India – Ramallah Municipality.

Country: Palestine

Issued on: March, 2021.

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CONSTRUCTION SPECIFICATIONS FOR MINISTRY OF PUBLIC WORKS AND HOUSING

1. GENERAL PROVISIONS

1.1. ABBREVIATIONS

Wherever the following abbreviations of titles, terms and units of measurement are used in the Specifications or on the Drawings, the intent and meaning shall be interpreted as described hereunder.

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ASTM	-	American Society for Testing and Materials
BS	-	British Standard
CBR	-	California Bearing Ratio
DCO	-	Designated Contract Officer
DCOR	-	Designated Contract Officer Representative
H:V	-	Horizontal: Vertical
ISO	-	International Organization for Standardization
L.L.	-	Liquid Limit
L.S.	-	Lump Sum
PCC	-	Portland Cement Concrete
P.G.L.	-	Profile Grade Line
P.I.	-	Plastic Limit
Plasticity Index	-	
PVC	-	Polyvinyl Chloride
RC	-	Reinforced concrete
RCP	-	Reinforced Concrete pipe
ROW	-	Right-of-way
S.G.	-	Specific Gravity
SI	-	System International D`Unites
ST	-	Station (location along a survey line) PS

1.3. CONTROL OF WORKS

1.3.2. PLANS AND WORKING DRAWINGS

The Engineer shall approve working drawings before any work involving the drawings is performed. It is expressly understood that approval of the Contractor's working drawings shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. Approval of working drawings shall not operate to waive any of the requirements of the plans and specifications or relieve the Contractor of any obligation thereunder, and defective work, materials and equipment may be rejected notwithstanding the approval.

Full compensation for furnishing all working drawings shall be considered as included in the prices paid for the contract items of work to which the drawings relate and no additional compensation will be allowed therefor.

1.3.4. ORDER OF WORK

When required by the special provisions or plans, the Contractor shall follow the sequence of operations as set forth therein. Full compensation for conforming to those requirements will be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefor.

1.3.5. CONTRACTORS WORK AREAS

The Contractor shall make all necessary arrangements, regarding any land outside the Site that may be needed as work areas. The Owner will not accept any liability in respect of such land.

The Contractor shall locate and select sites outside the right-of-way for the use of his plant, equipment, site offices if required, residences, Temporary Works, disposal areas or any other uses that are essential

during the execution of the Contract. The Contractor shall take the necessary measures for using these sites and shall be responsible for all expenses that may become due in return for such use.

1.3.6. TRAFFIC

The Contractor shall be responsible at his own cost for safely maintaining traffic during construction. The Contractor shall provide and maintain all necessary diversions, temporary roads signs with posts, fencing, flag men, and lighting.

1.3.8. USE OF MATERIALS FOUND ON THE WORK

Unless otherwise indicated in the Contract documents, the contractor, with the approval of the Engineer, may use in the proposed construction such stone, gravel, and or other material suitable in the opinion of the Engineer as may be found in excavation. The Contractor shall not excavate or remove any material from within the highway right-of-way that is not within designated excavation areas, as indicated by the slope and grade lines indicated on the plans, without written authorization from the Engineer.

1.3.9. EXISTING UTILITIES

Utilities shall include, but not be limited to, existing water lines, gas lines, sewer lines, wire lines, service connections, water and gas meters and valve boxes, light poles and masts, cableways, signals, and all utility appurtenances within the limits of the proposed construction. The Contractor shall, safeguard from injury or damage existing utilities that are below and above ground that are not to be removed or relocated and specified on the construction drawing.

The necessary utility diversions may be specified or directed to be carried out by the Contractor. The Contractor shall be responsible for safeguarding and protecting from damage all utilities and appurtenances encountered during the Works. He shall be responsible for the costs of making good any damage thereto, arising out of his own negligence.

1.3.10. SURVEYING EQUIPMENT

The Contractor shall provide for his own use and the use of the Owner on site suitable surveying instruments and other equipment for use in setting out and leveling of the works.

1.3.11. SETTING OUT OF WORKS

The Contractor shall set out the works and obtain approval of his setting out before proceeding with construction. If, in the opinion of the Engineer, modification of the lines or grade is advisable, before or after survey, the Engineer will issue detailed instructions to the Contractor who shall revise the setting out accordingly.

The Contractor shall be responsible for preservation of all existing stakes, marks and monuments and if any construction stakes or marks are destroyed or disturbed, the Contractor shall replace them at his own expense.

1.3.12. SITE CLEANING

All parts of the Site, and adjacent roads affected by the works, shall be maintained in a clean and tidy condition during progress of the works. All waste and surplus materials and other rubbish resulting from the works or otherwise, shall be cleared away at intervals as directed by the Engineer.

The entire site shall be delivered up on completion of the Works, in a clean, neat and presentable condition.

1.3.13. MEASUREMENT

All works prescribed in Section 1.3, except for any Work listed in the BOQ as a separate payment item, shall not be measured for direct payment, but shall be considered as subsidiary work, the costs of which will be deemed to be included in the Contract prices for pay items.

1.4. CONTROL OF MATERIALS

1.4.1. SOURCE TESTS

All source samples shall be taken by the Contractor in the presence of the Engineer, using approved sampling procedures. All source approval tests shall be performed under the supervision of the Engineer and in accordance with approved testing procedures or, when so specified, by an independent laboratory approved by the Engineer and paid for by the Contractor.

1.4.2. PROJECT CONTROL TESTS

All Project Control samples shall be taken jointly by the Engineer and the Contractor. Tests shall be performed in an approved laboratory, under the supervision of the Engineer.

1.4.3. UNACCEPTABLE MATERIALS

All materials not conforming to the requirements of the Specifications at the time they are used will be rejected and shall be removed immediately from the Site unless otherwise instructed by the Engineer. No rejected material, the defects of which have been corrected, shall be used until approval has been given.

1.4.4. SUPERVISION STAFF SITE OFFICE "not applicable"

The contractor shall furnish a site office and other equipment and supplies for the use of the Owners representatives during the construction period as specified in detail in the Contract Special Provisions. The Contractor shall keep the office clean and supply it with water and electricity. No direct payment shall be included in the Contract for this work unless otherwise set forth in the Contract Special Provisions or the Contract Bill of Quantities. The facility and equipment shall remain the property of the Contractor.

3. REMOVAL OF STRUCTURES AND OBSTRUCTIONS

3.1. DESCRIPTION

This work consists of removal and disposal of buildings, fences, structures, pavements, abandoned pipelines, pipe culverts, other obstructions that are not designated or permitted to remain, and which are not removed and disposed of under other items in the contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits. Refer to Paragraph 1.3.9 for existing utilities information.

3.2. MATERIALS (NOT SPECIFIED)

3.3. CONSTRUCTION

Designated salvageable material shall be carefully removed, in sections or pieces, which may be readily transported, and shall be stored at places specified. Unusable perishable material shall be destroyed. Nonperishable material may be disposed of outside the limits of view from the project with written permission of the property owner. Pipe shall be removed and disposed of as nonperishable material.

Basements or cavities left by structure removal shall be filled to the level of the surrounding ground and, if located in an area of an embankment or other structure, shall be compacted under the same specification as the embankment. In other areas the fill material shall be compacted as necessary to preclude undue settlement and shall be slightly mounded. Concrete basement floors and similar structures shall be broken up to prevent entrapment of water.

Bridges, culverts and other drainage structures used by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic. The substructures of existing structures shall be removed down to the natural stream bottom. Those parts outside the stream shall be removed 300 mm below natural ground surface. When portions of existing structures are within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

All designated salvageable steel or wood bridges shall be dismantled without damage. Structures designated to become the property of the Contractor shall be removed from the right-of-way.

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may

damage new construction, shall be completed prior to placing the new work.

Pipe to be reset shall be removed, transported to the site of installation and stored, so there will be no damage before resetting. The Contractor will be required to replace sections of pipe damaged by negligence at their own expense. In removing pavement, curb, gutter, sidewalk and similar structures, where portions of the existing structures are to be left in the finished work, the old structure shall be removed to an existing joint, or sawed and chipped to a true line with a vertical face. When removing manholes, catch basins or drop inlets, any functioning sewer lines connected to them shall be rebuilt and properly connected. Satisfactory by-pass service shall be maintained during construction operations.

4. EROSION AND SEDIMENT CONTROL

4.1. DESCRIPTION

These Works shall consist of temporary control measures as shown on the Drawings or required by the Engineer during progress of the Works, to control soil erosion and water pollution, by use of berms, dikes, silt fences, brush barriers, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

The temporary erosion control provisions shall be coordinated with permanent erosion control features to assure economical, effective and continuous erosion control throughout the period of the Works.

4.2. MATERIALS

Geotextile or jute matt lining or any other approved material as appropriate may be used for soil erosion control. All other materials shall meet commercial grade standards and be approved before being incorporated in the Works.

4.3. CONSTRUCTION

A plan for temporary (and permanent) soil erosion control Works shall be developed by the Contractor at the commencement of the Contract, in consultation with the Engineer and to his satisfaction.

The Contractor shall carry out (and maintain) temporary erosion control to prevent soil erosion that will adversely affect construction operations, damage adjacent properties, or cause contamination of adjacent streams or other watercourses, lakes, ponds or other areas of water impoundment. Such Works may involve construction of temporary berms, dikes, dams, sediment basins, slope drains or use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion. Cut--and fill slopes shall be seeded and mulched as the excavation proceeds, to the extent considered desirable and practicable by the Engineer.

Temporary erosion control may include construction outside the right-of-way where such work is necessary because of roadway construction such as borrow pit operations, haul roads and equipment storage sites.

The Contractor shall incorporate all permanent erosion control features as shown on the drawings into the Works at the earliest practicable time as outlined in his schedule, to minimize the need for temporary erosion control measures.

Where erosion is a problem, clearing and grubbing operations shall be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.

The Engineer will limit the area of clearing and grubbing, excavation, borrow and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding and other permanent erosion control measures current in accordance with the schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified. The Engineer may increase or decrease the amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions.

In the event that temporary erosion control measures are required due to the Contractor's negligence, carelessness or failure to install permanent controls as part of the Works, scheduled or ordered by the Engineer, such Works shall be carried out by the Contractor at his own expense.

5. HIGHWAY EXCAVATION

5.1. DESCRIPTION

The Works under this section shall consist of excavating and grading the roadway including watercourses, side ditches, storm drains, intersections, approaches, and benches under side- hill fills; excavating of unsuitable material from roadbed and beneath embankment areas.

All suitable soils, rock, boulders and other materials shall be excavated in such a manner that they can be utilized, if intended to be used, as embankment fill or in subgrade, shoulder or elsewhere as appropriate. Materials suitable for embankment are described in Table 7.2.1

5.2. MATERIALS

5.2.1. UNCLASSIFIED EXCAVATION

All materials except those classified, as rock excavation, unclassified/rock excavation, or muck excavation, encountered during the construction of the work, regardless of their nature or manner in which they are removed, will be considered unclassified excavation.

5.2.2. UNCLASSIFIED/ROCK EXCAVATION

Unclassified/Rock Excavation consists of the excavation and placement of both soil and rock when both are anticipated throughout the project area. This item differs from Unclassified Excavation in that an undetermined quantity of rock shall be excavated in addition to the materials included in Unclassified Excavation.

5.2.3. ROCK EXCAVATION

Rock excavation shall consist of a sound, solid mass of mineral matter in place and of such hardness and texture that it cannot be loosened or broken down by ripping in a single pass with a tractor mounted hydraulic ripper equipped with one digging point. The ripper and tooth shall be of a standard design, adequately sized and used with a large crawler type tractor rated between 370 and 460 net fly wheel horsepower (276 and 343 kilowatts at the fly wheel), operating in low gear, with sufficient downward force on the ripper. Material may also be classified as rock if the compressive strength after soaking in water for 24 hours

Exceeds 40 kg/m².

5.2.4. MUCK EXCAVATION

Muck Excavation consists of the removal and disposal of saturated organic mixtures of soils and organic matter that requires additional work or equipment not normally required for unclassified Excavation.

5.2.5. UNCLASSIFIED EXCAVATION, DIGOUTS

Unclassified excavation, digouts consists of the removal and disposal of unstable material below an existing surface on which surfacing material is to be placed. When granular material is used for backfill, the excavated area shall extend to a daylight point so that lateral drainage is provided. The exposed undercut surface shall be compacted prior to backfilling. The existing gravel shall be salvaged before and replaced after the unstable material has been removed.

5.2.6. SELECT SUBGRADE TOPPING

Sources of selected subgrade topping material will be confined to the areas specified. The upper 150 mm of sodded areas, materials with high humus or silt content and outwashed material in poorly drained areas will not be acceptable. Unsatisfactory material found within the specified sources shall not be used as select subgrade topping.

5.2.7. UNDERCUTTING

Undercutting shall consist of excavating, replacing, and compacting the material immediately below the finished subgrade surface, at locations specified and to the depth specified.

5.3. CONSTRUCTION

The excavation for the roadway, intersections and entrances shall be finished to smooth and uniform surfaces. Materials shall not be wasted without written permission. Grading operations shall be conducted so that material outside of the limits of slopes will not be disturbed. Prior to beginning grading operations in any area, clearing and grubbing shall have been performed.

The Contractor shall not begin earthmoving operations until all temporary erosion control measures are placed beyond the work limits but within the right-of-way and/or easements. The Contractor shall undertake erosion control measures as soon as possible after beginning the Work.

5.3.1. CLASSIFICATION OF EXCAVATION

Authority to identify and define the physical characteristics that determine classification shall be the Engineers.

5.3.2. SALVAGE OF TOPSOIL

Topsoil shall be removed from designated areas as described in the construction drawings. Topsoil that is not designated for use as topping shall be placed in the embankment. Suitable topsoil material, if specified, shall be stockpiled during excavation operations and shall subsequently be spread and compacted on embankment slopes and elsewhere as directed, to facilitate re-growth of vegetation.

5.3.3. UNDERCUTTING AND MATERIAL SELECTION

When specified, select materials shall be utilized to improve the roadbed. The work shall be performed in such manner that suitable materials may be selected, removed separately, and deposited in the roadbed within the limits and elevation required.

On specified density projects, the Contractor shall undercut to the limits specified. On ordinary compaction projects, the Contractor shall scarify the exposed subgrade surface for the width of the subgrade to a depth of 150 mm below the subgrade and recompact to the required density in cut sections. In embankments less than 450 mm, not including subbase gravel the Contractor shall scarify the width of the subgrade, to a depth 150 mm below the existing ground surface and recompact. Organic material existing in the top 150 mm of subgrade shall be removed and replaced with satisfactory material.

If the Contractor chooses to excavate suitable material to waste or put it to other uses, and replace it by borrow excavation for embankment areas, this shall be undertaken at no extra cost to Owner.

Materials such as existing concrete, bituminous other surfaces or other materials shall, if shown on the Drawings to be stockpiled for a specific purpose or for future use shall be excavated and handled in a manner that will exclude foreign or undesirable materials. Stockpiles shall be neatly formed and maintained in an approved manner.

5.3.4. WASTE AND SURPLUS EXCAVATION

Surplus excavation and waste material shall be disposed of as specified or directed. Unless a disposal site is specified, the Contractor will not be required to haul material in excess of the average plan shown haul for the entire project. Excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed on the side slopes of the nearest fill and placed to maintain a distinct shoulder line. Waste material shall be placed the maximum distance possible and at least 300 mm outside and 0.6 m below the finished shoulder elevation.

Excavated material that contains bentonite shall be placed in that portion of an embankment section which is more than six meters below the finished subgrade surface, in embankment slopes which are outside the subgrade shoulder line, or in designated waste areas. During placement of this material in the embankment, the thickness of the total placement in any one area shall be as directed by the Engineer.

5.3.5. OPTION BORROW EXCAVATION

Suitable materials removed from optioned borrow sources shall be used in the embankments. Optioned borrow sources shall be graded to a neat and sightly appearance in accordance with grades, slopes, and requirements of the option agreement and to permit accurate measurement of quantities.

5.4 MILLING & CLEANING

5.4.1 SCOPE

The work shall consist of milling the existing asphalt layer, cleaning and removing the resulting debris.

5.4.2 CONSTRUCTION

1. The existing asphalt layer shall be milled with a special machine (scarify) to a maximum depth of not more than two centimeters or as the case may require and agreed with the Project Manager.
2. The milling shall modulate a new leveling of the surface of the road.
3. The pavement shall be trimmed vertically at the curbs.
4. The debris created by the milling process shall be removed.
5. The milled surface of the road shall then be cleaned thoroughly using mechanical sweepers and/or laborers with brooms.
6. The debris and dust created by milling and sweeping shall be removed and transported by a truck to a dump site designated by the Project Manager.

6. EXCAVATION AND BACKFILL FOR STRUCTURES

6.1. DESCRIPTION

Structure excavation shall consist of excavation in any kind of material for the construction of foundations for structures; excavation of trenches for the construction of culverts, cutoff walls and other facilities; other excavation designated on the plans or in these specifications or in the special provisions as structure excavation; the control and removal of water and the construction or installation of cofferdams and other facilities as necessary to accomplish construction of the work; and the subsequent removal of those facilities, except when the facilities are required or permitted by the plans and specifications to remain in place.

Structure backfill shall consist of furnishing, placing and compacting backfill material around structures to the lines designated on the plans or specified or directed by the Engineer. Structure excavation and structure backfill may be classified on the plans or in the Engineer's Estimate into various types or classifications.

Material from structure excavation not used as structure backfill shall be deposited in roadway embankments as provided in Section 7, "Embankment Construction," or disposed of as provided in Section 5.3.4 all as directed by the Engineer.

6.2. MATERIALS

6.2.1. CULVERT BEDDINGS

Culvert beddings shall consist of shaped bedding, sand bedding, or soil cement bedding and shall be constructed, where shown or specified, in accordance with the details shown on the plans and these specifications. When more than one type of bedding is permitted, the same bedding shall be used throughout the length of the culvert. Culvert beddings shall conform to the following requirements:

6.2.2. SHAPED BEDDING

The trench bed shall be shaped to fit the bottom of the culvert, as shown on the plans, and shall provide uniform support throughout the entire length of the culvert. The trench may be excavated below the bottom of the culvert and the shaped bedding constructed by backfilling and compacting culvert backfill material to the required line, grade and shape. Shaping shall be accomplished by use of a template conforming to the outside shape of the culvert and guided by headers set parallel to the grade of the culvert established by the Engineer. The headers may be left in place.

6.2.3. SAND BEDDING

Sand shall be free from clay or organic material, suitable for the purpose intended, and shall be of such size that 90 percent to 100 percent will pass a 4.75-mm {No. 4} sieve and not more than 7 percent will pass a 75-µm {No. 200} sieve.

6.2.4. SOIL CEMENT BEDDING

Water used for soil cement bedding shall be free from oil, salts and other impurities which would have an adverse effect on the quality of the bedding material. Aggregate for soil cement bedding shall be either material selected from the excavation, imported material, or a combination thereof; be free of organic material and other deleterious substances; and meet the following grading requirements:

Percentage Passing	Sieve Sizes
100	37.5-mm {1 1/2"}
80 – 100	25-mm {1"}
60 – 100	19-mm {3/4"}
50 – 100	9.5-mm {3/8"}
40 – 80	4.75-mm {No. 4}
150-µm {No. 100}	10-40

The aggregate, cement and water shall be proportioned either by mass or by volume. Not less than 175 kg of cement shall be used for each cubic meter of material produced. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

Materials for soil cement bedding shall be thoroughly machine-mixed in a pugmill, rotary drum or other approved mixer. Mixing shall continue until the cement and water are thoroughly dispersed throughout the material. Soil cement bedding shall be placed in the work within one hour after mixing.

Soil cement bedding shall be placed in a uniform manner that will prevent voids in, or segregation of, the bedding, and will not float or shift the culvert. Foreign material that falls into the trench prior to or during placing of the soil cement bedding shall be immediately removed.

Backfilling with earth on culverts set in soil cement bedding shall not commence until 8 hours after the soil cement bedding has been placed.

6.2.5. PERVIOUS BACKFILL MATERIAL

Pervious backfill material shall be placed behind bridge abutments, wingwalls and retaining walls as shown on the plans and in accordance with the following requirements.

Pervious backfill material shall consist of gravel, crushed gravel, crushed rock, natural sands, manufactured sand or combinations thereof. Pervious backfill material, except for sacked material at wall drain outlets, shall conform to the following grading requirements:

Percent (%) Passing	Sieve Sizes
100	50-mm
0 – 100	300-µm {No. 50}
0 – 8	150-µm {No. 100}
0 – 4	75-µm {No. 200}

6.3. CONSTRUCTION

6.3.1. EXCAVATION

When the plans require embankment construction prior to culvert excavation the embankment shall first be constructed to the required height as shown on the plans, and for a distance each side of the culvert of not less than 5 times the diameter or height of the culvert, after which the trench shall be excavated and the culvert installed. Where the embankments are to be constructed on a steep slope or at a difficult location, the height of new embankments may be varied as directed by the Engineer before installing culverts.

Care shall be taken during excavation to prevent disturbing the foundation. If ground water is encountered

during excavation and a concrete seal course is not to be used, dewatering shall be commenced and shall proceed in advance of or concurrently with further excavation. The foundation shall be free of water at the time footing concrete or pipes are placed, and water control shall continue as necessary to prevent damage to the work.

If suitable foundation material has been disturbed by the Contractor's operations, has been damaged by water or has been removed for the Contractor's convenience in dewatering the foundation, the foundation shall be restored by the Contractor, at the Contractor's expense, to a condition at least equal to the undisturbed foundation as determined by the Engineer. For culverts, the material used to replace the damaged or removed foundation material shall be aggregate base and shall be compacted as required for structure backfill, unless the Engineer determines that a different type of material is required to provide the equivalent bearing capacity. When undisturbed original material at the planned grade of the excavation is determined by the Engineer to be unsuitable material, the Engineer will direct corrective work.

When footing concrete or masonry is to rest upon rock, the rock shall be fully uncovered and the surface thereof shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled or cut to steps, and shall be roughened. Cracks in the rock shall be grouted under pressure or treated as the Engineer may direct.

When excavating for culverts, other than arch (not circular) culverts, and solid rock or other unyielding material is encountered at the planned elevation of the bottom of the culvert, the material shall be removed below the bottom of the culvert to a depth of 0.05- of the height of embankment over the top of culvert, but in no case less than 0.3-m nor more than 1.5 m. The resulting trench below the bottom of the culvert shall be backfilled with structure backfill material.

6.3.2. STRUCTURE BACKFILL

Backfill material shall be placed in uniform layers and shall be brought up uniformly on all sides of the structure or facility. The thickness of each layer of backfill shall not exceed 0.2m after compaction except when compaction is done by using water, the thickness shall not exceed 1.2 m.

Compaction equipment or methods that may cause excessive displacement or may damage structures shall not be used.

Structure backfill shall not be placed until the structure footings or other portions of the structure or facility have been inspected by the Engineer and approved for backfilling. No backfill material shall be deposited against the back of concrete abutments, concrete retaining walls, or the outside walls of cast-in-place concrete structures until the concrete has developed a strength of not less than 17 MPa in compression, or until the concrete has been in place for 28 days, whichever occurs first.

Backfill at the inside of bridge wingwalls and abutments shall be placed before curbs or sidewalks are constructed over the backfill and before railings on the wingwalls are constructed.

Compaction of structure backfill by ponding and jetting will be permitted when, as determined by the Engineer, the backfill material is of such character that it will be self-draining when compacted and that foundation materials will not soften or be otherwise damaged by the applied water and no damage from hydrostatic pressure will result to the structure. Ponding and jetting of the upper 1.2 m below finished grade will not be permitted. The work shall be performed without damage to the structure and embankment, and in such a manner that water will not be impounded. The use of vibratory or other compaction equipment when necessary to obtain the required compaction shall supplement Ponding and jetting methods.

Unless otherwise shown on the plans or specified in these specifications or the special provisions, structure backfill shall be compacted to a relative compaction of not less than 95 percent of the maximum dry density.

Where structure excavation is performed and material is removed outside the limits designated for structure excavation, as shown on the plans or specified in these specifications or the special provisions, backfill material placed in those excavation areas shall conform to the material and compaction requirements of the adjacent structure backfill.

Pervious backfill material shall be placed in layers along with and by the same methods specified for

structure backfill. Pervious backfill material at any one location shall be approximately the same grading, and at locations where the material would otherwise be exposed to erosion shall be covered with at least a 0.3-m layer of earthy material approved by the Engineer.

7. EMBANKMENT CONSTRUCTION

7.1. DESCRIPTION

The works under this section shall consist of constructing embankments, including preparation of the areas upon which they are to be placed: all in accordance with these Specifications and in conformity with the lines, grades, cross sections, and dimensions shown on the construction drawings.

7.2. MATERIALS

Material for embankments shall consist of suitable material approved by the Engineer. Material specified in Table 7.2.1 or in the A-1, A-2-4, A-2-5 or A-3 "When confined" groups as in AAHSTO M145 shall be used, if material of this character is not available then materials from A-2-6, A-2-7, A-4, A-5, groups (AASHTO M145) may be used provided it complies with Table 7.2.1; Materials classified as A-6 or A-7 shall not be used.

The material used in rock-fill embankments shall consist predominantly of rock fragments of such size that the material can be placed in layers of the thickness prescribed conforming to requirements stated on Table 7.2.1-A

7.2.1. BORROW MATERIALS

Table 7.2.1 Soil Suitable for Embankment

No	DESCRIPTION	CRITERIA	TEST METHOD
1.	Maximum dry density	Not less than 1.7	(T – 180 D)
2.	Organic Matter	Not more than 5%	(T – 267)
3.	No use of A-6 A-7 Soil		(AASHTO M – 145)
4.	Maximum size	Not more than 2/3 of the layer thickness	
5.	No use of high to medium expansive soil		
6.	CBR	Not less than 8%	(AASHTO T – 193)

Table 7.2.1– A Rockfill suitable for Embankment

No	DESCRIPTION	CRITERIA	TEST METHOD
1.	Size	20% larger than 30 cm	
		40% larger than 7.5 cm	
2.	Bulk specific gravity	Not less than 2.25	
3.	Water absorption	Not more than 6%	
4.	Testing by: (a) Plate bearing test (ME ₂ /ME ₁ < 2.2{E=Young's Modulus}) (b) Surveying method		
5.	Filling material	Not A-6 or A-7 soil	(AASHTO M – 145)

Borrow material shall not be used until all roadway excavation has been placed in the embankment unless otherwise directed by the Engineer. If using borrow causes a waste of mainline excavation, the volume wasted shall be deducted from the volume measured in the borrow area. Unsuitable material encountered in the subgrade or slopes shall be removed and the area backfilled to the finished graded section with approved material. Operations shall be conducted so the Engineer can take necessary cross sectional measurements before the backfill is placed. Unsuitable material shall be disposed of at locations acceptable to the Engineer.

7.3. CONSTRUCTION

7.3.1. PREPARATION OF EMBANKMENT AREAS:

When undercutting is not required and an existing compacted road surface containing granular material lies within one meter of the subgrade surface, the old road surfacing shall be scarified to a depth of at least 150 mm and compacted.

When embankment is placed and compacted on hillsides, against existing embankments, or when embankment is built half width at a time, the slopes that are steeper than 4:1 shall be continuously benched as the embankment is built in horizontal layers. Benching shall be of sufficient width to permit operations of placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Excavated benching material shall be recompacted along with the new embankment material.

7.3.2. PLACING EMBANKMENT

A disk shall be in use while embankment is being placed, processed, or dried. The disk shall be a tandem disk approximately 3.5 m wide with eight disk blades, approximately 0.9 m in diameter, per row, and shall weigh approximately 5350 kg. This requirement will be waived for A-3 and A-2-4 (0) soils. The subgrade shall be finished to within minus 25 mm to plus 13 mm from the design grade and typical section shown in the plans. The quarter crown within any 3.6 m transverse length shall not exceed 25 mm when measured with a straight edge, stringline, or by other suitable equipment.

Sod or topsoil used in the embankment shall be thoroughly disked and pulverized. It shall be placed in the fill slopes outside the shoulders of the subgrade or spread in the lower 300 mm of the fill between the roadbed shoulder lines, provided it is at least 1.2 meters below the top of the subgrade. Sod or topsoil shall not be placed within three meters of pipe or within 15 meters of box culverts or bridges.

Rocks, broken concrete or other solid materials shall not be placed in areas where piling is to be driven or in areas that would interfere with the construction of other structures. Embankments constructed through lakes or swamps shall be constructed by end dump methods to an elevation that permits the use of normal construction methods. This elevation will be determined by the Engineer and will be subject to moisture and density requirements.

Roadway embankment of earth material shall be placed in horizontal layers not exceeding a loose depth of 200 mm and shall be compacted before the next layer is placed.

Material may be placed in lifts greater than 200 mm provided test results verify that the specified density for the entire depth of the lift is obtained.

Effective spreading equipment such as graders or bulldozers shall be used on each lift to obtain uniform thickness prior to compacting. Each lift shall be thoroughly mixed to provide uniform moisture distribution. As the compaction progresses, continuous leveling and manipulating will be required to assure uniform moisture and density. Construction equipment shall be routed uniformly over the entire surface of each layer. When excavated material consists predominantly of rock that cannot be placed in 200 mm layers without crushing, pulverizing, or further breaking down the rock, such material may be placed in the embankment in layers not to exceed the thickness of the average size of the larger rocks or one meter whichever is less.

Each layer shall be leveled and smoothed by distribution of spalls and finer fragments of earth. Specified density will not be required. The material shall be satisfactorily compacted. These layers shall not be constructed above an elevation 300 mm below the finished subgrade.

Filling that contains more than 20% stones bigger than 12 cm is considered "rock excavation material for filling". The contractor shall use this material for filling, and if necessary, break the larger stones and turn them into filling material, on his own expense. The rock excavation material containing larger stones shall be laid and compacted in layers whose thickness depends on the size of the stones as follows:

1. The top layers between the subgrade to minus 100 cm, the maximum stone size shall be 12 cm. The layers shall be laid through the entire embankment width. The thickness of each layer shall not exceed 20cm. In the top layer (subgrade) the quantity of stones larger than 8cm shall not exceed 20%.

2. Layers between subgrade surface minus 100 cm and minus 200 cm, the maximum stone size (largest dimension) shall not exceed 20 cm. The layers shall be laid through the entire embankment width. The thickness of each layer shall not exceed 30 cm.
3. Layers between subgrade surface minus 200 cm and natural ground surface, the maximum stone size (largest dimension) shall not exceed 45 cm. The layers shall be laid through the entire embankment width. The thickness of each layer shall not exceed 60 cm.

If the maximum stone size is smaller than specified above, the thickness of the layer should be decreased accordingly.

The layers shall be spread while voids between stones shall be filled with thin material. Clay shall be avoided in the top two layers. When the processing lot contains few large stones, that their removal shall lessen the thickness of the layer, the contractor shall remove those stones and the thickness of that layer shall be adjusted based upon the remaining stone size.

In excavated areas composed mainly of bentonite or unstable material, additional undercutting to a depth necessary to stabilize the areas shall be required. Excavated material that does not contain bentonite may be used to reconstruct undercut sections below the selected subgrade topping zone, and the entire section when no selected subgrade topping is specified. Rock, 75 mm in diameter or larger, within the right-of-way and easement areas shall be disposed of. The top 150 mm of embankments shall be free of rock fragments or stone that cannot be hand-passed through a 100 mm square opening. Field and farm entrances ditch and channel blocks, and dikes shall be constructed and compacted as directed. Berms for structures requiring slope protection shall be finished to grade with ± 30 mm tolerance to provide a positive support for the slope protection. Other berms will be neatly finished to the same tolerance specified for embankment. When portions of foundations for box culverts are constructed of embankment, the embankment shall be constructed to the flow line grade, as specified. The Contractor shall be responsible for the stability of embankments prior to acceptance and shall repair any portions that have failed. Embankment shall not be constructed on frozen ground and frozen material shall not be used in construction of embankments.

7.3.3. COMPACTION

7.3.3.1. SOIL-TYPE MATERIALS

Soil type materials shall be compacted to at least 95% modified maximum density for the full depth of embankment. The 400 mm of embankment material immediately below the subgrade layer shall be compacted to at least 95% modified maximum density. Soil-type materials shall be tested as follows:

1. Proctor, classification of materials as per AASHTO: one test for every 500 m or when materials change.
2. Field Density: one test every linear 100 m. for each layer.

Prior to placement of granular surfacing materials, the upper 150 mm of subgrade shall be reworked and recompacted to moisture and density requirements. This requirement shall be waived for A-3 and A-2-4(0) soils. Material retained on a 3/4 inch (19.0 mm) sieve will be considered durable when, after soaking in water for 24 hours, it cannot readily be broken with the fingers and passed through the sieve.

The embankment shall be compacted with sheepsfoot or other approved rollers to the satisfaction of the Engineer. When A-1 soil (gravelly) is encountered, density requirements shall be adhered to, the moisture content shall be as needed to obtain density. When A-3 soil (fine sand) or A-2-4 (0) soil consisting of primarily fine one grain size sandy material is encountered, specified density requirements will be waived.

Embankment shall be spread in layers not exceeding a 200 mm loose depth and adequately compacted, with approved vibratory or pneumatic rollers, at the moisture content needed to obtain stability.

Compaction may be accomplished with any type of equipment, which with adequate moisture content will give uniform satisfactory results. A rolling procedure shall be established which will produce densities specified. Sufficient tests will be taken during establishment of the rolling procedure to insure that the required density is being obtained.

7.3.3.2. ROCK-FILL TYPE MATERIALS

Rock-fill type materials shall be compacted initially with a minimum of three passes of a vibratory roller. Leveling points are then established. Short lengths of steel bars hammered flush with the surface of the rockfill have been found suitable for this purpose. A level reading is taken at each leveling point on top of a moveable 30 cm square flat steel plate. A hole drilled in the center of the plate will enable a visual check to be made that the plate is located centrally over the bar each time.

Further readings are taken at the leveling points after two additional passes with the roller. If the average settlement is less than half of one per cent (0.5%) of the average compacted layer thickness, or as determined by the Engineer, the rockfill compaction test is complete.

The total number of passes of the rolling equipment necessary to obtain the required result will establish the minimum number of passes to be used on the rock embankments. The contractor shall then use this simplified procedure, that is, the equipment, rolling pattern, and number of passes, during the construction of rock embankments. However, in no case the number of passes be less than 5.

Excess moisture in the embankment material shall be removed by drying operations. The drying under such circumstances shall be carried on until the moisture content is such that the required density can be attained. Each layer shall be satisfactorily compacted before the next layer is placed. Compaction shall be extended to cover the subgrade width in completed cut sections under the same requirements, without additional compensation. Cut sections excavated below grade and refilled with the removed excavation or with selected soils shall be compacted in the same manner as embankments.

7.3.3.3. SELECT SUBGRADE TOPPING

The Contractor shall develop a plan, which demonstrates that an adequate quantity of the designated material will be salvaged or reserved for select subgrade topping. It will be the responsibility of the Contractor to follow the established grading plan to the extent that an adequate quantity of material for select subgrade topping will be conserved for use. The surface upon which the select subgrade topping will be placed shall be constructed to within ± 60 mm of the required elevation. Compaction of select subgrade topping shall be by the specified density method.

7.3.3.4. WATER

Sufficient equipment shall be available to apply the quantity of water required to secure the proper compaction before evaporation, absorption, or drainage prevents or interferes with the specified results. Moisture content of material shall be uniform for the full depth and extent of each layer.

11. GRANULAR SUB-BASES

11.1. DESCRIPTION

This work shall consist of furnishing granular sub-base material of the required class, mixing, spreading on prepared subgrade, compacting and finishing, all as and where shown on the Drawings.

11.2. MATERIALS

11.2.1. GENERAL REQUIREMENTS

The natural gravel blended with other aggregates for granular bases and surfacing shall consist of sound durable particles of gravel and may include limited amounts of fine soil particles, but shall be free of organic material, roots, vegetation, wood, paper, metal, glass, and other foreign objectionable material. The physical characteristics and quality of the materials shall conform to the specifications for the particular material required by the contract.

11.2.2. SPECIFIC REQUIREMENTS

Granular material for use in sub-base courses, shall be a naturally occurring gravel, blended as necessary with fine or coarse material and screened to produce the specified gradation.

Sub-base materials delivered to the road site shall meet the requirement of class A or B as shown in Table 11.2.2, when tested in accordance with AASHTO T-27 after dry mixing and just before spreading

and compacting. The class of sub-base material to be used shall be as shown on the Drawings or otherwise as selected by the Engineer. The actual gradation shall, in all cases, be continuous and smooth within the specified limits for each class.

Table 11.2.2

Class	Sieve No.	2 1/2"	2"	1 1/2"	1"	1/2"	#4	#10	#40	#200*
A	%Passing	100	80-100	70-95	55-90	45-75	30-60	20-48	10-30	5-12
B		-----	100	80-100	60-95	47-80	30-60	22-45	10-30	5-12

- When gradation test is carried after compaction a tolerance of 3% shall be given to #200.
 - The sub-base material shall contain a minimum of 25% sand equivalent.
 - The loss in weight of sub-base material shall not exceed 45% after 500 revolutions, when tested in accordance with AASHTO T 96 (Los Angeles Abrasion Test).
 - The ratio of wear loss = $\frac{\text{Abrasion after 100 Rev.}}{\text{Abrasion after 500 Rev.}}$, should not be more than 20% of maximum allowed abrasion after 500 Rev.
 - The sub-base material shall have a CBR of not less than 40 when compacted at 100% of modified proctor AASHTO (T 180-D) and tested in accordance with AASHTO T193.
 - When tested for soundness in accordance with AASHTO T 104, the sub-base material shall not show signs of disintegration and the percentage loss in weight after 5 cycles shall not exceed 12% in the case of the sodium sulfate test and 18% in the case of the magnesium sulfate test.
 - The portion of sub-base material, including any blended material, passing the 0.425 mm (No 40) mesh sieve shall have a liquid limit (L.L.) of not more than 30 and a plasticity index (P.I.) shall be neither less than 2 nor greater than 8 when tested in accordance with AASHTO T 89 and T 90.
 - Maximum dry density (gm/cm³) 2.05min
 - Crystalline gypsum (expressed as SO₃) shall not exceed 5%
 - Clay lumps and friable particles shall not exceed 10%
 - Flakey and elongated particles shall not exceed 40% for crushed rock, 45% for crushed gravel, and 50% for natural gravel.

11.3. CONSTRUCTION

The material shall be processed by either road mix or plant mix methods. Materials processed by road mix methods shall be windrowed and equalized to the satisfaction of the Engineer prior to placement. The material in the windrow will be limited to the quantity necessary to construct a maximum compacted layer of 200 mm- layer. The equipment used to spread the material shall be a blade or other suitable equipment. Granular material that is dumped on the prepared surface shall be windrowed prior to incorporating additives. Materials processed by plant mix methods shall be fed uniformly into the mixer at a predetermined rate. The plant shall be equipped with positive proportioning devices and shall thoroughly mix the materials. When the material is laid by a spreader, it shall have been previously processed by a central plant.

Granular sub-base placed on shoulders adjacent to existing asphalt concrete or Portland cement concrete pavement, shall be mixed with water by a central plant and placed on the shoulder by an approved spreader. The material placed shall be limited to the quantity necessary to construct a maximum of a 100 mm-compacted layer. Each layer shall be compacted to the specified density before the next lift is placed and shall be rolled until a uniform, stable surface is obtained.

The sub-base material shall not be handled in such a way as to cause segregation. All segregated material shall be removed and replaced with well-graded material.

The sub-base material shall be compacted by means of approved compaction equipment, progressing gradually from the outside towards the center, with each succeeding pass uniformly overlapping the previous pass.

Rolling shall continue until the entire thickness of each sub-base layer is thoroughly and uniformly

compacted to 100% compaction of modified proctor according to AASHTO180 (Method D) maximum density. Final rolling of the completed course shall be by means an approved self-propelled roller. Rolling shall be accompanied by sufficient blading, to insure a smooth surface, free from ruts or ridges and having the proper shape.

Any areas inaccessible to normal compaction equipment shall be compacted by use of portable mechanical tampers until the required standard of compaction is achieved.

Each layer shall be completely compacted and approved prior to delivery of materials for the next layer. Prior to placing the next layer, the existing surface shall be made sufficiently moist as directed, to ensure proper bond between the layers.

Every 200 m along the roadway where sub-base material is placed or whenever there is a change in the material source shall be tested and if found satisfactory, shall be approved for compaction. Compaction shall be tested in accordance with AASHTO T 191 or any acceptable method.

12. GRANULAR BASE COURSES

12.1. DESCRIPTION

This works shall consist of furnishing crushed aggregate base course material of the required class, mixing, spreading on prepared sub-base course, compacting and finishing, all as and where shown on the Drawings.

12.2. MATERIAL

Aggregates and sand shall be crushed products, and shall not contain aggregates and sand which are natural or a product of blasting. The aggregate shall be strong, rigid and durable, water resistant and having features enabling its processing into a uniform, dense and stable base layer, by watering and compaction.

The stone used for aggregate production shall be of natural, crushed Dolomite, Limestone or basalt rock, or riverbed crushed gravel, except for Basalt or Flint riverbed gravel. The stone for the production of fine aggregate shall be of natural, crushed Dolomite or Limestone, or riverbed crushed stones. Samples for quality tests of base course and its components shall be taken from the production plant and the construction site after the material is spread.

Crushed aggregate for base course delivered to road site shall meet the requirements of class A or B gradations as shown in Table 12.2 –A, when tested in accordance with AASHTO T 27 after dry mixing and just before spreading and prior to compacting. The class of aggregate to be used shall be as shown on the Drawings or otherwise as selected by the Engineer. The actual gradation shall, in all cases, be continuous and smooth within the specified limits for each class as defined in Table 12.2.

Table 12.2

class	Sieve No.	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#200*
A	%Passing	-----	100	75-100	60-90	45-80	40-70	30-65	20-40	8-20	5-10
B		100	70-100	55-85	50-80	-----	40-70	30-60	20-50	10-30	5-12

When gradation test is carried after compaction a tolerance of 3% shall be given to #200.

Crushed stone and crushed gravel shall consist of hard, durable and sound particles or fragments of stone, free from other deleterious substances not mention below, other requirements are gypsum, or flaky particles.

The base course material shall contain a minimum of 35% sand equivalent at any stage of construction.

When tested in accordance with AASHTO T 96 (Los Angeles Abrasion Test), the loss in weight shall not exceed 45% after 500 revolutions,

The ratio of wear loss = $\frac{\text{Abrasion after 100 Rev.}}{\text{Abrasion after 500 Rev.}}$, should not be more than 20% of

the crushed aggregate base course material shall have a CBR of not less than 80 when compacted at 100% of modified proctor AASHTO (T180-D) and tested in accordance with AASHTO T 193.

When tested for soundness in accordance with AASHTO T 104, the material shall not show signs of disintegration and the loss by weight shall not exceed 12% in the case of the sodium sulfate test and 18% in the case of the magnesium sulfate test.

The portion of aggregate, including any blended material, passing the 0.425 mm (No.40) mesh sieve shall have a liquid limit (L.L.) of not more than 25 and plasticity index (P.I) 2-6 when tested in accordance with AASHTO T 89 and T 90. In case of using cohesion less base course material the exposed surface shall exhibit intact and coherent surface to resist water erosion and fretting, the contractor at his own expense shall ensure such property.

Elongated and flaky particles should not exceed a maximum of 35% each. Maximum Dry density (g/cm^3) 2.1 min. Clay lumps and friable particles shall not exceed 8%.

12.3. CONSTRUCTION

12.3.1. STOCKPILING OF AGGREGATE MATERIALS

Methods used for stockpiling aggregate materials and removing them from stockpiles shall not result in significant degradation or the introduction of significant amounts of foreign materials or extraneous matter. Aggregate materials adversely affected, in the opinion of the Engineer, by stockpiling or handling procedures, shall not be incorporated in the Works regardless of previous approval of such material, until the deficiencies have been rectified in an acceptable manner.

12.3.2. MIXING AND SPREADING

1. All components of base course material may be premixed with water, in a pugmill mixing plant or on site. The amount of water added, as determined, shall be such that the material will be uniform and within the specified moisture content range at the time of compaction. The Engineer may allow other methods of mixing provided such method(s) do not reduce the standard of work required by the specifications. If such alternative mixing methods are allowed the Contractor will be required to demonstrate, in the presence of the Engineer, his ability to attain the requirement given in the General Specification or Special Conditions as applicable.
2. The premixed material shall be placed on the sub-base in a uniform layer or layers not exceeding 250mm in thickness (before compaction). Where the required uncompacted thickness is greater than 250mm but less than 500 mm, the material shall be placed in layers of equal thickness.
3. If approved, heavy-duty vibratory compaction equipment is used, the maximum layer thickness may be increased up to 350 mm (after compaction) provided compaction tests indicate that the specified compaction standard will be attained.
4. The base course material shall be placed to the required width using a self-propelled spreader or motor grader, and shall be delivered such that it is ready for compaction without further shaping.
5. The material shall not be handled in such a way as to cause segregation. If the spreader causes segregation in the material, or leaves ridges or other objectionable marks on the surface which cannot be readily eliminated or prevented by adjustment of the spreader operation, the use of such spreader shall forthwith be discontinued and it shall be replaced by a spreader capable of spreading the material in a proper manner.
6. All segregated material shall be removed and replaced with well-graded material. "Skin" patching will not be permitted. Only minor surface manipulation and watering to achieve the required surface tolerances will be permitted during the compaction process.
7. Hauling or placement of material will not be permitted when, in the judgment of the Engineer, the weather or surface conditions are such that hauling operations will cause cutting or rutting of the sub-base or subgrade or cause contamination of the base course material.

12.3.3. COMPACTION

The Contractor shall plan the sequence of operations so that the least amount of water will be lost by evaporation from uncompleted surfaces. If the Contractor delays placing of succeeding layers of material to the extent that additional water is required to prevent raveling or excessive drying, the application of such Water shall be carried out in an approved manner and at the Contractor's expense. The base course material shall be compacted by means of approved compaction equipment, progressing gradually from the outside towards the center, with each succeeding pass uniformly overlapping the previous pass.

Rolling shall continue until the entire thickness of each base layer is thoroughly and uniformly compacted to 100% AASHTO T 180 (Method D) maximum density. Final rolling of the completed course shall be by means of an approved self—propelled roller. Rolling shall be accompanied by sufficient blading, to ensure a smooth surface, free from ruts or ridges and having the proper shape. When additional water is required, it shall be applied in an approved manner.

Any areas inaccessible to normal compaction equipment shall be compacted by use of portable mechanical tampers until the required standard of compaction is achieved, or to the satisfaction of the Engineer.

Each layer shall be completely compacted and approved prior to delivery of materials for the following layer.

Prior to placing a following layer, the surface shall be made sufficiently moist as directed, to ensure proper bond between the layers.

The edges and edge slopes of the base course shall be bladed or otherwise dressed to conform to the lines and dimensions shown on the Drawings and to present straight, neat lines and slopes as free of loose material as practicable.

Material which has dried out prior to final compaction, or which has dried and decompacted subsequent to final compaction, shall be watered and recompacted using approved equipment and procedures. If the Contractor is unable to return the material to its original or specified condition with respect to compaction, thickness and surface tolerances, for the final layer only the Contractor shall scarify the material and reconstruct the base course on a re-approved sub-base surface or to the satisfaction of the Engineer.

12.3.4. TOLERANCES

The fully compacted and completed base course shall conform to the lines, grades and cross sections as shown on the Drawings.

The elevations of the finished base course shall be checked by the Contractor in the presence of the Engineer at intervals of 20m on straight lines and of 10 m on curves, and at intermediate points as directed.

The tolerances (for final layer only) on elevations of finished surface shall not exceed +10mm or -15mm. When the finished surface is tested with a 4 m long straightedge, placed parallel to, or at right angles to the centerline, the maximum deviation of the surface from the testing edge between any 2 contact points shall not exceed 12 mm.

All areas which exceed the specified tolerances shall be corrected by removing the defective sections of base course and reconstructing them or, by scarifying and adding new material and recompacting and finishing to the specified standard.

12.3.5. MAINTENANCE OF COMPLETED BASE

Following completion and acceptance of the base course, the Contractor at his own expense shall maintain it. The surface shall be broomed, rolled and otherwise maintained, keeping it free from raveling and other defects until such time as the following course is placed. Water shall be applied at such times and in such quantities as directed.

12.3.6. TESTING

Table 12.3.6 Required Tests

Source of Materials		Control on Site (The Road)	
Required Test (A)	Repetition Required for all Tests in (A)	Required Tests (B)	Repetition Required for all Tests in (B)
1. Gradation of Materials	*Test for each source	1. Proctor	*Test for every 500 LM for each layer.
2. Plasticity Index	*For every 2000 cum.	2. Gradation of Materials	*When Materials changed
3. Abrasion	*When Materials changed	3. Plasticity Index	
4. C.B.R.		4. C.B.R.	
5. Sand equivalent		5. Abrasion	
6. Percentage of fractured Grains/Basecourse		6. Sand equivalent	
7. Any other tests as required in Tech. Specs and drawings		7. Clay Lumps & Friable particles	
		8. Any other tests as required in Tech. Specs. and drawings	
		9. Field Density	
		10. Thickness	
			* Test for every 750 sq.m. and for every layer

Sub-Base and Base course material shall be tested in accordance with Table 12.3.6 at stock pile and at the mixing plant for source of material tests and in-situ after dry mixing prior to spreading and compaction for control on site tests and if satisfactory shall be approved for use. This approval shall not be deemed to constitute acceptance of the base course for full payment purposes.

Compaction shall be tested in accordance with AASHTO T 191, AASHTO T 205 or any acceptable method. If there is a significant delay between the construction of any layer and the following layer, the Engineer may require the compaction of the lower layer to be re-verified to ensure that it has not loosened due to traffic, passage of construction equipment, adverse weather conditions or otherwise.

13. STABILIZED BASE COURSES

13.1. DESCRIPTION

These Works shall consist of furnishing, mixing, spreading, compacting and finishing courses composed of sand, sandy gravel, sandy clay soil or similar material including granular material which does not meet the standards specified for subbase, stabilized with cement or bitumen or lime as appropriate.

13.2. MATERIALS

Cement, bitumen and lime for use as stabilizing agents shall conform to the relevant requirements of materials as specified in other sections unless otherwise shown on the Drawings, the Engineer will determine the type of cement to be used or the type and grade of bitumen to be used, or whether hydrated lime or quicklime shall be used.

The material to be stabilized shall conform with the gradation and other requirements specified for the particular stabilizing agent to be used.

Curing seal shall consist of an approved proprietary curing compound, or MC-70 cutback bitumen to Prime Coat standard as specified in other Sections.

Water shall be potable and shall conform with the relevant requirements of Section 19.2.2.

13.3. CONSTRUCTION

Prior to placing of stabilized sub-base on subgrade, the subgrade shall have been properly completed and approved.

13.3.1. CONSTRUCTION OF TRIAL SECTION

If requested by the Engineer before commencement of the stabilization process and after completion of laboratory mix design, the Contractor shall lay a trial section of stabilized material 2 lanes wide by 50 m long, at an approved location on or near to the Site. This trial section shall be laid using the same materials, mix proportions, mixing, spreading and compaction equipment, and construction procedures that are proposed for use in the Works.

The trial section shall serve as a field verification of the laboratory mix design. The results of the dry density and moisture content measurements made in the trial section will be used in association with the laboratory team to establish the moisture content and minimum per cent compaction to be attained in the stabilization process.

The trial section shall also demonstrate the adequacy of mixer spreading and compaction equipment and the suitability of the methods and organization proposed.

13.3.2. CEMENT STABILIZATION PROCEDURES

13.3.2.1. MIX DESIGN

The material to be stabilized shall be a sandy or gravelly soil of a plasticity or aggregate, which conforms to the following gradations:

Table 13.3.2 Sandy and Gravelly Soils

. % By Weight Passing		
Sieve No	Aggregate	Soil
50 mm (2 in)	100	
20 mm (3/4 in)	60 – 95	100
4.75 mm (No 4)	15 – 75	50 - 100
0.425 mm (No 40)	10 – 35	15 - 60
0.150 mm (No 100)	5- 15	5 – 30
0.075 mm (No 200)	0 – 5	0 – 10

The cement content and optimum moisture content for the proposed mix shall be determined in the field laboratory and in the presence of the Engineer. Cylinders (or cubes) molded in accordance with AASHTO T 134 shall be cured and tested in compression at 7 days and 28 days. Curing shall be in accordance with AASHTO T 126. Load rate of application shall be in accordance with AASHTO T 22. The minimum compressive strength at 7 days after molding shall be 4 Mn/sq.m (40 kg/sq.cm) and the cement content of trial mixes shall be adjusted until this strength is achieved.

The maximum volume change (swelling) shall be 2% and the maximum loss in weight shall be not more than 8%, when cylinders are molded and tested in accordance with AASHTO T135, Method B. Cement content and water content of the mix on the Site shall each be within -0.2% to +2% of the approved mix design.

13.3.2.2. PLANT MIXING-GENERAL

When cement and granular material are to be mixed in a stationary plant, the plant shall be an approved type pugmill mixing plant of either the batch mix type with revolving blade or rotary drum, or the continuous mixing type. Proportioning of materials and of water may be by either weight or volume. Cement shall be added in such a manner that it is uniformly distributed during the mixing operation. Safe, convenient facilities shall be provided for sampling cement in the supply line to the weigh hopper or pugmill.

Means shall be provided whereby the Engineer may verify the amount of water per batch or the rate of flow for continuous mixing. The time of the addition of water and the points at which it is introduced into the mixer shall be as approved.

The charge in a batch mixer, or the rate of feed to a continuous mixer, shall not exceed that which will permit complete mixing of all of the material. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected.

The moisture content of the completed mixture shall be not more than one per cent below optimum moisture content at the point of delivery to the Works.

13.3.2.3. BATCH MIXING

Batch mixing plants shall be equipped with a sufficient number of paddles of a type and arrangement to produce a uniformly mixed batch.

The mixer platform shall be of ample size to provide safe and convenient access to the mixer and other equipment.

The mixer shall be equipped with a timing device which will indicate by a definite audible or visual signal the expiration of the mixing period. The device shall be accurate to within 2 seconds.

The time of mixing a batch shall begin after all ingredients are in the mixer and shall end when the mixer is half emptied. Mixing shall continue until a homogeneous mixture of uniformly distributed and properly coated materials of uniform appearance is produced. The time of mixing shall not be less than 30 seconds. When blending of different sizes is required, the materials shall be blended as they enter the mixer.

Cement for each batch shall be weighed on scales separate from the aggregate batching scales. Each cement scale graduation shall be approximately 0.001 times the total capacity of the scales. The total capacity shall not be greater than that of commercially available scales when weighing twice the amount of cement required when the plant is operated at full capacity. No scale shall be used with a capacity less than 500 kg.

13.3.2.4. CONTINUOUS MIXING

Continuous mixing plants shall be designed such that granular materials are drawn from the storage facility by feeders which continuously supply the correct amount of granular material in proportion to the cement and so arranged that the proportion of each size can be separately adjusted if more than one size is used. Storage facilities containing fine material shall be equipped with vibrating units which shall vibrate the side walls of the feeder to prevent any hang-up of materials while the plant is operating.

A control system shall be provided that will automatically close down the plant when the material in any storage facility approaches the strike-off capacity of the feed gate. The plant will not be permitted to operate unless the control system is in proper working order.

The feeder for the granular material shall be mechanically or electrically driven. Mechanically driven feeders shall be directly connected with the drive on the cement feeder. The drive shaft on the feeder shall be equipped with a revolution counter reading to 0.1 of 8 revolutions. Electrically

driven feeders shall be actuated from the same circuit that services the motor driving the cement feeder.

The cement feeder and the granular material feeders shall be equipped with devices by which the rate of feed can be determined while the plant is in full operation.

13.3.2.5. MIXED IN PLACE PROCEDURES

Mixed in place procedures will normally be permitted when the granular material to be stabilized is in situ Site material.

Plant and equipment for pulverizing (if required) and for mixing all materials will be approved on the basis of preliminary trials to establish that such plant and equipment are capable of producing the specified degree of mixing and uniformity of stabilized material for the full thickness of each layer. Single pass or multi-pass equipment may be used.

The mixing equipment shall be equipped with a device for controlling the depth of processing and the mixing blades shall be maintained or reset periodically so that the correct depth of mixing is obtained at all times. Cement shall be spread ahead of the mixer by means of a cement spreader, fitted with a device to ensure a uniform and controllable rate of spread of cement transversely and longitudinally.

If multi-pass equipment is utilized, the fine cohesive fraction (if any) of the material shall first be pulverized to the required depth with successive passes and the moisture content adjusted if it is more than 3% below the value required for compaction. Cement shall then be spread and mixing continued with successive passes until the required depth and uniformity have been achieved.

If it is necessary to adjust the moisture content of the material to the optimum for compaction, water shall be added during the mixing operation using a water sprayer of such design that the water is added in a uniform and controllable manner both transversely and longitudinally.

The mixing equipment shall be set so that it cuts slightly into the edge of any adjoining completed lane so as to ensure that all material forming the layer has been properly processed. The Engineer may approve the use of scarifiers or preparlzers ahead of the mixing equipment. The output of the mixing equipment shall be such that a minimum rate of 20 m/hr measured longitudinally of completed stabilized layer can be maintained in order to permit satisfactory compaction of the mix.

13.3.2.6. PLACING OF STATIONARY PLANT MIXES

Immediately prior to depositing the mix, the surface area to be covered shall be moistened and kept moist. The cement stabilized mix shall be protected against moisture loss during transporting, by use of suitable covers. The mix shall be deposited on the roadbed at a quantity per lin. m which shall provide the compacted thickness for the width being spread without resort to spotting, picking up, or otherwise shifting the mixture. Segregation shall be prevented and the mix shall be free from pockets of coarse or fine materials.

The mix shall be spread in widths of not less than 2 lanes, insofar as the width of surface permits. Longitudinal construction joints shall fall within 300 mm of lane lines. One or more spreaders operating in a staggered position across the subgrade shall spread the mix. If traffic conditions require that less than 2 lanes be spread, not more than 2 hours shall elapse between the times of placing the material in adjacent lanes.

The compacted thickness of any one layer shall not exceed 200 mm and shall be not less than 80 mm. When more than one layer is placed, the surface of the lower layer of compacted mix shall, until covered with the next layer, be kept moist with water or a curing seal as specified.

In the case of areas inaccessible to mechanical spreading equipment, the mix may be spread in one layer by approved methods only. After spreading, the material shall be thoroughly compacted to the required lines, grades, and cross section by means of pneumatic tampers, or other approved compacting equipment.

Use of motor graders will not be permitted during spreading or compacting operations. Motor graders may be used only to trim the edges and surface after compaction in order to finish within the specified tolerances.

A motor grader may be classified as a self-propelled mechanical spreader if it has been equipped

with end wings on the blade, has the blade locked in a position perpendicular to the direction of travel, and is equipped with cross slope and automatic grade controls that meet the requirements for the specified type of spreading.

Each layer of the mix shall be spread in one operation with an approved type self-propelled mechanical spreader such that the layer is made ready for compaction without further shaping. The spreader shall be provided with a fully automatic and adjustable screed that strikes off and distributes the material to the full width being spread and to the surface tolerances specified.

The spreader shall be equipped with grade sensing controls to automatically control the longitudinal grade and transverse slopes of the screed. Screed action includes any cutting, crowding, or otherwise that produces a finished surface texture of uniform appearance.

Cement stabilized mixes shall not be mixed or placed while the atmospheric temperature is below 2 degrees C and shall not be placed on frozen ground. A curing seal as specified shall be applied to the surface of the compacted mix before the atmospheric temperature approaches 2 degrees C.

13.3.2.7. COMPACTION AND FINISHING

Immediately upon completion of spreading or spreading and mixing in place operations, and completion of shaping, the mix shall be initially compacted by one complete coverage using approved type rollers.

If the finished surface after initial compaction is outside the specified tolerance, all high spots shall be trimmed off to within the specified tolerance. Filling of low areas by drifting or hauling of trimmed material will not be permitted.

Following trimming, the finished surface shall be finally compacted to not less than 100% of the laboratory density of the approved Job mix specimens as determined by AASHTO T 134. Final compaction shall be accomplished in such a manner that no loose material remains on the surface and all tear marks are eliminated.

The surface tolerances shall conform with the tolerance requirements for granular sub-base. In the case of any areas which are lower than the allowable tolerance, the stabilized layer shall be removed and fresh stabilized mix placed and properly compacted and finished, unless filling of the low areas with bituminous concrete or cement concrete is approved.

When the superimposed course will be cement concrete, the low areas may, if approved, be filled with concrete at the time and during the same operation that the concrete pavement is placed. Such additional concrete shall be at the Contractor's expense.

When the superimposed course will be bituminous concrete, the low areas may, if approved, be filled with bituminous concrete to the same standard. This filling shall be carried out as a separate operation prior to placing the bituminous concrete course (unless the thickness to be placed is too small to make this practicable) and shall be at the Contractor's expense.

Not more than 2 hours shall elapse between the time water is added to the mixed materials and the time of completion of initial compaction. Final compaction shall be completed within 30 minutes of initial compaction.

At the end of each day's work and when operations are delayed or stopped for more than 2 hours, a vertical construction Joint shall be made in the fully compacted layer, perpendicular to the centerline. Additional mix shall not be placed until the construction joint has been approved.

One hour after the stabilized mix has been finally compacted, vertical longitudinal joints shall be constructed by cutting into flue existing edge to a depth of approximately 100 mm. The mix cut away shall be discarded. The face of the cut joints shall be moistened in advance of placing the adjacent lane.

13.3.2.8. CURING

Curing seal as specified shall be applied uniformly to the completed surface at a rate of between 0.75 and 1.25 ltr/m², as determined by the Engineer. The curing seal shall be applied on the same day that final compaction is performed and as soon as practicable thereafter. The surface shall be kept moist until the seal is applied.

Damage to the curing seal or stabilized surface shall be promptly repaired by the Contractor at his own expense, in an approved manner

13.3.2.9. TESTING OF CEMENT STABILIZED COURSES

For every 5,000 m² of each stabilized layer or for each day completed area, (whichever is smaller), the following sampling and testing shall be carried out.

In situ density of a minimum of 3 samples (taken immediately after final compaction) determined in accordance with AASHTO T 191 or T 205 and which shall be not less than 100% of the density of the approved laboratory mix. Cement content in accordance with AASHTO T 211. Gradation of mix in accordance with AASHTO T 27.

Moisture - density relationship for mix sampled fresh from the Site, in accordance with AASHTO T 134 if the source of the material is changed.

Compressive strength of a set of 3 test specimens molded and cured in accordance with AASHTO T 134 and T 126, and tested in accordance with AASHTO T 22.

13.3.3. BITUMEN STABILIZATION PROCEDURES

13.3.3.1. MIX DESIGN

The material to be stabilized if specified in the Special Specification shall be a sand, sandy gravel or silty or clayey gravel and sand material with a P.I. not exceeding 12% and L.L. not exceeding 25% and with not more than 30% passing a 0.075 mm (No. 200) sieve.

Field laboratory trial mixes, carried out in the presence of the Engineer, shall establish bitumen-soil mix proportions. The compressive strength shall be determined in accordance with AASHTO T 167 and in such a way to insure that the optimum composition of the mix is established.

The laboratory trial mixes, after being air cured for a period of 7 days and tested in accordance with AASHTO T 167, shall have a minimum compressive strength at 25 degrees C, of 2 MN/m² (20 Kg/cm²) and a Marshall stability at 60 degrees C, of 2,000 N (204 kg). The Retained Strength when tested using a Marshall mould shall be not less than 70%.

13.3.3.2. STATIONARY PLANT MIXING

When approval is given to utilize stationary plant for mixing, whether batch mixing plant or continuous type mixing plant, the plant and equipment and handling and mixing procedures shall conform with the relevant requirements of Section 16 and with the appropriate requirements specified herein for plant mixing of cement stabilized materials.

13.3.3.3. MIXED IN PLACE PROCEDURES

Approved type multi-pass or approved type purpose-built, single-pass equipment shall be utilized for on Site mixing and placing. Operators shall be trained and fully experienced in the operation of such equipment. Multi-pass equipment may consist of suitable bitumen distributor and motor graders or as otherwise approved.

The process of pulverizing the fine-grained cohesive fraction (if any) of the granular material shall be as specified for cement stabilized courses. Bitumen, of the type and grade selected by the Engineer, shall then be applied to the surface using approved type heating and pressure distribution equipment. Emulsified bitumen shall not normally require heating.

Spreading and mixing of the bitumen and granular or other material shall be carried out as specified for cement-stabilized courses.

13.3.3.4. PLACING AND SPREADING STATIONARY PLANT MIXES

The placing and spreading of stationary plant mixes shall be as specified for cement stabilized courses.

13.3.3.5. COMPACTION AND FINISHING

Compaction of bitumen stabilized courses to 100% of laboratory density of approved job mix specimens, finishing, and provision of longitudinal joint shall be as specified for cement stabilized courses.

13.3.3.6. TOLERANCES AND REPLACEMENT OF UNSATISFACTORY AREAS Finished surface tolerances and the rectification procedures for any area which fail to meet such tolerances shall be as specified for cement stabilized courses.

In the case of high spots requiring trimming after initial compaction raking or similar procedures may be required. If the area is unduly damaged pitted, the stabilized mix shall be removed and replaced with fresh stabilize mix spread and properly compacted and finished.

13.3.3.7. TESTING OF BITUMEN STABILIZED COURSES

For every 5,000 m² of each stabilized layer or for each days completed area (whichever is the smaller), the following sampling and testing shall be carried out.

In situ density of a minimum of 3 samples (taken immediately aft completion of final compaction) determined in accordance with AASHTO T 191 or T 205 and which shall be not less than 100% of the density of the approved laboratory mix.

Composition of the mix by extraction in accordance with AASHTO T 164

Compressive strength in accordance with AASHTO T 167, of samples before compaction. Marshall stability in accordance with AASHTO T 245, of samples before compaction.

13.3.4. LIME STABILIZATION PROCEDURE

13.3.4.1. MIX DESIGN

The material to be stabilized shall be a clayey gravel, clayey sand lean clay soil with not more than 50% passing 0.425 mm (No. 40) sieve Plasticity Index greater than 10%. 1.2 The lime content and optimum moisture content shall be determined in the field laboratory and in the presence of the Engineer. Cylinders or cubes molded in accordance with AASHTO T 220 shall be cured and tested at 7 days and 28 days. Load rate of application shall be in accordance with AASHTO T 22. The minimum compressive strength at 7 days after molding shall be one MN/m² (10 kg/cm²).

Lime content and water content of the mix on Site shall each be within -0.2% to +2.5 of the approved mix design percentages.

13.3.4.2. SAFETY PRECAUTIONS

Special precautions shall be taken when handling quicklime as it will rapidly corrode equipment and can inflict severe skin burns to personnel coming in contact with it.

Suitable methods for handling quicklime shall be adopted, including fully mechanized or bottom dump handling equipment and protective clothing worn by the operators. Working operations should take into account the wind direction to minimize the dust problem and consequent eye or skin irritation to any personnel in the vicinity.

When hydrated lime is used, precautions shall also be taken against the effects of prolonged exposure to the skin.

13.3.4.3. STATIONED PLANT MIXING

When approval is given to utilize stationary plant for mixing, whether batch mixing plant or continuous type mixing plant, the plant and equipment and handling and mixing procedures shall be as specified for cement stabilization and as specified herein for plant mixing of lime stabilized materials.

13.3.4.4. MIXED IN PLACE PROCEDURES

Mixed in place procedures will normally be permitted when the soil to be stabilized is in situ site material.

Spreading and mixing of the lime and soil material shall be carried out as specified for cement stabilized courses.

13.3.4.5. PLACING AND SPREADING STATIONARY PLANT MIXES

The placing and spreading of stationary plant mixes shall be as specified for cement stabilized courses.

13.3.4.6. COMPACTION AND FINISHING

Compaction of lime stabilized courses to 100% of laboratory density of approved job mix specimens, finishing and provision of longitudinal joints, shall be as specified for cement stabilized courses with the following modifications:

When quick lime is used, the layer shall not be compacted immediately after spreading the lime, as hydration of the lime will cause damage to the compacted layer. The time within which the compaction shall be completed will be estimated in the laboratory.

Compaction shall not take place after lime hydration. Any lime stabilized material that has been mixed or deposited after lime hydration, shall be removed and replaced with fresh material, mixed and treated as specified.

13.3.4.7. TOLERANCES AND REPLACEMENT OF UNSATISFACTORY AREAS Finished surface tolerances and the rectification procedures for any areas that fail to meet such tolerances shall be as specified for cement stabilized courses.

13.3.4.8. TESTING OF LIME STABILIZED COURSES

For every 5,000 m² of each stabilized layer or for each day's completed area (whichever is the smaller) the following sampling and testing shall be carried out.

In situ density of a minimum of 3 samples (taken immediately after completion of final compaction) determined in accordance with AASHTO T 191 or T 205 and which shall be not less than 100% of the density of the approved laboratory mix.

Lime content in accordance with AASHTO T 232. Gradation of mix in accordance with AASHTO T 27.

If the source of materials changes, the moisture - density relationship in accordance with AASHTO T 134 and gradation of the new mix in accordance with AASHTO T 27.

Compressive strength of a set of 3 test specimens molded and cured in accordance with AASHTO T 134 and T 126, and tested in accordance with AASHTO T 22.

14. BITUMINOUS PRIME AND TACK COATS

14.1. DESCRIPTION

These works shall consist of furnishing and applying prime coat to a previously constructed subgrade, sub-base or aggregate base course, shoulders, and furnishing and applying bitumen as a tack coat to a previously constructed bituminous base or wearing surface to provide bond for a superimposed bituminous course; all as and where shown on the Drawings.

14.2. MATERIALS

14.2.1. PRIME COAT

MC-70 cutback bitumen (for prime coats) shall conform with the requirements of AASHTO M 82 or equivalent.

14.2.2. TACK COAT

RC-250 cutback bitumen (for tack coats) shall conform with the requirements of AASHTO M 81 or equivalent.

14.3. CONSTRUCTION

Application of prime coats and tack coats shall be performed only when the surface to be treated is sufficiently dry for tack coat and sufficiently moist for prime coat, and when the atmospheric temperature is above 10 C for the application of tack coat, 15 C for the application of prime coat. There should be no fog, rain, strong winds, dusty conditions, or dust storms.

Traffic shall not be permitted on surfaces after they have been cleaned and prepared for prime or tack coat application.

The Contractor shall maintain prime coats and tack coats intact until they are covered by the subsequent

pavement course. Any area where the coats have been damaged shall be cleaned of all loose material, any surface defects repaired and the coat re-applied at the Contractor's expense

Prime coat (MC-70) shall be applied at the rate selected by the Engineer (1-1.5 kg/m²).

Prime coats shall be cured for 3 days before traffic is allowed on it or before the succeeding pavement layer is placed, or as directed by the Engineer.

Tack coat (RC-250) application shall be applied on clean dry surface and the rate shall be as ordered by the Engineer (0.2 - 0.5 kg/m²).

The tack coat shall be allowed to dry only until it is in a suitable tacky condition to receive the superimposed bituminous course. Tack coat application shall not proceed so far in advance of the following course that it dries out completely.

15. BITUMINOUS SEAL COAT

15.1. DESCRIPTION

These Works shall consist of the furnishing of materials and one or more applications of cutback bitumen and cover material, or a single application of emulsified bitumen, to previously prepared base course or wearing course surfaces, as and where shown on the Drawings.

15.2. MATERIALS

15.2.1. BITUMEN

Bitumen for seal coat applications shall be Rapid-Curing RC-800 Grade and or any suitable grade conforming AASHTO M-81.

15.2.2. AGGREGATES

Cover aggregates for bituminous seal coats shall consist of screenings of crushed stone. Gravels shall not be used for seal costs.

Flakiness Index and Elongation Index tested in accordance with BS-812 shall not exceed 25% for each of flakiness and elongation index. The percentage by weight of clay lumps & friable particles as determined by AASHTO T 112 shall not exceed 3%. Light weight aggregate of specific gravity of 2 or less shall not exceed 3% as determined by AASHTO T113.

Cover aggregates when tested in accordance with AASHTO T 27 and T11 shall conform to the gradations given in Table 15.2.

Table 15.2: GRADATION OF AGGREGATES FOR SEAL COATS

2nd Application Grading C	1st Application Grading B	Sieve Size Designation (Square openings)
	100	1"
	90 – 100	3/4"
100	20 – 55	1/2"
58 - 100	0 – 15	3/8"
10 - 30	0 – 5	No.4
0 - 10	-	No.8
0 - 5	-	No.16
0 - 0.5	0 - 0.5	No. 200

1. The loss in weight of aggregate after 500 revolutions, when tested in accordance with AASHTO T 96 (Los Angeles Test), shall not exceed 35%.
2. When tested for soundness in accordance with AASHTO T 104, the aggregates shall not show signs of disintegration and the loss by weight shall not exceed 10% in the case of the sodium sulfate test or 12% in the case of the magnesium sulfate test.
3. When tested for resistance to stripping in accordance with AASHTO T 182, at least 95% of the aggregate surface area shall remain coated with a bitumen film.
4. The material shall contain minimum 50% of sand equivalent as determined by AASHTO T 176.

15.3. CONSTRUCTION

Application rates for bitumen and for the various cover aggregate gradations will be determined by the Engineer from the trial sections and shall be generally within the ranges given in Table 15.3

Table 15.3: APPLICATION RATES

Types of seal Coat	Approx. Rate of Application	
	Aggregate	Bitumen
	(kg./m ²)	(Kg/m ²)
Coarse agg. Seal Coat (1st)	12.5 – 20.0	1.00 – 1.80
Medium agg. Seal Coat (2nd)	10.0 – 15.0	0.90 – 1.80

Applications of bitumen and aggregate and subsequent rolling shall be completed between sunrise and sunset and under favorable weather conditions as determined by the Engineer. The atmospheric temperature shall be above 15 degrees C and the weather shall not be foggy, rainy, dusty or unduly windy.

The surface to be treated shall be dry or slightly damp and the moisture content of aggregates at the time of application to the coated surface shall not exceed 3% by weight.

Unless otherwise directed, the minimum time interval between successive seal coats shall be 5 days.

When coatings are applied to existing pavement surfaces, all pavement repairs shall first be completed. Immediately before applying any bituminous material, all dirt, dust and other objectionable material shall be removed from the surface and cracks shall be repaired or sealed as directed. If required, the surface shall be slightly dampened with a light application of water immediately prior to application of bitumen.

The bitumen cutback or emulsified bitumen for fog and seal coats shall be applied by means of a pressure distributor uniformly and continuously over the section to be treated. The rate of application shall be as designated by the Engineer.

Distribution of bitumen shall be so regulated and sufficient material left in the distributor at the end of each application, that there will be a uniform distribution across the spray bar. In no case shall the distributor be allowed to expel air with the bitumen, thereby causing uneven coverage.

Immediately upon application of bitumen, aggregate of the required gradation shall be spread at the rate designated by the Engineer. Spreading shall be accomplished in such a manner that the tires of the hauling units or aggregate spreader do not come in contact with the uncovered bitumen surface.

Initial “breakdown” rolling shall proceed behind the spreader (after any adjustments by hand methods to correct for uneven distribution, etc.). One complete coverage shall be achieved using 2-axle self-propelled steel-wheeled rollers of 6-8 tons weight and operating at a maximum speed of 5 km/h. Initial rolling shall be completed within 30 minutes of spreading aggregate.

The Engineer may order the alternative use of pneumatic-tired rollers for initial rolling if the achievement of adequate embedment of the aggregate is liable to result in excessive crushing when steel-wheeled rollers are used.

Immediately following completion of the initial rolling, the surface shall be rolled using self- propelled pneumatic-tired rollers operated at a maximum speed of 8 km/h, until at least 3 complete coverage's have been achieved.

If necessary during rolling operations, additional screenings shall be lightly spread by hand methods and re-rolled, to make good any small areas visibly deficient in cover material.

16. ASPHALT CONCRETE

16.1. DESCRIPTION

These Works shall consist of furnishing materials, mixing at a central mixing plant, and spreading and compacting bituminous binder course and bituminous wearing course on an approved base course as and where shown on the Drawings.

16.2. MATERIALS

16.2.1. AGGREGATE

1. Aggregates for use in bituminous binder and wearing courses, and leveling course shall consist of crushed stone of Dolomite, limestone, or basalt with minimum bulk specific gravity of 2.5 on dry basis.
2. Coarse aggregate shall be the fraction of crushed aggregate material retained on 4.75 mm (No. 4) sieve. Fine aggregate shall be the fraction of crushed aggregate material passing 4.75 mm (No.4) sieve. Mineral filler shall be added when the combined grading of coarse and fine aggregates is deficient in material passing 0.075 mm (No.200) sieve.
3. The material from hot bins passing the number 40 sieve (0.425mm) when tested in accordance with AASHTO T90 shall be non plastic. In addition the material from cold bins should not have P1 larger than 4.
4. The percentage by weight of friable particles, clay lumps, and the deleterious matter shall not exceed 1.0% as determined by AASHTO T112.
5. The flakiness index and the elongation index test should be conducted in accordance with BS 812, the following are the maximum limits:

	Wearing Course	Binder Course
Flakiness Index F.1	25	30
Elongation Index E.1	25	30

6. Combined coarse and fine aggregates for bituminous mixes, including mineral filler, when tested in accordance with AASHTO T 27 and T11, shall conform to the gradations shown in Table 16.2.1.
7. The loss in weight of aggregate after 500 revolutions, when tested in accordance with AASHTO T 96, shall not exceed 35%.

$$\text{Ratio of wear loss} = \frac{\text{Abrasion after 100 Rev.}}{\text{Abrasion after 500 Rev.}}, \text{ less than or equal to } 20$$

8. When tested for soundness in accordance with AASHTO T 104 the coarse aggregate (retained on No.4 sieve) shall not show signs of disintegration and the loss by weight after 5 cycles shall not exceed 9% in the case of the sodium sulfate test and 12% in the case of the magnesium sulfate test.
9. When tested for resistance to stripping in accordance with the AASHTO T-182 at least 95% coated particles should be achieved.
10. The material shall contain a minimum of 50% sand equivalent. Test sample shall be taken from hot bins.
11. The material shall not contain more than 5% chert .

Table 16.2.1: GRADATION OF COMBINED COARSE AND FINE AGGREGATES FOR BITUMINOUS MIXES

SIEVE SIZE	PERCENT PASSING BY-WEIGHT GRADATION			
	Binder Course	Wearing Course	Thin Course*	Thin Course*
	(1")	(3/4")	(1/2")	(3/8")
1"	100	–	–	–
3/4"	70–100	100	100	–
1/2"	54–82	74–95	90–100	100
3/8"	44–74	60–86	–	90–100
No 4	32–54	40–65	45–70	60–80
No 8	–	–	25–55	35–65
No 10	–	25–45	–	–
No 16	–	–	–	–
No 20	14–30	16–30	–	–
No 30	–	–	–	–
No 40	8–23	10–22	–	–
No 50	–	–	5–20	6–25
No 80	4–15	6–15	–	–
No 100	–	–	–	–
No 200	2–8	3–8	2–9	2–10

*For less than 4 cm wearing or leveling courses.

16.2.2. MINERAL FILLER

Mineral filler where required shall consist of limestone dust, dolomite dust, Portland cement, or other nonplastic mineral matter from sources approved by the Engineer. It shall be free from foreign or other objectionable material. It shall be dry and free from lumps and when tested by means of laboratory sieves shall meet the following grading requirements:

Sieve Designation	Percentage By Weight Passing Square Mesh Sieves (AASHTO T27)
No. 30 (.60 mm)	100
No. 80 (.18 mm)	95 – 100
No. 200 (.07 mm)	65 – 100

16.2.3. AGGREGATE TESTING

Aggregates quality test samples shall be taken daily as a minimum or according to the contract document requirements, during the whole time of production. The samples shall be taken from the crusher belts, from storage or from the hot bins at the asphalt plant, after the drying.

16.2.4. BITUMEN FOR ASPHALT

Unless otherwise shown on the Drawings, bitumen for binder and wearing courses construction shall be PG (68-10), or (70-10), or any other suitable grade for the climatic condition of the project.

Binder Course	Wearing Course	
3.5 - 6.0	4.0-7.0	Bitumen Content %

16.2.5. THE MIXTURE PROPERTIES

The finished mixture properties, prepared and tested, shall be as defined in the following table (the exact amount of bitumen shall be determined as defined in Table 16.2.5):

Table 16.2.5

JOB MIX REQUIREMENTS TO BITUMINOUS BINDER AND WEARING COURSE

No	Property	Heavy	Traffic	Medium–	Light Traffic
		Binder	Wearing	Binder	Wearing
1.	Marshall Stability min.(kg) *	900	1000	800	900
2.	Flow (mms)	2 – 3.5	2 – 3.5	2 – 4	2 – 4
3.	Voids in Mineral Aggregate (VMA)	13 (-1)	14 (-1)	13 (-1)	14 (-1)
4.	Air Voids (%) **	4 – 7	4 – 6	3 – 5	3 – 5
5.	Stiffness (kg/mm)	500 Min	500 Min	400 Min	400 Min
6.	Loss of Stability (%) ***	25 max	25 max	25 max	25 max

*Loss of stability after 30 minutes versus stability after 24 hours for samples immersed in water at 60C

* Only one cylinder shall be allowed to reach lower stability by not more than 100 kg.

** The % of the voids shall be determined by direct measurement using the theoretical maximum density of the sample.

16.3. CONSTRUCTION**16.3.1. DESIGNING THE COMPOSITION AND FORMULA OF THE MIXTURE**

At least 30 days prior to the date the Contractor intends to begin production at the mixing plant and after receiving approval of the aggregates, and after the delivery to the Site of the bitumen specified, the Contractor shall submit for approval his proposed Job Mix Formula. Therefore sample from materials use in preparing mix design (aggregates and bitumen) shall be sent to the Owners laboratories to be tested for final approval of the mix design.

The Job Mix Formula shall stipulate a single combined grading of all aggregate and filler materials showing the specific % by weight passing each sieve size and the specific % by weight of each material to be used in the total mix.

The Job Mix Formula shall be established by the Contractor, under the supervision of the Engineer, in the field laboratory. Mix design procedures shall conform with the Marshall method of mix design and relevant procedures contained in Asphalt Institute Manual MS-2. All trial mixes shall be prepared and tested by the Contractor in the presence of the Engineer.

The job Mix Formula shall specify a combination of mineral aggregates including filler and bitumen (plus bitumen modifier if any) in such proportions as to produce a Job Mix which is within the limits of the specified gradation and bitumen content ranges and which meets the Marshall test requirements, as prescribed for each particular type of bitumen course. it shall also stipulate the mixing temperature at discharge from the mixer which, unless otherwise directed, shall be 170 degrees C.

The Marshall test procedure shall be used to determine the percentage of bitumen to be incorporated in the mix. The job Mix Formula shall take into consideration the absorption of bitumen into the aggregates. Air voids shall be calculated in accordance with the procedure given in the Asphalt Institute Manual, MS-2.

When compacting specimens in accordance with the Marshall test procedure, the number of blows applied with the compaction hammer shall be 75 on each side, unless otherwise specified.

In order to meet the requirements, an approved additive such as portland cement, hydrated lime or a liquid antistrip agent, may be required in the Job Mix. Portland cement shall meet the requirements of AASHTO M 85. hydrated lime shall meet the requirements of ASTM C207, Type N. Cement or hydrated lime will normally be required in the approximate range of 2-3% by weight of the aggregates and shall be added at the cold feed in dry or slurry form as directed. Liquid antistriping agent, if needed will normally be required in the approximate range of 0.6-1.0% by weight of the bitumen, or according to the manufacturers specifications.

Upon receipt of approval of the job Mix Formula, the Contractor shall adjust his mixing plant to proportion the individual aggregates, mineral filler and bitumen to produce a final project mix within the limits given in Table 4.10 with respect to the Job Mix gradations:

Table 16.3.1 Maximum Variations of Project Mix From Approved Job Mix

Sieve Designation (square openings)	Specified Tolerances
9.5 mm (3/8 in.) and above	+ or - 5.0%
4.75 mm (No. 4)	+ or - 4.0%
2.36 mm (No. 8)	+ or - 4.0%
1.18 mm (No. 16)	+ or - 4.0%
0.600 mm (No. 30)	+ or - 4.0%
0.300 mm (No. 50)	+ or - 4.0%
0.150 mm (No. 100)	+ or - 4.0%
0.075 mm (No. 200)	+ or - 1.5%
Bitumen Content	+ or - 0.3%
Temperature of Mix on discharge temperature	+ or - 5°C of the specified mixing temperature

Any deviation from these limits shall be made only with the approval of the Engineer, unless it is allowed for in the Special Conditions.

Conformance to gradation requirements will be determined on the extracted aggregate in accordance with AASHTO T 30. The bitumen content shall be determined in accordance with AASHTO T 164.

The Engineer will test the project mix at least twice daily during plant operation and, if necessary, direct the Contractor to readjust the plant to conform to the job Mix Formula. If, due to differing cold feed or hot bin gradations, the Contractor cannot consistently produce a project mix meeting the Job Mix requirements, production shall cease, the job Mix shall be redesigned and re-approved and the plant readjusted to produce a new Job Mix.

The participation of the Engineer in the preparation of the Job Mix Formula shall in no way relieve the Contractor of responsibility for producing project mixes meeting the specified requirements.

16.3.2. REQUIREMENTS FOR ALL PLANTS

The central plant for mixing the mineral aggregate and asphalt binder may be a batch or drum mix type mixing plant. When mineral filler hydrated lime, or other additives are required, a separate feed system shall be provided to store and accurately and uniformly proportion the required quantity into the mixture. All cold feed bins shall be equipped with dividers to prevent overflow of aggregate to adjacent bins.

The plant shall be equipped with emission control equipment including a dust collector capable of eliminating or conserving the dust necessary to meet gradation limits and environmental standards.

A pyrometer or other thermometric instrument shall be installed in the supply line between the storage tank and the discharge point in the plant to accurately measure the temperature of the asphalt binder. The plant shall be equipped with accurate weighing or volumetric measurement devices.

Asphalt binder storage tanks shall be kept level. Accurate calibration charts which show the quantity of material contained in a tank at each 1/4 inch (5 mm) increments of depth and a suitable device to measure the depth of the material shall be provided. Storage tanks shall uniformly heat the material, under effective and positive control, to the required temperature. Heating shall be accomplished by steam coils, electricity, or burners, provided the flame does not come in direct contact with the heating tank. The asphalt circulating system shall be of adequate size to insure proper and continuous circulation

during the entire operating period. If hydrated lime is used, the Contractor's hydrated lime system shall be equipped with scales to accurately determine the amount of hydrated lime used at any time. Alternate methods to accurately determine the amount of lime used must be approved by the Engineer. Hydrated lime shall be added at the specified rate with a tolerance of ± 0.10 percent by weight of mix.

16.3.3. BATCH TYPE MIXING PLANTS

Batch type plants shall have at least two storage bins with sufficient capacity to furnish the quantity of mineral aggregate materials necessary to operate at the calibrated capacity of the plant. Each compartment shall have partitions that prevent diversion of materials into other compartments. Vibrators shall be provided to prevent bridging or arching of the bin contents.

Batch plants shall be fully automatic, to the extent that the only manual operation required would be for the proportioning of one batch utilizing a single actuation switch or starter. The automatic unit shall include a timer to automatically control the measuring, mixing and dumping processes through a central control. The automatic unit shall include a time lock device, which is capable of controlling the operations of a complete mixing cycle. A recording pyrometer shall be mounted in the discharge chute of the dryer. Daily charts of continuous aggregate temperature readings shall be submitted to the Engineer.

16.3.4. DRUM MIX PLANTS

The dryer drum shall uniformly heat, coat and mix the materials without overheating the materials and adversely affecting the mixture. Materials and additives shall be fed simultaneously into the dryer. Recycled asphalt (RAP) when specified to be used shall be fed at the midpoint of the drum unless the drum mix plant has a manufacturer's design technology made specifically for RAP entry at a different location.

The aggregate feed system shall provide positive control of the aggregate feed that can be easily and accurately calibrated. The rate of feed shall be continuously monitored, by belt scale, or other device that is interlocked with the asphalt metering mechanism.

The asphalt metering device shall positively control the rate asphalt is introduced into the mixture and shall respond instantaneously to variation in the aggregate feed rate.

Production shall be limited to the rate required to obtain uniform aggregate coating and a uniform mixture meeting job mix temperature requirements. The rate must be within manufacturers rated plant capacity.

A RECORDING PYROMETER SHALL BE MOUNTED IN THE DISCHARGE END OF THE MIXER FOR DETERMINING THE TEMPERATURE OF THE MIX. DAILY CHARTS OF CONTINUOUS MIX TEMPERATURE READINGS SHALL BE SUBMITTED TO THE ENGINEER.

16.3.5. PAVERS

Bituminous courses shall be spread and finished using approved type, self-contained, power—propelled pavers of sufficient capacity to be capable of laying up to 80 ton/hr. Pavers shall be provided with electronically controlled vibratory screed or strike-off assembly with devices for heating the screed, and shall be capable of spreading and finishing the various courses of bituminous plant mix to the proper thickness and in lane and shoulder widths applicable to the typical cross sections shown on the Drawings, and in incremental widths down to 2.4 m minimum and up to 8 m maximum.

The pavers shall employ mechanical devices such as equalizing runners, straightedge runners, evener arms or other compensating devices, to maintain trueness of grade and confine the edges of the mix to true lines without the use of stationary side forms. Joint leveling devices shall be provided for smoothing and adjusting longitudinal joints between lanes.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mix uniformly in front of the full length of the screed.

The screed or strike-off assembly and extensions shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mix.

The paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mix. Speed shall be fully adjustable between 3 m/min and 6 m/min.

The automatic controls shall consist of an automatic linkage arrangement such that, through the process of automatically adjusting the screed thickness control, the mix can be placed and finished to a predetermined grade and a uniform crown or cross section. Articulated averaging beams shall be at least 9 m in length.

If during construction, it is found that the spreading and finishing equipment in operation leaves in the pavement surface tracks or indented areas or other objectionable irregularities that are not satisfactorily corrected by scheduled operations, the use of such equipment shall be discontinued and other satisfactory spreading and finishing equipment shall be provided by the Contractor.

The Contractor shall make available, for reference by the Engineer, the manufacturer's instruction and operating manuals for each paver intended for use.

16.3.6. COMPACTION

All rollers shall be self-propelled vibratory steel wheel, 2—axle tandem steel-tired and pneumatic-tired types, in proper operating condition, capable of reversing without backlash or tearing of the surface, and shall be operated at speeds slow enough to avoid displacement of the bituminous mix. The minimum numbers of rollers required is 3, of which one must be a pneumatic type. The Contractor shall select a suitable method and pattern of rolling that will achieve the required compaction, to the Engineers approval.

Rollers shall be equipped to prevent "pickup" on the tires or drums. Moistening the drums or tires with water, a water detergent solution, or enclosing the roller to prevent heat loss from the tires may be required. The use of fuel oil or other petroleum solvents to prevent "pickup" will not be permitted. Measures shall be taken to prevent oil, grease, or fuels from being dropped on the mat by rollers or any other type of equipment.

If vibratory rollers are used, when it is required to change direction the vibration should be turned off before the roller is stopped, and turned on after motion in the new direction begins.

Rolling shall begin as soon as the mixture will bear the roller weight without undue displacement. The minimum temperature of the mat at which rolling shall be allowed to start is 120°C.

Breakdown rolling shall consist of 3 complete coverage's unless otherwise directed. Rolling shall be longitudinal, beginning at the low side of the spread of material and proceeding towards the high side, overlapping on successive trips by at least one half the width of the rear wheels. Alternate trips of the rollers shall be of slightly differing lengths.

The Engineer shall approve the speed of the rollers, rolling pattern and, in the case of vibratory rollers, the frequency and amplitude of vibration. To prevent adhesion of the mix to the rollers, the wheels shall be kept properly and lightly moistened with water. An excessive use of water will not be permitted.

The rolling pattern, type and number of rollers shall be established by a site trial so as to achieve the required compaction. The approved rolling pattern shall be followed.

Intermediate rolling involving 3 coverages with pneumatic-tired rollers unless otherwise specified shall follow the initial or breakdown rolling. Tire contact pressure shall be as approved.

Finishing rolling shall then be carried out by means of tandem power steel rollers unless otherwise designated. If, the specified density is not achieved, changes shall be made in size and number of rollers being used to ensure the compaction requirements are met.

The compacted density shall be equal to or greater than 97% and 98% for binder course and wearing course, respectively, of the average Marshall bulk specific gravity for each day's production unless otherwise directed by the Engineer, or allowed for in the Special Specification.

Any mix that becomes loose, broken, mixed with foreign material, or which is in any way defective in finish or density, or which does not conform in all other respects with the specified requirements shall be removed, replaced with suitable material and properly finished.

16.3.7. STOCKPILING AGGREGATE

Stockpiles of mineral aggregate for Asphalt Concrete shall be built in layers, completing each layer over the full area of the pile before the next layer is started. The height of each layer shall be controlled to minimize segregation. The maximum drop of the materials from the conveyor shall not exceed three meters. Coning shall not exceed three meters. The stockpile shall be leveled with rubber-tired equipment between layers to maintain a level platform for the next layer. Dumping, casting, or pushing over the sides of the previous layers will not be permitted. Segregated piles will be rejected until corrected.

The equipment operating on the pile shall be free of dirt, grease, oil, and other contaminants. The size of the equipment shall be limited to that which can be operated on the stockpile without degradation of the material. The leveling requirement will be waived for the fines stockpile when split on a 6.3 mm or smaller screen unless there is indication of segregation. Aggregate stockpiles shall be kept separate and adequate measures to prevent contamination must be used at stockpile sites.

16.3.8. STOCKPILE TESTS

The Contractor shall run process control tests on the mineral aggregate when producing material. A gradation, PI, crushed and lightweight particles test shall be run for every 1500 metric tons produced per pile. The Contractor shall also test the quality (abrasion and soundness) of the mineral aggregate. The quality shall be tested once per source. The Engineer may reduce the frequency of the stockpile tests on ledge rock sources depending on the quality and uniformity of the materials. Test results shall be recorded on forms furnished by the Contractor, and shall be immediately submitted to the Engineer.

16.3.9. PREPARATION OF THE MIXTURE

The mineral aggregate shall be satisfactorily mixed with the proper quantity of asphalt binder at the central mixing plant. The mixing plant shall be operated using automatic controls. Manual operation will be permitted for the remainder of the day when automatic controls fail, provided specified results are obtained. The Contractor shall restore automatic operation prior to the next day's production.

The asphalt binder shall be added to the mix in the proportionate quantity and at the temperature established by the job mix formula. After introducing the required aggregate and asphalt binder into the mixer, the materials shall be continuously mixed until the aggregate is completely and uniformly coated and a thorough distribution of the asphalt throughout the aggregate is obtained.

Hydrated lime, when added, shall be added at the pugmill to moistened aggregate containing a minimum moisture content of 1.0 percent above the saturated surface dry condition of the aggregate. The mixing of the aggregate, hydrated lime, and water shall be accomplished by using an enclosed twin-shaft pugmill with a minimum effective length of 1.4 m. A water spray must be used at the pugmill to prevent fugitive lime dust from being released into the air.

When hot mix storage bins are used, storage of the mix shall be limited to a maximum of 15 hours.

16.3.10. TRANSPORTATION AND DELIVERY OF THE MIXTURE

A sufficient number of haul vehicles shall be provided so that adequate supplies of mix are delivered to ensure that continuous paving will be achieved.

Hauling equipment for aggregates and bituminous mixes shall consist of vehicles having dump bodies suitable for dumping materials in a windrow or in spreader boxes. The bodies shall be so constructed that their volume measurement can be accurately determined. They shall be constructed and maintained such that loss of materials during hauling operations will not occur. Dump controls shall be capable of operation from the driver's seat.

Hauling equipment for hot bituminous mixes shall have tight, clean, smooth metal beds which are periodically thinly coated with a lime solution or other approved material to prevent adherence of the mix. All hauling units shall be equipped with a canvas or other approved type cover which shall be used to cover the hot material upon loading at the mixing plant and shall not be removed until the mix is discharged into the paver.

The dispatching of the hauling vehicles to the Site shall be so scheduled that all material delivered is

placed at least 90 minutes before sunset to allow sufficient time for compaction, unless the use of artificial light is approved. Delivery of material shall be at a uniform rate and in an amount well within the capacity of the paving and compacting equipment.

The mix at delivery to the paver shall be not more than 10°C below discharge temperature at the mixing plant. The minimum temperature for the commencement of breakdown rolling is 120°C. Mix loads of temperature less than 120°C shall not be accepted, and the load shall be disposed of and another load used. If there is consistent failure to meet the temperature requirement the Engineer shall order paving operations to stop until suitable measures are taken by the Contractor to ensure that temperature requirements are met.

Each haul vehicle shall be weighed after each loading at the mixing plant and accurate records shall be kept of the gross weight and net weight of each load, for each vehicle and dates and time of loading.

16.3.11. TACKING, SPREADING, AND COMPACTING

The surface, including all vertical contact faces, on which the asphalt concrete is to be placed, shall be primed or tacked. The prime or tack coat shall be allowed a cure period, as determined by the Engineer, prior to asphalt concrete placement.

Self-propelled pavers shall place asphalt concrete. Handwork is permissible in inaccessible or odd shaped areas. Paver laid mix shall be spread using automatic transverse and longitudinal grade controls. If the automatic controls fail or malfunction, the Engineer may permit manual operation for the remainder of the day, provided the finished product meets the specifications. Frequent breakdowns shall constitute cause for suspension of the work until repair or replacement is made.

Following placement of the first pass using the traveling stringline for control, adjacent passes and succeeding lifts shall be placed using the traveling stringline riding on the previously laid material. A shoe attachment may be used to match the longitudinal joint(s) on the final paver pass(es) of the top lift unless otherwise directed by the Engineer. A shoe attachment on the paver shall be used to automatically match the elevation of asphalt concrete shoulders with concrete pavements.

Automatic slope controls will be required on paving equipment for placing asphalt concrete on shoulders [2.4 meters or more in finished width] next to asphalt or concrete pavement.

Asphalt concrete shall be placed directly on the roadbed in a uniform windrow and then fed into the paver by a paver feeder. The use of a paver feeder is not required on shoulders, turning lanes less than 150 m, roadway paving less than 150 m, and transitions into bridge decks less than 150 m. The paver feeder shall pick up substantially all of the mix and feed it into the paver without segregation. A Material Transfer Vehicle (MTV) that takes material directly from the trucks stores and mixes it, and then dumps into the paver hopper may be used if approved by the Engineer. The size of the windrow shall be regulated so the paver is fed a continuous and adequate supply of mix.

The "temperature of mixture on delivery to the road" shall be defined as the temperature of the mix just prior to placement or just prior to spreading by blade. Spot leveling and repair of the existing surface with asphalt concrete shall be required prior to the paver laid courses at locations designated. Potholes and areas of localized disintegration shall be cleaned of loose material, squared, tacked, leveled with asphalt concrete, and satisfactorily compacted. Spot leveling may be blade laid in lifts not exceeding 75 mm of uncompacted depth. Compaction shall be by the specified roller coverage method, except a steel face roller will not be required.

On the final surfacing lift, laydown operations shall commence at the farthest point and progress continuously toward the plant. On rural projects, a partial width pass may be extended beyond the adjacent pass by as much as one day's run. The paver shall be moved back the following working day to place the adjoining pass. Where a difference in elevation exists between two lanes carrying traffic in the same direction on rural multilane asphalt concrete construction, one of the effected lanes shall remain closed to traffic.

The plant production and availability of hauling vehicles shall be sufficient to provide a uniform and consistent quantity of asphalt concrete to the paver so laydown operations are continuous. Stops and starts shall be restricted to a minimum. Stopping normal laydown operations to surface an approach,

thereby creating an unnecessary joint will not be permitted.

Laydown operations shall proceed from the center to the shoulders of the roadbed surface. When turning lanes are present, the Contractor may alter the laydown operation. The Contractor shall submit his proposed laydown operation to the Engineer for prior approval.

The center joints of succeeding lifts shall be offset approximately 150 mm. The center joint of the top lift shall be located on centerline. Longitudinal joints below the top lift shall be offset from the previously constructed joints by approximately 150 mm, and be located within 300 mm of the lane line. In curb and gutter sections, laydown may proceed from the gutter line to the centerline.

Transverse joints of the final lift shall be formed by sawing back the previous run to expose the full depth of the course. The finished transverse joint of all lifts shall have a uniform texture and comply with the straightedge requirement. Waste material resulting from forming joints and temporary ramps shall be removed and disposed of.

Segregation or excessive pulling of the mix shall warrant suspension of operations. Immediately after the mix has been placed and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. Vibratory rollers shall have an automatic shutoff to deactivate the vibrators when the roller speed is less than 1.0 kmh. They shall operate according to the manufacturer's recommendations for speed, impacts per foot, and amplitude of vibration for the thickness of the mix being compacted. Rollers shall be operated with the drive wheel nearest the paver.

Rolling shall be longitudinal, commencing at the outer edges of the mat and progressing toward the center in straight, parallel strips, overlapping at least 150 mm. On superelevated curves, rolling shall progress from the lower to the upper edge. The Contractor shall vary the points of reversal to prevent a transverse crease. The rollers shall not stand idle on any part of the mat, which has not been completed and cooled sufficiently to resist deformation.

The beveled edge shall be satisfactorily compacted. Longitudinal joints shall be compacted in accordance with the following:

1. For confined edges, on the first pass adjacent to the confined edge, the compaction equipment shall be entirely on the hot mat 150 mm from the longitudinal joint.
2. For unconfined edges, the compaction equipment shall extend 150 mm beyond the edge of the mat.

The surface of each lift shall be free of waves and other irregularities. The final lift surface shall be checked with a three-meter straightedge. The variation of the surface from the straightedge between any two contact points shall not exceed 6 mm. The crown, on all lifts, as indicated by checking with a three-meter straightedge, shall be within 13 mm of specified crown in any three-meter length.

Irregularities shall be corrected while the material is in a workable condition. Under no circumstances shall operations continue when it becomes evident final rolling is not producing a smooth, uniform, compacted surface free from roller marks and other irregularities.

16.3.12. SPECIFIED DENSITY METHOD

The mix shall be compacted to the density specified (98%) for the class of asphalt concrete designated. The percent of density shall be based on the maximum bulk specific gravity of the test specimens prepared in the field or as approved by the Engineer. Compaction rolling shall be completed before the temperature of the mix drops below 80 °C. Vibratory rollers may be used in the static mode for finish rolling.

Compaction of mix placed on entrances to farms, residences, or businesses and intersecting road approaches shall be compacted by the specified roller coverage method.

16.3.13. SPECIFIED ROLLER COVERAGE

The mix shall be compacted by at least four complete coverage with pneumatic tired rollers and at least one complete coverage with steel faced rollers, or as approved by the Engineer. Breakdown rolling may be accomplished by steel-faced rollers, only when approved by the Engineer. Self-propelled pneumatic tired rollers shall cover an overall surface width of at least 1500 mm and furnish a minimum rolling weight (mass) 4.5 Kilograms per millimeter of roller width. Self-propelled tandem smooth steel rollers

(two steel drums operating in the same track) shall furnish a minimum rolling weight (mass) of 4.9 kilograms per millimeter of roller width.

Rolling shall proceed on the mat as soon as lay down is completed. Completion of rolling on any segment shall not lag behind the laydown more than 300 meters. During periods of cool weather this maximum distance between laydown and final rolling shall be reduced as directed. Compaction to a specified density will not be required. However, additional roller coverage may be required in order to obtain a smooth surface finish.

When directed by the Engineer, the Contractor shall core, saw and remove an undamaged, 150 mm square sample, or a 150 mm diameter round sample from a designated area and repair the hole to the satisfaction of the Engineer.

16.3.14. MAINTENANCE

The Contractor shall maintain the work during construction and until final acceptance. Maintenance shall include protection and repair of the prepared base course, tack coat, wearing surface mat, shoulders, and seal course. Rich or bleeding areas, breaks, raveled spots, or other nonconforming areas in the wearing surface or base shall be corrected.

16.3.15. TRAFFIC CONTROL

Hauling or allowing traffic on the roadway will not be permitted until the surface has been compacted and cooled sufficiently to resist marking or distortion. Where traffic is to be maintained by means of part width construction, the Contractor shall control all traffic by identified pilot cars and flaggers. The Contractor shall schedule work so traffic will not be greatly inconvenienced with long one-way lanes.

16.3.16. SHOULDER JOINTS

When specified a continuous groove shall be constructed by forming, sawing, or routing the joint between the Portland cement concrete pavement and the asphalt concrete shoulder. Sawing may be done with either diamond or water-cooled abrasive blades. If a router is used it must be capable of cutting a groove to the required dimensions. Equipment designed to plow the groove to dimension will not be permitted. The walls of the finished groove shall be vertical and the groove bottom shall be flat.

The groove shall be thoroughly cleaned immediately after forming, sawing, or routing. Dry sawed joints shall be cleaned with high-pressure air. Wet sawed joints shall be cleaned with high-pressure water followed by high-pressure air. The air compressor shall produce a minimum of 0.06 cubic meters per second output and shall be equipped with a maximum 20 mm nozzle. The groove (including the sides) shall be free of dirt, dust, water, oil, grease, and loose material immediately prior to sealing. The Portland cement concrete surface shall be free of asphalt and any curing compound that would prevent bonding. The groove shall be completely dry and filled level with joint sealer by a sealing device, which will not entrap air in the sealed joint.

Joint sealer application will not be permitted when the air temperature near the joint is less than 5°C or is 5°C and falling.

19. PLAIN AND REINFORCED CONCRETE

19.1. DESCRIPTION

Works shall consist of the specifications for concrete materials including sampling, testing and storage of such materials, concrete strength requirements, concrete testing procedures and requirements, and job mixes.

19.2. MATERIALS

19.2.1. CEMENT

The cement used in the work shall be a Portland cement type 1, conforming to the requirements of AASHTO M 85. The Contractor shall provide suitable means for storing cement and protecting it

from dampness. Different types of cement shall be stored separately, and shall not be mixed.

Bags of cement which for any reason have become partially set, or which contain lumps or caked cement, shall be rejected. The use of cement reclaimed from discarded or used bags will not be permitted.

19.2.2. WATER

All water used in concrete shall be reasonably clear and free of oil, acid, alkali, sugar, and vegetable substances and, if required by the Engineer, shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness, time of setting, and mortar strength. Any indication of unsoundness, change in time of setting of plus or minus 30 minutes or more, or decrease of more than 10 percent in strength from results obtained with mixtures containing distilled water shall be sufficient cause for rejection of the water that is being tested.

19.2.3. FINE AGGREGATE

The fine aggregate for concrete shall consist of natural sand or, other inert materials with similar characteristics, having durable particles.

The fine aggregate shall conform to the following requirements:

Table 19.2.3 Gradation

#100	#50	#16	#4	3/8"	Sieve No.
2-10	10-30	45-80	95-100	100	% passing by weight

The Engineer may approve the use of other gradations provided that there is satisfactory data on the properties of concrete made with them.

1. Absorption – 6% max.
2. Fineness Modulus (F.M) - 2.3-3.1 and 0.2 tolerance from the approved
3. Sand Equivalent (S.E) - 70 (min.) for concrete classes B250 & B300 and for concrete classes B200 & B150. (AASHTO-T 176) -65 (min.)
4. Soundness Test - 12 max. if tested by sodium sulfate. 18 max. if tested by magnesium sulfate (AASHTO-T 104)
5. Clay Lumps & Friable particles - 0.5% max. (AASHTO T 112)
6. Passing Sieve # 200 - 5% max.
7. Organic impurities - not darker than standard color (AASHTO-T 121-181)

19.2.4. COARSE AGGREGATE

The coarse aggregate for concrete shall consist of crushed stone, or gravel, having durable pieces, free from undesirable adherent coatings.

The coarse aggregate shall conform to the following requirements:

Table 19.2.4 Gradation

#8	#4	1/2"	1"	1 1/2"	Sieve No.
0-5	10-30	25-60	95-100	100	% passing by weight

The engineer may approve the use of other gradations providing there is satisfactory data on the properties of concrete made with them.

1. Absorption- 4% max.
2. Abrasion - 35% max. for concrete B250 & B300. - 40% max. for concrete B200 & B150. (AASHTO-T 96)
3. Soundness Test - 12 max. if tested by sodium sulfate. - 18 max. if tested by magnesium sulfate. (AASHTO-T 104)
4. Chlorides (CL) - 0.35% max. (by weight of cement)

5. Sulfate (S03) - 2.5% max.(by weight of cement)
6. Passing #200 - 1% max.
7. Flakiness & Elongation Index - 25% max. for each (BS-812)
8. Clay lumps and friable particles shall not exceed 0.5%

19.2.5. ADMIXTURES

The quantity and method of using admixtures shall be in accordance with the manufacturers recommendations and in all cases shall be subject to the approval of the Engineer.

The contractor shall if required, submit samples of proposed admixture to an approved testing authority in order to ascertain its suitability for use in the works.

The cost of such admixtures shall be included in the cost of concrete and no extra payment shall be made if they are used.

The approval by the engineer of such mix designs does absolve the contractor of any of the requirements of the specifications.

19.2.6. CLASSES OF CONCRETE

The classes of concrete and the minimum required compressive strengths shall be as shown in the following table:

Comp. Strength - kg/ cm² (15 X 15 X 15 cm Cubes)		Concrete Class
28 days	7 days	
345	240	B-300
287	200	B-250
230	160	B-200
180	125	B-150

19.2.7. TRIAL MIXES

Following the Engineer's approval of the materials for each class of concrete, the contractor shall prepare a trial mix of each grade of concrete in the presence the Engineer or his representative. Each trial mix shall comprise not less than 1/3 of a cubic meter of concrete and shall be mixed in an approved type of concrete mixer similar to that which the contractor proposes to employ on the works. The quantities of all ingredients of each trial mix including water shall be carefully determined by weight according to the approved mix design. Each trial mix shall show no tendency to segregate when handled and compacted by the methods by which the contractor propose to handle and compact the grade of concrete in the works.

The Contractor shall give notice to enable the Engineer to be present at the making of trial mixes and preliminary testing of the cubes. The Contractor shall prepare trial mixes, using samples of approved material typical of those he proposes to use in the works, for all grades, to the Engineer's satisfaction before commencement of concreting.

The Contractor shall ascertain the workability of the trial mixes to the Engineers satisfaction. The concreting plant and means of transport employed to make the trial mixes and to transport them representative distances shall be similar to the corresponding plant and transport to be used in the Works. A clean dry mixer shall be used and the first batch discarded. Test cubes shall be taken from trial mixes as follows. For each mix a set of six cubes shall be made from each of three consecutive batches. Three from each set of six shall be tested at an age of 28 days and three at an age of seven days. The tests shall be carried out in a laboratory approved by the Engineer.

The average strength of the nine cubes tested at 28 days shall exceed the specified characteristic strength by the current margin minus 3.5 N/sq.mm.

19.2.8. PRELIMINARY TESTING OF CONCRETE MIXES

The following method of testing shall apply to standard concrete cubes or cylinders. After the materials have been approved at least 10 days before any concrete is poured, the contractor shall make preliminary sets of test cubes. Each set shall comprise of six cubes 15x15x15 (or 10x10x10) cms made from a single sample of concrete taken from the point of final discharge of the wet concrete.

Three cubes shall be tested 7 days after the date of manufacture and three cubes after 28 days. Should either the test crushed at 7 days or that crushed at 28 days fall below the specified strength the contractor shall upon the Engineer's instructions, alter the mix design and/or the source of aggregates, cement or water and/or the method of mixing including alteration of the type of mixer. The compressive strength of the concrete cube or cylinder at 7 days shall not be less than 70% of the specified 28 days strength.

19.3. CONSTRUCTION

19.3.1. MEASUREMENT FOR PROPORTIONING MATERIALS

19.3.1.1. CEMENT

The cement shall be measured in bulk or as packed by the manufacturer, a sack of cement shall weigh 50 kilograms. Measurement shall be accurate to within (0 - +4%) throughout the range of use.

19.3.1.2. WATER

The mixing water shall be measured by weight or by volume. In either case the measurement shall be accurate to within (+ or - 1.0%) throughout the range of use.

19.3.1.3. AGGREGATES

The aggregates shall be measured by weight. The measurement shall be accurate to within (* + or - 2.0% fine, coarse aggregates) throughout the range of use.

19.3.1.4. ADDITIVES

Additives shall be measured by volume if in liquid form and by weights if solid. The measurement shall be accurate to within 3.0 per cent throughout the range of use.

19.3.2. HANDLING, MEASURING, AND BATCHING MATERIALS

Concrete of the class indicated shall be composed of accepted material batched in the proportions set by the Engineer. Corrections necessitated by variations in the moisture content of the raw materials or for other reasons shall be made as directed by the Engineer.

19.3.2.1. PORTLAND CEMENT

Use of either bagged or bulk cement is permissible. When cement is measured by the bag, the average weight of the bags of cement in each batch shall not be less than 50 kilograms per bag. All cement used in bulk shall be weighed on an approved weighing device.

19.3.2.2. WATER

Water shall be from approved sources measured by volume, including metering, or by weighing. The measuring tank shall be equipped with an outside tap and valve to provide for calibration, unless other means are provided for readily and accurately determining the amount of water delivered from the tank.

The quantity of mixing water used shall not be changed without the consent of the Engineer. The consistencies of the various classes of concrete shall be such as to give slumps within the following ranges, using AASHTO T 119:

1. Vibrated Concrete - (50-100) mms. slump
2. Non - Vibrated Concrete - (100-200) mms. slump

The above ranges represent the extreme limits of allowable slump, the engineer may order that slightly lower slumps than the above minimum be used in certain cases. The amount of water used in any concrete shall be the minimum necessary to obtain required workability within the range of slump specified for concrete of its class.

19.3.2.3. AGGREGATES

Coarse and fine aggregates shall be handled and measured separately. Aggregates shall be stockpiled clear of passing vehicles and in such manner as to avoid segregation or containment in with dust, dirt, leaves or other foreign matter, and shall be stockpiled, measured, and patched or hauled to the mixer in a manner approved by the Engineer.

Stockpiling - Stockpiles shall be built up in layers of not more than 1 meter in thickness. Each layer shall be completely in place before beginning the next layer, which shall not be allowed to “cone” down over the preceding layer. Aggregates from different sources and of different gradings shall not be stockpiled together. Each separated size of coarse aggregate, if separated sizes are required by the contract, shall be stored separately.

Handling. - The aggregates shall be handled from the stockpiles or other sources to the patching plant in such a manner as to obtain material having a typical gradation. Aggregates that are mixed with earth or foreign materials shall not be used. Fine aggregate and separate sizes of coarse aggregate, when separate size are required, shall be separately weighed in the respective amounts specified by the Engineer.

19.3.3. ON - THE - JOB – PATCHING

In cases where the volume of concrete to be placed is small or where, for other reasons, proportioning by patching equipment is impracticable or would work an undue hardship on the contractor, the materials may with the approval of the Engineer, be proportioned by weighing on approved platform scales or by loose volume. The quantities shall be measured separately in an approved manner for which purpose the contractor will be required to use such equipment as will insure uniform proportioning. The use of approved wheelbarrows or bottom-less boxes, whose volumes have been carefully predetermined, or other equally satisfactory methods may be employed. Proportioning by means of shovels, baskets, buckets or cans will not be permitted. In determining the volumes of the aggregates, due consideration shall be given to the bulking effect of any moisture contained in these materials.

19.3.4. MIXING

19.3.4.1. MIXING AT SITE

Concrete shall be mixed thoroughly in a batch mixer of approved type and capacity. Mixing time shall be not less than 1 1/2 minutes after all component materials, including water, are in the drum for a mixer with a capacity of 1 cubic meter or less. The mixing time shall be increased by 20 seconds for each additional cubic meter (or fraction) of capacity of mixer. The charging of water into the mixer shall begin before the cement and aggregates enter the drum. During mixing, the drum shall be operated at drum speed specified by the manufacturer and shown on his nameplate on the machine. The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein. Preferably the mixer shall be equipped with mechanical means for preventing the addition of aggregate after mixing has commenced.

The mixer shall be equipped with an approved timing device to insure mixing for the minimum time specified. The volume of a batch shall not exceed the manufacturers rated capacity of the mixer. Any concrete mixed less than the specified time shall be dumped outside the work area and removed by the contractor at his own expense.

The concrete shall be mixed only in such quantities as are required for immediate use. Retempering of concrete will not be allowed. Concrete that is not of the required consistency at the time of placement shall not be used.

19.3.4.2. READY-MIXED CONCRETE

Ready-mixed concrete may be used in the construction of all works, when approved by the Engineer. Permission to use ready-mixed concrete from any previously approved plant may be revoked at any time upon failure to comply with the requirements of the Specifications. Where transit mixers are used, the constituent materials shall be mixed dry in the mixer and water added directly before pour and mixed at the speed and number of turns in accordance with the manufacturer's recommendations.

19.3.5. PLACING CONCRETE

All concrete shall be placed before it has taken its initial set and, in any case, within 25 minutes after mixing unless set retarding additives have been used. Concrete shall be placed in such manner as to avoid segregation of coarse or fine portions of the mixture, and shall be placed in horizontal layers when practicable. Chutes used as aids in placing concrete shall be arranged and used in such a manner that the ingredients of the concrete do not become separated. Where steep slopes are required, chutes shall be equipped with baffle boards or shall be in short length that reverses the direction of movement.

Dropping the concrete a distance of more than 1 1/2 meters or depositing a large quantity at any point and running or working it along the forms will not be permitted.

Vibrators shall be used for compacting concrete. Sufficient vibrators shall be used to consolidate the incoming concrete within 15 minutes after placing. Vibrators shall not be held against forms or reinforcing steel nor shall they be used for flowing the concrete or spreading it into place. Vibrators shall be so manipulated as to produce concrete that is free of voids, is of proper texture on exposed faces, and of maximum consolidation. Vibrators shall not be held so long in one place as to result in segregation of concrete.

19.3.6. CURING CONCRETE

19.3.6.1. WATER CURING

All concrete surfaces shall be kept wet for at least 7 days after placing in hot weather or drying winds and for at least 4 days in other conditions.

19.3.6.2. MEMBRANE CURING

A liquid membrane-forming material may be used for curing. It shall be sprayed on the concrete surface in one or more coats at the rate specified by the manufacturer.

19.3.7. CONCRETE TESTING

19.3.7.1. WORKABILITY

The contractor shall carry out slump tests at such frequency, as the Engineer's considers necessary to ensure that workability and consistency is maintained in accordance with the specified mix or accepted mix design and the trial mix. Workability tests shall be carried out at least once every one-hour during which concrete is being mixed at the construction site.

19.3.7.2. COMPRESSIVE STRENGTH

The contractor shall make test cubes or cylinders as required by the Engineer. One set of cubes shall normally be taken from each individual concrete member e.g. culvert bottom slab, walls, abutment, etc., but additional cubes shall be taken as directed by the Engineer. Three cubes shall be tested at 7 days and three cubes at 28 days as the Engineer directs. Should either of the cubes fall below the specified requirements, the contractor shall, on the Engineer's instructions, either alter the mix design and/or the method of making the concrete and controlling its quality and/or cut out and replace at his own expense concrete placed in the works on any day on which a defective cube was made, if in the opinion of the Engineer such concrete is likely not be capable of fulfilling its purpose.

The Engineer may require the contractor to cut out the defective part from the works due to other defects even though test cubes made from that concrete have not failed.

19.3.7.3. FREQUENCY OF TESTING

The frequency of testing for control purposes shall be as indicated below or as directed by the Engineer's representative. No direct payment is made for testing. The price of this work shall be included in the bid prices of concrete.

Frequency	Type of Test
1 Set for 30 m ³ of concrete but in no case be less than one set for each working day.	Concrete Cube Test
Once from each Transit Mixer or every one hour for mixes carried at the construction site	Slump Test
Once for each source of aggregate or every combination of sources	Mix Design

20. REINFORCING STEEL

20.1. DESCRIPTION

The work shall consist of the supply and fixing of the steel bars, for the reinforcement of concrete in accordance with the Drawings and Specifications.

20.2. MATERIALS

Hot rolled steel bars shall conform to AASHTO M31M (ASTM A615M) or to BS 4449.

20.3. CONSTRUCTION

All reinforcing steel shall be free from detrimental dirt, loose mill scale, scaly rust, paint, grease, oil or other foreign substance. Rust shall be removed by wire brush. Light rust need not be removed.

Reinforcing steel shall be stored clear of the ground on platforms, skids or other supports and be protected against contamination by dirt, grease, oil etc. at all times. If directed by the Engineer, the contractor shall provide cover to the reinforcing steel.

Reinforcing steel of different grades and different diameters shall be stored separately and marked to facilitate inspection and checking.

Bars shall be, bent to the following minimum bend diameters: (4d for mild steel -G40- and 6d for high yield steel -G60-).

<u>Bar Diameter, d.</u>	<u>Mild Steel (G40)</u>	<u>High Yield Steel (G 60)</u>
60 mm	40 mm	10 mm
72	48	12
84	56	14
96	64	16
108	72	18
120	80	20
132	88	22
150	100	25

Reinforcing steel shall be placed and maintained in the position shown on the Drawings.

The correct cover to the reinforcing steel on all exposed faces of concrete shall be maintained by using approved proprietary spacers.

Wherever it is necessary for the contractor to splice reinforcing steel at positions other than those shown on the Drawings the approval of the Engineer shall be sought and obtained before the reinforcing steel is placed. Splices shall be staggered where possible and shall be designed to develop the strength of the bar without exceeding the allowable unit bond stress.

21. REINFORCED CONCRETE PIPE CULVERTS & PVC CONDUITS

21.1. DESCRIPTION

The work shall consist of furnishing materials, and installing and testing pipe culverts and storm drains of the various types specified, for cross drainage, surface drainage and the removal of storm water; and the installation of utility ducts of the various types specified; all as shown on Drawings.

21.2. MATERIALS

21.2.1. PRE-CAST REINFORCED CONCRETE PIPE

Pre-cast concrete pipe for culverts and storm drains shall conform with the requirements of AASHTO M 170M, Class IV.

Internal and external pipe surfaces shall be smooth and sound and the pipe correctly dimensioned.

Tests shall be performed in accordance with AASHTO T 280.

Crushing strength tests shall be performed in accordance with AASHTO T33.

21.2.2. PLASTIC PIPE (P.V.C) OR UPVC

Plastic pipes for use as utility ducts shall be polyvinyl chloride (P.V.C) or UPVC pipes conforming with AASHTO M 278 “class PS 50” polyvinyl chloride (P.V.C) pipes.

21.3. CONSTRUCTION

No pipes shall be installed until the excavations, foundations and bedding have been approved.

The inside of each pipe shall be cleaned and brushed out and the pipe inspected for any major or minor damage immediately prior to laying. Pipes with minor damage shall be re inspected by the Engineer following completion of field repairs and, if approved, may be installed in the works. Pipes with major damage shall be rejected.

All pipes shall be fully and firmly bedded over the entire length of each pipe and shall be laid true to line, level and grade, commencing at the downstream end unless otherwise approved. Inverts shall be properly matched to form a continuous line free of appreciable irregularities.

Multiple pipe culverts shall have a clear separation between adjacent pipelines of 300 mm or 0.5 x external pipe diameter whichever is larger, unless shown otherwise on the Drawings. Back-fills between pipe culverts shall be placed and compacted in equal layers not exceeding 150 mm .

Pre-cast concrete pipe shall be installed with the bell (i.e. socket) end facing upstream. The pipes shall be fully engaged. Internal gaps of more than 20 mm will not be accepted.

Installation and jointing procedures for P.V.C pipe shall conform with the relevant requirements specified for installing pre-cast concrete pipe and with the plastic pipe manufacturer's instructions. All couplings and gaskets shall be installed in accordance with the manufacturer's instructions.

21.4 REINFORCED CONCRETE BOX CULVERTS AND RETAINING WALLS

21.4.1 SCOPE

These works shall consist of furnishing materials and the construction of reinforced concrete box culverts and retaining walls and headwalls.

21.4.2 MATERIALS

The materials shall conform to the sub-sections “Materials” of each of the following sections:

- Concrete
- Reinforcement

21.4.3 CONSTRUCTION REQUIREMENTS

1. Where box culverts are located in road embankments, the embankments shall first be constructed. The compacted embankments shall then be excavated in trenches for the culverts.
2. The forms and false-work shall be inspected by the Engineer after assembly on the work area and immediately before concreting. No pour shall commence until the forms and false-work have been approved by the Engineer.
3. Unless shown on the Drawings or instructed by the Engineer, the base slab of the box culvert for its entire length shall first be completed before proceeding with the walls and roof slab and the construction joints in the walls shall be located at not less than 100m above the top of base slab. Unless shown otherwise on the Drawings or directed by the Engineer, the walls and roof slabs shall be concerted in one pour between expansion joints.

4. During concerning, the forms and their supports shall be constantly monitored for signs of imminent failure. There shall be skilled operatives in constant attendance during concerning who are qualified to make immediate adjustments to the forms and false-work so that concerning can satisfactorily be completed.
5. Form-work shall be removed in a manner not to damage the concrete, and at times to suit the requirements for its curing and to prevent restraint that may arise from elastic shortening, shrinkage or creep.
6. Immediately after the removal of the forms, all fins caused by form joints and other projections shall be removed and all pockets cleaned and filled with a cement mortar composed of 1 part by volume of Portland cement and 2 parts sand.
7. Back-filling and compaction shall be carried out in layers not exceeding 200 mm.

22. STEEL GUARDRAIL AND CONCRETE SAFETY BARRIER

22.1. DESCRIPTION

These Works shall consist of the furnishing, construction and erection of steel guardrail, concrete barriers, impact attenuators, and glare screens as and where shown on the Drawings.

22.2. MATERIALS

22.2.1. METAL BEAM GUARDRAIL

Rail elements and backup plates for W-Beam or other similar shapes of steel rail shall conform to AASHTO M 180, Class A, Type 2 galvanized. Rail elements for triple corrugated beam rail used in Guard Rail Energy Absorbing Terminal (G.R.E.A.T.) proprietary impact attenuators shall conform to AASHTO M 180, Class B, Type 2 galvanized. Rail element joints shall be fabricated to lap not less than 300 mm and be bolted.

Rail metal shall withstand a cold bend, without cracking, of 180 degrees around a mandrel of a diameter equal to 2.5 times the thickness of the sheet metal plate.

Rail elements to be erected on a radius of 45 m or less shall be shaped in the shop. The radius of curvature shall be stenciled on the back of each section of rail.

Rail elements shall be designed to be spliced at intervals not to exceed 4 m and such splices shall be made at posts, unless otherwise shown on the Drawings.

22.2.2. BOX BEAM GUARDRAIL

Rails shall be hot-formed welded and seamless carbon steel structural tube or cold-formed welded. Posts, splice tongues, and plates shall conform to ASTM A 36. Rails shall conform to ASTM A 500, Grade A or B, or ASTM A 501.

Mill transverse welds will not be permitted on rail sections. Longitudinal welds shall be made by the resistance, gas shielded arc, submerged arc or plasma arc welded process and shall be sound, free from defects, and shall not be repaired. The welded joint, in cold and hot-formed welded rail, shall have a minimum tensile strength specified for the railing when subjected to the tensile strap test specified in ASTM E8M (metric).

Rail sections for tangent runs shall be not less than 6 m in length. Rail splices shall be a minimum of 400 mm from the centerline of any post.

22.2.3. WIRE ROPE

Wire rope for cable guardrail, cable guardrail anchor terminals and metal beam guardrail anchor terminals, shall conform to AASHTO M 30, Type 11, Class A. Equivalent galvanized wire rope with a minimum breaking strength of 19,400 kg will be acceptable.

Wire rope restraining cable for G.R.E.A.T. Hi-Dro and Hi-Dri impact attenuators shall be minimum 22 mm nominal diameter galvanized wire rope conforming to ASTM A 603, Class A.

Pull out and secondary cable for Hi-Dro and Hi-Dri impact attenuators shall be minimum 9.5 mm nominal diameter galvanized wire rope conforming to ASTM A 603, Class A. ;

22.2.4. POSTS AND MISCELLANEOUS HARDWARE

Unless otherwise shown on the Drawings, all steel posts, plates, angles, channels, brackets and anchor assembly units shall conform to ASTM A 36. Cold rolled post sections shall conform to ASTM A 446, Grade B.

The swaged fittings for anchor terminals shall be machined from hot rolled carbon steel conforming to ASTM A 576, Grade 1035 and shall be annealed in a manner suitable for cold swaging. A lock pin hole shall be drilled through the swage fitting head to accommodate a 7 mm, plated, spring steel pin to retain the stud in the proper position. The stud shall be steel conforming to ASTM A 449. Prior to galvanizing, a 10 mm slot for the locking pin shall be milled into the stud end. The swaged fitting, stud, and nut shall develop the full breaking strength of the wire cable.

Anchor rod eyes shall be hot forged or formed with full penetration welds. After fabrication, anchor rods with eyes that have been formed with any part of the eye below 370 degrees C during the forming operation or with eyes that have been closed by welding shall be thermally stress relieved prior to galvanizing. The completed anchor rod, after galvanizing, shall develop a strength of 23,000 kg.

Clevises shall be drop forged galvanized steel and shall develop the full specified breaking strength of the wire cable.

The concrete insert assembly for Type 4 anchor terminals (beams of corrosion resistant steel - AASHTO M180) shall be fabricated as shown on the Drawings. Ferrules shall be steel conforming to ASTM A 108, Grade 12 L 14. Inserts shall be tapped to the dimensional requirements specified in ASTM A 563 for nuts receiving galvanized bolts. Insert assembly wires shall conform to ASTM A 510, Grade 1030, and have a minimum tensile strength of 686 MN/sq.m (7,000 kg/sq.cm). Welded attachment of wire to ferrule shall develop the full tensile strength of the wire.

Turnbuckles shall be steel of commercial quality and shall have a minimum breaking strength of 1,500 kg. Turnbuckles shall be galvanized in accordance with ASTM A 153. Compensating and non-compensating cable ends shall be cast steel conforming to ASTM A

27 or malleable iron conforming to the requirements of ASTM A 47M (metric).

Compensating devices shall have spring constants of 8,000 kg/m plus or minus 500 kg/m and permit a travel of 150 mm plus or minus 25 mm. All elements shall be galvanized.

Cable connecting hardware shall develop the full strength of the wire rope. At all locations where the cable is connected to a cable end with a wedge type connection, one wire of the wire rope shall be crimped over the base of the wedge to hold the cable firmly in place.

Restraining chains for G.R.E.A.T. impact attenuators shall be 12 mm nominal size and shall conform to ASTM A 413, Grade 28.

Glare screen fabric shall be chain link mesh conforming to ASTM A 491 or ASTM A 392. Mesh size and wire diameter shall be as specified on the Drawings.

22.2.5. GLARE SCREENS

Posts shall be galvanized steel pipe conforming to ASTM A 153 and of the diameter shown on the Drawings. Posts shall be furnished with galvanized watertight caps.

Tension wire shall conform to ASTM A 64 1 M (metric)- Class 1, Hard Temper, with a minimum diameter of 4.5 mm. Tension cable shall conform to ASTM A 474 or A 475, 6 mm minimum diameter, high strength grade. All hardware shall be typical of the types shown on the Drawings and shall be galvanized in accordance with ASTM A 153.

If shown on the Drawings, the fence fabric, posts and all exposed galvanized hardware shall be coated with a minimum 0.25 mm coating of bonded PVC. PVC shall be applied by the thermal extrusion process and shall withstand a minimum exposure of 1,500 hr at 62 degrees C without any deterioration when tested in accordance with ASTM D 1499.

Slats, when required, shall be either wood or plastic and of the dimensions shown on the Drawings. Wood slats shall be treated with a suitable preservative.

Plastic slats shall be Tubular polyethylene, color pigmented material consisting of high density polyethylene and color pigments designed to retard ultraviolet penetration. The material shall have a minimum wall thickness of 0.7 mm and shall remain flexible without distortion and without

becoming brittle through a temperature range of zero degrees C to 60 degrees C. Plastic slats shall be retained in place by means of U-shaped retainer members at the bottom and top of the glare screen. Retainer members shall be of the same material as the slats. Samples for the color of plastic slats shall be submitted for approval before use.

22.2.6. BOLTS, NUTS, AND OTHER FITTINGS

All bolts shall conform to ASTM A 307, except those designated on the Drawings as high strength which shall conform to ASTM A 325 or A 449. All nuts shall conform to ASTM A 563, Grade A or better, except those designated on the Drawings as high strength which shall conform to ASTM A 563, Grade C or better.

22.2.7. GUARDRAIL

All of the exposed Materials For guardrail, guardrail anchor terminals, Impact attenuators, glare screen, and delineators, which consist of steel or iron shall be galvanized after fabrication unless otherwise specified. Whenever a galvanizing requirement is not included in the Specifications, it shall be in accordance with ASTM AN 123 or ASTM A 153 as appropriate.

All components shall be fabricated and galvanized for installation without additional drilling, cutting, or welding. When field modifications are approved or when minor damage to the galvanized coating occurs, the exposed surfaced shall be repaired by thoroughly cleaning and applying 2 applications of zinc dust-zinc oxide primer.

22.3. CONSTRUCTION

22.3.1. GUARDRAIL

Guardrail shall be installed as and where shown on the Drawings. Posts shall be installed by driving plumb to the required elevations or shall; be set in concrete, as shown on the Drawings

If ground conditions are such that pilot holes are necessary to prevent damage to posts during driving, all space around steel posts after driving shall be filled with dry sand or fine gravel.

When posts are set in concrete, the concrete shall be placed against the excavated earth unless otherwise approved.

Continuous lengths of rail or cable shall be installed and alignment checked and adjusted before final tightening of bolts, etc. Unless otherwise specified, bolted connections shall be torqued to between 6 and 7 kg-m. Lapped rail shall be installed with exposed ends away from the stream of traffic.

22.3.2. GUARD ANCHOR

Guardrail anchor terminals shall be installed as and where shown on the Drawings. Posts, anchors and footings shall be driven or installed in concrete as required. Concrete shall be placed against the excavated earth unless otherwise approved.

Bolted connections shall be torqued as for guardrail bolts.

Cable guardrail end assemblies shall be attached to the breakaway anchor angle and turnbuckles tightened to provide the spring compression as shown on the Drawings. Backfill above the tops of concrete anchor footings shall not be placed before cables are tensioned. Cables shall be uniformly tensioned prior to bending tabs on end post caps.

22.3.3. NEW JERSEY CONCRETE BARRIERS AND TERMINAL SECTIONS

Concrete barriers shall present a smooth, continuous, uniform appearance in their final position, conforming to the horizontal and vertical lines shown on the Drawings, and shall be free of lumps, sags, or other irregularities. The top and exposed faces of they barrier shall not vary more than 6 mm between any 2 contact points when tested with a 4 m straightedge laid on the surfaces.

Concrete barriers may be precast, cast in situ with fixed forms, or extruded with slip forms.

If concrete barriers are constructed by means of an extrusion machine orbit or other similar type equipment, the concrete shall be thoroughly consolidated and the exposed surfaces shall conform with the relevant requirements of "Plain & Reinforced Concrete Structures" and as specified herein.

The Contractor shall furnish evidence of successful operation of the proposed extrusion machine or other equipment, by constructing a trial section of barrier or by other evidence acceptable to the Engineer.

Concrete shall be fed to the extrusion machine at a uniform rate. The machine shall be operated under sufficient uniform restraint to forward motion to produce a thoroughly consolidated mass of concrete free from surface pits larger than 20 mm in diameter and requiring no further finishing. The concrete shall be of such consistency that, after extrusion, it will maintain the shape of the barrier without support. The grade for the top of the concrete barrier shall be indicated by an approved offset guideline.

The forming portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine to conform to the predetermined grade line. A grade line gauge or pointer shall be attached to the machine in such a manner that a continual comparison can be made between the barrier being placed and other established grade line as indicated by the offset guideline. Other means of controlling barrier grade may be approved.

Expansion joints of the width shown on the plans shall be constructed in the extruded concrete by sawing through the barrier section to its full depth. If sawing is performed before the concrete has hardened, the adjacent portions of the barrier shall be firmly supported with close fitting shields. When sawing is performed after the application of curing compound, the exposed faces of the barrier in the vicinity of the joint shall be treated with curing compound after sawing the joint.

If stationary forms for concrete barriers are used, they shall be removed as soon as possible after the concrete has set sufficiently to maintain the shape of the barrier without support. The surface shall be free from pits larger than 20 mm in diameter and shall be given a final soft brush finish with strokes parallel to the line of the barriers. Finishing with a brush application of grout will not be permitted.

Concrete surfaces shall be finished as necessary to produce smooth, even surfaces of uniform texture and appearance, free of bulges, depressions and other imperfections. The use of power sanders, Carborundum stones, or disks may be required to remove bulges or other imperfections.

Exposed surface of concrete barriers shall be cured by membrane curing.

22.3.4. DELINEATORS

Delineators shall be attached directly to guardrail in an approved, sect manner, as and where shown on the Drawings. Delineators shall be attached directly to the surface of the New Jersey Barriers as and where shown on the Drawings, by use of epoxy adhesive.

22.3.5. IMPACT ATTENUATORS

Impact attenuators shall be installed as and where shown on the Drawing and in accordance with the manufacturer's recommendations and instructions. A copy of these recommendations and instructions shall be submitted to the Engineer upon delivery of the impact attenuator materials and before installation commences

22.3.6. GLARE SCREENS

Glare screen fabric shall be placed on the face of the posts designate by the Engineer. On curves, the fabric shall be placed on the face of the post that is on the outside of the curve.

Fabric shall be stretched taut and securely fastened to posts as shown on the Drawings. Fabric shall be cut and each span attached pull and brace posts. Rolls of wire fabric shall be connected by weaving a single strand into the end of the rolls to form a continuous mesh between pull posts.

22.3.7. TESTING

Copies of all Certificates of Guarantee and test reports for al manufactured items shall be submitted to the Engineer. The Engineer may request additional sample materials for testing for strength, galvanizing, or other parameters.

23. FINISHING THE ROADWAY

23.1. DESCRIPTION

Upon completion of all construction operations, the entire roadway or roadways shall be finished as specified in these specifications.

23.3. CONSTRUCTION

The roadbed shoulders shall be trimmed and shaped to the finished cross section to produce smooth surfaces and slopes, and uniform cross sections. In the case of a graded roadbed without surfacing or pavement, the entire roadbed shall be trimmed and shaped to uniform cross sections and slopes.

Stockpiling of material on the finished pavement and drifting of material across the pavement will not be permitted. The finished pavement shall be cleaned of all dirt and foreign material.

The slopes of embankments, excavations, road approaches, road connections, ditches, channel changes and material sites within or adjacent to the highway right of way shall be finished to the lines and grades called for by the plans. All areas within or adjacent to the highway right of way shall be cleared of debris and obstructions. Slopes of gutters shall be trimmed to the required grade and cross section. Sewers, culverts and other drainage facilities and appurtenant structures constructed under the contract shall be checked and cleaned out. Excess earth, debris or other waste material adjacent to culvert headwalls and endwalls, bridge ends, poles, posts, trees or other objects shall be removed and the areas shaped as directed by the Engineer and left in a neat and orderly condition. Stones, roots and other waste material exposed on slopes, which are liable to become loosened, shall be removed and disposed of. Materials and debris resulting from clearing and grubbing operations not previously removed, shall be disposed of. Loose rock larger than 60 mm in maximum dimension shall be removed from the finished roadbed and disposed of.

Materials resulting from the above specified finishing operations shall become the property of the Contractor and shall be disposed of outside the highway right of way unless otherwise permitted by the special provisions. Earth and rocky material may be disposed of along the roadway as directed by the Engineer. The entire roadway and right of way shall be left in a neat and presentable condition.

24. ROADSIDE SIGNS

24.1. DESCRIPTION

This work shall consist of furnishing and installing roadside signs in conformance with these specifications and the special provisions, and in conformance with the details shown on the plans.

24.2. MATERIALS

24.2.1. METAL POSTS

Mountings for roadside signs to be installed on barriers or railings shall be fabricated from welded or seamless steel pipe conforming to the requirements in ASTM Designation: A 53, Grade B and structural steel conforming to the requirements in ASTM Designation: A 36/A

36M. Bolted connections and anchorages shall conform to the provisions in Section 56-1.02C, "Bolts, Nuts and Washers".

Mountings for ground-mounted roadside signs shall be wide flange metal posts fabricated from structural steel conforming to the requirements in ASTM Designation: A 36/A 36M. Bolts, nuts and washers for the breakaway connections of wide flange steel posts shall conform to the requirements in ASTM Designation: A 325 or A 325M. All metal parts of roadside sign mountings shall be galvanized after fabrication.

24.2.2. SIGN PANEL FASTENING HARDWARE

Frame assemblies for multiple sign installations shall be fabricated of structural steel conforming to the requirements in ASTM Designation: A 36/A 36M, or of aluminum alloy as shown on the plans. Frames fabricated of structural steel shall be hot-dip galvanized after fabrication.

Back braces for signs shall be commercial quality, mild steel, hot-dip galvanized after fabrication.

Straps and saddle brackets for mounting sign panels on sign structure posts and traffic signal standards or where shown on the plans shall be stainless steel conforming to the requirements in ASTM Designation: A 167, Type 302 or 304. Theft-proof bolts shown on the plans shall be stainless steel with chromium content of at least 16 percent and a nickel content of at least 8 percent.

Lag screws, bolts (except theft-proof bolts), metal washers and nuts shall be commercial quality steel, hot-dip galvanized after fabrication. Fiber washers shall be of commercial quality.

24.2.3 Steel Channels

Steel channels shall conform with AASHTO M183 M (ASTM A63M)

24.2.4 Galvanizing

Unless otherwise shown on the Drawings, all steel supports shall be galvanized in conformity with ASTM A 123. All bolts, nuts, and washers shall be galvanized in conformity with ASTM A 153.

24.2.5 Sign Materials

Sheets for plain aluminum signs shall have a minimum thickness of 3 mm unless otherwise specified this sheet. This sheet shall be non-porous, smooth, flat, rigid, weather proof and shall not rust or deteriorate. It shall be cut such that the corners are rounded off to a radius of 30 mm. Any trade mark or other printing shall be carefully removed with lacquer thinner.

24.2.6 Reflective Sheeting

- Reflective sheeting shall consist of synthetic sheet resin or other approved moncellulostic materials, transparent plastic of the colors specified, and a retro-reflective system (i.e. glass spheres). These spheres shall adhere to the synthetic sheet resin and be embedded beneath a flexible transparent plastic film forming a smooth flat surface.
- The reflective sheeting shall have a precoated pressure sensitive adhesive backing, or a precoated tack-free solvent or heat activated adhesive backing. The sheeting shall adhere tightly to the prescribed surfaces when applied in accordance with the manufacturer's recommendation. The precoated adhesive shall not require additional adhesive coats on the reflective sheeting or application surface.
- After 48 hours aging at 24 degrees C from time of application, the precoated adhesive shall be capable of withstanding 8 hours of soaking in water at 24 degrees C without appreciable decrease in adhesion.
- The precoated adhesive shall have no staining effect on the reflective sheeting and shall be mildew resistant. The protective liner for preventing contamination or premature adhesion shall be removable by peeling without the necessity of soaking in water or other solvents.
- The Reflective sheeting shall meet the requirements and satisfy the tests as laid down in the US Federal specification L-5-300B.

24.2.7 SIGN FACE AND BACK FACE

1. The sign faces for different messages shall be made with wide angle reflective sheeting which shall be processed on to the aluminum plate. The base of the sign face shall be normally of white, blue or yellow wide angle reflective sheeting but the particular sign message shall, however, be in black non-reflective film. The application of the reflective film and the non-reflective film shall be in accordance with the manufacturers recommendations.
2. The sheeting of different colors, reflective or non-reflective, shall have a life of 5 years after application to the face of the sign. This life of 5 years shall be to the outdoor at site-life during which period it shall not fade in color or its reflectivity nor shall it deteriorate in any way.
3. The back-face of the aluminum sign plate shall be provided with gray opaque non reflective film so that the life of the two faces remains the same, i.e. about 5 years. The colors shall be in accordance with the colors used on international road signs. They have to be approved by the Engineer.

24.3. CONSTRUCTION

Posts shall be placed in holes excavated in the ground. Holes shall be excavated to the required depth for the bottom of the posts as shown on the plans. Backfill material for metal posts shall consist of Portland cement concrete produced from commercial quality aggregates and cement, containing not less

than 275 kg of cement per cubic meter.

The line between the center of the top of a post and the center of a post at the ground line shall be plumb within a tolerance of not to exceed 6 mm in 3.0 m.

Holes for bolts, threaded rods or expansion anchorage devices drilled in existing concrete shall be drilled by a method that will not shatter the concrete adjacent to the holes.

Sign panels shall be installed by the Contractor in conformance with the details shown on the plans. Any chipping or bending of sign panels shall be considered as sufficient cause to require replacement of panels at the Contractor's expense. Closure inserts shall be installed into the openings at the edges of adjacent sign panel sections. Adjacent edges of sign panels shall be in contact their full length. At sign panel joints, the Contractor shall mount any overlapping letters and borders on the face of the sign with blind, self-plugging type rivets.

Sign panels shall be attached to metal posts, sign structure posts and traffic signal standards and mast arms with fastening hardware of the types and sizes shown on the plans. Lag screws shall be installed by turning the lag screw into pilot holes by use of a wrench. The pilot holes shall be bored with a bit diameter equal to the root diameter of the lag screw thread.

Signs shall normally be erected so that the edge and face of the sign are truly vertical and the face is at an angle of 87 degrees to the centerline, i.e. facing slightly towards the centerline of the traffic lanes which the sign serves.

The Engineer will establish the longitudinal location of each sign which shall be laterally positioned from the shoulder or curb as shown on the Drawings. The Contractor shall establish the location of the sign supports and shall be responsible for the proper elevation, off-set, and orientation of all signs.

24.4 LETTERING

- The correct Arabic (and English) spelling of the official names of towns, districts, roads and streets etc. will be supplied by the Engineer. Sign messages for each direction sign shall be either as indicated on the Drawings or as otherwise directed. Where English lettering is shown, the lateral extent of Arabic and English lettering for each message shall coincide.
- Sign lettering shall be in clear, open capital letters of type in accordance with drawings. To get better legibility a relatively wide spacing between letters should be used.
- The space between letters should be 1 or 2 widths of the letter stroke, depending on whether the sides of the adjacent letters are vertical or round.
- The space between lines of copy should be approximately equal to the height of upper case used in that line copy. Space between lines of copy should be approximately 3/4 of the average height of the upper case letters in adjacent lines of copy.
- Spacing to top and bottom borders should be approximately equal to average letter height of adjacent line of copy. Spacing to side borders from ends of longest line of copy should be approximately equal to height of upper case letters in that line. Longest line should be "Visually Centered" on sign to account for slant-or open-sides letters on either end.
- A brilliant reflective border makes the sign more conspicuous. Border width should be approximately 1/3 to 3/4 the stroke width of the largest letters on the sign.

25 PRECAST CONCRETE CURB

25.1 SCOPE

These work shall consist of furnishing and constructing concrete curbs as and where shown in the Drawings.

25.2 MATERIALS AND PRECAST MANUFACTURE

25.2.1 Concrete

Portland cement concrete shall be class 250 for all in situ and precast concrete except base course and backing concrete which shall be 200

25.2.2 Mortar

Mortar shall consist of cement and fine aggregate having the same proportions used in the concrete construction.

25.2.3 Precast Concrete Units

All precast units shall be manufactured to the dimension shown on the Drawings Manufacturing tolerances shall be 3mm in any one dimension. End and edge faces shall be perpendicular to the base. Each precast curb unit shall normally be 0.5m in length and this length shall be reduced to 0.25m or as directed where units are to be installed along curves of less than 10m radius.

For horizontal curves of radius less than 10m, curb units shall be manufactured to the radius shown and in such circumstances where straight elements or portions of straight elements shall not be used.

Precast concrete tiles (paving slabs) shall be 400mm by 40 mm thickness with 5mm edge level. The tile face shall be grooved in squares of size agreed by the engineer as appropriate to the tile dimensions coloring of the top layer, where required shall be achieved using mineral oxides.

Precast units shall be cast upside down in approved steel molds under conditions of controlled temperature and humidity. The Engineers approval of the samples will not be considered final and the Engineer may reject any precast units delivered to the site which do not meet the required standards.

25.3 CONSTRUCTION AND INSTALLATION OF PRECAST CONCRETE CURBS

1. The subgrade shall be excavated to the dimensions as shown in the drawings, and the surface of subgrade shall be leveled and compacted to at least 95% AASHTO T180 maximum density.
2. Forms for the concrete base shall be approved wood or steel. All forms shall be sufficiently strong and rigid and securely staked and braced to obtain a finished product correct to the dimensions, lines and grade required. Forms shall be cleaned and oiled before each use. If approved, forms for the concrete base may be omitted and the concrete placed directly against undisturbed excavated faces.
3. Base course concrete shall be placed, compacted and shaped to the sections shown on the Drawings. Concrete shall be compacted with an approved internal type vibrator or if approved, by hand spudding and tamping. Edges shall be rounded if necessary by the use of wood molding or by the use of an edger as applicable. The concrete base shall be finished to a true and even surface with a wood float. Concrete shall be membrane or water cured for at least 7 days before precast units are placed thereon.
4. Precast units shall be soaked in water immediately before installation. Units shall be set accurately in position in mortar on the concrete base. Joints between precast units shall not be mortared unless otherwise shown on the Drawings. Units shall be closely spaced and every 10 m run shall be provided with an expansion joint.
5. Where curbs or gutters are installed on existing concrete pavement and using epoxy resin adhesive, the installation procedures shall conform with those specified for raised pavement markers in Section "Pavement Markings for Traffic".
6. After curbs have been installed, steel forms shall be erected and concrete backing, shall be placed as shown on the Drawings. Pavement courses shall not be laid against curbs until the concrete backing has membrane or water cured for at least 14 days.
7. The tolerances on alignment of completed precast shall be as specified for in situ concrete construction.
8. The area adjacent to completed and accepted curbs shall be backfilled with approved material to the top edges of the curbs to 95 % AASHTO T180 maximum density.

26.0 PRECAST CONCRETE TILES (PAVING SLABS)

26.1 CONSTRUCTION AND INSTALLATION

1. Excavation and the placing of bedding material shall be as specified for in situ concrete paving. The surface of the completed bedding shall be dampened and base course concrete shall be placed and finished to the thickness 40 mm minimum thickness.
2. The base course concrete shall be water or membrane cured as specified for in situ concrete paving, for not less than 7 days before placing precast tiles.

3. Immediately prior to tile laying, the concrete base course shall be dampened and the on concrete tiles shall be immersed in water. Tiles shall then be laid true to line and grade on a 10 mm to 20 mm thickness of mortar joints shall be 3 mm wide.
4. The tolerance on smoothness of precast concrete tiled areas and removal and replacement of defective tiling, shall be as specified for in situ concrete paving .
5. Tiles shall be cleaned 24 to 36 hours after laying and joints shall be mortared using, if approved, a plasticizer in the mortar to improve workability and to enable the mortar to be readily smoothed and finished. As soon as the mortar has partially set, all mortar material shall be raked from the top 3 mm depth of the joint, using a grooving tool to produce a smooth circular section.
6. When the mortar is sufficiently set, the surface shall be sprinkled with water and covered with plastic or nylon sheets during the curing period. The sheets shall be left in place until final hardening of the mortar, or as directed. All foreign material, wood, concrete, mortar lumps, etc., shall then be removed and the surface cleaned of staining, discoloration and other blemishes.
7. In cases where tiles are required to be cut at the boundaries of tiled areas, due to the presence of obstacles, poles, hydrants, etc., or in the construction of the driveways or side roads, the contractor shall cut the tiles or substitute in situ concrete of at least the same quality as the tile concrete. The Engineer will decide, after trials, on the method to be adopted. Cutting of tiles or substitution of in situ concrete shall be kept to a minimum. The contractor shall complete the areas using uncut precast tiles to the maximum extent practicable.
8. Where a side walk crosses the entrance to a shop or a house, etc., which is higher than the side walk, the contractor shall construct steps, formed by a curb and a complete or partial tile. Steps shall be backfilled with concrete of the same quality as specified for concrete base course.
9. Steps shall be constructed wherever the difference in elevation between the entrance and the side walk is more than 250 mm. The contractor shall submit for approval, prior to commencing any sidewalk construction, a list of locations where steps will be required, together with design details for their construction.
10. In situ concrete paving and precast concrete tiling shall be measured by sq. m furnished, constructed or installed, completed, and accepted. Measurements shall be of the surface area and no deduction shall be made for minor obstructions such as manholes, poles or similar small unpaved or untiled areas
11. Concrete Tiled steps shall be measured by sq. m furnished, constructed or installed, completed, and accepted. Measurements shall be of the horizontal projection of the steps.
12. Excavation, backfilling, bedding, concrete base course, concrete backing, construction in and around obstacles, poles, manholes, flower beds, cutting and shaping of tiles on curves, jointing, and finishing at walls and fences, etc. shall not be measured for direct payment, but shall be considered as subsidiary works, small the costs of which will be deemed to be included in the contract prices for the pay items.

27.0 RIP RAP

27.1 SCOPE

These works shall consist of furnishing and placing of dry stone Rip-rap, with or without mortar, to in accordance with these specifications in the locations and to the extent and grades as shown on the plans or ordered by the Engineer.

27.2 MATERIALS

Stones used as rip rap shall be hard, angular, quarry stones, of such quality that they will not disintegrate on exposure are to water or weathering. and shall have a specific gravity (bulk saturated surface dry) of 2.5. when tested in accordance with AASHTO T- 85. If grouted, the mortar shall consist of one part cement and three parts of fine aggregate.

27.3 CONSTRUCTION

27.3.1 Preparation of Slopes

The surfaces upon which rip-rap and other slope protection works are to be placed shall be excavated and compacted to the required grades and lines, all as shown on the Drawings or as directed.

27.3.2 Loose Stone Rip-rap

Stones shall be placed so as to minimize the voids. Larger stones shall be placed in the lower levels of the slope.

After completion and approval of the rip-rap placement, the surface voids of the rip-rap shall be filled with excavated material and dressed to the satisfaction of the Engineer.

27.3.3 Mortared Stone Rip-rap

- Stones shall be placed so as to minimize voids. Larger stones shall be placed on the lower levels of the slope.
- The stones shall be wetted with water at least 24 hours prior to construction.
- Rip-rap shall be placed in the same manner as for loose Rip-rap. The surfaces of the stones shall be cleaned of all adhering dirt and clay before placing any mortar.
- While still plastic, the mortar between stones should be removed to a depth of about 3 cm. The cavity should be refilled with special lining mortar (kuhle) proportioned at a minimum of 500 kg Portland cement for each cubic meter of sand. The mortar should be cut to a proper width to produce aesthetically acceptable decorative shapes.
- The exposed mortar shall, immediately after completion of each section of rip-rap, be cured using clear curing compound or kept moist for at least 3 days after completion of mortar placement.

28.0 GABIONS

28.1 SCOPE

These works shall consist of furnishing and placing wire mesh boxes rectangular in shape filled with clean and uniform rocks larger than mesh openings in accordance with the plans, and these Specification.

28.2 MATERIALS

- Wire mesh shall consist of galvanized steel fabricated in double twist woven hexagonal with the following dimensions

Wire Diameter	Mesh Size
3 mm	8 cm x 10 cm

- The rocks shall consist of clean solid rock non friable and resistant to weathering and frost action larger in size than the larger mesh dimension. The maximum. Dimension of rocks shall not exceed 30 cm. The rocks in the middle of the unit shall have a minimum size equal to the smaller mesh dimension.

28.3 CONSTRUCTION

Excavation required for the placement of gabions shall be made in accordance with the dimensions as shown on plans or as directed. gabions shall be constructed in units to the dimensions indicated on the plans. Gabion boxes shall be placed on a well compacted material. Foundation material shall consist of any of the A-1, A-1-b, A-2-4 and, A-3 groups or other granular material containing up to 3" max. size aggregates.

29.0 PAVEMENT MARKINGS

29.1 SCOPE

These works shall consist of furnishing and applying traffic markings to road pavements in the locations and to the extent indicated on the plans or ordered by the Engineer and in conformity with these Specifications.

29.2 MATERIALS

1. The pavement markings consist of white and yellow lines, pedestrian crossing lines, stop lines, chevron striping and directional arrows shall be of thermoplastic, reflectorized paint (TRP) consisting of a mixture of binder, white or yellow pigment, glass spheres, filler, and other materials in granular form especially

compounded for traffic paint that is to be applied to the pavement in a molten state by mechanical means with surface application of glass beads.

2. White and yellow TRP shall conform to AASHTO M249. Surface application glass sphere (beads) shall conform to AASHTO M 247, Type 1.
3. Pre-mixed glass beads shall occupy 20-25% by weight of the TRP mixture and shall conform to the following requirements:
4. Crushing Resistance: An 18 Kg dead weight shall be the average resistance when tested in accordance with ASTM D 1213.
5. Roundness: A minimum of 75% shall be true spheres when tested in accordance with ASTM D 1155.
6. Index of Refraction: When tested by the liquid immersion method at 25 degree C, the spheres which will mix with the material shall have a minimum index of refraction of 1.65 and the spheres that will be applied to the TRP line will have a minimum index of refraction of 1.5.
7. Gradation: When tested in accordance with ASTM D 1214, the spheres used in the TRP shall have the following gradation:

<u>standard Sieve Size</u>	<u>% Passing By Weight</u>
1.70 mm (No. 12)	100
0.180 mm (No. 80)	0-5

29.3 APPLICATION AND INSTALLATION

- The equipment used for pavement marking shall consist of approved types of truck-mounted units, or motorized equipment, or manually operated equipment, depending on the type of marking required.
- The truck-mounted units or motorized equipment shall be used for applying centerlines, lane lines, and edge lines. The hand application equipment may be used for other applications.