UNITED NATION DEVELOPMENT PROGRAM

AREA BASED APPROACH TO DEVELOPMENT EMERGENCY INITIATIVE (ABADEI)

TECHNICAL SPECIFICATION

Kabul,

AFGHANISTAN
CONTENTS

Description of Items                                       Page no

SERIES 1000:  GENERAL REQUIREMENTS.......................... Error! Bookmark not defined.

  SECTION 1200:  CONTRACTOR'S ESTABLISHMENT .......................... 12
  SECTION 1300:  ENVIRONMENTAL PROTECTION .................................. 155
  SECTION 2100:  CLEARING.......................................................... 24
  SECTION 2200:  DRAINS............................................................ 26
  SECTION 2300:  CULVERTS ......................................................... 29
  SECTION 3200:  EARTHWORKS...................................................... 35

SERIES 4000:  ROAD WORKS .......................................................... 39

  SECTION 4100:  GRAVEL SUB-BASE ............................................. 39
  SECTION 4300:  BASECOURSE ...................................................... 44
  SECTION 5600:  BAR CONCRETE ROAD ......................................... 46
SECTION 1100: GENERAL REQUIREMENTS AND PROVISIONS

CONTENTS

1101 SCOPE
1102 PROGRAMME OF WORK
1103 WORKMANSHIP AND QUALITY CONTROL
1104 MEASUREMENT AND PAYMENT
1105 SUBSTANTIAL COMPLETION OF THE WORKS
1106 PROTECTION OF THE WORKS
1107 REMEDIAL WORK
1108 WATER
1109 ELECTRICITY SUPPLY
1110 PAYMENTS AND TOLERANCES
1111 PHOTOGRAPHIC RECORDS
1112 ACCESS TO SITE
1113 CO-OPERATION AT SITE
1114 ROADS AND SITE TO BE KEPT CLEAN
1115 SECURITY OF THE WORKS
1116 SUPPRESSION OF NOISE
1117 SAFETY
1118 METHOD OF WORKING
1119 TEMPORARY WORKS
1120 ACCOMMODATION OF PUBLIC TRAFFIC
1121 SELECTION OF LABOUR
1122 PROJECT INFORMATION BOARDS
1123 APPROVAL OF SOURCE OF MATERIALS
1124 STOCKPILLING OF MATERIAL
1125 COMPACTION EQUIPMENT
1126 COMPACTION
1127 MIXING AND CONTROL OF MOISTURE CONTENT
1128 CONSTRUCTION PROVISIONS
1101 SCOPE

This section covers matters which relate to the construction work as a whole.

1102 PROGRAMME OF WORK

The programme of work required in terms of the General Conditions of Contract shall be submitted to the Engineer not later than 14 days after the Contractor has been issued with the order to commence.

The Programme shall not be in the form of a bar chart only, but shall show clearly the anticipated quantities of work to be performed each week/month, the resources to be applied to each activity, as well as the anticipated earnings for the various sections of work. If, during the progress of the work, the quantities of work performed per week/month fall below those shown in the programme, or if the sequence of operations is altered, or if the programme is deviated from in any other way, the Contractor shall, within one week after being notified by the Engineer, submit a revised programme.

If the programme is to be revised by reason of the Contractor falling behind his programme, he shall produce a revised programme showing the modifications to the original programme necessary to ensure completion of the works or any part thereof within the time for completion as defined in the Conditions of Contract or any extended time granted pursuant to the Conditions of Contract. Any proposal to increase the tempo of the work must be accompanied by positive steps to increase production by providing more labour and plant on Site, or by using the available labour and plant in a more efficient manner.

Failure on the part of the Contractor to work according to the programme or revised programme, shall be sufficient reason for the Employer to take steps as provided for in the Conditions of Contract and shall be construed as not executing the Works in accordance with the Contract.

The approval by the Engineer of any programme shall have no contractual significance other than that the Engineer would be satisfied if the work is carried out according to such programme and that the Contractor undertakes to carry out the work in accordance with the programme, nor shall it limit the right of the Engineer to instruct the Contractor to vary the programme should circumstances make this necessary. The above shall not be taken to limit the right of the Contractor to claim for damages or extension of time to which he may be fairly entitled to in terms of the General Conditions of Contract for delay or disruption of his activities.

Should the Employer request and the Contractor undertake to finish the whole or part of the Works ahead of the time originally required by the Contract, payment for accelerating the work shall only be made if agreed to beforehand in writing and according to the terms of such agreement.

1103 WORKMANSHIP AND QUALITY CONTROL

The onus is on the Contractor to produce work which conforms in quality and accuracy of detail to the requirements of the Specifications and/or Drawings, and the Contractor must, at his own expense, institute a quality control system and provide experienced engineers, foremen, surveyors, materials technicians, other technicians and other technical staff, together with all transport, instruments and equipment, to ensure adequate supervision and positive control of the Works at all times.

The cost of all supervision and process control, including testing, so carried out by the Contractor, shall be deemed to be included in the rates tendered for the related items of work except that the cost of certain tests and the provision of certain items of testing and sampling equipment will be paid for separately as provided for in those sections of the Specifications where this applies.

Unless otherwise instructed by the Engineer, the Contractor shall obtain approval for each layer of the works, in embankments, sub-grade, or any gravel or road layers and shall not proceed with subsequent layers until each approval is granted. The Contractor shall be required to give reasonable notice to the Engineer to allow any inspection to be carried out. If any test is required to verify compliance with these specifications, then the Contractor shall plan his Works so as to allow the Engineer sufficient time to carry out such tests. Unless instructed otherwise, the Contractor may proceed with the Works even though the results of tests may not yet be available. However, the Contractor shall be required to re-execute work if tests indicate non-compliance with these Specifications. Any approval given by the Engineer shall not relieve the Contractor of any of his obligations under the Contract.

1104 MEASUREMENT AND PAYMENT

Bill of Quantities

The quantities set out in the Bill of Quantities are estimated quantities and are used for the comparison of Tenders and awarding the Contract. It must be clearly understood that only the actual quantities of work done or materials supplied will be measured for payment, and that the billed quantities may be increased or decreased as provided for by the General Conditions of Contract.
Contract Rates

In computing the final contract amount, payments shall be based on actual quantities only of authorised work done in accordance with the Specifications and/or Drawings. The tendered rates shall apply, subject to the provisions of the General Conditions of Contract, irrespective of whether the actual quantities are more or less than the billed quantities.

The Contractor shall accept the payment provided in the Contract and represented by the prices tendered by him in the price schedule) and applied to the respective item in the Bill of Quantities, as payment in full for executing and completing the work as specified, for procuring and furnishing all materials, labour, supervision, plant, tools and equipment, for wastage, transport, loading and offloading, handling, maintenance, temporary work, testing, quality control including process control, overheads, profit, risk and other obligations and for all other incidentals necessary for the completion of the work and maintenance during the Period of Maintenance.

This Clause shall be applicable in full to all pay items except as these requirements may be specifically amended in each case.

In particular, the Contractor shall be deemed to have included time related and fixed costs as specified in Section 1200 under the appropriate items in the General and Preliminary section of the Bill of Quantities and not in rates for work items.

Pay items

The descriptions under the pay items in the various sections of the Specifications, indicating the work to be allowed for in the tendered prices for such pay items, are for the guidance of the Contractor and do not necessarily repeat all the details of work and materials required by and described in the Specifications.

These descriptions shall be read in conjunction with the relevant Specifications and/or Drawings and the Contractor shall, when tendering, allow for his prices to be inclusive as indicated above.

Materials on Site

No payment will be made in any Certificate for any materials on site until such time as they have been incorporated in the permanent works and approved.

Provisional Sums

The Bill of Quantities may contain certain Provisional Sums so designated and entered as a preliminary allowance to cover the cost of work, materials, goods or services to be provided by the Contractor and which have not been fully specified or measured or to cover the cost of unforeseen items of work or contingent expenditure. Work done under a Provisional Sum shall only be executed upon a written order by the Engineer which order shall also specify the method of payment.

The Contractor shall furnish to the Engineer such receipts or other vouchers as may be necessary to prove the amounts paid and, before ordering materials, shall submit to the Engineer quotations for the same for his approval. In respect of such of the works executed on a day works basis, the Contractor shall, during the continuance of such work, deliver each day to the Engineer an exact list of the names, occupation and time of all workmen employed on such work and a statement showing the description and quantity of all materials and equipment used other than the Contractors equipment which is included in the percentage addition in accordance with such daywork schedule. Each list and statement will, if correct, or when agreed, be signed by the Engineer and a copy returned to the Contractor.

The Contractor shall not be entitled to any payment unless such lists and statements have been fully and punctually provided. Where the Engineer considers that for any reason the provision of such lists was impracticable he shall nevertheless be entitled to authorise payment for such work provided that, such work or value thereof shall, in his opinion, be fair and reasonable.

1105 SUBSTANTIAL COMPLETION OF THE WORKS

The Contractor shall note that the Engineer reserves the right not to certify the Works to be "substantially completed" as required by the Conditions of the Contract, unless the following portions of the Works are completed according to the Specifications:

(a) all bituminous seal works or, where a seal is not included, the uppermost gravel layer.
(b) all drains and drainage structures, for the construction of which timeous instructions were given by the Engineer.
(c) finishing of all support or retaining structures.
Opening of individual sections or lots shall not entitle the Contractor to receive a Completion Certificate unless the sections are separately identified in the contract or qualifies otherwise in terms of the Conditions of Contract.

1106 PROTECTION OF THE WORKS AND REQUIREMENTS TO BE MET BEFORE CONSTRUCTION OF NEW WORK ON TOP OF COMPLETED WORK IS COMMENCED

The Contractor is to provide temporary drainage works such as drains, open channels, banks, etc. and furnish and operate temporary pumps and such other equipment as may be necessary to adequately protect, drain and dewater the works and temporary works. This will be in addition to any permanent drainage works specifically paid for separately. Care shall be exercised to keep all completed layers properly drained, not to cause dumps of material on completed layer work to inhibit surface drainage or to form wet spots under and around dumps, and to protect all parts of the work against erosion by floods and rain.

Material shall not be spread on a layer that is so wet such as to damage underlying layers or prevent adequate compaction of overlying layers. Such wet layers shall be dried and re compacted or removed. Excavations for pipe drains, culverts, sewer drains, water mains, manholes, service ducts and similar structures shall be adequately protected against the possible ingress of water during rainstorms.

All completed layer work shall be protected and maintained until the following layer is applied. Maintenance shall include immediate repairs to any damage or defects which may occur and shall be repeated as often as is necessary to keep the layer continuously intact and in a good condition. Before any completed layer is primed or a succeeding layer constructed thereon, any damage to the existing layer shall be repaired so that after repair or reconstruction if necessary, it will conform in all respects to the requirements specified for that layer. All repair work other than minor surface damage repairs shall be submitted to the Engineer before covering up.

Work performed as part of the above obligations shall not be measured and paid for separately and the cost thereof is to be included in the prices tendered for the various items of work requiring protection and for the Contractor's establishment on Site as specified in Section 1200.

1107 REMEDIAL WORK

When any part of the Works or any equipment or material is found upon examination by the Engineer not to conform to the requirements or is at any stage before final acceptance damaged so that it no longer conforms to the requirements of the Specifications, the Engineer may order its complete removal and replacement, at the Contractor's expense, with satisfactory work, equipment or material or he may permit the Contractor to apply remedial measures in order to make good any such defects or damage. The actual remedial measures taken shall at all times be entirely at the Contractor's own initiative, risk and cost, but subject to the Engineer's approval regarding the details thereof.

In particular, remedial measures shall ensure full compliance with the Specifications of the final product, shall not endanger or damage any other part of the Works and shall be carefully controlled.

1108 WATER

The Contractor shall make his own arrangements for procuring, transporting, storage, distribution and application of water needed for construction and other purposes, except where otherwise specified. No direct payment will be made for providing water and the cost thereof shall be included in the prices tendered for the various items of work for which water is needed. Only clean water, free from undesirable concentrations of deleterious salts and other materials shall be used. The Contractor shall ensure that sufficient supply of water is at all times available to ensure continuity of work. All sources of water used must be approved by the Engineer.

1109 ELECTRICITY SUPPLY

The Contractor shall provide and maintain at his own expense his own electrical supply and shall provide and maintain all temporary power and lighting and all associated apparatus for the duration of the Contract at his own expense. Once equipment becomes redundant, and having received the approval from the Engineer, the Contractor shall disconnect and remove said equipment and make good any works disturbed at his own expense.

1110 PAYMENTS AND TOLERANCES

The work specified in the various sections of these Specifications shall comply with the various dimensional and other tolerances specified in each case. Where no tolerances are specified, the standard of workmanship shall be in accordance with normal good practice.

Where the work is not constructed in accordance with the "authorised" dimensions, plus or minus any tolerances allowed, the engineer may nevertheless in his sole discretion accept the work for payment. In such cases no payment will be made in respect of quantities of work or material in excess of those calculated from the "authorised" dimensions and where the
actual dimensions are less than the "authorised" dimensions, minus any tolerance allowed, quantities for payment shall be based on the actual dimensions as constructed.

1111 PHOTOGRAPHIC RECORDS

The Engineer shall make photographs and other records to be agreed with the Contractor of the condition of the surfaces of the site immediately before entering upon them for the purpose of constructing the Works. Each month, the Contractor shall make a set of up to 100 digital colour photographs illustrating progress of the Works, or any other photograph that he may deem necessary for record purposes, and provide these to the Engineer for his records. The copyright of all photographs shall be vested in the Employer and the Contractor shall not use any photograph for any purpose whatsoever without the Engineer's approval.

1112 ACCESS TO SITE

The Contractor shall make his own arrangements for access to the various parts of the Site where works are to be constructed but all such accesses shall be subject to the approval of the Engineer.

Where the access to the Site proposed to be used by the Contractor lies across the land of any third party the Contractor shall produce to the Engineer the written consent of the owner and the occupier of the land over which the access lies before making use of the same.

The Contractor shall also make a record to be agreed by the Engineer of the conditions of the surfaces of any land (and of any crops on such land) over which access lies before he uses it for access purposes and he shall keep all such surfaces in a reasonable state of repair during the executing of the Works. On the termination of the Contractor's use of such access he shall restore any lands, roads or other property to a condition at least equal to that existing before his first entry upon them.

1113 CO-OPERATION AT SITE

All work shall be carried out in such a way as to allow access and afford all reasonable facilities for any other contractor and his workmen and for the workmen of the Employer and any other person who may be employed in the execution and/or operation at or near the site of any work in connection with the Contract or otherwise.

The Contractor shall use his best endeavours to co-operate with such persons without interfering with them and shall observe all the instructions and orders of the Engineer in that connection.

In the preparation of his programme of work the Contractor shall at all times take full account of and co-ordinate with the programming of work of other contractors.

1114 ROADS AND SITE TO BE KEPT CLEAN

The Contractor shall take great care and all reasonable precautions to ensure that roads and thoroughfares used by him either for the construction of the Works or for the transport of plant, labour and materials are not made dirty as a result of such construction or transport and in the event of their becoming thus dirtied in the opinion of the Engineer the Contractor shall take all necessary and immediate steps to clean them.

1115 SECURITY OF THE WORKS

Watching of the Works shall be provided by the Contractor at his own expense. If the Engineer considers it necessary, he will order in writing that additional watchmen be provided at all the Contractor's expense.

1116 SUPPRESSION OF NOISE

The Contractor shall make every reasonable endeavour both by means of temporary works and by the use of appropriate plant or silencing devices to ensure that the level of noise resulting from the execution of the Works does not constitute a nuisance.

1117 SAFETY

The Engineer shall be notified by the Contractor immediately any accident occurs whether on Site or off Site in which the Contractor is directly involved which results in any injury to any person whether directly concerned with the Site or whether a third party. Such initial notification may be verbal and shall be followed by a written comprehensive report within 24 hours of the accident.

Transportation of any material by the Contractor shall be in suitable vehicles which when loaded do not cause spillage and all loads shall be suitably secured. Any vehicle which does not comply with this requirement or any of the local traffic regulations and laws shall be removed from the Site.
1118 **METHOD OF WORKING**

The Contractor shall adopt a method of working such as to permit the satisfactory and timely completion of the Works and to limit disturbance and damage to a minimum.

The Contractor shall only open up sections of the Works for which his resources are sufficient to maintain continuous and methodical progress. If in the opinion of the Engineer, the Contractor has not complied with the foregoing, he shall be entitled to suspend sections of the works until other sections have been completed to a stage where risk of damage through exposure to traffic and the elements and inconvenience to public traffic has been minimised.

Constructional Plant used in the execution of the Works shall be of a design and used in a manner approved by the Engineer. The Engineer may at any time withdraw his approval for any method of working proposed by the Contractor and the Contractor shall immediately adopt another method of Working. If such change shall be required to achieve satisfactory progress or workmanship, the Contractor shall have no claim against the Employer for costs incurred by him in changing the method of working or in the provision and use of other plant.

1119 **TEMPORARY WORKS**

The Contractor shall provide, maintain and remove on completion of the Works all temporary works necessary for the construction of this permanent works. All temporary works shall be properly designed and constructed to carry such loads as may be imposed upon them and shall be safe and suitable in every respect for providing access or carrying plant or for the construction of the Works or other purposes.

1120 **ACCOMMODATION OF PUBLIC TRAFFIC**

The Contractor shall so plan his operation so as to maintain the flow of traffic through the Works without disruption or delay. Road closures may be permitted by the Engineer in exceptional circumstances. The Contractor shall give at least 7 days notice of any proposed road closure.

Upon completion of a days work, or if the Works are to be left unattended, the Contractor shall leave the Works in such a condition so as to allow the safe passage of traffic. The Contractor shall be responsible for complying with all regulations relating to the temporary closure of roads in the country.

Should the road width be restricted or should there be any form of obstruction or danger to traffic, the Contractor shall supply adequate flagmen, signs, barriers, lights, communications and staff to ensure that the traffic is safely conducted through the Works.

1121 **SELECTION OF LABOUR**

The Contractor will be expected to maximise the use of labour for all operations where it can be effectively used to attain the required standards. The Contractor is expected to show number of Labourers used each month including participation of female worker if appropriate in specific project area in the form shown below:

<table>
<thead>
<tr>
<th>Month</th>
<th>Work Days Generated</th>
<th>Number of Labourers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
</tbody>
</table>

Initiation of Equal participation of women for the work is also a major objective of this contract. To achieve this, the Contractor is expected to select the labour force by lottery. Prior to recruiting the labour, the Contractor should inform the people in the surrounding area at least 5 days before the selection takes place by announcing through a public announcement system and by displaying posters in public places of the target villages (Any person within than 3 km of the work site). All participants of the lottery will be registered as per their identification card. Two parallel draws will be arranged for men and women separately. The Contractor can select more people than he needs, keeping them in a reserve list, to allow for changes in the attendance. A new lottery should take place if the work proceeds for more than two months or advised by engineer/UNDP.

To comply with the construction standards required using labour-based technology, the Contractor will be expected to make extensive use of a variety of setting out and other construction aids. These shall include:

- ranging rods
- Profile boards
- Pegs and string lines
- line levels
- ditch templates
The Contractor shall set out, using pegs and string lines, the various construction operations in sufficient detail to ensure that the required standards and tolerances are achieved, and in such a way that any task work system adopted may be easily checked by the Engineer. The Contractor is responsible for training the labourers.

1122 PROJECT INFORMATION BOARDS

The Contractor shall provide, erect and maintain at least two information boards per road in a format acceptable to the Engineer. Each sign shall be of no less than 2 m² area and comprise white lettering on a blue background. The following information should be given on each board:

- Project Title (Area Based Approach to Development Emergency Initiative)
- Name of Responsible Ministry (---)
- Name of Funding Agency (UNDP)
- Name of Project Implementation Organisation
- Contractor's Name

These information boards shall be erected at locations to be selected by the Engineer.

The boards are to be erected as the Contractor commences work on a particular Project road. The Contractor shall be responsible for removing the sign at the end of the Defects Liability Period.

1123 APPROVAL OF SOURCES OF MATERIALS

The sources of the materials shall be selected by the Contractor, but approved by the Engineer prior to their incorporation in the Works. For this purpose, the Contractor shall furnish all relevant test data for representative samples from each source area as desired by the Engineer and also afford opportunities for the Engineer to visit the source areas. The number of representative samples to be tested shall not be less than two for each type of material in each source area. Notwithstanding approval of sources of materials, materials as brought to the work site for use in the work shall be subject to acceptance or rejection by the Engineer based on quality control tests to be performed before use in construction.

1124 STOCKPILING OF MATERIALS

All materials brought to the site shall be stockpiled and stored in a systematic manner so as to prevent deterioration or mixing of materials or intrusion of foreign matter. Preparation and storage of materials along the alignment will not be allowed. The Contractor shall make all arrangements and bear all costs associated with the provision of these storage areas.

The site of stockpile shall be cleared of vegetation and debris, graded and drained. The bottom 50mm layer of aggregate or any contaminated aggregate shall not be used in the work. Materials which have suffered intrusion and deterioration due to improper storage shall not be used in the works.

Control Tests on Material Stockpiles

The Contractor shall use only such materials in construction as conform to the requirements regarding composition, grading, physical properties and engineering characteristics specified for different kinds of material. For this purpose, pre-construction control tests shall be carried out on representative samples collected at random from material brought to the site or at stockpiles. Any stockpile or any material brought to the site found not conforming to the Specification requirements shall be removed promptly.

1125 COMPACTING EQUIPMENT

Mechanical equipment shall be used for compacting materials by rolling, tamping and watering (if needed). For other operations such as spreading, mixing and shaping, manually operated tools and equipment is preferred on mechanical equipment alone or a combination of the two shall be used. The choice of equipment and the procedure for their use shall be subject to the approval of the Engineer upon his being satisfied about their effectiveness on the basis of trial compaction.

It shall be understood by the Contractor that different types of material are likely to require different kinds of compaction equipment, including successive applications thereof, to achieve the specified degrees of compaction, and the Contractor shall keep available compaction equipment of the requisite kind, size and number.

For compacting narrow strips and for compaction in restricted areas smaller sized compacting equipment may be required and if so, the same shall be provided for by the Contractor.

1126 COMPACTING
Compaction of materials shall be done in layers of uniform thickness using approved compaction equipment including combinations thereof if desired by the Engineer.

Compaction with rollers shall commence at the edges and progress towards the centre except in super-elevated and other stretches of unidirectional cross fall, where the rolling shall commence at the lower edge and progress towards the upper edge. When commencing rolling from an edge, rollers shall run forward and backward along the edge several times till the edge strip becomes firm to provide lateral support. The roller shall then move inwards parallel to the centre line of the road in successive passes with the tracks made by successive passes overlapping. Rolling shall continue till the specified degree of compaction is achieved throughout. When rolling is terminated at an edge, the procedure similar to that for commencing rolling at an edge shall be adopted. During rolling, the top of the layer being rolled shall be checked for levels and cross fall and any irregularities in these regards corrected by loosening the material in the affected area and by removing or adding materials and continuing with the rolling until the entire area being rolled has been brought to a state of uniform and desired compaction.

Compaction Trials
To demonstrate the efficiency of mixing and compaction equipment and the working methods proposed to be used by the Contractor for different kinds of materials, the Contractor may be required to carry out compaction trials before starting full-scale construction on the road. Based on results of compaction trials and construction observations, the Engineer may direct the use of particular mixing and compaction equipment and methods and disallow the use of others.

Compaction Control
After the compaction of each layer of material, field density tests shall be done on the compacted material. For locating test points, successive compaction panels covering the entire area of work shall be designated in advance of compaction. The frequency of the tests (in terms of square metres of compacted area of each layer for which minimum one test is to be done) shall be separately specified for different kinds of material. The test locations shall be chosen through random sampling techniques.

For material other than bituminous mixes, the compaction panels in which the compaction work is found as non-acceptable shall be given re-compaction accompanied with scarifying and wetting/drying for the entire thickness of the compacted layer to achieve the specified degree of compaction.

1127 MIXING AND CONTROL OF MOISTURE CONTENT

Before compaction is taken up (other than for bituminous mixes), each layer of material shall be brought to a state of uniform composition, texture and moisture content by thorough mixing and addition of water or drying as required. The Contractor shall be deemed to have taken account of the fact that the materials encountered may vary widely with respect to their in-situ moisture content and the moisture content at which the materials are to be compacted.

Drainage During Construction
All embankment, subgrade, shoulder and road layers under construction shall be protected from any accumulation of water due to rains or other causes and from erosion. All such layers under construction shall be provided with cross fall to facilitate surface run-off and, if necessary, the cross fall shall be supplemented with temporary drains or pumping arrangements to prevent accumulation of water.

1128 CONSTRUCTION PROVISIONS

Protection to Existing Embankment/Road Layers

Excavation for new construction, and placement of materials and their in-situ processing and compaction shall be done in such a manner and with such precautions as not to cause any damage to embankments, subgrade layers, shoulders and road layers in position including those pre-existing and intended to form part of the improved road.

Disposal of Hauling Equipment

Hauling equipment bringing materials to the site of work shall be dispersed uniformly over the surface of the previously constructed layers in order to avoid rutting and uneven compaction. The materials from hauling equipment shall not be dumped in concentrated heaps but deposited as evenly distributed layers.
Plying of Traffic

Layers of embankment, subgrade, road and shoulder during construction shall be protected against the plying of any kind of traffic other than construction equipment, till the new construction has been finally opened to traffic.

Making Good Damage to Layers under Construction

Placing, mixing, watering and compaction of material shall be done in layers of uniform thickness as specified for different types of material. Placement of a new layer of material shall not be started before the previous layer has been compacted as per Specification and Drawings and accepted by the Engineer. Different layers in any particular stretch shall be constructed as per Specification one after another without any time lag, unless otherwise instructed or agreed to by the Engineer. If in the time that might elapse between the acceptance of a lower layer by the Engineer and the placing of the overlying layer, damage such as cracking, rutting, corrugations, potholes, ravelling, softening, erosion etc., is caused to the lower layer due to whatever reason, such damage shall be made good by the Contractor at his own cost to the satisfaction of the Engineer before starting the placing of material for the overlying layer.

Drawings

The drawings referred to in the contract document are the standard cross sections of the road.

Typical Cross Section

The "Standard Cross Sections" given in the drawings are provided as a guide only. The locations and extent of works to be undertaken will be ordered by the Engineer on site.
SECTION 1200: CONTRACTOR’S ESTABLISHMENT

CONTENTS

1201 SCOPE
1202 GENERAL REQUIREMENTS
1203 PAYMENT

1201 SCOPE

This section covers the setting up of the Contractor’s establishment on the site, maintenance of the site establishment and the removal thereof after completion, and compliance with the provisions of the contract.

1202 GENERAL REQUIREMENTS

Siting of construction camps

The Contractor shall establish his principal construction camp at or near to the site at a location of his choice, subject to the approval of the Engineer. The principal construction camp shall accommodate the Contractor’s administrative offices and testing facilities but the Contractor may establish other camps as he may require to accommodate stores, plant workshops, casting yards, concrete batching facilities, crushing plant etc. The Contractor shall be solely responsible for the provision of land for construction camps, the cost of which shall be deemed to be included in his tender.

Provision of facilities, plant and equipment

The Contractor shall provide all facilities, personnel, equipment, plant and all other things whether of a permanent or temporary nature required for the execution and maintenance of the.

Compliance with the Conditions of Contract

The Contractor shall be deemed to have examined the documents comprising the contract and to have included in his tender for the cost of complying with the provisions thereof whether itemised in the Bill of Quantities or not.

1203 PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200.01</td>
<td>Mobilisation</td>
</tr>
</tbody>
</table>

Payment **unit price schedule and as given in the billed items** for mobilisation shall be compensation in full for the cost of establishing plant equipment facilities and personnel upon the site and shall include (but not necessarily be limited to).

(i) Transport of plant, buildings, temporary facilities to the site.

(ii) Provision and erection of temporary buildings, office facilities on the site.

(iii) Provision of access roads, hard standings etc. within construction camps.

(iv) Airfares, temporary accommodation during the mobilisation phase, permits, bonds etc. necessary to establish expatriate supervisory personnel upon the site.

(v) Establishment of testing and process control facilities on the site.

(vi) Erection of contract signboards.

(vii) Provision of transportation facilities for supervisory, administrative and technical personnel.

(viii) Provision of housing for supervisory, administrative and technical personnel.
Payment for mobilisation shall be made when the Contractor has established himself upon the site to the satisfaction of the Engineer.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1200.02  | Maintenance of the Contractor's Establishment | (as per BoQ) Payable as stated in the unit price schedule and as given in the billed items for maintenance of the Contractor's establishment on the site. Costs shall include, but not be limited to:

(i) Salaries, leave fares, gratuities and miscellaneous entitlements of supervisory personnel, technical personnel, surveyors, administrative personnel, security personnel, storemen etc.

(ii) Maintenance of offices, buildings, laboratories and transportation facilities for administrative, supervisory and technical personnel.

(iii) Communications.

(iv) Maintenance of housing for administrative, supervisory and technical personnel.

(v) Overheads off site.

(vi) Financing charges.

(vii) Compliance with the provisions of the contract whether specified or implied.

This item shall not include for maintenance or depreciation of plant, the cost of which shall be deemed to be included in the relevant work item.

Payment shall be made at a lump sum rate per week/month in respect of the period commencing from the Engineer's order to commence until the date for completion of the whole of the Works subject to the Contractor having provided an acceptable Performance Bond in accordance with the Conditions of Contract.

Notwithstanding equal monthly payments as aforesaid, in the event that the Contractor shall fail to complete to Works, total payment under this item shall be limited to the sum of all items pertaining to maintenance of the Contractors establishment multiplied by the value of works completed (excluding General and Preliminary items, Day works and Provisional Sums) divided by the total value of the Works (excluding General and Preliminary items, Day works and Provisional Sums) and any over payment shall be recoverable as a debt by the Employer.

In the event that the Contractor shall complete the Works before the date for completion, then the whole of the sum under this item shall become due and payable with the first interim certificate after completion has been certified pursuant to the Conditions of Contract. Subject to the above provisions relating to failure to complete the whole of the Works, this provision shall apply equally to Sections of the Works defined in the contract.

In the event of an extension of the Contract period being granted by the Engineer (excluding any extension for which the Contractor is not entitled to costs) then payment shall be due at the lump sum rate per week/month for an extension not exceeding three months. Thereafter, costs associated with time extension shall be determined as provided for by the contract.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1200.03  | Demobilisation              | Payable as stated in the unit price schedule and as given in the billed items for demobilisation shall be compensation in full for the costs of removing plant, equipment, facilities and personnel from the site and shall include (but not necessarily be limited to):

(i) Transport of plant, buildings, temporary facilities from the site and export if required.

(ii) Dismantling and removal of all temporary facilities on the site.

(iii) Airfares for repatriation of expatriate personnel.

(iv) Removal of contract sign boards.

Notwithstanding equal monthly payments as aforesaid, in the event that the Contractor shall fail to complete to Works, total payment under this item shall be limited to the sum of all items pertaining to maintenance of the Contractors establishment multiplied by the value of works completed (excluding General and Preliminary items, Day works and Provisional Sums) divided by the total value of the Works (excluding General and Preliminary items, Day works and Provisional Sums) and any over payment shall be recoverable as a debt by the Employer.
(v) Restoration of all construction camp areas to a satisfactory condition.

Payment shall be made upon completion of demobilisation to the satisfaction of the Engineer. This item shall be payable only in respect of the whole of the Works and shall not apply in cases of sectional completion.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200.04</td>
<td>Performance Bond</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Payment for Performance Bond shall be payment in full for providing and maintaining the Performance Bond for the period stipulated in the contract. Payment shall be due when a Performance Bond acceptable to the Employer has been delivered to him.

In the event of extensions to the contract period (excepting extensions for which costs are not due to the Contractor) the Employer shall either (a) pay the cost of extending the period of validity of the bond or (b) reduce the period for which the bond shall remain valid.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200.05</td>
<td>Insurances</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Payment for insurances shall be compensation in full for the cost of providing all insurances required by the contract. Payment shall become due when evidence of satisfactory insurances has been provided to the Engineer.

Unless the Insurance of the Works has been effected for the whole of the contract period, payment of the lump sum shall be made only in the proportion that the period of the insurance coverage (in respect of the Works) bears to the contract period named in the Contract Data.

In the event of extensions to the contract period (excepting extensions for which costs are not due to the Contractor) the Employer shall pay the cost of extending the period of validity of the insurances.
SECTION 1300: ENVIRONMENTAL PROTECTION

CONTENTS

1301 GENERAL
1302 LAND ACQUISITION
1303 CONTRACTOR'S ACTIVITIES IN RESPECT OF PROPERTY OUTSIDE THE SITE BOUNDARY AND SERVICES MOVED, ALTERED OR DAMAGED
1304 ENTRY UPON LAND WITHIN THE SITE BOUNDARY
1305 PROVISION OF CONSTRUCTION MATERIALS
1306 CONSTRUCTION CAMPS
1307 RESTORATION OF CONSTRUCTION CAMP SITES
1308 ENVIRONMENTAL MEASURES
1309 CLEARING
1310 DISPOSAL OF UNSUITABLE OR EXCESS MATERIALS
1311 EXTRACTION OF RIVER GRAVELS
1312 MEASUREMENT AND PAYMENT

1301 GENERAL

The Contractor shall take all reasonable precautions, whether specified in the contract or not to prevent damage to the natural environment occurring as a result of the execution of the Works and shall strictly observe all regulations procedures etc. in relation to entry upon land, whether within the Site or not.

This section of the specification shall prevail over any other section in the event of ambiguity or conflict in requirements for environmental protection or treatment of social issues.

Program execution

The contractor will have to submit to the approval of the Project Manager a detailed program of environmental and social management, comprising *inter alia*:

- An organigram of the Site personnel with clear identification of the responsible person(s) for the environmental and social management of the project.
- A plan of environmental and social management for the construction site including: management of construction wastes (standard of waste envisaged, mode of collection, mode and place of storage, mode and place of treatment and disposal); mode and source of water supply for the site; hygiene and safety measures; measures that will be used to avoid as well as to remedy against pollution of: ground, surface and underground waters, bush fire, as a result of road accidents etc; mitigating measures and remedial action plan; a plan for any demolition works and removal of trees and vegetation
- Construction and base sites that will be used by the construction workers and for the storage of raw materials and construction equipment; the dates of installation, disassembling or displacement of the installations shall be indicated.
• Monthly: An updating of the status pertaining to the level of Health and Safety on the construction site and the measures implemented to maintain it at the highest standard in conformity with local regulations.
• At the end of the construction works: the itinerary of the diagram of route supplemented by work which it will have undertaken and with the indications of the improvements of the environment which it will have operated.

Site Establishment
The selected site for establishment of the construction site must be located at a distance of at least 500 m from water bodies (rivers, lakes, etc.) and far away from human habitats to avoid the negative impacts due to nuisances associated with construction equipment. The site will have to be selected in order to limit the removal of trees, the destruction of dwellings and commercial activities, avoid zones of agricultural activities. Environmental sensitive zones must also be avoided. Provisions for dedicated areas with protective measures are required for the storage of chemicals and other hazardous products.

At the end of the construction works, the contractor will have to reinstate the Site used to its original state and all remaining construction materials will have to be removed as well as any wastes in whatever states. All construction equipment whether in operation or broken will have to be removed from Site.

Barriers and fences of building sites
The contractor must maintain in good conditions all fences and barriers associated with his Construction Site.

1302 LAND ACQUISITION

No land will be made available to the Contractor on the Site or on any other land for which it is the Employer’s responsibility before all compensation arrangements have been satisfactorily agreed with a legally binding agreement between the Employer and the landowner. To this end, the Contractor shall comply strictly with specified procedures for obtaining possession of those parts of the Site required for the Works.

1303 CONTRACTOR’S ACTIVITIES IN RESPECT OF PROPERTY OUTSIDE THE SITE BOUNDARY AND SERVICES MOVED, ALTERED OR DAMAGED

The Contractor shall seek the prior approval of the Engineer for activities outside of the site boundary prior to commencing negotiations with landowners. The Contractor shall plan such operations in a manner that will minimise inconvenience to local communities (including dust, noise, etc.) and shall undertake to restore the area to an acceptable condition upon completion of his activities in that area. The Contractor shall not enter upon private or government land without written confirmation to the Engineer that:

(a) in the case of borrow or spoil areas the necessary negotiations with the owner of the property have been concluded and permission is granted for the Contractor to enter upon the land and take or deposit material
(b) in the case of temporary access, bypasses and access roads to borrow areas, the Contractor has complied with the requirements stated below and elsewhere regarding the serving of notice and making detailed arrangements with the owner for access, compensation, reinstatement, etc.

The Contractor shall put in writing all his agreements with owners of property outside the site boundary or of services inside or outside the boundary in respect of the following matters:

(a) The location, extent and use of borrow pits spoil areas haul roads, construction roads and bypasses outside the site boundary;
(b) Compensation for land or materials taken or for land temporarily used or occupied;
(c) Reinstatement of property occupied, used, damaged or destroyed or compensation thereof in lieu of reinstatement;
(d) The procedure for moving of services and details of how and when this is to be done;
(e) Any similar matter directly concerned with the Contractor's activities on or in respect of private property or services.

These arrangements shall be signed by all the parties concerned and delivered to the Engineer.

Where, in addition to any agreement with the owner of any property to be entered upon or temporarily occupied or service to be moved, it is understood or required that the Contractor shall serve notice immediately before actually entering or occupying private property or moving a service, proper notice in writing shall be given and the Engineer is to be supplied with a copy of such notice with acknowledgement of receipt.

On completion of his operation the Contractor shall obtain, from the owner concerned, a written statement that either:

(a) the owner is satisfied that the Contractor has fulfilled his obligations under any written agreement, or in the absence of a written agreement, that

(b) the owner is satisfied that he has received all the compensation he is entitled to and also is satisfied that all property occupied, including borrow pits spoil areas, haul roads, construction roads, is properly restored and in a satisfactory condition.

If the Contractor fails to compensate the owner, or otherwise fails to properly restore or landscape the area in accordance with any agreement or the Engineer's instructions, the Employer shall be entitled to employ others to carry out such works and to recover the cost there of from the Contractor.

1304 ENTRY UPON LAND WITHIN THE SITE BOUNDARY

The Contractor shall not enter upon any land or commence any work within the site boundary until authorised in writing to do so by the Engineer. At least 7 days prior to commencement of any part of the Works, the Contractor shall give notice to the Engineer to facilitate assessment of compensation in respect of any buildings, crops, trees or other improvements by the Employer.

The Employer shall be responsible for the assessment and payment of compensation in respect of land to be acquired and incorporated in the works within the Site together with all buildings, crops, trees and any other properties so defined on the land.

The Contractor shall be responsible for agreement and payment of compensation and any royalties in respect of land temporarily occupied, spoil areas, working areas, borrow areas, road deviations and sites for Contractor's and Engineer's accommodation, where such land or area is not within the Site.

1305 VISION OF CONSTRUCTION MATERIALS

The Contractor will be responsible for all payments in respect of all materials required for use in the Works. The Contractor must fully acquaint himself with required protocol and legislation regarding the sourcing of earthworks and road materials. The Contractor shall, unless otherwise stated, be solely responsible for negotiation and payment of all fees, licenses, goodwill, royalty and any other charge in respect of materials obtained from any land.

1306 CONSTRUCTION CAMPS

Unless otherwise specified the contractor is at liberty to make his own arrangements with land owners to establish construction camps. Prior to the development of such camps the Contractor shall submit to the engineer the signed authority of the land owner.

Equipment and sanitary facilities

Site offices and living areas must have equipped with sanitary facilities (latrines, septic tanks, absorbing wells, wash-hand basins and showers) according to the number of the workmen. Water tanks will have to be installed in sufficient and adequate quantity and quality for human consumption.

Rules and regulations for the personnel pertaining to the Construction Site shall include but not limited to:

- A summary of good practice and responsibility on a construction site to avoid environmental damages, reduce all forms of pollution, maintaining hygiene, for waste management, health and safety aspects, emergency procedures in case of fire and others
- Road safety requirements (speed limit in the neighbourhood of habitats);
- The working hours for a normal working day in conformity with local regulations
These rules and regulations shall be posted around key areas of the construction sites and regular Meetings shall be held to sensitize the workers on all these aspects.

1307   RESTORATION OF CONSTRUCTION CAMP SITES

At the completion of the construction work the contractor shall dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates. The whole of the construction camp site shall be grassed and if trees originally grew on the site they shall be replaced with similar tree species. At the completion of restoration, the site shall be in no way inferior to the condition that pertained prior to commencement of the works.

All oil or fuel contaminated soil shall be carefully removed from the site and transported and buried in waste soil disposal areas.

1308   ENVIRONMENTAL MEASURES

Erosion control

The Contractor is required to enter into the spirit of environmental protection and conservation and to construct works in terms of agreed programmes, methods and sequences that will prevent or mitigate against erosion. The Contractor shall employ such temporary measures as are necessary to prevent or mitigate against erosion or salutation of any natural water course in addition to permanent drainage or erosion control systems that are detailed in the contract documents.

The Contractor shall programme the works to demonstrate that the sequence of operations involving drainage installation, earthworks, drainage facilities, erosion protection measures, road construction and revegetation are implemented to minimise the period over which earth is exposed to the potential for erosion.

Permit

The Contractor shall be responsible and shall seek all authorization in conformity with local laws and regulations pertaining to Environmental Protection and natural resources. Before commencement of Works, the Contractor shall have applied and in possession of all permits that are required.

Health and Safety

The Contractor shall abide to the local health and safety regulations. The Contractor shall have an emergency medical unit to attend to the basic needs for primary health as well as emergency procedures. The Contractor shall also have a responsible person for health and safety aspects pertaining to the security of the site personnel but also for health and safety issues for the local population.

Safeguard of rive rain properties

The contractor will be responsible and bear the costs for the reinstatement to its original state the property of rive rains in the event of any form of pollution due to his activities, and to any compensation to those which will have undergone the effects of this pollution.

Access

The contractor must maintain at all times road access and access to individual property during the construction works. The construction activities during night time and off days are subject to the approval of the Project Manager/Engineer. If the contractor has received the authorization or instructed to carry out construction works during the night, he shall undertake them in such ways as not to cause any inconveniences to the local inhabitants or other activities bordering the construction sites. The contractor will ascertain that no excavation or trench remains opened at night without adequate safety measures. The contractor will have to apply to the local authority for a speed limit for all vehicles on the said public road.

Record

The contractor will maintain a record of all shortcomings or incidents that may have negative impacts on the environment. Any complaints or incidents involving the local population shall also be recorded. The remedial actions/measure undertakken by the Contractor with respect to each incident shall also be recorded.
Cancellation of Contract
The non-observation of the clauses pertaining to the environmental and social issues may entail the cancellation of the contract. Moreover a Contractor for whom a Contract has been cancelled due to this non-observation, will not be allowed to submit a bid for any other subprojects under this Program.

Notification
The Contractor shall be duly notified of any infringement to these regulations and he shall take all the necessary measures to rectify the situation. The Contractor shall be responsible for all cost associated with the resumption of construction work or any additional work arising from the non-observation of environmental and social clauses.

Kick off Meeting before Commencement of works.
Before commencement of works, the Contractor shall organize a kick off meeting on the Construction Site, attended by the Project Manager/Engineer and other stakeholders (representatives of Ministries, Provinces, local population etc.). The Contractor shall inform the authorities and local population on the construction works, location, duration, personnel mobilization, site office locations, etc. and obtain the views from all parties.

The Contractor shall also provide details on the communication channel between the Contractor and the local population, method of communication, methods for evaluation of any compensation for pollution events, etc. Works will only commence when all payments for land acquisition have been settled.

Protection of the site Workers
The contractor must provide his workmen with clean and appropriate working clothes as well as protective equipment for operations such as:

- Quarry, stone crushing plant: Dust masks, noise attenuation helmets, safety shoes,
- Earthwork, borrow pits: Dust masks, boots
- Cement and welding: gloves, safety glasses, boots;
- Masonry and formwork: gloves and boots.

Establishment of vegetation
The Contractor shall establish vegetation and erosion protection measures on all cut and fill batters as soon as possible during the construction period. In bench cut batters the establishment of vegetation and erosion protection measures shall be undertaken on the bench and upper batter as soon as it is completed. Such work shall not wait until the completion of the total excavation. The Contractor shall maintain the vegetation and erosion control measures throughout the construction period.

Traps, bench, toe and roadside drains
The Contractor shall establish all such drains as soon as practicable during the construction of the works and in terms of the programme which has been agreed by the Engineer. Erosion protection and sediment control measures as detailed and specified shall be established as soon as possible to minimise erosion. Outlets to all drains shall be passed through silt traps and or silt ponds prior to their discharge to natural water courses all as detailed and specified.

Silt fences
Throughout the construction of the works the Contractor shall install silt fences in locations as directed by the Engineer. Such fences as are specifically ordered by the Engineer shall be measured and paid from amounts entered as provisional within the Dayworks Bill Group. No payment shall be due for silt fences required for environmental controls for any of the Contractor’s temporary works including campsites, stockpiles, haul roads accesses and the like and the cost of providing these shall be deemed to be included in the rates for associated work items. Silt fences shall be constructed of appropriate materials as instructed by the Engineer.
Silt fences shall be maintained in efficient operating condition throughout the construction of the works. Material periodically cleaned from such drains shall be transported and disposed of in waste disposal areas approved by the Engineer.

1309 CLEARING

The Contractor shall only clear vegetation from between the batter limit lines shown in the drawings, the nett agreed area for the construction camp and the agreed area of proposed waste material disposal areas. On no account is the Contractor to damage vegetation outside the above areas. Should such damage occur the Contractor shall forthwith take such steps as are necessary to prevent erosion and to re-establish vegetation.

The Contractor shall install such temporary or permanent drainage systems as are required to collect stormwater run off from stripped areas. Silt traps or silt retention ponds shall be constructed at appropriate locations in such temporary or permanent drains which traps or ponds shall be maintained in efficient operation throughout the contract period.

Protection of the vegetation and the surrounding landscape

The natural areas adjacent to the construction sites cannot assimilate the construction debris (excavated soil, rocks etc.). Temporary use of these areas may be necessary however. In this case, the Contractor shall be responsible for the reinstatement of these areas including the replanting of trees, vegetation etc. When there are risks that the negative impacts may be irreversible then the Contractor shall implement protection measures in consultation with the Project Manager.

Pruning and deforestation

The Contractor will carry out work of pruning and deforestation only after clearance from the local authority and enforcement agency (forest services for example). Pruning relate to the immediate surroundings of the road, in order to improve road visibility. All the tree branches overhanging the road will be removed according to a vertical passing by the limit of undergradment clearance. All trees will be cut down overhanging the accesses and that represent a risk during extreme weather conditions.

Plantation of trees

The Contractor will replace the number of trees cut down during work, according to the ratio: two (2) trees planted to compensate for one (1) cut down tree. The plantation will consist of the supply and the manual plantation of trees of species adapted to the natural environment for plantations of alignment or to constitute screens on road borders with the approval of the Project Manager. The Contractor shall be responsible for: (1) the supply of the seedlings, minimum height one meter; (2) their plantation, their protection, watering and maintenance until the final acceptance, and their replacement in the event of non growth.

1310 DISPOSAL OF UNSUITABLE OR EXCESS MATERIALS

The Contractor shall locate waste excavation disposal areas as agreed with the Engineer. All excavated material which by virtue of its organic content, moisture content, or other characteristics, which is unsuitable for incorporation into embankment construction shall be transported and placed in such waste excavation disposal areas. On no account shall waste excavated material be disposed of by side tipping or flattening of fill batters unless specifically directed by the Engineer.

After agreement with the Engineer on the location of waste excavation disposal areas the Contractor shall strip the topsoil from such sites and stockpile this material for later restoration work. Material excavated to waste shall be placed in such areas and compacted by track rolling, and shaped to conform with the adjacent topography.

Surface water discharged from such areas shall be collected into perimeter drains which shall discharge through silt traps and or silt ponds in order to minimise the discharge of silt laded water to natural water courses. At the completion of use of waste excavation disposal areas, they shall be resurfaced with topsoil from previously stripped areas to promote revegetation.

The Contractor shall locate topsoil stockpiles clear of future works in locations agreed with the Engineer. They shall be located on terrain which is suited for the construction of toe drains around the topsoil stockpile in order to minimise topsoil laden water discharging directly into natural water courses or onto adjacent land.

After each day’s work and before rain the stockpiles shall be smoothed off track rolled with suitable equipment to minimise the amount of loose material on the stockpile at any time.
SECTION 1400: TERMS AND DEFINITIONS

Fill Materials (also termed as "Fill")
- Naturally occurring inorganic soils and soil like materials including sand and crushed rock but excluding individual particles of sizes greater than 75mm.

Ordinary Fill
- Fill material to be used for forming the road embankments other than in improved sub-grade and in back fill behind bridge abutments.

Sub-Base
- The road layer composed of a homogeneous mixture of crushed stone aggregates and local sand and soil lying immediately below the base course.

Base Course
- The road layer composed lying between the bituminous surfacing at its top and the sub-base course at its bottom and within the carriageway on either side of the center line.

Surfacing
- Gravel or stone or bituminous bound layer at the top of the road structure extending full width of carriageway only.

Hard Shoulder
- Compacted gravel or any hard strips beyond the carriageway of the roadway width, adjacent to the surfacing.

Earth Shoulder
- Compacted earth strips protected on top at the extremities of the roadway width, adjacent to the hard shoulders.

Maximum Dry Density (MDD)
- Maximum dry density as determined in the laboratory using Standard Compaction.

Optimum Moisture Content (OMC)
- Optimum moisture content as determined from moisture-density relationship tests for Standard Compaction.

Dynamic Cone Penetrometer (DCP)
- Device for field checking of in situ CBR.

Boulders
- River-borne or blasted hard stone materials of sizes exceeding 100mm.

Atterberg Limits
- PI, PL, LL

Sand equivalent
- Test used for evaluating the plastic properties of the sand fraction of aggregate

Application (spread) rate
- The rate of spreading chippings or spraying bitumen on the surface.

Wearing Coarse
- The surface allowed to ply the traffic

Plasticity Limits (PL)
- The limits that are used to estimate the engineering behaviour of clayey soils. They include the Liquid Limit and Plastic Limit, which are determined by arbitrary tests on the fine soil fraction passing the 0.42 mm sieve.

Liquid Limit (LL)
- The water content of the soil that allows the divided soil sample to flow together after fixed times of applying dynamic force on it.

Plastic Limit (PL)
- The water content of the soil when the thread crumbles

Plasticity Index (PI)
- The difference between PL and LL

Plasticity Product (PP)
- The combined product of PI and fine content

California Bearing Ratio (CBR)
- Test method to evaluate the bearing capacity of the soil

Speedy Moisture Tester
- The speedy moisture tester needs a chemical i.e. Calcium carbide that mixed with a measured amount of moist soil in a closed container. The gas formed by reaction gives the % moisture through a pressure gauge (Calibrated accordingly). The % moisture is found in "Wet weight basis" and this is transformed to "Dry weight basis" using a Conversion curve.
Formation width: Full width of road, including drains and embankments.

Roadway: Width of road, including shoulders.

Carriage way: Pave width of the road, available for traffic.

Shoulders: Paved or unpaved width of road next to the edge of the carriage way adjacent to the ditch or embankment slope.

Camber: A camber road has a cross-section like a roof on a house, to drain the rainwater away from the carriage way to the side drains.

Gravel surfacing: A layer of compacted laterite which forms the surface (or road) of the carriage way.

Embankment: Compacted earth fill below the roadway.

Cut: Excavation in the natural ground on the hill side of the road usually with graded slopes. The material dug out is used to fill the embankment on the valley side of the road.

Sub grade surface: Upper layer of the soil (natural material) supporting the roadway including embankment and slopes.

Side drain: The side drain runs along the road and collects the water from the carriage way and adjoining land, and transports it to a convenient point of disposal.

Original ground level: The natural surface of the cross-section prior to construction.

Back slope: The outer slope of the side drain with an appropriate angle to prevent the soil from sliding to the ditch.

Ditch slope: Inside slope from the shoulder to the side drain.

Embankment slope: Natural material slope on embankment.

Crown: Peak or highest point of the camber.

Road centre line: The line running along the centre of the road (important in surveying and setting out the road alignment).

Chainage: Is a term frequently used for describing distances measured along the centre line of the road.

High flood level (HFL): The highest elevation to which the peak flood waters are expected to rise.

Mitre drains: Mitre drains (or turnout drains) lead the water out of the side drains and safely disperse it on adjoining land. Mitre drains should be provided as often as possible so that the accumulated water volume in each drain is not too high and does not cause erosion to the adjoining land.

Catch water drains: Where the road is situated on a hillside a significant amount of rainwater may flow down the hill towards the road. This may cause damage to the cut face (back slope) of the road and may even cause landslides. Catch water drains intercept or "catch" surface water flowing towards the road from adjacent land, and lead it away.

Scour checks: Scour checks prevent erosion in side drains on steep gradients by slowing down the water (steps). Scour checks are usually built using locally available material, such as stones or wooden sticks.

Culvert: The culvert is a transverse drain built under the road and its function is to lead water from the upper, uphill side of the road to the lower, valley side. In tropical countries with high rainfalls three or four culverts are required per kilometre. Culvert rings are usually made of concrete or prefabricated corrugated steel rings.

Head wall: A wall 300 mm. thick stone masonry constructed perpendicular to the culvert pipes.
(at the end) to retain backfill material. The headwall shall extend vertically to an elevation of 200mm above the surface of the road.

Wing wall: Continuation of headwall at an angle, generally 45 degrees, and shall extend a minimum of 1m out from the pipes, to retain the soil of the road side slope and to allow the free flow of water into and away from the pipes.

Reinforced concrete pipes: Reinforced concrete pipes prefabricated in a standard steel mould.

Pipe bedding: The foundation on which pipes are laid.

Upstream apron: Part of a culvert at the upstream inlet made of stone/masonry, where water enters into the pipes to prevent any scour or damage to the pipes.

Downstream apron: Part of a culvert at the downstream outlet, where the water goes out slowly to the natural water course, to prevent any scour or damage to the pipes.

Cut-off wall: Wall generally constructed at the downstream and of a structure and constructed into the ground, to prevent scouring of the apron, as well as the structure.

Headwall foundation: Headwall foundation provided to the main culvert headwall so that it can retain the earth pressure.

Gravel: Gravel is defined as stones (2-60mm) but for roadwork use, a more useful definition is a mixture of stones (maximum 30mm), sand and clay.

Sand: A coarse-to-fine gritty soil, with grains of size 0.06-2mm. Sand is normally firm when damp.

Silt: A soil with very small particles (0.002-0.06mm), which is powdery when dry but very soft when wet. For a quick test, when you roll a lump of silt between your hands they will not get stained.

Clay: This is a soil with even smaller particles (<0.002mm). It forms hard lumps when dry and the surface is cracked, but is sticky and soft when wet. For a quick test, your hands will be stained if you roll a lump of clay between your hands.

Organic Soil: This is dull and dark in colour, and often has a distinct smell. Topsoil is almost always organic. Swamp soils usually contain remains of plants (fibres, roots, and so on).

Well-graded: Material with a wide range of particle sizes which are well distributed (Note: a mixture of particle sizes means that the soil will be easier to compact)

Poorly-graded: Material with too much of some sizes and too little of others

Uniformly-graded: Material with a limited range of sizes mainly concentrated in one size category.

OTHER CHARACTERISTICS

Cohesive: The particles of a soil stick together (mainly the clay fraction)

Non-cohesive: Does not stick together (mainly sand and gravel)

Coarse-grain soil: Mainly sand and gravel (little or no clay, little or no sand)

Fine-grain soil: Mainly silt and clay.

SOIL CONDITIONS

Density: In a dense soil the particles are close together (or well-compacted)

Compaction: The process that packs the particles close together, and so increases the density

Bearing capacity specified: The strength of the soil (measured by the weight that can be loaded on to a area without penetration or the amount of penetration under a certain load on a
specified area)

Plasticity : Measures whether soil can be moulded and hold its new shape

Permeability : The degree to which water can penetrate a particular soil

Optimum moisture content : The water content that gives the best effect of soil compaction.
SECTION 2100: CLEARING

CONTENTS

2101  SCOPE

2102  DESCRIPTION OF WORK

2103  EXECUTION OF WORK

2104  MEASUREMENT AND PAYMENT

2101  SCOPE

This section covers general clearing activities along the roadside and includes cutting back of vegetation and cleaning out existing drains and ditches.

2102  DESCRIPTION OF WORK

Clearing of vegetation shall consist of cutting back all trees, brush, other vegetation, rubbish, fences and all other objectionable material including the disposal of all material resulting from the clearing operations.

Cleaning out existing drainage paths will consist of removing all soil, stones/boulders and vegetation from existing drains, ditches and culverts. Any reinstatement works will be measured and paid for in accordance with relevant sections of these specifications, provided that such reinstatement has not arisen out of the actions of the contractor.

2103  EXECUTION OF WORK

The portions of the road to be cleared shall extend for a distance of at least 5m from the edge of the existing road ‘shoulders’. All grass, weeds, and bushes shall be cut back to as close as practicable to ground level ensuring that the root structure remains. Branches of large trees, which overhang the road, will need to be lopped to allow passage of regular traffic.

The sections where drainage paths are required to be cleaned will be instructed by the Engineer. Cleaning of existing drainage paths will include removal of all materials that block or cover the drains and/or culverts and shall include all small, localised slips/slumps etc. up to 5 m³; removal of material in slips/slumps larger than 5 m³, as determined by the Engineer, shall be carried out under the provisions of section 3200. Where no existing drain is apparent the contractor will be required to investigate (through trial holes, local knowledge etc.) the existence of any such feature. Classification of ‘hard’ excavation shall be as defined in section 3200.

Material obtained from the above operations shall be disposed of, as indicated by the Engineer, in borrow pits, spoil areas or other suitable places and covered up with soil or gravel.

2104  MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing and cleaning of:</td>
<td></td>
</tr>
<tr>
<td>2100.01 Végétation</td>
<td>mètre (m)</td>
</tr>
<tr>
<td>2100.02 Drainage paths</td>
<td>mètre (m)</td>
</tr>
</tbody>
</table>

The unit of measurement for clearing is the linear metre.

The quantity shall be taken as the road length in metres designated by the Engineer and cleared in accordance with these Specifications.

The length to be cleared for vegetation shall include both sides of the road and be measured in full whether works are required or not.

The length of drainage paths to be cleaned shall be the total length of existing drain and/or culvert cleaned, irrespective of which side of the road it is situated, and be measured in full whether works are required or not. The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 2200: DRAINS

CONTENTS

2201 SCOPE
2202 OPEN DRAINS
2203 BANKS AND DYKES
2204 SUB-SURFACE DRAINS
2205 MEASUREMENT AND PAYMENT

2201 SCOPE

This section covers all work in connection with the excavation and construction of open drains, banks and dykes at the locations and to the sizes, shapes, grades and dimensions as shown on the Drawings or as directed by the Engineer.

2202 OPEN DRAINS

Open drain excavation shall consist of re-excavating or excavating open drains and channels inside or outside the road reserve, including channels to direct the course of streams, all as shown on the Drawings or directed by the Engineer.

Open drains shall be constructed true to line, grade and cross section and shall be so maintained for the duration of the contract. Care shall be exercised to avoid excavation below the required grade for the drains and any excavation carried below the required grade shall be backfilled with suitable material and compacted to at least 93% MDD (BS Heavy) density at the Contractor's own expense.

Material resulting from the excavation of open drains shall be used in the construction of fills, banks and dykes, or for other purposes, or disposed of to spoil, depending on the classification of such material. In respect of material resulting from open drain excavation and not taken to spoil but used elsewhere in the construction of the Works, payment shall be made for open drain excavation as well as for any item of permanent construction built from such material. Material from open drain excavation and taken to spoil will be paid as open drain excavation only.

2203 BANKS AND DYKES

Mitre banks, catchwater banks and dykes shall be constructed of approved soil or gravel obtained from open drain excavation or, if no suitable material can be obtained from that source, from suitable alternative sources and placed so that the water will flow on the natural ground and against the bank. The banks and dykes shall be properly compacted in layers not exceeding 150 mm in thickness, true to the lines, levels and cross sections shown on the drawings or directed by the Engineer.

If the Contractor prefers, and the Engineer approves, mitre banks may also be constructed of hand-packed stone provided that the interstices are filled with the approved cohesive soil.

2204 SUB-SURFACE DRAINS

Materials

Pipes for subsurface drains shall have the specified internal diameter, which shall not be less than 100 mm, and shall be Perforated or slotted un plasticised PVC pipes. Pipes without slots or perforations that are required for transporting subsoil water from the subsoil drain proper to the point of discharge, shall be unperforated PVC.

Permeable filter materials for subsurface drains shall consist of sand, all of which shall pass the 6.70 mm sieve and not more than 10% passing the 0.150 mm sieve. Use may also be made of synthetic fibre filter fabrics.

Sub-surface Pipe Drains

Trenches for pipe drains shall be excavated to the dimensions and gradients shown on the Drawings or directed by the Engineer. A layer of permeable material of the class and thickness as shown on the drawings shall be placed on the bottom of the trench and lightly tamped and finished to the required gradient.
Pipes of the type and size required shall than be firmly bedded on the permeable material true to level and grade, coupled where required and the trench backfilled with further permeable material to such height above the pipes as shown on the Drawings or directed by the Engineer. The permeable material shall be lightly compacted and finished to the required level. Further layers of finer permeable material shall then be placed, lightly compacted and finished to an even surface as directed by the Engineer. The remainder, if any, of the trench shall be backfilled with approved impermeable material, as required by the Engineer, in layers not exceeding 100 mm and compacted to at least the same density as the surrounding material.

The trench must be specially protected against the ingress of water before completing the impermeable layer. If directed by the Engineer, or shown on the Drawings, the pipe drains may be surrounded by synthetic fibre filter.

Care shall be taken to prevent the contamination of permeable material during construction of the subsurface drains and all permeable material contaminated by soil or silt shall be removed and replaced by the Contractor at his own expense.

Perforated pipes shall be laid with the perforations on top or in the bottom as instructed. The higher end of subsurface pipe drains shall be sealed off with a loose concrete cap of Class 20/20 concrete and, at the lower end, the pipe drain shall be built into a concrete head wall providing a positive outlet or connection to stormwater pipes, culverts or drains.

Any section of subsurface drain constructed from pipes without perforations or slots shall be backfilled with impermeable backfill material as described above. Where suitable, the excavated material may be used for backfilling.

**Synthetic Fibre Filter Fabric**

Where specified for use in subsoil drains, filter blankets and other applications, synthetic fibre filter fabrics shall be procured, furnished and installed as shown on the Drawings or as directed by the Engineer. Filter fabric shall not be exposed to direct sunlight for prolonged periods and protected from mechanical damage during installation and construction.

### 2205 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2200.01.1</td>
<td>Excavation for open drains: Soft material</td>
</tr>
<tr>
<td>2200.01.2</td>
<td>Hard material</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the cubic metre of material excavated, measured in place before excavation. Only open drains as defined in Sub-clause 2202 shall be measured.

The tendered rate shall include full compensation for the excavation of the material to the required line, levels and grades and the disposal of the material as directed.

Payment for excavation for side drains shall not be under this item, but shall be paid for under items in Section 3200. Payment shall distinguish between soft and hard material as defined in Clause 3202.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2200.02</td>
<td>Sub-surface drains:</td>
</tr>
</tbody>
</table>

The unit of measurement for subsurface drains shall be the metre of drain measured in place along its centre line.

The tendered rate shall include full compensation for:

(a) The excavation of the material to the required line, levels and grades, all temporary shoring and strutting, and the disposal of the material. Payment shall distinguish between soft and hard material as defined in Clause 3202.

(b) Procuring, furnishing, placing and compacting the impermeable backfilling.

(c) Procuring, furnishing, transporting permeable material from commercial sources and placing the material as specified.

(d) Procuring, furnishing, laying and jointing the pipes and fittings as specified.

(e) Providing the concrete caps as required

The payment shall be made according to the unit price schedule and as given in the billed items.
<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2200.03</td>
<td>Synthetic fibre filter fabric (description of type, grade, etc.)</td>
</tr>
</tbody>
</table>

The unit of measurement shall be square metre of filter fabric supplied and installed as specified including the specified overlap.

The tendered rate shall include full compensation for furnishing, procuring, cutting, wastage, placing and protecting the filter fabric as specified.

The payment shall be made according to **the unit price schedule and as given in the billed items**.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2200.04</td>
<td>Concrete outlet structures to subsurface drains (including formwork)</td>
</tr>
</tbody>
</table>

The unit of measurement shall be cubic metre of Class 20/20 concrete provided for subsoil outlet structures.

The tendered rate shall include full compensation for procuring and furnishing of all materials, the provision and erection of formwork and the mixing, placing and transporting of concrete.

The payment shall be made according to **the unit price schedule and as given in the billed items**.
SECTION 2300: CULVERTS

CONTENTS

2301 SCOPE
This section covers the work in connection with the construction of culverts using units under construction.

2302 MATERIALS
Construction culvert units shall be produced by a skill labors at site and shall comply with the following requirements:

Concrete box culvert units shall comply according to the drawings and specifications. The minimum thickness & cements and strength of materials shall be according to the drawings.

All broken, bent, chipped, cracked, dented, corroded or otherwise damaged units, shall be repaired to the Engineer's satisfaction or, where this is not possible, they shall be removed and replaced with undamaged units.

2303 CONSTRUCTION METHODS
Culverts shall be installed under either:

(a) 'trenched conditions', where the units are laid in a trench excavated below existing ground level or in a trench excavated in previously constructed sub-grade and, if necessary, sub-base layers;

(b) 'embankment conditions', where the units are laid approximately on the existing ground surface and the sub-grade is then constructed on either side and over the culvert.

As a general rule, all box culverts shall be constructed under trenched conditions. The only exceptions shall be those permitted by the Engineer. These can include pipe culverts, larger box culverts and where the Engineer considers it advisable under certain local or climatic conditions that prefabricated culverts be constructed ahead of the fills.

Surface drainage must be controlled by the construction of temporary earth berms and drainage channels to prevent storm water from entering the trench.
The Contractor shall make good with bedding materials any excavation at or below the bottom of drainage trenches if the Contractor allows the trench bottom to become soft or otherwise unsuitable for the construction of the culvert.

Any culverts or box which deform or crack, or which are not constructed to the required lines, levels and grades, or which become displaced in the process of the work or during the Maintenance Period, shall be removed and replaced by the Contractor at his own expense.

The Contractor shall exercise due care not to damage, overstress or displace any box culvert with his own traffic or compaction equipment. Where loads in excess of those prescribed in the Schedule for Drainage Works or Drawings are likely to pass over completed culverts, the Contractor shall provide additional cover over the box so as to ensure that the design stresses on the boxes are not exceeded.

All concrete work shall be carried out in accordance with the provision of Section 8300 of these Specifications.

2304 DEPTH OF EXCAVATION

In the case of culverts to be constructed under trenched conditions, the Contractor shall first construct the fill, sub-grade and, if necessary, the gravel wearing course to such a level as will provide a minimum cover above the proposed level of the top of the culvert as described hereinafter for the various types of culvert. Thereafter, the Contractor may commence excavation of the trench for the culvert.

The side of trenches shall be adequately supported at all times. Except where otherwise authorised by the Engineer, they shall not be battered. The amount by which the excavation is to exceed the proposed level of the invert of the culvert shall be sufficient to allow for the type and thickness of bedding material to be placed as specified or as shown on the Drawings.

The minimum cover above the top of the culvert and minimum depth of excavation below the underside of the culvert shall be as follows:

*Concrete box Culverts*

The minimum height of embankment over the top of the proposed box culvert before excavation may commence is 300 mm.

The minimum amount by which the excavation is to exceed the proposed level of the underside of the pipe shall be 75 mm or such other amount required to accommodate the type of bedding required for the pipe in each case.

2305 WIDTH OF EXCAVATION

The widths of trenches shall be sufficient to allow for proper laying, bedding and backfilling culverts, but shall not exceed four thirds of the external diameter of the pipe(s), plus 400 mm for single barrel culverts and also plus the allowable gap between each pipe for multiple barrel culverts. If the width of any trench is increased by slipping or collapsing of the trench, the Contractor shall immediately inform the Engineer and not proceed with any further pipe-laying or backfilling until the Engineer has reviewed the circumstances and given instructions as to the need for any altering of the class of pipe or bedding conditions.

2306 UNSUITABLE FOUNDING CONDITIONS

Where the bottom of the trench as excavated does not provide a suitably firm foundation for the culvert, due to soft or otherwise unsuitable material being encountered, the unsuitable material shall be excavated to a depth below the bottom of the culvert as instructed by the Engineer and replaced with gravel, rockfill or other approved material properly compacted to provide a firm earth cushion. When ordered by the Engineer, the Contractor shall construct a blinding layer of concrete to provide a suitable working floor.

The width of the excavation and earth cushion shall be as directed by the Engineer but, in the case of culverts to be constructed under embankment conditions, the width shall be at least one diameter or span, as the case may be, wider than the culvert on either side.

2307 EXCAVATION FOR EMBANKMENT CONDITIONS

Where culverts are to be constructed under embankment conditions as defined in Clause 2303 above, the Contractor shall level the existing ground by excavating and filling and compacting as required so that the foundation for the culvert is true to grade and of uniform density over the whole length of the culvert.

The finished level of the ground on which the culvert is to be bedded shall be below the proposed level of the underside of the culvert by the same amounts as specified in Clause 2304 above, for the various types of culverts.

2308 CLASSIFICATION OF EXCAVATION
All excavations for prefabricated culverts shall be classified as follows for payment purposes:

Hard material: Where, in the opinion of the Engineer, material cannot be excavated except by drilling and blasting or the use of pneumatic tools or mechanical breakers (1t rock hammer attachment for 15t excavator) and when isolated boulders (in excess of 0.5 m³ in volume) cannot be pushed or rolled aside with available equipment, such material shall be classified as hard material.

Soft material: All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, sub-grades and subbase shall be classified as soft material.

2309 DISPOSAL OF EXCAVATED MATERIAL

Where excavated material does not comply with the requirements for backfilling material as specified hereafter or is surplus to backfilling requirements, such excavated material shall be removed from the Site and disposed of in a manner approved by the Engineer. Material suitable for use in the Works, shall however, be used in the Works.

2310 BEDDING AND LAYING OF PREFABRICATED CULVERTS

All pipe culverts shall be laid on bedding as specified below. The inside of the pipes shall be smooth with no displaced joints. All pipes shall be laid true to line and level.

Bedding materials: Concrete Cradle Bedding

The culvert pipes shall be bedded in a Cradle constructed of concrete having 28 days compressive strength (cylinder test) of 15 Mpa (N/mm²). The shape and dimension of the Cradle shall be as indicated on the drawing. The pipes shall be laid on the concrete bedding before the concrete has set.

Installation of Culvert Pipe:

The outlet shall be excavated before the pipe is laid. Pipe laying shall commence at the downstream end of the pipe line with pipe collars upstream. The pipe shall be laid in a straight line, with the pipe joints made as follows:

a) jute or any fibre packing shall be placed around the full circumference of the groove of the pipe already laid;

b) the lower half of the groove shall then be filled with sufficient mortar to bring the inner surfaces of the a butting pipes flush;

c) the upper half of the tongue of the pipe to be laid shall be similarly filled with mortar;

d) after laying, the inside and outside of the joint shall be grouted with mortar to a smooth finish;

e) the joint shall be kept moist and protected for at least two days before backfilling commences.

2311 BACKFILLING OF PREFABRICATED CULVERTS

After the boxes have been firmly laid on the required bedding as described above in clause 2210, backfilling shall be carried out as follows:

The material used for backfilling shall have a CBR of not less than 8 when compacted to 90% MDD (BS Heavy) and shall not contain any stones larger than 150 mm, nor more than 20% with a size between 75 mm and 100 mm.

The material used for backfilling of those portions of culverts or pipes within 0.5 m of the underside of the sub-base layer shall be selected material of at least sub-base quality. Where the excavated material is not of adequate quality, selected material shall be imported for this purpose.

Backfilling alongside and over all pipes shall be placed and compacted in layers not exceeding 150 mm after compaction, to a density of at least the density required for the material in adjoining layers of fill, sub-grade and sub-base. The density of backfilling in excavations made in the natural ground shall be at least 90% MDD (BS Heavy) density. Backfilling shall be carried out simultaneously and equally on both sides of a pipe to avoid any unequal lateral forces and distortion.
Where the Engineer so directs, metal culverts with large diameters or spans, or culverts with multiple openings, shall be constructed under embankment conditions as defined in Sub-clause 2303(b). In such cases, the backfilling shall be carried out to the same standard as described above, simultaneously and equally on both sides of the culvert and over the culvert until the minimum specified cover is obtained. The width of backfill on each side of the culvert, after completion, shall be at least equal to the diameter (or span) of the culvert.

2312 INLET AND OUTLET STRUCTURES

Inlet and outlet structures for prefabricated culverts shall be constructed in accordance with the details shown on the Drawings.

2313 REMOVAL OF EXISTING WORK

Where shown on the Drawings or where directed by the Engineer, existing inlets or outlets to pipe culverts shall be broken down or demolished and debris or rubbish removed off site. Existing pipes shall be removed when necessary. All such work shall be carried out in a manner to prevent damage to old work which is to remain.

2314 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300.01</td>
<td>Excavation of unsuitable material below culvert bedding level and replacement with suitable material cubic metre (cu m)</td>
</tr>
</tbody>
</table>

The payment shall be made according to the unit price schedule and as given in the billed items. The unit of measurement shall be the cubic metre of excavation to the widths and depth as instructed by the Engineer.

The tendered rate shall include full compensation for excavation, loading, transporting to spoil, backfilling with approved material and compacting.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300.02.1 Concrete Pipe</td>
<td>metre (m)</td>
</tr>
<tr>
<td>2300.02.2 Corrugated metal Pipe</td>
<td>metre (m)</td>
</tr>
</tbody>
</table>

The unit of measurement for prefabricated culverts (concrete pipe, corrugated metal pipe and rectangular culverts) shall be the metre of culvert laid as shown on the drawings or as directed by the Engineer. The length shall be measured along the OBERV of each barrel of the culvert. Alternatively, where an installation is fully described on the Drawings or in the Bill of Quantities, the unit of measurement may be the Number. The payment shall be made according to the unit price schedule and as given in the billed items. The tendered rate shall include full compensation for:

(a) All excavation, temporary timbering, shoring and strutting, for preparing the bottom of the excavation for the culvert beds, for disposal of excavated material unsuitable for backfilling, for keeping excavations safe, for dealing with any surface or sub-surface water for any other operations necessary to complete the work as specified.

(b) Backfilling under, alongside and over culverts, for watering and for compacting the approved backfill material to the specified densities.

(c) Procuring, furnishing of all materials, including fine granular backfill where required, and placing and laying all materials to line and level and the joining of culverts including cutting on Site and waste.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300.03 Cast in situ concrete; in inlet and outlet structures</td>
<td>cubic metre (cu m)</td>
</tr>
</tbody>
</table>

Payment for and measurement of concrete cast in situ shall be made as provided for in Section 7300 of these Specifications except that formwork for pipe bedding and invert slabs and inlet and outlet structures shall not be payable separately and all payments thereof shall be included in the Contractor's rates for concrete.

The tendered rate shall also include full compensation for:

(a) All excavation, temporary timbering, shoring and strutting, for preparing the bottom of the excavation for the culvert beds, for disposal of excavated material unsuitable for backfilling, for keeping
excavations safe, for dealing with any surface or sub-surface water for any other operations necessary to complete the work as specified.

(b) Backfilling under, alongside structures, for watering and for compacting the approved backfill material to the specified densities.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel cement:</td>
<td></td>
</tr>
<tr>
<td>2300.04.1 Mild steel</td>
<td>ton (t)</td>
</tr>
<tr>
<td>2300.04.2 Mild steel mesh</td>
<td>Kilogram (kg)</td>
</tr>
</tbody>
</table>

Measurement and payment for steel cement shall be made as specified in Section 7200 of these Specifications. The payment shall be made according to the unit price schedule and as given in the billed items.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300.05 Service duct pipes:</td>
<td></td>
</tr>
<tr>
<td>(type and diameter indicated)</td>
<td></td>
</tr>
<tr>
<td>Ordinary pipes</td>
<td>metre (m)</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the metre of service duct laid.

The tendered rate shall include full compensation for procuring, furnishing and laying the box, including end plugs and draw wires and complete installation, and including excavation, backfilling and encasing in concrete where specified or ordered by the Engineer. The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 3100: SETTING OUT HORIZONTAL AND VERTICAL ALIGNMENT

CONTENTS

3101 SCOPE
3102 CONSTRUCTION METHOD
3103 MEASUREMENT AND PAYMENT

3101 SCOPE

Setting out the horizontal alignment and elevation levels shall consist of the provision and placement of ranging rods and profile boards to determine the exact alignment of the road. The ranging rods and profile boards shall be of good quality metal and their finish of such a standard that they can be used for good and correct setting out. The setting out shall include vertical as well as horizontal alignment. The contractor shall ensure that the setting out is maintained for the entire period required to achieve the dimensions of the road according to the drawings.

3102 CONSTRUCTION METHOD

Setting out of alignment shall be carried out following the instructions of the Engineer. The setting out shall ensure that the dimensions of the road are according to the drawings and shall be maintained by the contractor for the time required to complete the works.

Both alignments shall follow as closely as appropriate to the existing terrain and road lines and they shall be established by pegging the centre line, edge of carriageway and ditch lines. Reference pegs shall be provided at intervals outside the roadway to allow for the reestablishment of the alignment during construction. Chainage shall be clearly marked on pegs at not less than 100 metre intervals.

The Contractor shall set out, using pegs and string lines, the various construction operations in sufficient detail to ensure that the required standards and tolerances are achieved, and in such a way that any task work system adopted may be easily checked by the Engineer.

The limits of the embankments shall be marked by fixing out wooden pegs (at least 50mm dia and 500mm long) at 20m intervals or closer if desired by the Engineer. The pegs shall be fixed at about 0.5m beyond the actual limits of the fill and painted in a distinctive colour.

3103 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3100.01</td>
<td>metre</td>
</tr>
</tbody>
</table>

The unit of measurement for setting out is metre (m). The quantity shall be measured as the length of the road section where setting out has been carried out for centre line and other edges of the road. The payment shall be made according to the unit price schedule and as given in the billed items.

No extra payment shall be made for the re-placement of pegs, profile boards or any other setting out materials which are removed from the site prior to instructions of the Engineer.
SECTION 3200: EARTHWORKS

CONTENTS

3201 SCOPE
3202 EXCAVATION
3203 FILL CONSTRUCTION
3204 MEASUREMENT AND PAYMENT

3201 SCOPE

This section covers all works connected with the construction of cuts and fills, removal to spoil of unsuitable or surplus material, construction and compaction of fills using suitable materials from cut or from borrow pits, compaction of the road bed, finishing of cuts and fills to the stage where the sub-grade is ready for the placing of a road layer or gravel wearing course. All suitable materials arising from cuttings or excavations required for the execution of the Works shall be used for the construction of embankments unless such material is surplus to requirements.

Due to the fragile environment, unstable geology and potential hazards associated with slope stability the contractor must carefully consider the type of equipment (and methods) to be employed in order to limit potential damage that may occur during the works.

During construction, the works shall be kept well-drained and protected at all times and damaged sections shall be repaired by the Contractor at his own cost. Side drains discharging from cuts and all other drains shall be so constructed as to avoid damage to fill by erosion. Where necessary for the protection of the environment in areas outside of the works, temporary drainage shall incorporate silt traps or silt fences at the point of discharge.

3202 EXCAVATION

Classification

The excavation of earthworks material shall be classified as follows for the purpose of measurement and payment:

Soft excavation - shall be excavation in any material which does not comply with the definition for ‘Hard Excavation’ given below.

Hard excavation - shall be excavation in material which, in the opinion of the Engineer, cannot be excavated without recourse to large earthmoving equipment (excavators >20t / bulldozers larger than D6) in the case of large volumes of bulk operations or pneumatic tools/mechanical breakers in the case of small volumes encountered in drainage works. Isolated boulders within a mass of soft excavation which can be bodily moved by the Contractor’s plant and suitably disposed of to the Engineer’s satisfaction shall be measured as soft excavation. Notwithstanding the foregoing, any isolated boulder of less than one cubic metre shall be measured as soft excavation.

Cut operations shall also differentiate between the following:

(a) - Excavate material from within slip/slump zones.

(b) - Excavate material from cut.

(c) - Excavate material from borrow.

Unsuitable material

The Engineer shall determine whether material is suitable for use in the works or not.

Sub-grade treatment

The Contractor shall seek instructions from the Engineer regarding the treatment of the sub-grade in cut areas. This may include excavation of the floor of the cutting to a depth as directed by the Engineer and replacement with suitable material. The finished level of the cutting shall be within +25mm and -50mm of the required level.
Cut to spoil

Material arising from cuttings which is unsuitable for use in the Works (other than topsoil) or surplus to requirements shall be spoiled in areas selected by the Contractor and approved by the Engineer. Notwithstanding the terms of any agreement that the Contractor may have with the landowner, spoil shall be deposited in a manner that is to the satisfaction of the Engineer, and in accordance with Section 1300 of the specification.

Borrow

Where sufficient quantities of suitable material from cut are not available for use in subgrade or general fill, additional material shall be excavated from borrow areas found and provided by the Contractor and approved by the Engineer.

3203 FILL CONSTRUCTION

Layer thickness

The thickness of individual layers shall depend upon the type of material used and the maximum size of the particles in such material. The layer thickness shall however not exceed 150mm after compaction except where otherwise specified or instructed by the Engineer. Fill shall be placed in successive layers’ parallel to the final road surface wherever this is practicable. The construction of tapered layers shall be restricted to the lower layers of fill where this may be unavoidable due to the existing topography.

Benching

Where the slope of the road bed is more than 20% at right angles to the road centreline, the road bed shall be cut away to form benches to form a key for the embankment construction into the undisturbed existing ground. The lowest bench shall be cut before the commencement of filling and shall be at least 2.5 metres wide or of such width as to permit the proper operation of construction plant for the full height of the bench. The second bench shall form a key by cutting at least one metre into undisturbed existing ground. Material excavated from benches shall if suitable be incorporated into the fill. No separate payment shall be made for the making of benches, the cost of which shall be deemed to be included in the rates for other earthworks items.

Common fill

Material used shall be capable of achieving a CBR of at least 3 at 90% MDD (BS Heavy compaction). Where directed by the Engineer, special measures shall be employed to ensure the stability of high fills or of fills constructed over weak sub-grade. Such measures may include the use of selected materials (as working platforms or sandwich layers), strict control of moisture content during construction and limitations upon the rate of construction. Should any instability become apparent during the construction of an embankment, the Contractor shall immediately cease construction and seek direction from the Engineer.

Sub-grade

The top 500mm of all embankments (the subgrade) shall be constructed using selected materials to provide a subgrade CBR of at least 8 at 93% MDD (BS Heavy compaction). The finished level of the fill shall be within +25mm and -50mm of the required level.

Compaction

Fill materials shall be compacted to a density of not less than 90% and 93% MDD (BS Heavy) in common fill and sub-grade respectively. Any loose or un compacted material shall be trimmed from the slope surface as the embankment is raised and used as fill within the embankment if suitable, or disposed of it not.

In the absence of site testing facilities the Engineer shall instruct the Contractor on the method of compaction with the available plant. In general, and as guidance only, this will be in the range for vibrating rollers, of

<table>
<thead>
<tr>
<th>Weight</th>
<th>Passes (Earthworks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 kg</td>
<td>12</td>
</tr>
<tr>
<td>1000 kg</td>
<td>10</td>
</tr>
<tr>
<td>5000 kg</td>
<td>7</td>
</tr>
</tbody>
</table>
3204 MEASUREMENTS AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Excavation in soft material:</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3200.01.1</td>
<td>Within slip/slump zones</td>
<td>m³</td>
</tr>
<tr>
<td>3200.01.2</td>
<td>From cut</td>
<td>m³</td>
</tr>
<tr>
<td>3200.01.3</td>
<td>From borrow</td>
<td>m³</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the cubic metre measured in situ except where borrow material is required. For borrow the unit of measurement shall be the cubic metre of suitable material placed as specified in fill. The payment shall be made according to the unit price schedule and as given in the billed items.

The tendered rate for excavation in soft material shall include for excavation of material from the road prism, for loading and transporting the material for a free haul of 5 kms, shaping and trimming to required lines levels and tolerances, for draining and keeping the earthworks free of water, and for furnishing all labour, tools, equipment and incidentals necessary to complete the work in accordance with the specifications.

The tendered rate for borrow shall include all royalties, the cost of negotiations, payments, compensation of any description to landowners, the removal of overburden, excavation loading haulage to the point of deposition, and restoration, landscaping.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3200.02 Cut to Spoil</td>
<td>m³</td>
</tr>
</tbody>
</table>

Cut to spoil shall be measured as the net difference between the total volume of cut and the net volume of fill. The net volume of fill shall include any fill, sub-base or any other material used elsewhere on the Works, which is measured and paid for as per these specifications under a separate pay item and originated from a cut. The payment shall be made according to the unit price schedule and as given in the billed items.

The net volume of fill shall exclude the net volume in place in a fill of material arising from a borrow pit, or excavated from the road of the existing road, if such excavation is not within the road prism. No account shall be taken of variations in actual quantities due to bulking.

The tendered rates for cut to spoil shall include full compensation for disposal of surplus materials, including the cost of providing disposal sites outside of the site, shaping compacting, landscaping and draining such sites.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3200.03 Excavation in hard material</td>
<td>Extra over Item 3200.01</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the cubic metre measured in situ. The area shall be the area as described for Excavation in Soft Material except that the original surface shall be taken as the surface of the hard excavation after the complete removal of any soft or loose material to the satisfaction of the Engineer. In the event of soft material underlies the hard material, additional measurement shall be made to determine the lower surface of the hard material and cross-sectional areas shall be computed accordingly. No material in excess of the authorised cross-section will be measured for payment.

The tendered rate shall be paid as an extra over the rate tendered for item 3200.01 and shall include full compensation for executing hard excavation, including the cost of all additional effort, specialised plant and personnel, explosives, tools, materials, blasting mats, safety measures and labour.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3200.04 Embankment Fill</td>
<td>Extra over Item 3200.03</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the net volume of fill in place. The payment shall be made according to the unit price schedule and as given in the billed items.

The tendered rate shall be full compensation for placing, spreading and compacting the material (common fill and sub-grade fill) at the site of the fill, forming benches in side-long ground, and for trimming the fill to the required profile and level tolerance and all works necessary to prepare the sub-grade to receive following layers. Note there will be no distinction between common fill and sub-grade fill.
<table>
<thead>
<tr>
<th>Item</th>
<th>Sub-grade preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>m²</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the square metre of the sub-grade prepared. The payment shall be made according to the unit price schedule and as given in the billed items.

Measurement shall be the nominal plan area of the lower surface of the gravel wearing course or road layer overlying the area of sub-grade prepared in accordance with requirements specified above for cut / fill areas. This item shall only be used when no specific cut and/or fill operation is required, where such operations are required preparation of the sub-grade shall be deemed to be included in the respective rates for those operations.

The tendered rate shall be full compensation for trimming and compacting material of any description to the specified levels and tolerances and all works necessary to prepare the sub-grade to receive following layers.
SECTION 4100: GRAVEL SUB-BASE

CONTENTS

4101  SCOPE
4102  MATERIALS
4103  CONSTRUCTION
4104  INSPECTION AND TESTING
4105  MEASUREMENT AND PAYMENT

4101  SCOPE

This section covers the provision and construction of granular sub-base layers. It includes the use of processed (crushed, screened or crushed and screened) gravels or rock, derived from blasting or ripping within road cuttings or approved borrow sources. The contractor may adopt alternative types of construction (ie wet/dry macadam) provided details of construction methods / specifications etc. are first provided to, and approved by, the Engineer.

4102  MATERIALS

Material shall be obtained from sources located by the Contractor and approved by the Engineer. Sub-base material shall consist of hard durable particles or fragments of stone, gravel or sand, and shall not include any material that breaks up when alternately wetted and dried. The complete sub-base shall contain no material having a maximum dimension exceeding two-thirds of the compacted layer thickness, or 75mm whichever is the lesser.

Unless otherwise authorised, it shall conform to the following requirements:

**Grading Modulus**

The minimum Grading Modulus after compaction shall be 1.5 except where a material, having a lower Grading Modulus but not less than 1.2, is approved for use by the Engineer.

The grading modulus is defined as the cumulative percentages by mass of material in a representative sample of aggregate, gravel or soil retained on the 2.00 mm; 0.425 mm and 0.075 mm sieves, divided by 100.

**Plasticity Index**

The maximum Plasticity Modulus of the material used for sub-base shall not exceed 250.

The plasticity modulus is defined as the product of the Plasticity Index and the percentage passing the 0.425 mm sieve. The percentage passing the 0.425 mm sieve shall be determined on samples that have been compacted to 100% of BS Heavy density using dynamic compaction.

**California Bearing Ratio (CBR)**

The minimum CBR of material shall be 30% at the specified in situ density after soaking for 4 days.

**Compaction Requirements**

The minimum in situ dry density of the compacted layer shall be 95% of BS Heavy density.

4103  CONSTRUCTION

The sub-base shall only be constructed provided that the underlying sub-grade layers conform to the requirements specified. Immediately before placing the material, the sub-grade shall be checked by the Contractor for any damage or deficiencies which shall be made good as directed by the Engineer. Oversize material or material not conforming to specified requirements shall be removed, by appropriate methods, from the sub-base before transportation to the placement area. The sub-base material shall be placed, spread, watered, and compacted in order to achieve the specified requirements and surface tolerances.
The Contractor shall protect and maintain the completed sub-base at his own expense. Maintenance shall include immediate repairs of any damage or defects which may occur and shall be repeated as often as is necessary to keep the sub-base continuously intact. Repairs shall be made in a manner that will ensure restoration to an even and uniform surface. Where the sub-base is required to carry traffic in both directions using part width only, the Contractor shall ensure that the wheel path position is varied, by means of coning or similar traffic control measures. If exposure to traffic over a part width is expected to be prolonged, the Engineer may order a protective layer of not less than 100mm of sub-base quality material to be spread and compacted over the part width exposed to traffic.

The sub-base shall be finished to give a hard dense surface throughout and free from irregularities of any kind. The finished surface shall vary not more than 10 millimetres above or 20 millimetres below the planned levels at any point. The deviation from a straight edge 3 metres long laid on the surface parallel to the centreline or at right angles to the centreline on a cross fall shall not exceed 15 millimetres. Sub-base which does not conform to the above requirements shall be reworked, watered and thoroughly recompacted to conform.

4104 INSPECTION AND TESTING

Routine inspection and testing will be carried out by the Engineer to test the quality of materials and workmanship for compliance with the requirements of this section. The density requirements specified in Clause 4102 for compaction of a granular sub-base shall be deemed to have been complied with if the minimum dry densities as shown in Table 4104/1 are achieved. In calculating the mean, density values differing by more than 5 percentage points from the mean, shall be disregarded and a new mean calculated.

Any materials or workmanship that do not comply with the specified requirements shall be removed and replaced with materials and workmanship complying with the specified requirements, or if the Engineer permits, be repaired so that after being repaired it will comply with the specified requirements.

<table>
<thead>
<tr>
<th>Specified density (% of BS Heavy density)</th>
<th>Number of tests per lot</th>
<th>Minimum mean density (% BS Heavy density)</th>
<th>Minimum density for any single test (% of BS Heavy density)</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>3 &amp; 4</td>
<td>95.6</td>
<td>92.0</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>95.8</td>
<td>91.8</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>95.9</td>
<td>91.6</td>
</tr>
</tbody>
</table>

4105 MEASUREMENT AND PAYMENT

Item: 4100.01 Sub-base (Gravel)  Unit: cubic metre (cu m)

The unit of measurement shall be the cubic metre of material, measured in the final position after compaction to the specified density and the quantity shall be calculated as the product of the nominal depth, the required surface plan width and the required length measured horizontally along the centre line. No additional payment will be made for alternative types of construction proposed and/or adopted by the contractor. The payment shall be made according to the unit price schedule and as given in the billed items.

The tendered rate shall include full compensation for procuring, including royalties, furnishing, crushing and screening (if required) and placing all materials, including transporting and the removal of all oversize material and for control, testing, protecting and maintaining the work specified in this section.
SECTION 4200: GRADED AGGREGATE SAND SUB-BASE

CONTENTS

4201 SCOPE

This work shall consist of the supply, mixing, placing, shaping and compaction of a sub-base course composed of a homogeneous mixture of aggregate and sand in accordance with the Specifications and to the lines, levels, dimensions and cross-falls shown on the Drawings or as directed by the Engineer.

4202 MATERIALS

The material for the sub-base course shall consist of a homogeneous mixture of crushed stone aggregate, local sand, free from vegetation, soft particles and excess clay or any other substance.

The aggregate shall be crushed stone or crushed gravel (Shingles) or other stones or approved salvaged materials only. They shall be clean, strong, durable, of fairly cubical shape, and free of disintegrated pieces, organic and other deleterious matter and adherence coatings. The aggregate shall preferably by hydrophobic and of low porosity.

The crushed stones shall comply with following requirements:

- Water absorption shall not exceed 2% (IS 2386, Part III).
- Aggregate Crushing Value shall be not more than 25 or Aggregate Impact Value shall not be more than 30% (IS 2386, Part IV). Los Angeles Abrasion Value shall not be more than 35% (IS 2386, Part IV)
- Flakiness Index shall not be more than 35% (IS 2386, Part I)
- The F.M. of the sand shall not less than 0.8.

The materials shall be well graded and conform to the following grading limits:

<table>
<thead>
<tr>
<th>Sieve Size mm</th>
<th>Percent by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>37.5</td>
<td>85-100</td>
</tr>
<tr>
<td>19</td>
<td>55-95</td>
</tr>
<tr>
<td>9.5</td>
<td>35-75</td>
</tr>
<tr>
<td>4.75</td>
<td>25-60</td>
</tr>
<tr>
<td>2.36</td>
<td>15-50</td>
</tr>
<tr>
<td>0.6</td>
<td>10-35</td>
</tr>
<tr>
<td>0.3</td>
<td>10-25</td>
</tr>
<tr>
<td>0.075</td>
<td>5-15</td>
</tr>
</tbody>
</table>
Material passing a 425-micron sieve shall have a Plasticity Index of 8-20% and a Liquid Limit not greater than 35%.

Sub-base material shall have a soaked (4day) CBR value of not less than 50% when compacted to 98% of the MDD.

If the material is sand the F.M. shall not be less than 0.80.

4203 CONSTRUCTION METHODS

Screening and mixing of materials to achieve the specified grading shall be done in a stacking yard. The mixing may be done by mechanical means or by manual labour. The materials shall be mixed thoroughly and uniformly to have a homogenous mass. During mixing, water shall be added to keep the mixed materials moist so as to prevent segregation.

The sub-base shall be spread in a single layer to give a compacted thickness of 100mm. The relationship between the loose thickness and compacted thickness shall be determined from field trials and used in controlling the loose thickness at the time of spreading the mixed materials.

Water shall be added as necessary during spreading so that at the time of compaction the moisture content is within ±5% of the OMC. On completion of spreading and watering the sub-base shall be shaped, and compacted using approved compaction equipment and procedures.

The compacted surface shall be checked for levels and cross-falls and any irregularities shall be corrected by loosening the affected areas, adding or removing the necessary quantities of mixed material and re-compacting until the entire surface conforms to the correct levels and crossfalls.

The material shall be compacted to a density of not less than 98% of the MDD. The surface shall be well closed free of compaction planes, roller marks and segregated pockets.

The finished surface shall be within ±10mm of the elevation shown in the drawings and shall nowhere vary more than 10mm from a straight edge 3 metres long applied to the surface parallel to the centre line of the road and no more than 12mm from a template conforming to the cross-section. The depth over each 100m shall be measured in at least 3 places by digging holes and the mean depth shall not be less than the required depth.

4204 INSPECTION AND TESTING

The Engineer shall exercise control over quality of the materials incorporated and works performed through quality control tests carried out to the frequencies indicated herein under. The frequencies are the minimum, and the Engineer shall have the authority to have these tests at more frequent intervals where quality of a material or work is in doubt.

Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Type of Test</th>
<th>Frequency of Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>Aggregate Impact Value</td>
<td>One per 1.0km (more frequently if material character changes)</td>
</tr>
<tr>
<td></td>
<td>Water Absorption</td>
<td>-do-</td>
</tr>
<tr>
<td>Sand</td>
<td>F.M.</td>
<td>-do-</td>
</tr>
<tr>
<td>Mixed Material</td>
<td>Gradation</td>
<td>One per 500m (more frequently if material character changes)</td>
</tr>
<tr>
<td></td>
<td>Atterberg Limits</td>
<td>-do-</td>
</tr>
<tr>
<td></td>
<td>CBR (set of 3 specimens)</td>
<td>One/1.0km (more frequently if material character changes)</td>
</tr>
<tr>
<td></td>
<td>Moisture-Density</td>
<td>-do-</td>
</tr>
</tbody>
</table>

Field Compaction

The compacted layer shall be tested for field density using the sand replacement method at the rate of minimum one test per 500sq.m. If the test results show that the density is less than the required density the Contractor shall carry out further compaction to obtain at least the required density. The field CBR shall be checked using at a DCP at the rate of minimum one check per 500sq.m.
### MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4200.01</td>
<td>Sub-base (Graded aggregate and sand) cubic metre (cu m)</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the cubic metre of material, measured in the final position after compaction to the specified density and the quantity shall be calculated as the product of the nominal depth, the required surface plan width and the required length measured horizontally along the centre line. No additional payment will be made for alternative types of construction proposed and/or adopted by the contractor. The payment shall be made according to the unit price schedule and as given in the billed items.

The tendered rate shall include full compensation for procuring, including royalties, furnishing, crushing and screening (if required) and placing all materials, including transporting and the removal of all oversize material and for control, testing, protecting and maintaining the work specified in this section.
SECTION 4300: BASECOURSE

CONTENTS

4301 SCOPE
4302 MATERIALS
4303 CONSTRUCTION METHODS
4304 INSPECTION AND TESTING
4305 MEASUREMENT AND PAYMENT

4301 SCOPE

This section covers the provision and construction of granular basecourse layers from approved materials. The contractor may adopt alternative types of construction (ie wet/dry macadam) provided details of construction methods / specifications etc. are first provided to, and approved by, the Engineer.

4302 MATERIALS

Basecourse shall be selected from an approved source and processed to conform with the specified requirements. Processing shall include where necessary, crushing, screening, separation, blending (including blending of constituent materials from other sources) and any other operation necessary to produce a material conforming to the requirements of this specification. The method of selection and processing of all constituent materials shall be subject to the Engineer's approval and full scale production shall not commence until the Engineer has given such approval.

The material for base course shall conform with the following requirements:

Grading Requirements

The grading of the crushed aggregate shall conform to the grading limits given in Table 4202/1 and shall follow a smooth curve which, for all sizes passing the 19.0mm sieve shall be confined within a grading sub-envelope as follows:

The grading envelope given in Table 4302/1 shall be sub-divided into 5 equal grading sub-envelopes, and the grading of the material shall be confined within any adjacent pair of grading sub-envelopes as defined.

Table 4302/1

<table>
<thead>
<tr>
<th>Sieve size mm</th>
<th>Percentage Passing (by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>100</td>
</tr>
<tr>
<td>37.5</td>
<td>95 - 100</td>
</tr>
<tr>
<td>19.0</td>
<td>60 - 80</td>
</tr>
<tr>
<td>9.5</td>
<td>40 - 60</td>
</tr>
<tr>
<td>4.75</td>
<td>25 - 40</td>
</tr>
<tr>
<td>2.36</td>
<td>15 - 30</td>
</tr>
<tr>
<td>0.6</td>
<td>8 - 22</td>
</tr>
<tr>
<td>0.075</td>
<td>5 - 10</td>
</tr>
</tbody>
</table>

Aggregate and layer requirements

Crushed faces > 50% by weight of all particles retained on the 4.75 mm sieve shall exhibit at least one crushed face.

Aggregate crushing value < 25
**Flakiness Index**  
< 35 for fraction passing 13.2 mm and retained 9.5 mm.

**Atterberg limits**  
Plasticity Index <= 6
Liquid Limit < 25
Linear Shrinkage < 3

**California Bearing Ratio**  
> 80% at 98% BS Heavy density after 4 days soaking.

**Compaction requirements**  
minimum in place dry density of the compacted layer shall be 98% of BS Heavy density.

### 4303 CONSTRUCTION METHODS

The base shall only be constructed provided that the underlying layers conform to the relevant requirements specified for those layers. Immediately before placing the material, the underlying layer shall be checked by the Contractor for damage or deficiencies which shall be made good as directed by the Engineer. Base material shall be evenly spread over the width of the road bed in layers of uncompacted thickness not exceeding 250 mm subject to the approval of the Engineer. The layers, if more than one shall be as nearly equal in thickness as possible and may be spread by any method which shall not cause the segregation of coarse and fine particles and this may include wetting prior to transporting to the Site. Any areas so segregated shall be corrected or removed and replaced with well graded material.

Rolling shall be carried out parallel to the road centreline beginning at the outer edge and progressing towards the crown on sections of normal crossfall and beginning on the low side and progressing towards the high side on superelevated sections. The base course shall be finished to give a hard tight dense stone mosaic surface free of segregated material, cakes of fines roller marks and other surface irregularities.

The base course shall conform to thickness and surface tolerances as follows:

- **Minimum thickness** - nowhere more than 15 mm less than the required thickness.
- **Minimum width** - nowhere less than the dimension shown on the drawings.
- **Finished surface** - shall vary by not more than 15 millimetres above or below the required level

Base course which does not comply with these requirements shall be reworked watered as necessary and re-compacted to conform.

### 4304 INSPECTION AND TESTING

Routine inspection and testing will be carried out by the Engineer to test the quality of materials and workmanship for compliance with the requirements of this section. The density requirements specified in Clause 4302 for compaction of a granular sub-base shall be deemed to have been complied with if the minimum dry densities as shown in Table 4304/1 are achieved. In calculating the mean, density values differing by more than 5 percentage points from the mean, shall be disregarded and a new mean calculated. Tests to determine whether the crushed stone material complies with the specified grading, crushed faces, flakiness index, Atterberg limits and California Bearing Ratio shall be conducted after the material has been mixed on the road, spread out and compacted to the specified density.

Any materials or workmanship that do not comply with the specified requirements shall be removed and replaced with materials and workmanship complying with the specified requirements, or if the Engineer permits, be repaired so that after being repaired it will comply with the specified requirements.

### TABLE 4304/1

<table>
<thead>
<tr>
<th>Number of Tests per lot</th>
<th>Minimum mean density (% BS Heavy density)</th>
<th>Minimum value of any (% BS Heavy density)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 and 4</td>
<td>98.6</td>
<td>95.0</td>
</tr>
<tr>
<td>5</td>
<td>98.8</td>
<td>94.8</td>
</tr>
<tr>
<td>6</td>
<td>98.9</td>
<td>94.6</td>
</tr>
</tbody>
</table>
4305  MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4300.01</td>
<td>Base course</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the cubic metre of material measured in the final position after compaction to the specified density and the quantity shall be calculated as the product of the Average depth, the required surface plan width and the required length of base course measured horizontally along the centre line. No additional payment will be made for alternative types of construction proposed and/or adopted by the contractor. The payment shall be made according to the unit price schedule and as given in the billed items.

Payment shall be full compensation for opening up pits, sampling, procuring and furnishing materials, royalties, trial processing, processing, haulage, placing compacting and finishing, and for all labour equipment and other incidentals necessary to complete the work. Payment shall also be deemed to be compensation for any material placed outside the plan surface area i.e. in the edge batter slopes, and for wastage.
Section-03 CONCRETE

3.1 CAST IN PLACE CONCRETE
The work specified in this section consists of the construction of all concrete structures members and requirements for concrete mixes and testing of concrete mixes. This work shall include the construction of footings, floor slabs, and pedestal columns.

3.1.1 Submittals
Each consignment of cement shall be accompanied by a manufacture’s certificate showing that the cement has been tested and analyzed by an independent Testing Laboratory, and the date of such tests and analyses.

Submit test results of a concrete compression machine which must have a minimum compressive strength test result of M 200 after 28 days.

3.1.2 Delivery, Storage and Handling
Materials shall be inspected upon delivery for damage. Cement shall be stored in a watertight and well-ventilated building with a raised platform not less than 300 mm off the ground. Each consignment of cement shall be identified and stored separately.

3.1.3 Floor concrete PCC (f’c: 200 kg/cm²)
All The concrete for floor shall be 15cm thick and 3cm PCC finishing for final floor surface. The strength used in floor concrete shall be 200kg/cm² and mixes of (1:1.5:3)

3.1.4 Cement
Type: Utilize Portland cement, Type I, ASTM C-150 or equivalent standard.

3.1.5 General Aggregate
3.1.5.1 Aggregates shall be clean from dust and soil, and neutral sand, on no account shall naturally occurring boulder, shattered rock or weathered rock be used. Rock which from flat or flaky particles when crushed or which contains excessive quantities of mica or laminated materials shall not be used. The rock shall be free from all chemical substance likely to react in a harmful manner with other constituents of the concrete.

3.1.5.2 Sand shall be washed to remove traces of salt or other impurities and shall be formed of sound, clean and durable particles free from hollow shall discoloration clay, silt, organic, impurities or other deleterious substance.

3.1.5.3 The nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

3.1.6 Formwork
Plywood or metal panel formwork shall be mortar tight and shall be sufficient for straight perpendicular structural and visual requirements. Do not use weak formwork that causes bulges gapes or holes in the poured concrete Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and all of other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a none staining bond breaker. Except as otherwise shown external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.1.7 Expansion Joints
Longitudinal and transverse contraction joints shall be placed as shows on drawings.

3.1.8 Concrete Mixing
3.1.8.1 General mixing for other than structural building members will be with ratio of 1:1.5:3 (M: 200).
Maximum water-cement ratio (w/c) by weight shall be 0.40-0.45

3.1.8.2 Concrete mixing for structural building members shall be according to mix design tested to show 200 kg/cm² the strength of the concrete will be considered satisfactory if the average of the all sets of three consecutive test results equals or exceeds the specified compressive strength and no individual test result falls bellow the specified strength by more than M200. Slump of the concrete for the structural building members, as delivered to the point of placement into the forms, shall be within 25 mm to 100 mm in accordance with ASTM C 143/C 143M or equivalent approved standards.

3.1.8.3 All concrete shall be power machine mixed and machine vibrated. About 10 percent of the water required for the batch shall enter the drum in advance of the cement and aggregates, and the remainder of the water shall be added gradually while the drum is in action so that all the water is in the drum by the end of the first quarter of the mixing time, the concrete shall be mixed until a mixture of uniform color and consistency is obtained.
3.1.8.4 The amount of concrete mixed in any one batch shall not exceed the rated capacity of the mixer. The whole of the batch shall be removed before materials for a fresh batch enter the drum. On cassation of work, including all stoppages exceeding 1 hour, the mixers and all handling plant shall be washed with clean water. Concrete mixed as specified above shall not be modified by the addition of the water or in any other manner to facilitate handling or for any other reason.

3.1.9 Concrete Placing
3.1.9.1 Before any concrete is placed the formwork shall be thoroughly cleaned of all dirt, shavings, loose stones, and other debris. Forms shall be treated with a non-staining material or shall be saturated with water immediately before the concrete is placed.

3.1.9.2 Immediately after mixing, the concrete shall be transported to the place of final deposit by methods which will prevent the separation, loss or contamination of any of the ingredients.

3.1.9.3 The concrete shall be placed gently in position and shall normally not have a free fall of more than 1.5 meter. The concrete shall be placed so as to prevent water from collecting at the ends, corners of along the faces of the forms, and water shall not be placed in large quantities at a given point and allowed to run or be worked over along distance in the form.

3.1.9.4 All concrete shall be placed and compacted in even layers with each batch adjoining the previous one. The thickness of the layers shall be 15cm.

3.1.9.5 The concrete shall be carefully and continually compacted and worked around the reinforcement steel and into the corners of the formwork so that the concrete shall be in close concrete with the reinforcement steel and free from honeycombing. All vibration compaction and finishing operations shall be completed immediately after the placing of concrete in its final position.

3.1.9.6 Concreting in any one part or section of the work shall be carried out in one continuous Operation and no interruption of concerning work will be allowed.

3.1.9.7 Freshly placed concrete shall be adequately protected from rain. Dust storms chemical attack and the harmful effects of sun, heat, wind, flowing water, vibrations and shocks.
<table>
<thead>
<tr>
<th>#</th>
<th>Air Temperature</th>
<th>Size of the Concrete Section e.g depth of slab</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>300-900 mm &lt; 300 mm Applies Mainly for Footings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>900-1800 mm Applies Mainly for Slabs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 1800 mm</td>
</tr>
</tbody>
</table>

**Final Placed Minimum Concrete Temperature**

<table>
<thead>
<tr>
<th></th>
<th>10°C</th>
<th>70°C</th>
<th>5°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**As Mixed Minimum Concrete Temperature for Indicated Air Temperature**

<table>
<thead>
<tr>
<th></th>
<th>Above - 1°C</th>
<th>16°C</th>
<th>10°C</th>
<th>7°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>- 18 to 1°C</td>
<td>18°C</td>
<td>13°C</td>
<td>10°C</td>
</tr>
<tr>
<td>4</td>
<td>Below - 18°C</td>
<td>21°C</td>
<td>16°C</td>
<td>13°C</td>
</tr>
</tbody>
</table>

**Max Concrete Temp. Drop in first 24 hours after end of Protection**

<table>
<thead>
<tr>
<th></th>
<th>22°C</th>
<th>17°C</th>
<th>11°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.1.10 Weather Precautions
The temperature of the concrete as delivered shall be between 12 and 32 degrees C. Proper planning and approval should be obtained to concrete under weather conditions that are expected to cause placed concrete temperature to be outside the recommended limits. The following is the recommended concrete temperatures as per ACI 306R-88 for cold weather concreting:

3.1.11 Concrete Curing and Form Removal
3.1.11.1 Concrete shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, rain or running water. The protection shall be applied as soon as practicable after completion of placing by covering concrete with a layer of sacking, canvass, Hessian, straw mat or similar absorbent material or a layer of sand kept constantly wet for 7 days.

3.1.12 Concrete Finishing
3.1.12.1 All concrete shall be given an ordinary clean surface finish. Immediately following the removal of forms, all fines and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced from by form ties and all other holes' honeycomb sports, broken corners or edges and other defects shall be thoroughly cleaned and after having been kept saturated with water for a period of not less than three hours shall be carefully pointed and trued with a mortar of cement and find sand. The resulting surfaces shall be smooth, true and uniform in shape and uniform in color.

3.1.13 Testing
The contractor shall perform the tests described below and shall take the action required and UNDP will choose the Lab for further process.

3.1.13.1 Slump Testing
At least two slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M or approved equivalent standards for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. When a single slump test reaches or goes beyond either the upper or lower action limit a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the record slump of the batch and for determining need for any remedial action. Whenever slump reaches the upper action limit an adjustment shall immediately be made in the batch weights of water and fine aggregate.

Remedial action: Whenever slump reaches the upper action limit an adjustment shall immediately be made in the batch weights of water and fine aggregate.

3.1.13.1 Concrete Testing
Fresh concrete will be sampled as delivered in accordance with ASTM C 172 or approved equivalent standards and tested in accordance with these specifications, as considered necessary. The contractor shall provide six concrete cylinder testing samples for each type of reinforced concrete cast in any single day.

3.2 REINFORCING STEEL
This subsection contains a description and the specification for the furnishing, bending, fabricating and placing of steel reinforcement of the type, size shape and grade required in accordance with the Drawings, as specified herein.

3.2.1 Material
All reinforcing steel bars shall be deformed billet steel and shall meet the requirements of Grade 60000psi. Testing shall be performed to verify tensile yield. The contractor shall submit test results of reinforcement steel.

3.2.2 Handling and Placing Reinforcement
All reinforcement steel shall be protected as far as practicable from mechanical injury or surface deterioration, rusting or other causes from the time of shipment until it is placed.

Reinforcement steel stored at the site shall be laid on wood floors or sills suitably spaced so that no reinforcement steel shall be laid upon or come on contact with the ground. When the weather is rainy or exceptionally humid bars shall be stored under cover.

3.2.3 Reinforcement
3.2.3.1 Each reinforcement steel bar shall be cut and bend to the dimension specified on the drawings. All bars shall be bent cold. Splicing will not be permitted, except where indicated on the drawings. Lap lengths shall be as indicated on the Drawings or approved standards from UZ bar.

3.2.3.2 The reinforcement steel shall be assembled to the shapes and dimension as indicated on the drawings. The rods shall be of the cross-sectional areas indicated and shall be fixed rigidly and accurately in the forms in the positions indicated on the drawings.
3.2.3.3 The rods shall be firmly bound to gather at intersections of rods to ensure that the reinforcement steel framework as a whole shall retain its shape, and the framework shall be so temporarily supported as to retain its correct position in the forms during the process of depositing and consolidating the concrete.

3.2.3.4 The end of all tying wires shall be turned in to the main body of the concrete and not allowed to project towards the surface. No temporary metal supports to the reinforcement steel will be allowed and metal clips or supports shall not be placed in concrete with forms for exposed surfaces.

3.2.3.5 At the time of concreting, all reinforcement steel shall have been thoroughly cleaned and freed from all loose rust, scale, mud, oil or any other coatings that might destroy or reduce the bond and it shall also have been cleaned of all set or partially set concrete which may have been deposited thereon during the placing of a previous lift of concrete.

3.2.3.6 The placing of all reinforcement steel bars will be checked by the CQC Manager and UNDP Engineer and in no case, is concrete to be placed around any reinforcement steel that has not been approved by the UNDP Engineer.

3.2.3.7 The insertion of bars into or the removal of bars from concrete already placed will not be permitted.

3.2.3.8 Reinforcement steel temporarily left projecting from the concrete at the joints shall not be bent without the prior approval of the CQC Manager.

3.2.3.9 All reinforcement steel shall have a clear coverage as indicated on the drawings.

3.3 PLACE ARCHITECTURAL CONCRETE

3.3.1 GENERAL REQUIREMENT

All materials, procedures, and requirements specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE shall fully apply to cast-in-place architectural concrete, except as otherwise specified.

3.3.1.1 Design Requirements

Concrete Mix: If it is determined that the concrete mix requires plasticizers, the requirements will be added in this paragraph. Slumps for plasticized concrete may range as high as 250 mm (10 inches). The concrete mix shall be designed in accordance with ACI 210.1 and ACI 210.2. The mix design shall include consideration of the finishes required.

3.3.1.2 Formwork Design

Formwork design shall conform to ACI 301 and ACI 347R

3.3.1.3 Detail Drawings

The Contractor shall submit detail drawings conforming to ACI SP-66 and ACI 318M/318RM ACI 318/318R. Detail drawings shall show location of cast-in-place elements in the work, building elevations, formwork fabrication details, reinforcements, embedment, dimensions, concrete strength, interface with adjacent materials, and special placing instructions, in sufficient detail to cover fabrication, placement, stripping, and finishing.

3.3.1.4 Panels

Sample panels shall be located as directed, shall be 1.8 m 6 feet long and 1.2 m 4 feet high with the thickness to match building conditions for each type of architectural concrete and finish. Panel forms shall include a typical joint between form panels, form tie conditions and finishes. Panels shall be protected from weather and other damage until acceptance of work. Sample panels shall be used as job standards throughout construction.

3.3.2 PRODUCTS

3.3.2.1 MATERIALS

Aggregates shall be crashed stone aggregate, clean and empty of dust and extra materials.

3.3.2.1.1 Reinforcing Steel

Reinforcing steel shall be galvanized and the clear cover to an exterior face is 25 mm 1 inch or less.

3.3.3 EXECUTIONS

3.3.3.1 Form work erection

Formwork shall be erected in accordance with the detail drawings to ensure that the finished concrete members conform accurately to the indicated dimensions, lines, elevations, and finishes. Deflection shall not exceed 1/360th of each component span or distance between adjacent supports. Deflections and tolerance shall not be cumulative. Form lines shall be installed as necessary to provide the required finish.

Forms shall be coated with form release agents before reinforcement is placed. Formwork shall conform to ACI 301 and ACI 347
3.3.3.2 Concrete finishes
Concrete finishes shall conform to the approved finishes. Finishing shall be accomplished at the time of concrete placement or immediately after formwork removal, as follows:

a. Smooth finish:
   (1) As cast using flat smooth nonporous forms.
   (2) As cast using fluted, sculptured, board finish or textured form liners.

b. Textured finish:
   (1) Textured form liners applied to inside of forms.
   (2) Distress finish by breaking off portion of face of raised portion of unit.

c. Exposed aggregate finish
   (1) Finish obtained by applying even coat of retardant to face of form, removing forms after concrete hardens, and exposing coarse aggregate to a depth of 5 mm by washing and brushing or lightly sandblasting away surface mortar.
   (2) Finish obtained by treating surface of unit with brushes which have been immersed in acid solution.

Cast-in-place concrete elements which are to have a finish other than the surface produced from standard formwork shall be accomplished by using the following procedures:

3.3.3.3 Joint Sealing
Joint sealing shall be as specified in Section, JOINT SEALANTS.

3.3.3.4 Cleaning
No sooner than 72 hours after joints are sealed, faces and other exposed surfaces of cast-in-place concrete shall be washed down, cleaned with soap and water applied with a soft bristle brush, then washed down again with clean water, or by other approved procedures. Discolorations which cannot be removed by these procedures shall be considered defective work. Cleaning work shall be done when temperature and humidity conditions are such that surfaces dry rapidly. Care shall be taken during cleaning operations to protect adjacent surfaces from damage.

3.3.3.5 Surface Sealing
After cleaning, exterior exposed architectural concrete surfaces indicated shall be given one coat of surface sealer, spray applied unless otherwise approved. Adjacent surfaces shall be protected to prevent damage from the surface sealer.

3.3.3.6 Protection of Work
Work shall be protected against damage from subsequent operations.

3.3.3.7 Defective Work
Defective work shall be repaired or replaced, as directed, using approved procedures.

3.3.3.8 CODES, RULES, PERMITS AND FEES
The contractor shall issue all necessary notices, obtain all permits and pay all government taxes, fees, and costs, including utility connections or extensions for all work associated with this specification section. The contractor shall file all necessary plans, prepare all documents and obtain all necessary approvals of all necessary jurisdictional government departments.

3.3.3.9 ACCEPTANCE TESTING
3.3.3.9.1 All acceptances testing and testing procedures shall be incorporated in the contractors Quality Control Plan.

3.3.3.10 Safety
3.3.3.10.1 The contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The contractor shall replace any devices or equipments which are damaged due to improper test procedures or handling.

3.3.3.10.2 Ground-Resistance Tests: The resistance of each grounding electrode shall be measured using the fall-off-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry.

3.3.3.10.3 Conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

3.3.3.10.4 Cable Tests: An insulation resistance test shall be performed on all low and medium voltage cable after the cables are installed in their final configuration and prior to energizing. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors.
The minimum value of resistance shall be: 

\[ R \text{ in mega ohms} = \frac{(\text{rated voltage in kV} + 1) \times 304.8}{\text{length of cable in meters}} \]

### 5609 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5600.01 Bar Cement Concrete Road</td>
<td>Square metre</td>
</tr>
</tbody>
</table>

The tendered rate shall include full compensation for the supply, delivery, cutting, bending, welding, placing and fixing of the bar cement concrete road, including all concreting, plant and equipments and hand tools, tying wire, spacers, stools, supports and waste, all types of joints, and services pipes under the road. The payment shall be made according to **the unit price schedule and as given in the billed items**.