UNITED NATION DEVELOPMENT PROGRAM

AREA BASED APPROACH TO DEVELOPMENT EMERGENCY INITIATIVE (ABADEI)

TECHNICAL SPECIFICATION

Kabul,

AFGHANISTAN
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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 pavement 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 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 COMPACTION 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 COMPACTION
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. In case of bituminous mixes, the compaction panels in which the compaction work is found as non-acceptable shall be stripped off and re-laid with fresh bituminous mix and re-compacted.

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 pavement 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 crossfall 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/Pavement 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 pavement 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, pavement 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>
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<tbody>
<tr>
<td>1200.01</td>
<td>Mobilisation</td>
</tr>
<tr>
<td></td>
<td>Lump Sum</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>
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<tbody>
<tr>
<td>1200.02</td>
<td>Maintenance of the Contractor's Establishment</td>
</tr>
<tr>
<td></td>
<td>Week or month</td>
</tr>
<tr>
<td></td>
<td>(as per BoQ)</td>
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</tbody>
</table>

Payment unit price schedule and as given in the billed items for maintenance of the Contractor's establishment on the site shall be compensation in full for the costs of maintaining offices, supervisory, technical and administrative personnel and facilities both on and off the site and shall include (but not necessarily 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, Dayworks and Provisional Sums) divided by the total value of the Works (excluding General and Preliminary items, Dayworks 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.

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<tr>
<th>Item</th>
<th>Unit</th>
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<tbody>
<tr>
<td>1200.03</td>
<td>Demobilisation</td>
</tr>
<tr>
<td></td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

Payment 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.
(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>Payment for Performance Bond shall be payment in full for providing and maintaining the Performance Bond for the period stipulated in the contract. Payment <strong>unit price schedule and as given in the billed items</strong> shall be due when a Performance Bond acceptable to the Employer has been delivered to him.</td>
</tr>
</tbody>
</table>

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>Payment for insurances shall be compensation in full for the cost of providing all insurances required by the contract. Payment <strong>unit price schedule and as given in the billed items</strong> shall become due when evidence of satisfactory insurances has been provided to the Engineer.</td>
</tr>
</tbody>
</table>

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 environmental 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 pavement 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, pavement 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 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 riverains 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/measures undertaken 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
- Reinforcement 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 benched 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 minimize 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 undergrowth 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.
1311  EXTRATION OF RIVER GRAVELS AND QUARY

Use of a permanent Quarry
The use of a quarry is subject to local laws and regulations. The Contractor shall seek authorization from the local authority before proceeding with the acquisition of the land for the quarry. The Contractor shall be responsible for all costs associated with the operation of the quarry. Furthermore, upon obtaining the authorization and during the operation of the quarry, the Contractor shall take all measures for:

- The protection of the surrounding trees and vegetation during the stockpiling of materials,
- An adequate drainage system to protect the spillover of the stock piled materials,
- Dust propagation to the natural areas adjacent to the site

1312  SPECIFIC CLAUSES (NON EXHAUSTIVE)

Management of waste
Waste bins shall be installed in sufficient number and capacity near the various places of activities. These bins are to be emptied periodically and disposed into an approved site. The service area for the equipment shall be concreted so that all spilled oil can be collected via a hydrocarbon separator. Construction wastes shall be disposed in ways that minimize the impact on the aesthetics of the surrounding areas and in consultation with the local authorities.

Public and Private domains
The works site areas are in the public domain in general but also on private property for which their temporary occupation or ultimately their acquisition is required during the construction period.

The perimeter for public use during the construction operation includes the construction site itself, the Contractor’s and building Site, adjacent areas to the construction sites used directly for the storage of excavated materials etc. Work can start in the private property areas only when either there has been agreement for the temporary use or the acquisition procedures have been completed. The construction works and the use of the Sites are subject to the conditions stipulated in the Construction Contract and under in conformity to laws and regulations of the Country. At the end of the construction works, these sites should be restored to their original state where applicable.

Authorizations
The Contractor is responsible for the obtention of all authorizations pertaining to the Construction works before the start of the works, in conformity to the laws and regulations of the Country. These administrative clearances include site installation, health and safety, disposal of wastes, etc.

Protection of the grounds, surface and underground waters
The contractor will avoid any direct discharge of wastewater and hydrocarbons, or other liquid pollutants on the land, in surface and underground waters, natural drains and the sea.

Noise Level
The contractor is responsible to minimize the noise level from the construction site so as not to cause nuisance to the local inhabitants. The operation of heavy construction equipment shall be limited during day time and all efforts shall be made to avoid the use of these equipment during night time near residential zones.

Storage of hydrocarbons
The storage of hydrocarbons (fuel, lubricants, etc.) shall be made according to best practice and in conformity to local regulations. Used oil from the maintenance of the construction equipment shall be stored in closed containers and deposited in a bunded area. The used oil should not be disposed at any time in the natural areas and on the construction site but these should be carted away to a disposal site with the approval of the Authorities.

**Control of dust emanation**
The contractor shall be responsible for the control of dust emanation from the construction site. The Contractor shall state the measures he intends to take to minimize dust emanation including limiting the speed of the construction equipment, managing excavated materials, etc.

**Degradation/demolition of private property**
The contractor will have to inform the local population on any activity associated with the construction works that can cause degradation to the agricultural fields, demolition of part private property etc. The Contractor shall seek agreement with the concerned party on the compensation to be paid. Work can only proceed when payment for compensations have been made with the approval of the Project Manager.

**Burning of waste**
It is strictly prohibited for the burning of vegetation wastes close to residential areas to avoid the harmful effects.

**Traffic Management**
During the construction works, the contractor shall be responsible for measures to limit the speed of the vehicles on the construction site such as by the installation of traffic signs, control of traffic (manning of flags), speed limit for the construction engines, etc. Traffic deviations and slow down of flows shall be approved by the local authority prior to the start of the operation.

**Stock pile of Construction Materials on road sides**
The contractor shall be responsible for the management of construction materials on road sides. The Contractor shall ascertain that:
- The stock piles materials are distributed in reasonable quantities at specified distances on only one side of the road,
- Materials loss from trucks is minimized to avoid dust pollution as well as a road hazard.

**Materials containing hydrocarbons**
The contractor shall ascertain that materials containing hydrocarbons are:
- Stored in specific dedicated areas equipped with a drainage system to prevent wash out of materials,
- Used in accordance with safety practices and handled with the appropriate equipment

Moreover the Contractor shall keep on the construction site, product absorbents in the event of spillage of these materials in the natural environment.

**Drainage systems**
The contractor will be responsible for the maintenance of the existing drainage systems within the construction site. He will ensure that the existing systems are functional during the progress of the construction works and no construction debris or materials shall impede their operation.

**Disturbance of pertaining to worship and cultural sites**
The Contractor shall make all the provisions to ascertain that worship and cultural sites in the vicinity of the works are not impeded upon during the works. He shall have to proceed with identification of their locations before the start of work. If during the course of progress of works, vestiges having an archaeological, paleontological or historical interest are discovered, the Contractor shall stop the works and
immediately inform the Project Manager. The responsible Authority will then be informed by the Project Manager. Work will resume only after clearance from the responsible Authority.

**Demobilisation**
During the demobilisation phase after construction works have been completed, the Contractor is responsible for site reinstatement as well as the removal of all his equipment and construction accessories. No equipment or parts as well as construction accessories shall be disposed on the site or in the vicinity. The site reinstatement shall be recorded and approved by the Project Manager.

**Partial work completion - final Acceptance of work**
Under the provisions of the contract, the non-adherence to the clauses pertaining to environmental and social management may result in the non-issue of final work completion certificate. The implementation of each environmental and social mitigation measures shall be subject to a partial completion approval until the final work completion certificate. The Contractor shall be responsible for remedial actions until all aspects of environmental and social measures have been carried out before the issue of the final completion certificate.

### 1313 MEASUREMENT AND PAYMENT

**Payment, unit price schedule and as given in the billed items** A provision some has been provide in BoQ. It is Lump sum amount which should not exceed than 5 percent of bidding price for all above elaborated items.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
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<tbody>
<tr>
<td>1300.00</td>
<td>Environmental and Social Measures</td>
</tr>
</tbody>
</table>
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 pavement layer composed of a homogeneous mixture of crushed stone aggregates and local sand and soil lying immediately below the base course.

Base Course: The pavement 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 pavement 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: Pavement 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 pavement) 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.

Up stream 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: The strength of the soil (measured by the weight that can be loaded on to a specified 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 1500: SPECIFICATION STANDARDS

The following Specifications issued by widely recognised bodies are referred to in this Specification:

BS  British Standard
AASHTO  American Association of State Highway and Transportation officials
IRC  Indian Road Congress
SERIES 2000: CLEARING AND DRAINAGE

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<table>
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<th>Description</th>
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<td>CLEARING</td>
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SECTION 2100: CLEARING

CONTENTS

2101 SCOPE

This section covers general clearing activities along the roadside and includes cutting back of vegetation and clearing 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 m$^3$; removal of material in slips/slumps larger than 5 m$^3$, 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

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<thead>
<tr>
<th>Item</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>2100.01</td>
<td>Végétation</td>
</tr>
<tr>
<td>2100.02</td>
<td>Drainage paths</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 unplasticised 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 uPVC

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 then 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>
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<tbody>
<tr>
<td>2200.01.1</td>
<td>Excavation for open drains:</td>
</tr>
<tr>
<td></td>
<td>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>
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</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>
<tr>
<td></td>
<td>square metre (m²)</td>
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</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>
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</thead>
<tbody>
<tr>
<td>2200.04</td>
<td>Concrete outlet structures to subsurface drains (including formwork)</td>
</tr>
<tr>
<td></td>
<td>cubic metre (cu m)</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: PREFABRICATED CULVERTS

CONTENTS

2301 SCOPE
2302 MATERIALS
2303 CONSTRUCTION METHODS
2304 DEPTH OF EXCAVATION
2305 WIDTH OF EXCAVATION
2306 UNSUITABLE FOUNDING CONDITIONS
2307 EXCAVATION FOR EMBANKMENT CONDITIONS
2308 CLASSIFICATION OF EXCAVATED MATERIAL
2309 DISPOSAL OF EXCAVATION
2310 BEDDING AND LAYING
2311 BACKFILLING
2312 INLET AND OUTLET STRUCTURES
2313 REMOVAL OF EXISTING WORK
2314 MEASUREMENT AND PAYMENT

2301 SCOPE

This section covers the work in connection with the construction of culverts using prefabricated units.

2302 MATERIALS

Prefabricated culvert units shall be factory produced by a reputable manufacturer and shall comply with the following requirements:

Precast concrete pipe culvert units shall comply according to the drawings and specifications. The minimum thickness & reinforcements and strength of materials shall be according to the drawings. Pipes shall be of the Tongue and groove ends or flush-joint type as supplied by the manufacturer.

Corrugated steel pipe sections shall comply with the requirements of AS 2041 and AS 2042 for Nestable and Bolted Pipes.

Wherever the use of fine granular material is specified in this section for the bedding of culverts, it shall mean sand or other cohesionless material, all of which shall pass a 6.70 mm square mesh sieve and not more than 10% shall pass a 0.150 mm square mesh sieve.

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

Prefabricated 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 prefabricated culverts shall be constructed under trenched conditions. The only exceptions shall
be those permitted by the Engineer. These can include box culverts, larger pipe 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
stormwater 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 pipes 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.

Precast units shall be lifted and handled by means of approved lifting devices only. Lifting eyes shall be caulked with a
suitable mortar after the units are installed.

The Contractor shall exercise due care not to damage, overstress or displace any prefabricated pipes 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 pipes so as to ensure that the
design stresses on the pipes 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 Pipe Culverts

The minimum height of embankment over the top of the proposed pipe 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.

Metal Pipe Culverts

The minimum height of embankment construction over the top of the proposed metal culvert before excavation may commence is the minimum cover specified on the Drawings for the type of metal culvert, or 0.25 times the diameter of
pipes or 0.25 times the span of pipe arches, whichever is the greater.

The minimum amount by which the excavation is to exceed the proposed level of the bottom of the pipe shall be 75 mm
or such other amount required to accommodate the type of bedding required for the culvert 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, subgrades 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 pipes 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</td>
</tr>
<tr>
<td></td>
<td>of unsuitable</td>
</tr>
<tr>
<td></td>
<td>material</td>
</tr>
<tr>
<td></td>
<td>below culvert</td>
</tr>
<tr>
<td></td>
<td>bedding level</td>
</tr>
<tr>
<td></td>
<td>and</td>
</tr>
<tr>
<td></td>
<td>replacement</td>
</tr>
<tr>
<td></td>
<td>with</td>
</tr>
<tr>
<td></td>
<td>suitable</td>
</tr>
<tr>
<td></td>
<td>material</td>
</tr>
<tr>
<td></td>
<td>cubic metre</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>Prefabricated culverts</td>
<td></td>
</tr>
<tr>
<td>(diameter and pipe class indicated):</td>
<td></td>
</tr>
<tr>
<td>2300.02.1 Concrete Pipe</td>
<td>metre</td>
</tr>
<tr>
<td>2300.02.2 Corrugated metal Pipe</td>
<td>metre</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 OVERT 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</td>
<td></td>
</tr>
<tr>
<td>Cast in situ concrete:</td>
<td></td>
</tr>
<tr>
<td>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>2300.04.1</td>
<td></td>
</tr>
<tr>
<td>Mild steel</td>
<td>ton (t)</td>
</tr>
<tr>
<td>2300.04.2</td>
<td></td>
</tr>
<tr>
<td>Mild steel mesh</td>
<td>Kilogram (kg)</td>
</tr>
</tbody>
</table>

Measurement and payment for steel reinforcement 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</td>
<td></td>
</tr>
<tr>
<td>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 pipes, 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.
SERIES 3000: SETTING OUT ALIGNMENTS, EARTHWORKS AND GRAVEL WEARING COURSES

CONTENTS

3100  SETTING OUT HORIZONTAL AND VERTICAL ALIGNMENT
3200  EARTHWORKS
3300  GRAVEL WEARING COURSE
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 pavement 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 uncompacted 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>
MEASUREMENTS AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</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>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3200.02</td>
<td>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 pavement 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>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3200.03</td>
<td>Excavation in hard material Extra over Item 3200.01</td>
<td>m³</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the cubic metre measured in situ. The payment shall be made according to the unit price schedule and as given in the billed items.

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>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3200.04</td>
<td>Embankment Fill</td>
<td>m³</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>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3200.05 Sub-grade preparation</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 pavement 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 3300: GRAVEL WEARING COURSE

CONTENTS

3301 SCOPE
3302 MATERIALS
3303 CONSTRUCTION METHODS
3304 TESTING
3305 MEASUREMENT AND PAYMENT

3301 SCOPE

This section covers the provision and construction of a gravel wearing course to unsealed roads.

3302 MATERIALS

Gravel Wearing Course material shall be obtained from sources located by the Contractor and approved by the Engineer. The completed layer shall contain no material having a maximum dimension exceeding two-thirds of the compacted layer thickness, or 50 mm whichever is the lesser. Unless otherwise authorised material shall conform to the following requirements:

Plasticity Index

The plasticity index shall be in the range of 6 to 12.

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

Where the nominal thickness of the Gravel Wearing Course is 150mm or less, it shall be compacted by a minimum of 8 passes of a vibrating roller with a static mass of at least 5000kg per metre width. If the layer thickness is greater than 150mm, the material shall be laid in two layers of approximately equal thickness and each layer shall be compacted as for a layer of less than 150mm thickness.

3303 CONSTRUCTION METHODS

The Gravel Wearing Course shall only be constructed provided that the underlying sub-grade layers conform to the requirements specified or preparation has been completed to the satisfaction of the Engineer. 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 shall be removed by appropriate screening methods from the Gravel Wearing Course before transportation to the placement area. The Gravel Wearing Course shall be placed, spread, watered, compacted and shaped to provide a surface free of irregularities, which could cause the pond of water. The Contractor shall protect and maintain the completed Gravel Wearing Course 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 Gravel Wearing Course continuously intact until the Works or section of the Works have been completed and handed over. Repairs shall be made in a manner that will ensure restoration to an even and uniform surface.

The Gravel Wearing Course shall be finished to give a hard dense surface throughout and free from irregularities of any kind. No specific tolerances shall apply to Gravel Wearing Course except that it shall be nowhere more than 15mm thinner than the nominal thickness shown on the drawings or instructed by the Engineer.

3304 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 3202 for compaction of
Gravel Wearing Course shall be deemed to have been complied with if the minimum number of passes of the roller of the weight specified have been applied in the presence of the Engineer.

### 3305 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3300.01 Gravel Wearing Course</td>
<td>Cubic metre (Cum)</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the cubic metre of material, measured in the final position after compaction and the quantity shall be calculated as the product of the nominal depth, the required surface plan width and the required length of gravel wearing course measured horizontally along the centre line. 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, screening (if required) and placing all materials, including transporting and the removal of all oversize material and for protecting and maintaining the work specified in this section.
**SERIES 4000: PAVEMENT WORKS**

**CONTENTS**

<table>
<thead>
<tr>
<th>4100</th>
<th>GRAVEL SUB-BASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4200</td>
<td>GRADED AGGREGATE SAND SUB-BASE</td>
</tr>
<tr>
<td>4300</td>
<td>BASECOURSE</td>
</tr>
<tr>
<td>4400</td>
<td>WATER BOUND &amp; DRY BOUND MACADAM</td>
</tr>
</tbody>
</table>
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 crossfall 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 4104/1

<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

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4100.001</td>
<td>Sub-base (Gravel)</td>
</tr>
<tr>
<td></td>
<td>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 4200: GRADED AGGREGATE SAND SUB-BASE

CONTENTS

4201 SCOPE
4202 MATERIALS
4203 CONSTRUCTION
4204 INSPECTION AND TESTING
4205 MEASUREMENT AND PAYMENT

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 with ±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 it shall nowhere vary more than 10mm from a straight edge 3 metres long applied to the surface parallel to the centre line of the pavement 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.
### 4205 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4200.01</td>
<td>Sub-base (Graded aggregate and sand)</td>
<td>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 (i.e. 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

<table>
<thead>
<tr>
<th>Plasticity Index</th>
<th>Liquid Limit</th>
<th>Linear Shrinkage</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\leq 6)</td>
<td>(&lt; 25)</td>
<td>(&lt; 3)</td>
</tr>
</tbody>
</table>

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 basecourse 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 Base course</td>
<td>cubic metre</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 4400: WATER BOUND & DRY BOUND MACADAM

CONTENTS

4401  SCOPE
4402  MATERIALS
4403  CONSTRUCTION METHODS
4404  INSPECTION AND TESTING
4405  MEASUREMENT AND PAYMENT

4401 SCOPE

This work shall consist of the supply, mixing, placing, shaping and compaction of a sub-base/base course composed of a broken stone aggregate mechanically interlocked by rolling and bonded together with screening, binding materials where necessary and water laid on a prepared sub-grade with the Specifications and to the lines, levels, dimensions and cross-falls shown on the Drawings or as directed by the Engineer. The probable mix proportion of the materials shall be 40% Crushed stone aggregate, 40% river gravel and 20% fine materials or clayey soil that shall be confirmed as per grading limits.

4402 Materials for WBM

Coarse Aggregate:

The coarse aggregate shall be crushed stone. The aggregate shall be sharp and angular of approximately cubical in size and shall be hard and durable to serve as ideal material for water bound macadam roads. The coarse aggregate shall be free from vegetation, soft particles and excess clay or any other substance which is considered deleterious.

The crushed stones shall comply with the following requirements:

- Water absorption shall not exceed 2%.
- Aggregate Impact value shall be not more than 36 (BS 812) or as directed by the Engineer.
- Flakiness Index shall not be greater than 15%.
- Plasticity Index of binding materials shall not more than 6.
- F.M. of sand shall not be less than 0.80 and shall be free from deleterious materials.

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

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>63mm</td>
<td>100</td>
</tr>
<tr>
<td>50mm</td>
<td>95-100</td>
</tr>
<tr>
<td>38mm</td>
<td>35-70</td>
</tr>
<tr>
<td>20mm</td>
<td>0-10</td>
</tr>
<tr>
<td>10mm</td>
<td>0-5</td>
</tr>
</tbody>
</table>

The base material shall have a soaked (4 day) CBR value of not less than 90% when compacted to 98% of the MDD.
Screening materials:

Screenings are used to fill the voids in the compacted layer of coarse aggregate. The screenings shall generally consist of smaller size and crusher dust of the same material as the coarse aggregate. The liquid limit and plasticity index shall be 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10%.

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

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>10mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75mm</td>
<td>85-100</td>
</tr>
<tr>
<td>150 micron</td>
<td>10-30</td>
</tr>
</tbody>
</table>

4403 Construction Methods

Preparation of foundation:

The sub grade to receive the Water Bound Macadam course shall be prepared to the grade and camber and cleaned of all dust, dirt and other extraneous matter. Weak places shall be strengthened, corrugation removed, depressions and pot holes made good with suitable materials before spreading the aggregate for WBM.

Aggregate lateral confinement:

Before starting the WBM construction, necessary arrangement shall be made for the lateral confinement of aggregate.

Option 1: Construct side shoulders in advance to a thickness corresponding to the compacted layer of the WBM. After the shoulders are ready, their inside edges shall be trimmed vertical and the included area to be cleaned.

Option 2: Complete the earthwork up to finished level of WBM and a make trench up to sub grade level to the required depth like as a box cutting.

Spreading of Coarse Aggregate:

The broken aggregate shall be spread uniformly upon the prepared sub grade in such quantities that the thickness of compacted layer is 75 mm. Thus the required compacted thickness of WBM base course shall be attained in two or more layers. The loose layer is consolidated to 66-75% thickness. In no cases shall these be dumped in heaps directly on the area where these are to be laid. The surface of the aggregate shall be carefully turned up with templates and level all high or low spots by removing or adding aggregates as may be the case. The irregularities are much easier to correct in loose layer than later. 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.

Dry rolling:

Immediately following the spreading of coarse aggregate, it is first rolled dry with aid of an 8 to 10 tons roller. The rolling shall begin from edges with roller running forward and backward, parallel to the centre line of the road until the layer has been firmly compacted. Rolling shall continue until the aggregates are thoroughly keyed and stone creeping ahead of the roller in no longer visible. Slightly sprinkling of water may be done during rolling, if required. Rolling should not be done if the sub grade is soft or elastic. The rolled surface shall be checked transversely and longitudinally with templates and if the irregularities exceed 12 mm, the surface should be loosened and aggregate added or removed before rolling again. In no case shall the use of screenings be permitted to make up depressions.

Applying of Screening material:

After the 1st layer of coarse aggregate has been rolled, screenings shall gradually be applied to the fill the voids between the coarse aggregate gradually over the surface. The screening materials shall not damp or wet during application. Dry rolling shall be done while screenings are being spread so that vibration of the roller causes the material to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by hand shovels or by mechanical spreader. The screenings shall be applied at a slow and uniform rate in three or more applications so as to ensure filling of all voids. This shall be accomplished by dry rolling and brooming I. In no cases shall the screening be applied so fast and thick so as to form cakes or ridges on the surface. These applications shall continue until no more screenings can be forced into the voids of the coarse aggregate.
**Watering and Wet Rolling:**

After the screenings have been applied, the surface shall be generously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and distribute them evenly. The sprinkling, sweeping, and rolling operations shall be continued, with additional screenings applied if necessary, until the coarse aggregate has been thoroughly keyed, well bonded and firmly set in its full depth and a grout of screening and water is seen squeezes out ahead of the roller.

Care shall be taken to see that the base or sub grade does not get damaged due to the addition of excessive water during construction.

**Second layer of Coarse Aggregate:**

A second layer of aggregate can now be spread and all the stages of dry and wet rolling should be repeated. It is recommended that a smaller size of aggregate can be used for the second layer. It is necessary that the lower layer should be dry before the top one is put. When the top layer is completed, the surface is finally checked to see irregularities and deviations and is corrected to proper camber and longitudinal slopes.

**Curing of WBM:**

After final compaction of WBM, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screening materials as directed by the Engineer, lightly sprinkling of water if necessary and rolled. No traffic shall be allowed on the road until the Macadam has set.

### 4404 Quality Control of Materials and Work

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.

<table>
<thead>
<tr>
<th>Materials</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 per 1.0km (more frequently if material character changes)</td>
</tr>
<tr>
<td></td>
<td>Moisture-Density</td>
<td>-do-</td>
</tr>
</tbody>
</table>

### 4405 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.

Control over quality of the materials incorporated and works performed through quality control tests describing Method Specification for application and compaction of WBM to determine the number of passes required for compaction of WBM course using compact to refusal technique.
An approximate test of compaction is to place a piece of metal or a one inch stone on the WBM surface and run the roller over it. If no imprints are made on the surface or no embedment’s results, the compaction may be considered as adequate.

### 4406 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4400.01 Water Bound Macadam-Basecourse</td>
<td>cubic metre</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. The quantity shall be calculated as the product of the Average depth, the required surface plan width and the required length of Water Bound Macadam 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.
## SERIES 5000: SEALING WORKS

### CONTENTS

<table>
<thead>
<tr>
<th>Series</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5100</td>
<td>BITUMINOUS PRIME COAT AND TACK COAT</td>
</tr>
<tr>
<td>5200</td>
<td>HOT ROLLED ASPHALT</td>
</tr>
<tr>
<td>5300</td>
<td>COLD MIX ASPHALT</td>
</tr>
<tr>
<td>5400</td>
<td>BITUMINOUS SURFACE DRESSING</td>
</tr>
<tr>
<td>5500</td>
<td>BITUMEN SAND SURFACE DRESSING (SAND-SEAL)</td>
</tr>
<tr>
<td>5600</td>
<td>BAMBOO REINFORCED CONCRETE PAVEMENT</td>
</tr>
<tr>
<td>5700</td>
<td>DRESSED STONE PAVEMENT</td>
</tr>
<tr>
<td>5800</td>
<td>BRICK PAVEMENT</td>
</tr>
</tbody>
</table>
SECTION 5100: BITUMINOUS PRIME COAT AND TACK COAT

CONTENTS

5101 SCOPE

5102 MATERIALS

5103 EQUIPMENT

5104 EXECUTION OF THE WORK

5105 MEASUREMENT AND PAYMENT

5101 SCOPE

This work shall consist of supplying and applying bituminous material to a previously prepared surface in preparation for the laying of a bituminous courses. Primer coat shall be used where the surface to be coated is non-bituminous (e.g. aggregate upper base), while Tack coat shall be used on bituminous material surfaces in accordance with these specifications to the areas shown in the drawings and as directed by the Engineer.

5102 MATERIALS

Materials for Prime coat

The primer should be cut-back asphalt of medium - curing type of MC - 30 or MC - 70 grade cut back, conforming to the requirements of AASHTO: M 82, and using kerosene or equivalent cutter approved by the Engineer. This may be prepared by cutting back 80-100 pen. grade bitumen with kerosene in the ratio of 100 parts by volume of bitumen to 50-80 parts by volume of kerosene.

Unless otherwise directed by the Engineer, spraying temperature shall be as follows:

<table>
<thead>
<tr>
<th>Type of Binder</th>
<th>Spraying Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC - 30 grade cut - back</td>
<td>35°C - 55°C</td>
</tr>
<tr>
<td>MC - 70 grade cut - back</td>
<td>60°C - 80°C</td>
</tr>
</tbody>
</table>

Materials for Tack Coat

The tack coat shall be 80-100 pen. grade bitumen, cut-back with between 25 and 50 parts of kerosene per hundred parts of bitumen.

Unless otherwise directed by the Engineer, spraying temperature shall be 100-120°C:

When specifically approved, bitumen without kerosene may be used as directed by the Engineer. Unless otherwise directed by the Engineer, spraying temperature shall be 130-150°C.

Blotting Material

Blotting material shall be clean dry, free-flowing sand not containing any cohesive materials or organic matter. Not more than 10 per cent of the sand shall be finer than 0.075 mm sieve.

5103 EQUIPMENT

The equipment to be provided by the Contractor shall include a self-propelled bitumen distributor having a pressurized spray bar and a capacity of not less than 3,500 litres equipped with heating tubes. Improvised heating of bitumen in its own drum container shall not be permitted. Bitumen boilers of approved types, may be used.

The distributor shall have pneumatic tires of such size and pressure that the load produced on the road surface shall not cause any rutting, and shall be so designed, equipped, maintained and operated that bituminous material at even temperature can be applied uniformly on variable widths of surface upto 5 metres
at readily-determined and controlled rates varying between 0.15 to 2.4 litres per square metre with uniform pressure, and with an allowable variation from any specified rate not exceeding 0.1 litre per square metre. Distributor equipment shall include instruments for measuring the speed of travel accurately at low speeds, the rate of flow of asphaltic material through the nozzles, the temperature of the contents of the tank, and the pressure. These instruments shall be so located that the operator can easily read them whilst operating the distributor.

Distributors shall be equipped with a separate power unit for pump and full circulation spray bars. The spray bar on the distributor shall be controlled by a man riding at the rear of the distributor in such a position that operation of all sprays is in his full view. Supplementary hand spraying equipment shall also be fitted to the bitumen distributor for spraying bitumen over small areas and for patch repairs.

The tanks of distributor shall be fitted with accurately calibrated dipsticks or contents gauges.

All measuring equipment on the distributor shall have been recently calibrated and an accurate and satisfactory record of such calibration shall be supplied to the Engineer. If, after beginning of the work, the distribution of asphaltic material is found to be in error, the distributor shall be withdrawn from the work and calibrated in a manner satisfactory to the Engineer before proceeding with the work.

The Engineer may require such tests as he considers necessary to check the performance of the distributor. At the beginning of the work and at any other time during the progress of the work, when directed by the Engineer, the Contractor shall make the distributor and its instruments available for field testing and shall supply any assistance required for this purpose. Any distributor which does not operate satisfactorily or does not conform to the requirements of the specification in all respects may be rejected by the engineer for further use on the road. Spraying equipment shall be kept clean at all times.

Extreme care shall be used when heating or blending of bitumen's and cut backs.

Heating quantities in excess of the requirements or prolonged heating at high temperatures should be avoided. Any material which in the opinion of the Engineer, has been damaged by overheating shall be rejected and shall be replaced at the Contractor's expense.

**5104 EXECUTION OF THE WORK**

**Weather Limitations**

Prime coat or tack coat work shall not be carried out when the weather conditions are, in the opinion of the Engineer, likely to adversely affect the stability of wet prime or tack coat. Such conditions may include but shall not necessarily be limited to rain, low temperatures or storms and wet base course or bituminous surfaces.

**Cleaning Surfaces**

Prior to the application of the prime or tack coats, loose dirt and other objectionable material shall be removed from the surface by means of a power broom or blower or both. If this does not provide a uniformly clean surface additional sweeping shall be done by hand using stiff brooms.

Sweeping shall extend at least 20 cm beyond each edge of the area to be sprayed.

Adherent patches of objectionable material shall be removed form the surface by steel scraper or other approved method and where the Engineer so directs the scraped area shall be washed done with water and hand brooms.

For prime coat on upper base, the final swept surface finish shall consist of a flat, tight, clean mosaic of coarse and fine aggregate a surface consisting only of fine aggregate shall not be acceptable. When so directed by the Engineer, a light application of water shall be made just before the application of primer.

No application of bituminous material shall be undertaken until the pavement has been prepared to the satisfaction of the Engineer.

**Application of Primer**

Primer shall be applied by the distributor to the prepared upper base at a nominal of 1.0 litre per sq. metre (residual bitumen) but shall be within the range 0.80 - 1.40 litres per sq. metre. The actual rate of application shall be decided by the Engineer based on the results of test areas. Sufficient prime coat shall be applied so that maximum penetration is achieved without excess asphalt remaining on the surface. The Engineer may alter the previous established rate of application where he deems it necessary. Additional primer shall be applied where surface conditions indicate it to be necessary, if the Engineer so directs. No further courses shall be applied until the prime coat has been cured as indicated below.
The surfaces of structures and trees adjacent to the areas being treated shall be protected in such a manner as to prevent their being spattered or marred. No asphaltic material shall be is charged into a borrow pit or gutter.

**Application Tack Coat**

A tack coat shall be applied where directed to bond a new bituminous surface to an older bituminous surface that has lost its ductility. A tack coat shall comprise a light application of bituminous material in a similar manner to the prime coat.

Spray rates (for residual bitumen) shall nominally be 0.20 litres per sq. metre but shall be in the range 0.15 - 0.50 litre per sq. metre as required for the existing surface and ordered by the Engineer.

Following spraying of the tack coat any areas of pooling or excessive binder shall be redistributes across the sprayed surface. A pneumatic tyred roller, hand brooms or squeegees may be used for this purpose.

Where a tack coat is required in the Engineer's opinion only to overcome a delay or damage to a bitumen surface which could have been reasonably prevented by the Contractor, then the take coat shall be applied at the Contractor's expense and shall not be measured for payment.

**Maintenance and Opening to Traffic**

After application of the primer there shall be a curing period of 48 hours or more, when traffic shall not be permitted on the primed surface. The period of curing shall be extended if necessary till the bituminous material has penetrated and dried and, in the opinion of the Engineer, will not be picked up by traffic. At the end of the curing period, minor areas where primer is still not dry shall be treated by sprinkling blotting sand as necessary to avoid picking up of primer before allowing traffic to use the primed areas. For existing roads, the work can be done over half width at a time, the other half being used to carry the traffic.

Tack coat shall be applied only so far in advance of placement of the overlying bituminous course as is necessary to obtain a suitable condition of tackiness. The overlaying bituminous course shall be applied before the tack coat has lost its tackiness through oxidation, wind blown dust or otherwise while the tack coat remains uncovered, the Contractor shall protect it from damage and prevent it from coming in contact with traffic.

### 5105 MEASUREMENT AND PAYMENT

Prime coat or tack coat shall be measured as the number of square metres of material applied to the areas shown on the drawings or ordered by the Engineer, complete in place and accepted.

Blotting material shall not be measured for payment and shall be considered incidental to the rate for prime coat.

**PAYMENT**

This work, measured as provided above, shall be paid for at the contract unit rate per unit of measurement for the item listed below and shown in the Bill of Quantities. The rate and payment shall be full compensation for preparation of the surface and furnishing and placing the materials including all labour, equipment, tools and incidental necessary to complete the work prescribed in this section.

Pay item shall be:

- Supplying and applying bituminous material to a previously prepared surface in preparation for the laying bituminous courses including cleaning of the surface, applying blotting material where called for by the Engineer and for all labour, equipment, tools and incidentals necessary to complete the works as under in conformity with clause of specification:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5100.01</td>
<td>Prime Coat</td>
</tr>
<tr>
<td>5100.02</td>
<td>Tack Coat</td>
</tr>
</tbody>
</table>

The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 5200: HOT ROLLED ASPHALT

CONTENTS

5201 SCOPE
5202 MATERIALS
5203 MIXES
5204 PLANT AND EQUIPMENT
5205 MIXING OF AGGREGATES AND BITUMEN
5206 TRANSPORTING AND LAYING
5207 SAMPLING AND TESTING
5208 MAINTENANCE
5209 MEASUREMENT AND PAYMENT

5201 SCOPE

This section covers the supply and furnishing of materials, methods of construction and requirements for the construction of a bituminous surface treatment using hot rolled asphalt. The contractor may adopt alternative types of construction provided details of construction methods / specifications etc. are first provided to, and approved by, the Engineer.

5202 MATERIALS

Aggregates

The aggregate shall consist of approved crushed stone, free from all clay and organic material, and which complies with the following requirements:

(i) Grading

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Coarse aggregate 19mm</th>
<th>Fine aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>12.7</td>
<td>30 – 100</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>0 – 55</td>
<td>100</td>
</tr>
<tr>
<td>4.75</td>
<td>0 – 10</td>
<td>90 – 100</td>
</tr>
<tr>
<td>2.36</td>
<td>80 – 100</td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td>25 – 100</td>
<td></td>
</tr>
<tr>
<td>0.075</td>
<td>0 – 1</td>
<td>3 – 11</td>
</tr>
</tbody>
</table>

(ii) Shape, strength, abrasion and durability

The following limits are set for coarse aggregates:

Flakiness Index < 45
Crushed gravels shall have at least two fractured faces.

**Bitumen**

The bitumen content shall be 60/70 penetration grade bitumen to BS 3690 unless otherwise approved by the Engineer. A bitumen certificate shall be provided for all material delivered to the site.

### 5203 MIXES

The asphaltic mixture shall be composed basically of aggregate and bituminous material. In some cases the addition of a filler will be necessary to ensure the requirements specified below are met:

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective bitumen content</td>
<td></td>
<td>6.8</td>
</tr>
<tr>
<td>Absorbed bitumen content</td>
<td></td>
<td>1.7</td>
</tr>
<tr>
<td>Total actual bitumen content</td>
<td></td>
<td>7.3</td>
</tr>
<tr>
<td>Air voids content (by volume)</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Marshall Quotient (K/mm)</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Marshall stability (kg)</td>
<td></td>
<td>450</td>
</tr>
<tr>
<td>Retained Marshall stability after soak for 24 hrs @ 60°C</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>

The design fractions of the mix shall generally lie within the limits indicated below, however the use of any filler is to be minimised.

<table>
<thead>
<tr>
<th>Component</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse aggregate</td>
<td>20 – 40</td>
<td>(% by weight of total mix)</td>
</tr>
<tr>
<td>Fine aggregate</td>
<td>26 – 50</td>
<td></td>
</tr>
<tr>
<td>Filler</td>
<td>4.5 – 7.5</td>
<td></td>
</tr>
</tbody>
</table>

Before starting work the Contractor shall submit to the Engineer, for his approval, a mix design for the material that he proposes to use. This will include details of material type and source, nominal particle sizes, combined percentages, total and effective bitumen contents and the temperature at which the material is to be delivered and placed. The contractor shall demonstrate the suitability of all proposed aggregates and proposed mix by making and testing trial mixes in the laboratory and also by field testing using his proposed procedure for production and placement. Permanent paving works shall not commence until a satisfactory trial has been placed and approved by the Engineer.

All material delivered to the site shall conform to the approved mix design within the following tolerances:

<table>
<thead>
<tr>
<th>Component</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate passing</td>
<td>± 7 %</td>
</tr>
<tr>
<td>9.5mm sieve</td>
<td>± 5 %</td>
</tr>
<tr>
<td>2.36mm sieve</td>
<td>± 5 %</td>
</tr>
<tr>
<td>75 micron sieve</td>
<td>± 1.5 %</td>
</tr>
<tr>
<td>Bitumen content</td>
<td>± 0.5 %</td>
</tr>
<tr>
<td>Temperature</td>
<td>± 10°C</td>
</tr>
<tr>
<td>Leaving mixer</td>
<td>± 10°C</td>
</tr>
<tr>
<td>Delivered on road</td>
<td>± 10°C</td>
</tr>
</tbody>
</table>

### 5204 PLANT AND EQUIPMENT

Plant and equipment required for the production, transportation, spreading and compaction of the bituminous material must be in good working order and shall have sufficient capacity to ensure the works are carried out in the required manner.

The batching plant must be capable of producing a mix to the required tolerances and in sufficient capacity to continuously supply the paving operation when spreading. Trucks for hauling the material shall have tight, clean and smooth metal trays that allow the material to be readily discharged – each load must be covered with a canvas to...
protect the material from the weather. Equipment for spreading and finishing shall be a self-propelled paver capable of spreading the material to the correct line and thickness. Compaction shall be undertaken with sufficient rollers of adequate size and weight to achieve the required compaction and surface finish. In trialling the design mix the contractor shall demonstrate the adequacy of his equipment in providing a bituminous layer to the specified requirements.

5205 MIXING OF AGGREGATES AND BITUMEN

The bitumen shall be heated so that it can be distributed uniformly. Care shall be taken not to overheat it. The temperature shall never exceed 180°C for 60/70 pen. bitumen and shall normally be between 130-150°C. Aggregates shall be dried and heated so that they are mixed at a temperature of 130-170°C.

The dried aggregates shall be combined in the mixer in the amount of each fraction required to meet the requirements established and agreed at the laboratory and site trials. Aggregate fractions shall be of uniform quality and of such gradings that when combined in proper proportions, with mineral filler if necessary, the resultant mixture meets the gradation requirements. Bitumen shall be introduced into the mixer in the amount specified. The materials shall then be mixed until a complete and uniform coating of the aggregate is obtained.

The mixing time shall be the shortest required to obtain a uniform mix and thorough coating. The wet mixing time shall be determined by the Contractor and agreed by the Engineer for each type of equipment and for each type of aggregate used. It shall normally not exceed 60 seconds.

5206 TRANSPORTING AND LAYING

The bituminous mix shall be kept free of contamination and segregation during transportation. If required each load shall be covered with canvas or similar covering to protect it from the weather and dust.

Immediately before placing the material the existing surface shall be cleaned of all loose or deleterious material by sweeping with a power broom, supplemented with hand brooming if necessary. After the surface has been prepared and approved a tack coat shall be applied in accordance with section 5100. The bituminous mixture shall then be spread to line and level by the laying equipment without segregation and dragging. The mixture shall be placed in widths of one traffic lane at a time, unless otherwise agreed by the Engineer. On areas where irregularities or unavoidable obstacles make the use of mechanical laying impracticable, the mixture shall be spread, raked and luted by hand. The temperature of the mixture at the time of spreading shall be at least 95°C where 60/70 bitumen is used.

Immediately after the bituminous mixture has been spread, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when rolling does not cause undue displacement or shoving. The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The sequence of rolling operations shall be as agreed with the Engineer.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept lightly moistened with water. Rolling shall begin at the side and proceed longitudinally parallel to the centre-line, each trip overlapping one half of the roller width. On super-elevated curves, rolling shall begin at the low side and progress to the high side. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve the specified compaction.

Any mixture that becomes loose and broken, mixed with dirt or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Spreading the mixture shall be as continuous as possible. Transverse joints shall be formed by cutting neatly in a straight line on the previous run to expose the full depth of the course. The vertical face so formed shall be painted with bitumen just before additional mixture is placed against it. Longitudinal joints shall be rolled directly behind the paving operation. The first lane shall be placed true to line and level and have an approximately vertical face. The mixture placed in the abutting lane shall then be tightly crowded against the face of the previously placed lane. The paver shall be positioned to spread material overlapping the joint face by 20-30 mm. Before rolling, the excess mixture shall be raked or luted and discarded.

When the abutting lane is not placed on the same day or the joint is destroyed by traffic, the edge of the lane shall be trimmed to line and painted with bitumen just before the abutting lane is placed. Any fresh mixture spread accidentally on the existing work at a joint shall be carefully removed by brooming it back on to uncompacted work so as to avoid formation of irregularities at the joint. The finish at joints shall comply with the surface requirements and shall present the same uniformity of finish, texture and density as other sections of the work.

5207 SAMPLING AND TESTING

Samples from Plant

During mixing and laying of bituminous mixtures, control tests on the constituents and on the mixed material shall be undertaken. If the results of any tests show that any of the constituent materials fail to comply with the Specification,
the Contractor shall carry out whatever changes may be necessary to the materials or the source of supply to ensure compliance. Samples of the plant mixture shall be taken and tested as frequently as deemed necessary to determine if grading, asphalt content and all mixing conditions conform to the job-mix formula requirements. The number of samples taken from the plant shall be as directed by the Engineer but there shall be a minimum of one sample for every days run from the mixing plant.

**Samples from Roadway**

The Contractor shall cut suitably sized samples for the determination of the air void and compaction rate (density) of the completed pavement from the finished work at his expense as required by the Engineer. Two samples shall be taken from the roadway for each day's run. Samples shall be taken at equal frequency in the middle of the paving lane and 100 mm from unconfined edges or cut back edges for cold joints.

The samples from the pavement shall be taken by core drilling at a minimum diameter of 100mm. Each sample shall be accompanied by a description giving the following information:

1. Date of placing and date of sampling
2. Chainage and offset of the sample

If instructed by the Engineer, the Contractor shall remove any faulty material laid and replace it by material complying with the Specification, all at his own expense.

**5208 MAINTENANCE**

The Contractor shall maintain the bituminous surface until the work is finally accepted by the Employer. Any damage occurring to the surface or any defects which may develop during the Defects Notice Period, fair wear and tear excepted, shall be corrected by the Contractor at his own expense and to the requirements of the Engineer.

**5209 MEASUREMENT AND PAYMENT**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5200.01 Hot rolled asphalt (depth indicated)</td>
<td>m²</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the square metre of material laid and compacted on the road calculated as the product of the length instructed to be laid and the net width as shown on the Drawings or instructed by the Engineer. No measurement or payment shall be made for alternative mixes proposed and/or adopted by the contractor nor for bituminous mixes laid in excess of the thicknesses or widths shown on the Drawings or instructed by the Engineer.

Payment shall include for the cost of all preparatory works; provision, storage and transportation of all materials; hauling, laying and compacting the bituminous mixture and all other incidentals that are necessary for the proper execution of the works. The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 5300: COLD MIX ASPHALT

CONTENTS

5301 SCOPE
5302 MATERIALS
5303 MIXES
5304 PLANT AND EQUIPMENT
5305 MIXING OF AGGREGATES AND BITUMEN
5306 PLACING AND COMPACTION
5307 MEASUREMENT AND PAYMENT

5301 SCOPE
This section covers the supply and furnishing of materials, methods of construction and requirements for the construction of a bituminous surface treatment using cold mix asphalt. The contractor may adopt alternative types of construction provided details of construction methods / specifications etc. are first provided to, and approved by, the Engineer.

5302 MATERIALS

Aggregates
The aggregate shall consist of approved crushed stone, free from all clay and organic material, and which complies with the following requirements:

(i) Grading

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Coarse aggregate 9mm</th>
<th>Coarse aggregate 19mm</th>
<th>Fine aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>12.7</td>
<td>100</td>
<td>30 – 100</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>85 – 100</td>
<td>0 – 55</td>
<td>100</td>
</tr>
<tr>
<td>4.75</td>
<td>20 – 45</td>
<td>0 – 10</td>
<td>90 – 100</td>
</tr>
<tr>
<td>2.36</td>
<td></td>
<td></td>
<td>80 – 100</td>
</tr>
<tr>
<td>0.6</td>
<td></td>
<td></td>
<td>25 – 100</td>
</tr>
<tr>
<td>0.075</td>
<td>0 - 5</td>
<td>0 - 1</td>
<td>3 – 11</td>
</tr>
</tbody>
</table>

(ii) Shape, strength, abrasion and durability
The following limits are set for coarse aggregates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flakiness Index</td>
<td>&lt; 45</td>
</tr>
<tr>
<td>Aggregate Crushing Value</td>
<td>&lt; 25</td>
</tr>
<tr>
<td>Aggregate Impact Value</td>
<td>&lt; 25</td>
</tr>
<tr>
<td>Los Angeles Abrasion</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>Aggregate Abrasion Value</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>Polished Stone Value</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>
Soundness  <12
Water absorption  <2

Crushed gravels shall have at least two fractured faces.

**Bitumen**

The bitumen content shall be MC 800 cut back bitumen to AASHTO M 82-75 unless otherwise approved by the Engineer. A bitumen certificate shall be provided for all material delivered to the site.

**5303 MIXES**

The asphaltic mixture shall be composed basically of aggregate and bituminous material. Before starting work the Contractor shall submit to the Engineer, for his approval, a mix design for the material that he proposes to use. This will include details of material type and source, nominal particle sizes, combined percentages, total and effective bitumen contents. The contractor shall demonstrate the suitability of all proposed aggregates and proposed mix by making and testing trial mixes in the laboratory and also by field testing using his proposed procedure for production and placement. Permanent paving works shall not commence until a satisfactory trial has been placed and approved by the Engineer.

The following mix composition is provided as a guide to property requirements for cold mix patching materials.

<table>
<thead>
<tr>
<th>MIX CLASS</th>
<th>C/10</th>
<th>C/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal particle size (mm)</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>Nominal minimum layer thickness (mm)</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Percentage by mass passing (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td>100</td>
<td>95 – 100</td>
</tr>
<tr>
<td>9.5</td>
<td>85 – 100</td>
<td>60 – 75</td>
</tr>
<tr>
<td>2.36</td>
<td>15 – 25</td>
<td>15 – 25</td>
</tr>
<tr>
<td>0.075</td>
<td>3 - 5</td>
<td>3 – 5</td>
</tr>
<tr>
<td>Residual bitumen (% by mass of total)</td>
<td>5.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Min(^m) effective bitumen (% by mass)</td>
<td>5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

All material delivered to the site shall conform to the approved mix design within the following tolerances:

- Aggregate passing
  - 9.5mm sieve  ± 7 % (by weight of total mix)
  - 2.36mm sieve  ± 5 %
  - 75 micron sieve  ± 1.5 %
- Bitumen content  ± 0.5 %  ± 0.0 %

**5304 PLANT AND EQUIPMENT**

All plant and equipment shall be in accordance with clause 5204 except where the Engineer determines that works are of a ‘minor’ nature.

In such instances mixing may be carried out using a mechanical concrete mixer of at least 200 litres capacity – alternative methods may be allowed by the Engineer provided the contractor can demonstrate its suitability. The equipment must be capable of producing a homogeneous, fully and uniformly coated material. Spreading and compacting the material using hand methods will require hand tools such as lutes, shovels, tampers (min\(^m\) 4kg) and brooms.

**5305 MIXING OF AGGREGATES AND BITUMEN**

Aggregates shall be as dry as possible and shall have no surface moisture. Aggregates shall be combined in the mixer in the proportion of each fraction required. When batched by hand, proportions shall be measured by weight or volume using correctly calibrated containers. After adding the bitumen mixing shall continue until the aggregate is fully and uniformly coated and a homogeneous material is produced.
5306 PLACING AND COMPACTION

The bituminous mix shall be kept free of contamination and segregation during transportation. If required each load shall be covered with canvas or similar covering to protect it from the weather and dust.

Immediately before placing the material the existing surface shall be cleaned of all loose or deleterious material by sweeping with a power broom, supplemented with hand brooming if necessary. After the surface has been prepared and approved a tack coat shall be applied in accordance with section 5100 to completely and uniformly coat all surfaces against which the cold mix is to be placed. The bituminous mixture shall then be spread to line and level by the laying equipment without segregation and dragging. Immediately after the bituminous mixture has been spread, it shall be thoroughly and uniformly compacted by rolling in accordance with clause 5206.

For minor works hand methods may be adopted. Areas of less than 1m² may be compacted using a hand tamper, larger areas shall be compacted using a mechanical roller or vibrating plate compactor. Cold mix shall be compacted in layers not exceeding twice the nominal thickness. Deeper patches must be filled using multiple layers.

5307 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Cold mix asphalt:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5300.01</td>
<td>In minor works</td>
</tr>
<tr>
<td>5300.02</td>
<td>For resurfacing large areas</td>
</tr>
<tr>
<td>Unit</td>
<td>m³</td>
</tr>
<tr>
<td>Unit</td>
<td>m²</td>
</tr>
</tbody>
</table>

For minor works the unit of measurement shall be the compacted volume of material laid and compacted on the road calculated on the basis of the approved surface area and thickness for each repair.

For resurfacing works the unit of measurement shall be the square metre of material laid and compacted on the road calculated as the product of the length instructed to be laid and the net width as shown on the Drawings or instructed by the Engineer.

No measurement or payment shall be made for alternative mixes proposed and/or adopted by the contractor nor for bituminous mixes laid in excess of the authorised dimensions. Payment shall include for the cost of all preparatory works; provision, storage and transportation of all materials; hauling, laying and compacting the bituminous mixture and all other incidentals that are necessary for the proper execution of the works. The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 5400: BITUMINOUS SURFACE DRESSING

CONTENTS

5401 SCOPE
5402 MATERIALS
5403 EQUIPMENT
5404 EXECUTION OF THE WORK
5405 ROLLING
5406 APPLICATION OF THE SECOND COAT OF SURFACE DRESSING
5407 OPENING TO TRAFFIC
5408 QUALITY CONTROL OF MATERIALS AND WORK
5409 MEASUREMENT AND PAYMENT

5401 SCOPE

This work shall consist of supply and application of one or two courses of bituminous binder material and cover aggregates over the Road Base in accordance with these Specifications and the lines, dimensions and cross-section shown on the Drawings. When one application of bituminous material and aggregate is placed it is termed as Single Bituminous Surface Dressing (SBSD). When two applications of bituminous material and aggregate are placed it is termed as Double Bituminous Surface Dressing (DBSD).

5402 MATERIALS

Bitumen

Bitumen shall be of penetration grade 80/100 conforming to the requirements of ASTM/AASHTO. The Contractor shall provide a supplier's test certificate that the bitumen conforms to Specification. The bitumen shall be stored and handled in such a manner that risks of fire and other hazards, and of pollution, are eliminated. Sufficient storage shall be provided to contain at least 7 days supply of bitumen to meet the programmed rate of production.

Aggregate

Aggregate shall consist of clean, hard, dry, tough, sound, crushed stone or crushed gravel of uniform quality free from dust, clay, dirt and other deleterious matter and from excess of flat or laminated pieces. The aggregate shall have the following characteristics:

| Aggregate Impact value shall not exceed 30 (BS 812) |
| Water absorption shall not exceed 2% |
| Flakiness Index shall not exceed 30 |

When crushed gravel is used, not less than 90% by weight of the particles retained on a 6.3 mm sieve shall have at least one fractured face. The size of stone chippings shall be as follows:

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Nominal Size of stone chippings</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Single bituminous surface dressing or the first coat of double bituminous surface treatment</td>
<td>14 mm</td>
<td>100% Passing through 20mm sieve and retained on 10mm sieve.</td>
</tr>
<tr>
<td>2. Second coat of double bituminous surface dressing</td>
<td>10 mm</td>
<td>100% Passing through 12.5mm sieve and retained on 6.3mm sieve.</td>
</tr>
</tbody>
</table>

The two sizes of aggregate shall be stockpiled separately.
Quantities of Materials

The quantities of materials used per square metre of this work shall be as follows:

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Stone Chippings</th>
<th>Bitumen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal Size</td>
<td>Quantity</td>
</tr>
<tr>
<td>1. Single bituminous</td>
<td>14 mm</td>
<td>0.015 m³</td>
</tr>
<tr>
<td>or the first coat of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>double bituminous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>surface dressing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Second coat of</td>
<td>10 mm</td>
<td>0.008 m³</td>
</tr>
<tr>
<td>double bituminous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>surface dressing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5403 EQUIPMENT

All plant and equipment required to undertake the works shall be in good working order, hand methods may be used. Equipment required shall Trailer type bitumen sprayer with nozzle and miscellaneous hand tools – the bitumen sprayer in particular will need to conform with the following:

**Bitumen Sprayer**

The bitumen distributor shall be so designed, equipped, maintained and operated that bituminous material, at even heat, may be applied uniformly over variable widths of surface, at a controlled rate.

The sprayer shall be pneumatic tire towed type of minimum 1000 litres capacity with spraying capacity of 30 ltr/min by gear rotary pump, gasoline engine or diesel with 5 hp/rated output, atomizing type diesel oil burner, 19 mm dia x 5 m long asphalt hose pipe with hand spray lance. The equipment must be double circulating system, the asphalt pump and piping system shall be such a way that heating chamber lines should be evenly heated.

A suitable dial type thermometer shall be installed in the heated drum to check that spraying temperatures are correct.

A spray test shall be carried out on the site in the presence of the Engineer before the spraying is permitted on the Works. The Contractor shall provide all necessary equipment for the test, the cost of which shall be deemed to be included in the contract rates.

5404 EXECUTION OF THE WORK

**Weather Limitations**

The surface treatment work shall be carried out only when the atmospheric temperature in the shade is above 16°C. No bituminous material shall normally be applied when the surface to be covered is damp and when the weather is foggy or rainy, or during dust storms.

**Preparation of Base**

The base on which the surface treatment is to be laid shall be thoroughly swept and clean of dust, loose dirt and any other objectionable material before the spraying of the binder.

**Application of Bituminous Material**

Bitumen shall be heated to between 135°C and 155°C and the specified quantity shall be sprayed on to the dry surface in a uniform manner using a mechanical sprayer. Bitumen that has been overheated by more than 10°C at any time shall be rejected. Excessive deposits of binder caused by stopping or starting spraying operations or through leakage or for any other reason shall be rectified before the stone chippings are spread.

**Application of Stone Chippings**

Immediately after the application of binder, stone chippings in a dry and clean state, shall be spread uniformly on the surface, by means of an approved aggregate spreader or manually, so as to cover the surface completely. If necessary, the surface shall be broomed to ensure the uniform spread of chippings. The stone chippings shall be spread not later than 3 minutes after application of the binder course.
5405 ROLLING

Immediately after the application of the stone chippings, the entire surface shall be rolled with an approved smooth wheeled steel roller having sufficient weight to embed the stone chippings into the binder without crushing them, or with a pneumatic tired roller. While rolling is in progress additional chippings shall be spread by hand in whatever quantities are required to make up irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present a uniform closed surface. The compacted surface shall be well closed with the stone chippings firmly embedded in the bitumen and not easily removed by hand. Based on trials, the Engineer shall fix the minimum number of roller passes for each coat, which shall not be less than four.

5406 APPLICATION OF THE SECOND COAT OF SURFACE DRESSING

In case of DBSD the second coat shall be applied immediately after laying the first coat or within 15 days. The construction operations for the second coat shall be the same as for the first coat.

5407 OPENING TO TRAFFIC

Traffic shall not be permitted to run on any newly laid area until the following day. In special circumstances, however, the Engineer may open the road to traffic immediately after rolling, but in such cases speed shall be limited to 16 km per hour until the following day.

5408 QUALITY CONTROL OF MATERIALS AND WORK

The Engineer shall exercise control over quality of the materials incorporated and works performed through quality control tests carried out to 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.

<table>
<thead>
<tr>
<th>Material</th>
<th>Type of Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen</td>
<td>Conform to Specification</td>
<td>As deemed necessary</td>
</tr>
<tr>
<td></td>
<td>Temperature of boiling</td>
<td>During boiling</td>
</tr>
<tr>
<td></td>
<td>Temperature of spraying</td>
<td>During spraying</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Gradation</td>
<td>One test per 500m (more frequently than one if material character changes)</td>
</tr>
<tr>
<td></td>
<td>Aggregate Impact Value</td>
<td>-do-</td>
</tr>
<tr>
<td></td>
<td>Flakiness Index</td>
<td>-do-</td>
</tr>
<tr>
<td></td>
<td>Water Absorption</td>
<td>-do-</td>
</tr>
</tbody>
</table>

5409 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5400.01 First layer bituminous surface dressing</td>
<td>Sqm.</td>
</tr>
<tr>
<td>5400.02 Second layer bituminous surface dressing</td>
<td>Sqm.</td>
</tr>
</tbody>
</table>

This work shall be measured as the area in square metres of surface treatment completed and accepted.

The work measured shall be paid for at the Contract unit prices and as shown in the Bill of Quantities. The payment shall (the unit price schedule and as given in the billed items) be full compensation for supply and placing all materials, including all labour, equipment, tools and incidentals necessary to complete the works.
SECTION 5500: BITUMEN SAND SURFACE DRESSING (SAND-SEAL)

CONTENTS

5501 SCOPE

This work shall consist of supply and application of one or two courses of bituminous binder material and cover river sand or crusher dust over the bituminous surface treatment in accordance with these Specifications and the lines, dimensions and cross-section shown on the Drawings. When one application of bituminous material and aggregate is placed it is termed as Single Bitumen-Sand Surface Dressing (SBSSD).

5502 MATERIALS

Bitumen

The binder for the Sand Seals should be cutback bitumen of type MC3000. The Contractor shall provide a supplier's test certificate that the bitumen conforms to Specification. The bitumen shall be stored and handled in such a manner that risks of fire and other hazards, and of pollution, are eliminated. Sufficient storage shall be provided to contain at least 7 days supply of bitumen to meet the programmed rate of production.

Aggregate

The aggregate for Sand Seal should be clean, non-plastic river sand or crusher dust made from crushed rock or boulders and free from organic matters or lumps of clay.

The grading requirements for Sand Seals are as follows:

<table>
<thead>
<tr>
<th>Sieve size (mm)</th>
<th>Natural river sand</th>
<th>Crusher dust</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Passing the sieve (%) by mass</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>85-100</td>
<td>85-100</td>
</tr>
<tr>
<td>1.18</td>
<td>20-60</td>
<td>20-80</td>
</tr>
<tr>
<td>0.425</td>
<td>0-30</td>
<td>-</td>
</tr>
<tr>
<td>0.300</td>
<td>0-15</td>
<td>-</td>
</tr>
<tr>
<td>0.150</td>
<td>0-5</td>
<td>0-30</td>
</tr>
</tbody>
</table>

Quantities of Materials

Bitumen and aggregate application rates for the Sand Seal are as follows:
### Application

<table>
<thead>
<tr>
<th>Application</th>
<th>Hot spray rates of MC3000 cutback bitumen (m³/m²)</th>
<th>Aggregate application rate (m³/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Sand Seal as a permanent seal (per layer)</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Single Sand Seal as a cover seal for Otta Seal or Surface Dressing</td>
<td>0.8-1.0</td>
<td>0.010-0.012</td>
</tr>
<tr>
<td>Single Sand Seal for very low trafficked roads or as maintenance treatment</td>
<td>0.6-1.0</td>
<td></td>
</tr>
</tbody>
</table>

### 5503 EQUIPMENT

See clause no 5403

### 5504 EXECUTION OF THE WORK

#### Weather Limitations

The surface treatment work shall be carried out only when the atmospheric temperature in the shade is above 16°C. No bituminous material shall normally be applied when the surface to be covered is damp and when the weather is foggy or rainy, or during dust storms.

#### Preparation of Base

The base on which the surface treatment is to be laid shall be thoroughly swept and clean of dust, loose dirt and any other objectionable material before the spraying of the binder.

#### Mixing of Bituminous Material

A cutter shall be mixed with the bitumen to produce a medium curing cutback bitumen. Kerosene shall be used as cutter. Power paraffin, Illuminating paraffin or Jet A1 may be used depending on the prevailing price. Power paraffin is normally preferred among the cutting oils producing a MC cutback bitumen. The following cutter proportions are indicative for blending the penetration grades 80/100 or 150/200 respectively.

<table>
<thead>
<tr>
<th>Required Product</th>
<th>Cutter (power paraffin) in per cent of total mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80/100 base bitumen</td>
</tr>
<tr>
<td>150/200</td>
<td>3-5% (flux oil is used instead of cutter)</td>
</tr>
<tr>
<td>MC 3000</td>
<td>8 – 10 % *</td>
</tr>
<tr>
<td>MC 800</td>
<td>18 – 20 % *</td>
</tr>
</tbody>
</table>

* The durability of the binder can be improved by replacing 3 % - points of the cutter with flux oil where the 80/100 penetration grade is used as base bitumen.

Cutter or flux oil should not be mixed with bitumen having a higher temperature than 140°C due to the hazards of flammable gas emissions from the tank. The correct procedure is to pre-heat the bitumen to 140°C and either pump the cold cutter or flux oil into the bottom of the tank through the designed hose and valve, or to pump the hot bitumen over in a new, cold tank already containing the cutter or flux. The following precautions should be strictly adhered to as the blending operation is a hazardous one and causes considerable risk of explosion and fire.

The manhole should NEVER be used for adding cutter or flux oil to hot bitumen

Cutter or flux oil should NEVER be pumped into a tank that is still hot after having contained bitumen

The bitumen level in the tank should NEVER be allowed to fall below that specified by the manufacturer while the heaters are in operation. This is normally a minimum of 150mm above the highest point of the heater pipes.

After combining bitumen with cutter or flux oil the mixture shall immediately be circulated for 1 hour in order to ensure a homogenous product.
Application of Bituminous Material

Bitumen shall be heated to between 135°C and 155°C and the specified quantity shall be sprayed on to the dry surface in a uniform manner using a mechanical sprayer. Bitumen that has been overheated by more than 10°C at any time shall be rejected. Excessive deposits of binder caused by stopping or starting spraying operations or through leakage or for any other reason shall be rectified before the sand aggregate is spread.

Application of Sand

Immediately after the application of binder, sand in a dry and clean state, shall be spread uniformly on the surface, by means of an approved aggregate spreader or manually, so as to cover the surface completely. If necessary, the surface shall be broomed to ensure the uniform spread of sand. The sand shall be spread not later than 3 minutes after application of the binder course.

5505 ROLLING

Immediately after the application of the sand, the entire surface shall be rolled with an approved smooth wheeled steel roller having sufficient weight to embed the sand into the binder, or with a pneumatic tired roller. While rolling is in progress additional sand shall be spread by hand in whatever quantities are required to make up irregularities. Rolling shall continue until all sand particles are firmly bedded in the binder and present a uniform closed surface. The compacted surface shall be well closed with the sand firmly embedded in the bitumen and not easily removed by hand. The sand seal should be compacted for not less than two days.

5506 APPLICATION OF THE SECOND COAT OF SURFACE TREATMENT

In case of DBSS the second coat shall be applied two months is required, in case of double Sand Seal, and the road should be open to traffic during this period. The construction operations for the second coat shall be the same as for the first coat.

5507 OPENING TO TRAFFIC

Traffic shall not be permitted to run on any newly laid area until the following day. In special circumstances, however, the Engineer may open the road to traffic immediately after rolling, but in such cases speed shall be limited to 16 km per hour until the following day.

5508 QUALITY CONTROL OF MATERIALS AND WORK

The Engineer shall exercise control over quality of the materials incorporated and works performed through quality control tests carried out to 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.

<table>
<thead>
<tr>
<th>Material</th>
<th>Type of Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen</td>
<td>Conform to Specification</td>
<td>As deemed necessary</td>
</tr>
<tr>
<td></td>
<td>Temperature of boiling</td>
<td>During boiling</td>
</tr>
<tr>
<td></td>
<td>Temperature of spraying</td>
<td>During spraying</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Gradation</td>
<td>One test per 500m (more frequently than one if material character changes)</td>
</tr>
<tr>
<td></td>
<td>Aggregate Impact Value</td>
<td>-do-</td>
</tr>
<tr>
<td></td>
<td>Flakiness Index</td>
<td>-do-</td>
</tr>
<tr>
<td></td>
<td>Water Absorption</td>
<td>-do-</td>
</tr>
<tr>
<td></td>
<td>Marshall stability at 600°C</td>
<td>-do-</td>
</tr>
</tbody>
</table>

5509 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5500.01 Single Sand-Bitumen Surface Dressing (Sand-Seal)</td>
<td>Sq.m.</td>
</tr>
</tbody>
</table>

This work shall be measured as the area in square metres of surface treatment completed and accepted.

The work measured shall be paid for at the Contract unit prices and as shown in the Bill of Quantities. The payment shall be full compensation for supply and placing all materials, including all labour, equipment, tools and incidentals necessary to complete the works. The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 5600: BAMBOO REINFORCED CONCRETE PAVEMENT

CONTENTS

5601  SCOPE
5602  MATERIALS
5603  SPLICING AND TYING
5604  PLACING, FIXING AND COVER
5605  QUALITY CONTROL
5606  FINISHING OF CONCRETE SURFACES
5607  CONTRACTION AND EXPANSION JOINTS
5608  CURING OF CONCRETE
5609  MEASUREMENT AND PAYMENT

5601  SCOPE

This section covers the furnishing and placing of bamboo reinforcement in concrete pavement slabs on grade.

5602  MATERIALS

Bamboo: is to be provided to site in mature poles. The bamboo should not be less than three years old, have a brown colour and a straight profile. All green bamboo poles is to be rejected. All bamboo is to be inspected for approval by the Engineer prior to delivery to site. All bamboo is to be stored by standing against a wall in a vertical position. Bamboo that has been stored on its side on uncovered ground will be rejected by the Engineer. The bamboo should be matured for a minimum of 3 years, free from rot or infestation, solid and straight in shape. In any case green bamboo shall not be accepted.

Cover and spacer blocks required to support the reinforcement shall be as small as possible consistent with their use and be of approved design and material. Cover blocks or spacers required for ensuring that the specified cover is obtained shall be of a material, shape and design acceptable to the Engineer.

Concrete: See clause no 8302

Binding Wire:

Bamboo reinforcement binding wire shall be best black annealed mild steel wire, approximately 1.6 mm in diameter.

5603  SPLICING AND TYING

Each bamboo pole is to be spliced to form uniform 15mm width x 10 mm thickness bamboo splints. Splints are to be made by splitting the bamboo pole with a blunt edge, NOY by cutting the poles with a saw or sharp edged blade. All notches are NOT to be removed from the splints. The splits shall be tied together using steel wire to form a mesh of 200mm x 200mm. Where possible the concave side of the bamboo splint shall be faced upwards to avoid air voids forming upon compaction.

Immediately before the concrete is placed around the reinforcement, the reinforcement shall be clean, free from mud, oil, grease, paint, loose rust, loose mill scale or any other substance that can have an adverse chemical effect on the steel or concrete, or reduce the bond.

5604  PLACING, FIXING AND COVER

Immediately before the concrete is placed around the reinforcement, the reinforcement shall be clean, free from mud, oil, grease, paint, loose rust, loose mill scale or any other substance that can have an adverse chemical effect on the steel or concrete, or reduce the bond. Reinforcement shall be positioned as shown on the Drawings and accurately
secured in these positions by tying with annealed wire or by the use of suitable clips or, where permitted by the Engineer, by tack welding. Projecting ends of ties or clips shall not encroach into the concrete cover.

Where protruding bars/splints are exposed to the elements for an indefinite period the bars/splints shall be adequately protected against corrosion and damage and shall be properly cleaned before being permanently encased in concrete.

The term “cover” in this context shall mean the minimum clear thickness of concrete between the surface of the reinforcement and face of the concrete. The minimum cover shall be as shown on the Drawings.

5605 QUALITY CONTROL

Strength of concrete: The strength of the concrete shall be 25 Mpa cylinder strength at 28 days and shall be tested in the laboratory. If average strength of the concrete does not comply with specifications, contractors shall re-concreting on his own expenses.

Water/Cement Ratio: The ratio of free water to cement when using saturated surface dry aggregate shall be as low as possible and may vary between 0.45 to 0.50 by weight for all concrete unless otherwise stated.

Workability: The concrete shall be of suitable workability to obtain full compaction. Slumps measured shall not exceed 75mm +/- 25mm unless otherwise directed or approved by the Engineer. Slump tests shall be carried out regularly during any concreting operations. The minimum frequency should be one slump test at the beginning of each casting and one each time test specimens are taken.

Sampling and Testing of Concrete: The Contractor shall take samples of the concrete for testing. The number, frequency and location shall be decided by the Engineer. A minimum of 3 concrete cubes/cylinders should be taken for each days of casting, or every 15 m3 of concrete cast in larger pours, and tested at 28 days.

Formwork: Formwork shall include all temporary or permanent moulds for forming the concrete. All formwork shall be of wood or metal and shall be built mortar tight and rigid enough to maintain the concrete in position during placing, compacting, setting and hardening. All forms shall be set and maintained true to the line designed until the concrete is sufficiently hardened and shall remain in place as required by Engineer. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Engineer may order the work stopped until the defects are corrected. If requested, the Contractor shall submit to the Engineer working drawings of the forms. The shape, strength, rigidity, water tightness and surface smoothness of reused formwork shall be maintained at all times. Any warped or bulged timber must be resized before being reused. Formwork that is unsatisfactory in any respect shall not be reused.

Mixing, Handling and Placing Concrete: Mixers at local site shall be approved drum-type capable of combining the aggregate, cement and water into a thoroughly mixed and uniform mass within the specified mixing period and of discharging the mixture without segregation. Suitable equipment for discharging the concrete shall be provided. The volume of concrete mixed per batch shall not exceed the mixer’s nominal capacity. Retempering concrete by adding water or by other means shall not be permitted. Concrete which is not of the required consistency at the time of placement shall not be used.

Concrete which does not reach its final position in the forms within 10 minutes of completion of mixing shall not be used. When placing operations would involve dropping the concrete more than 1.5m, it shall be deposited through sheet metal or other approved pipes.

Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject. Each layer shall be compacted so as to avoid the formation of a construction joint with a preceding layer which has not taken initial set.

5606 FINISHING OF CONCRETE SURFACES:

Immediately after placing concrete, concrete slabs shall be struck off using templates to provide proper crowns and shall be finished to the correct levels. Finish shall be slightly rough but uniformly roughened by brooming or steel racket. The finished surface shall not vary by more than 10 mm from a 3 metre straight edge placed in any direction on the roadway. Deviation from the gradeline shall not be more than +/- 30 mm in any 20 m length.

5607 CONTRACTION AND EXPANSION JOINTS

All contraction and expansion joints shall be made only where shown on the drawings or in the casting schedule by using removable cock sheets or any other materials unless otherwise approved by the Engineer. All joints shall be sealed by bitumen/sand mix neatly and scrap the excess materials from the top of the pavement surface.

5608 CURING OF CONCRETE
All concrete surfaces shall be kept thoroughly wet by moisten the surface covering by sand appropriate clay/lean mortared bund for at least 7 days after placing. After a period of 7 days, the concrete shall be watered daily at certain intervals approved by the Engineer to avoid drying out of the surface. This shall take place during the following 2 weeks.

Removal of Formwork:

Forms shall not be removed without the approval of the Engineer. Forms used on exposed vertical faces shall remain in place for periods which shall be determined by the Engineer and normally not less than 3 days.

Cleaning Up:

Upon completion of roadwork and before final acceptance, the Contractor shall remove all forms. Excavated or useless materials, rubbish etc, shall be removed from the site and the site shall be left in a neat and tidy condition, satisfactory to the Engineer.

### 5609 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5600.01 Bamboo Reinforcement Concrete Pavement</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 bamboo reinforcement concrete pavement, 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 pavement. The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 5700: DRESSED STONE PAVEMENT

CONTENTS

5701 SCOPE
5702 MATERIALS
5703 CONSTRUCTION METHODS
5704 PLACING AND PACKING STONES
5705 JOINT FILLING
5706 MEASUREMENT AND PAYMENT

5701 SCOPE

This work shall consist of the supply, shaping, packing and compaction of a pavement course composed of dressed stone blocks packed on a prepared sub-grade and within prepared and compacted shoulders with the Specifications and to the lines, levels, dimensions and cross-falls shown on the Drawings or as directed by the Engineer.

5702 MATERIALS

Dressed Stone Blocks: The stone blocks shall be hand broken blocks. The blocks shall be cubical in shape and shall be hard and durable to serve as ideal material for dressed stone pavement. The faces of the blocks shall form 900 angles with one face being relatively level to provide a good riding surface. The blocks shall be free from vegetation, soft particles and excess clay or any other substance, which is considered deleterious. The size of the block shall be according to the drawings with the tolerances of ± 25 mm

The stone blocks shall comply with the following requirements:

Water absorption shall not exceed 2%.

Los Angeles Abrasion value shall be not more than 30 (BS 812) or as directed by the Engineer.

Specific Gravity not less than 2.0

Plasticity Index of binding materials shall not more than 6.

F.M. of sand shall not be less than 2.0 and shall be free from deleterious materials.

Crushed stones: Coarse aggregate to pack the blocks shall be of the same material as stone blocks.

Screening materials: Screenings to fill voids shall be consists of coarse sand. The liquid limit and plasticity index shall be 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 5%.

Shoulders material:

The shoulders shall be constructed from naturally occurring gravels, crushed rock or stabilised gravel from sources approved by the Engineer. The material shall consist of stone and finer particles and the Engineer may require samples to be tasted at the Ministry of Public Works and Transport Laboratory before the material is used in the works.

Naturally occurring gravels shall comply with the following:
### road Rehabilitation Project Technical Specifications - Road Works

#### Sieve Size (mm) vs. Percentage Passing by (Mass)

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>37.5mm</th>
<th>20mm</th>
<th>10mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>37.5</td>
<td>80-100</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>60-80</td>
<td>80-100</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>45-65</td>
<td>55-80</td>
<td>80-100</td>
</tr>
<tr>
<td>5</td>
<td>30-50</td>
<td>40-60</td>
<td>50-70</td>
</tr>
<tr>
<td>2.36</td>
<td>20-40</td>
<td>30-50</td>
<td>35-50</td>
</tr>
<tr>
<td>0.425</td>
<td>10-25</td>
<td>12-27</td>
<td>12-30</td>
</tr>
<tr>
<td>0.075</td>
<td>5-15</td>
<td>5-15</td>
<td>5-15</td>
</tr>
</tbody>
</table>

For the material passing the 0.425 mm sieve, Liquid Limit shall not exceed 35%, Plasticity Index in the range 8-20%, Soaked CBR of not less than 35%

Where testing facilities are not conveniently available the Contractor shall submit samples to the Engineer for approval.

**Cushion material:** Materials for the sand cushion shall consist if coarse sand of FM (Fines Modulus) not less than 2.0. The liquid limit and plasticity index shall be 20 and 6 respectively and fraction passing 75-micron sieve does not exceed 5%.

### 5703 CONSTRUCTION METHODS

#### Preparation of foundation:

The sub base to receive the sand cushion shall be prepared to the grade and camber and cleaned of all dust, dirt and other extraneous matter. Weak places shall be strengthened, corrugation removed, depressions and pot holes made good with suitable materials before spreading the sand.

#### Shoulders construction:

Side shoulders shall be constructed in advance to a thickness corresponding to the compacted layer of the dressed stone pavement and according to the drawings. The shoulders material shall be spread with a thickness not exceeding 150mm. In case of using heavier compaction methods, thicker layers can be specified by the engineer. The shoulder shall then be water to the Optimum Moisture Content and compacted with proper compaction equipment. The shoulders shall be compacted to a dry density of at least 95% MDD (AASHTO, Modified Proctor). The second layer of the material shall be spread and compacted in a similar manner. After the shoulders are ready, their inside edges shall be trimmed vertical and the included area to be cleaned.

#### Spreading of sand cushion:

The coarse sand shall be spread uniformly upon the prepared sub grade in such quantities that the thickness of compacted layer is 50 mm. The loose layer is consolidated to 85% thickness. In no cases shall these be dumped in heaps directly on the area where these are to be laid. 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 materials.

#### Compaction:

Immediately following the spreading of coarse sand, it is first rolled dry with aid of vibrating roller. The rolling shall begin from edges with roller running forward and backward, parallel to the centre line of the road until the layer has been firmly compacted. Slightly sprinkling of water may be done during rolling, if required. Rolling should not be done if the sub base is soft or yielding. The rolled surface shall be checked transversely and longitudinally with templates and if the irregularities exceed 12 mm, the surface should be loosened and aggregate added or removed before rolling again. In no case shall the use of screenings be permitted to make up depressions.

#### Filter Drains:

The drains shall be continuous, rectangular and 200mm deep on both sides of the road's cross section under the side edges of the subgrade and the road shoulders. The drain shall be between 1 and 1.5m long depending on the width of the shoulders and the drain’s longitudinal slope, which shall vary between 2-5%.
The drain shall be excavated to a suitable depth (200-300mm) under the subgrade, with the filter shoulders reaching the side of the embankment. Dry compaction by hand rammer shall be carried out. The drain shall be watered and compacted again.

The box shall then be filled with a 100mm layer of broken stone and sand (1:1) to reach the level of the subgrade according to drawings. Watering and hand compaction shall be carried out to assure a dense mixture of stones and sand.

Cross Drains:

See Filter Drain above

5704  PLACING AND PACKING STONES

Before placing the stones, string lines shall be placed using metal pegs made of reinforced steel. The peg interval shall be 5 metres. Lines shall be placed longitudinally and along the cross section of the road to indicate the desired camber.

The kerbstones shall be laid first, followed by the rest of the. Stones shall be placed from the edges of the road to the centreline. Stones should be laid so that each block settled on the sand cushion without any support from the blocks nearby and with an average space of 5-15mm between blocks. The voids between the stones shall then be filled with broken stones packed in with proper tools. A regular top surface should be achieved during the laying operation. A camber board shall be used longitudinally and across the section to assure an even surface.

Compaction:

A vibrating roller or a plate compactor shall be used, static weight compactors are not recommended for this operation. Compaction should be carried out to level the height of the stone blocks, providing a smoother running surface on the carriageway. Compacting shall be carried out from the edge to the centreline of the road to avoid extra stress on the shoulders.

Quality Control of Materials and Work:

The Engineer shall exercise control over quality of the materials incorporated and works performed through quality control tests carried out to the frequencies indicated hereunder. 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.

<table>
<thead>
<tr>
<th>Material</th>
<th>Type of Test</th>
<th>Frequency of Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>Los Angeles Abrasion 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 per 1.0km (more frequently if material character changes)</td>
</tr>
<tr>
<td></td>
<td>Moisture-Density</td>
<td>-do-</td>
</tr>
</tbody>
</table>

5705  JOINT FILLING

The joint filling materials shall be confirmed according to the drawings.

Granular joint filling: The granular materials shall fill the interstices between the blocks.

Bitumen-Sand Sealing of Joints: Sealing of joints in Dressed Stone Surfacing with 100/80 grade bitumen and blinding with coarse sand. The hot bitumen shall be spread evenly into all joints, ensuring an adequate amount of bitumen is placed in each joint, using a watering can or funnel device. Immediately after placement of the bitumen the joints shall be covered with a layer of coarse sand such that the joints are filled to the road surface level.

5706  MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5700.01</td>
<td>Dressed Stone Road Pavement</td>
</tr>
<tr>
<td>5700.02</td>
<td>Sand Cushion</td>
</tr>
<tr>
<td>5700.03</td>
<td>Filter drain</td>
</tr>
<tr>
<td>5700.04</td>
<td>Stone block edging both sides (150x200x300 mm)</td>
</tr>
</tbody>
</table>
This work shall be measured as the area in Square metres of Dressed Stone road pavement compacted and accepted. Area shall be computed from field measurement of the width of the base course at its top surface and the nominal depth as shown in the Drawing or as ordered by the Engineer. The payment shall be made according to the unit price schedule and as given in the billed items.

The work as measured shall be paid for at the Contract unit price shown in the Bill of Quantities. Payment shall be full compensation for performing the work including supplying the all materials, and providing all labour, tools, equipment, joint filling and incidentals necessary.
SECTION 5800: BRICK PAVEMENT

CONTENTS

58.01 SCOPE
58.02 BRICK ON END EDGING
58.03 SINGLE LAYER BRICK FLAT SOLING
58.04 DOUBLE LAYER BRICK FLAT SOLING
58.05 HERRINGBONE BOND BRICK PAVEMENT
58.06 GROUTED HERRINGBONE BOND BRICK PAVEMENT

58.01 SCOPE

This section covers the furnishing of materials and construction of a brick paved road by 1st class bricks for open drain slopes, covered drains and HBB road, brick masonry retaining walls all as shown on the Drawings or ordered by the Engineer.

58.02 BRICK ON END EDGING

Description

This work consists of provided and placing brick on ending along the road adjacent to the side the pavement of single layer brick flat soling and herringbone bond brick or of water bound macadam and bitumen carpet.

Materials

The materials shall consist of First Class or Picked Jhama Bricks, Sand and Mortar all of which should meet the requirements of Section 9200: Brick Work of these Specifications and as given below.

Bricks

First Class Bricks shall be made from good brick earth free from saline deposits, and shall be sand molded. They shall be thoroughly burnt by coal without being vitrified, of uniform and good colour, shall be regular and uniform in size, shape and texture with sharp square edges and parallel faces. They must be homogeneous in texture and emit a clear metallic ringing sound when struck one against the other. They shall be free from flaws, cracks, chips, stone, modules of lime or canker and other blemishes. A first Class Brick shall not absorb more than 16% of its weight of water after being soaked for one hour, and shall show no sign of efflorescence on drying.

Picked Jhama bricks are those which are so to become vitrified. Those bricks may be broken and used for aggregate in road works provided the vitrified mass has not become porous or spongy as a result of over burning and aggregate satisfies the requirements of those Specifications.

First Class Bricks should have the following dimensions after burring: 250mm x 120mm x 70mm. Picked Jhama Bricks may have dimensions slightly below those for other brick but not less than 235mm x 110mm x 70mm. The unit weight of First Class Bricks shall not be less than 1100 kg per m³ and the unit weight of picked Jhama Bricks shall not be less than 1200kg per m³. The crushing strength of bricks shall be tested in accordance with ST 7.9. The average crushing strength of Bricks shall not be less than 17 N/mm².

Construction Methods

Bricks shall be laid on end edging with their longest side (250mm) vertical and the shortest side (70mm) perpendicular to the road centre line all including necessary excavation filling and ramming to the satisfaction of the Engineer. The completed work shall be true to line and level and grade as indicated on the Drawings. Interstices between brick edging and adjacent paving or soling shall be filled by brushing in sand until voids are filled; the edging shall be sprinkled then with water.
Measurement and Payment

This item shall be measured in linear metres of completed brick on end edging.

This work shall be measured as provided above and shall be paid for at the Contract unit price per unit measurement. The prices and payment shall be full compensation for the edging including excavation, furnishing and placing of materials, backfilling, ranging including provision of labour, equipment, tools and incidentals necessary to complete the works as specified in this Section. The payment shall be made according to the unit price schedule and as given in the billed items.

Pay item shall be:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5800.02</td>
<td>Brick on end edging Linear Metre</td>
</tr>
</tbody>
</table>

58.03 SINGLE LAYER BRICK FLAT SOLING

Description

This item consists of providing single layer brick flat soling on a 20mm sand cushion layer over the subgrade or improved subgrade as directed by Engineer.

Materials

The materials shall consist of First Class or Picked Jhama Bricks, Sand and Mortar all of which should meet the requirements of Section 9200: Brick Work of these Specifications and as given under Article B of Specifications.

Construction Methods

The bricks shall be laid flat in one layer or as specified on the consolidated and prepared sand cushion surface. Bricks shall be laid in a regular and uniform manner. Interstices of bricks shall be filled with sand of FM 0.8 and water shall be applied by sprinkling. No bricks shall be laid on a foundation or any surface until the same has been inspected and approved by the Engineer. The gaps between two adjacent bricks should not exceed 10mm. The pattern and placing of the bricks shall be as indicated in the drawings.

Measurement and Payment

Brick flat soling shall be measured in square metres for areas covered by the same.

This item of work shall be measured as provided above and shall be paid at the contract unit price. The price and payment shall include all costs for completion of the work and supply of all required materials, including cost of all labour, equipment, tools and incidentals necessary to complete the works as specified in this Section. The payment shall be made according to the unit price schedule and as given in the billed items.

Pay item shall be:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5800.03</td>
<td>Single layer brick flat soling Square Metre</td>
</tr>
</tbody>
</table>

58.04 DOUBLE LAYER BRICK FLAT SOLING

Description

This item consists of providing double layer brick flat soling on the sub-grade or improved sub-grade as directed by the Engineer.

Materials

The materials shall consist of First Class or Picked Jhama Bricks, Sand and Mortar all of which should meet the requirements of Section 9200: Brick Work of these Specifications and as given under Article B of Specifications.

Construction Methods
First layer of the brick shall be laid flat on the consolidated and surface in a regular and uniform manner. Intertices of bricks shall be filled with sand of FM 0.8 and water shall be applied by sprinkling as described under Article C. Then sand cushion of 20mm thickness (minimum) with sand of FM not less than 0.8 should be placed over the first layer. Second layer of the brick shall be laid flat on the sand cushion in a regular and uniform manner. Intertices of bricks shall be filled with sand of FM 0.8 and sprinkling water as did in case of first layer described under Article C. No bricks shall be laid on a foundation or any surface until the same has been inspected and approved by the Engineer. The pattern and placing of the bricks shall be as indicated in the drawings.

Measurement and Payment

Double layer brick flat soling shall be measured in square metres for areas covered by the same.

This item of work shall be measured as provided above and shall be paid at the Contract unit price. The price and payment shall include all costs for completion of the work and supply of all required materials, including cost of all labour, equipment, tools and incidentals necessary to complete the works as specified in this section. The payment shall be made according to the unit price schedule and as given in the billed items.

<table>
<thead>
<tr>
<th>Pay item shall be:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
</tr>
<tr>
<td>5800.04</td>
</tr>
<tr>
<td>Double layer brick flat soling</td>
</tr>
</tbody>
</table>

58.05 HERRINGBONE BOND BRICK PAVEMENT

Description

This work shall consist of a base composed of bricks, laid on edge in a herringbone pattern, placed on a prepared single layer brick flat soling in accordance with these Specification and to the lines, grades, levels, dimensions and cross sections shown in the Drawings and as required by the Engineer.

Materials

The materials shall consist of First Class or Picked Jhama Bricks, Sand and Mortar all of which should meet the requirements of Section 9200: Brick Work of these Specifications and as given under Article B of Specifications.

Construction Methods

The bricks shall be laid on edge with the shortest side (70mm) horizontal in a single layer in a herringbone pattern over a sand cushion of 20mm thickness (minimum) with sand of F.M. not less than 0.8. The bricks shall be laid to the lines, grades, dimensions and cross section shown on The Drawings and as required by the Engineer. The edge of the layer shall be made with cut bricks to produce a line which is compatible with brick edging. The joint shall be filled with sand of F.M. 0.8 brushed in and the completed layer shall be sprinkled liberally with water.

Surface Tolerance

In those areas in which pavement are to be placed, any deviation in excess of ten millimetres from the specified surface when measured with a 3 metre straight edge shall be corrected by removal, reshaping and relaying.

Measurement and Payment

This item shall be measured in square metres of material in place and accepted.

The work measured as provided above shall be paid for at the Contract unit price per square metre. The price and payment shall include all costs for completion the work including all materials, labour and equipment necessary to complete the work prescribed under this section. The payment shall be made according to the unit price schedule and as given in the billed items.

<table>
<thead>
<tr>
<th>Pay item shall be:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
</tr>
<tr>
<td>5800.05</td>
</tr>
<tr>
<td>Brick Pavement (HBB only), Excluding soling and edging</td>
</tr>
</tbody>
</table>
58.06 GROUTED HERRINGBONE BOND BRICK PAVEMENT

Description

This work shall consist of a base composed of bricks, laid on edge in a herringbone pattern, placed on a prepared single layer brick flat soling in accordance with Article C and D of these Specification and to the lines, grades levels, dimensions and cross sections shown in the Drawings and as required by the Engineer.

Materials

The materials shall consist of First Class or Picked Jhama Bricks, Sand and Mortar all of which should meet the requirements of Section 9200: Brick Work of these Specifications and under Article B these Specifications. Specified Sand (FM = 1.2 to 1.8)

Construction Methods

The bricks shall be laid on edge as described under article D, Herring Bone Bond Brick Pavement. The joints shall be filled with Cement mortar (1:2), sand of F.M. 1.2 to 1.8 is to mix with cement, and completed layer shall be sprinkled liberally with water.

Surface Tolerance

In those areas in which pavement are to be placed, any deviation in excess of ten millimetres from the specified surface measured with a 3 metre straight edge shall be corrected by removal, reshaping and relaying.

Measurement and Payment

This item shall be measured in square metres of material in place and accepted.

The work measured as provided above shall be paid for at the Contract unit price per square metre. The price and payment shall include all costs for completion the work including all materials, labour and equipment necessary to complete the work prescribed under this section. The payment shall be made according to the unit price schedule and as given in the billed items

Pay item shall be:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5800.6</td>
<td>Grouted HBB Bricks pavement (HBB only), excluding soling and edging</td>
</tr>
</tbody>
</table>
SERIES 6000: ROAD SUPPLEMENTARY WORKS

CONTENTS

<table>
<thead>
<tr>
<th>Series</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6100</td>
<td>TREE PLANTATION</td>
</tr>
<tr>
<td>6200</td>
<td>ROAD SIDE DRAINAGES-LINED</td>
</tr>
<tr>
<td>6300</td>
<td>KERBS AND DRAINAGE OUTLETS</td>
</tr>
</tbody>
</table>
SECTION 6100: TREE PLANTATION

CONTENTS

6101 SCOPE

This work shall consist of planting tree seedlings at the base of embankment and side slope fills to prevent erosion of the material in which it is planted.

The most recommend trees Type are as follow:

- Heaven tree
- Robina Acacia
- Pine trees
- Any Shrub to avoid glare and protect the embankment surface.

6102 CONSTRUCTION METHODS

The planting shall be carried out at intervals and locations as directed by the Engineer. The tree seedlings shall be planted with their root system substantially undamaged, well buried in firm material, and packed around with moist earth in which they have grown.

Tree seedlings shall be planted at such a time and the work shall be done in such a way that at the time of the final construction inspection all seedlings are well established, firmly rooted and the planted area is free from erosion channels.

The Contractor shall maintain the seedlings at his expense until the issuance of the Practical Completion Certificate. Maintenance shall consist of preserving, protecting, watering and replacing seedlings and such other work as may be necessary to keep them in a healthy condition.

6104 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6100.04.1 Heaven Tree</td>
<td>Number</td>
</tr>
<tr>
<td>6100.04.2 Robina Acacia</td>
<td>Number</td>
</tr>
<tr>
<td>6100.04.3 Pine</td>
<td>Number</td>
</tr>
<tr>
<td>6100.04.4 Shrubs</td>
<td>L.S</td>
</tr>
<tr>
<td>6100.04.5 Seedlings</td>
<td>L.S</td>
</tr>
</tbody>
</table>

The tendered rate shall include full compensation for the supply of all materials including trees, watering regularly, and cage protecting the trees from animals. The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 6200: ROAD SIDE DRAINAGES-LINED

CONTENTS

6201 SCOPE
6202 MATERIALS
6203 PREPARATION OF SAND BEDDING
6204 PLASTERING SIDE DRAIN IN CEMENT MORTAR
6205 NET CEMENT FINISHING
6206 BACKFILLING
6207 PLACING SIDE DRAINS
6208 MEASUREMENT AND PAYMENT

MASONRY ROAD SIDE DRAIN

6201 SCOPE

As shown on the drawing, side drains should be constructed in stone or brick masonry works with cement mortar. The Specification of cement and sand should comply with the standards specified in clauses of materials in respective sections.

6202 MATERIALS

The materials shall be dressed stone or bricks comply with the specifications in sections no 5700 and 9200.

6203 PREPARATION OF SAND BEDDING

A layer of sand as shown in the drawing should be placed over the excavated side drain prior construction of lined drain. Sand should be spread in uniform thickness, brought up to the optimum moisture content and compacted with proper equipment such as vibrating plate compactor.

6204 PLASTERING SIDE DRAIN IN CEMENT MORTAR

All brick works should plaster in cement mortar (1:3). The plaster should be even and smooth. No cracking is allowed.

6205 NET CEMENT FINISHING

The internal sides of the drains shall be plastered with net cement finishing. The layer should be even and smooth.

6206 BACKFILLING

All spaces which have been excavated shall be backfilled and compacted with material as shown in the drawing. The layers shall not be more than 250mm in depth and shall be compacted to a density comparable with the adjacent undisturbed material.
PRE-CAST CONCRETE SIDE DRAINS

This work consists of supply and installation of pre-cast or in-situ concrete side drains.

6207 PLACING SIDE DRAINS

The pre-cast concrete drains shall be placed according to the drawings or as instructed by the engineer. Care has to be taken to maintain the alignment specified in the drawings.

The drains shall be connected by both mechanical and plaster joints.

6208 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6200.01 Masonry lined road side drain</td>
<td>Linear metre</td>
</tr>
<tr>
<td>6200.02 Masonry lined Pre-cast or in-situ roadside drain</td>
<td>Linear metre</td>
</tr>
</tbody>
</table>

The unit of measure shall be in linear metres according to the drawings and accepted. 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 the supply of all materials including excavation, backfilling, loading, transporting and offloading, plastering, neat cement finishing, sand cushions, lean concrete, tools, local haulage etc complete. No extra item shall be measured.
SECTION 6300: KERBS AND DRAINAGE OUTLETs

CONTENTS

6301 DESCRIPTION
6302 MATERIALS
6303 CONSTRUCTION METHOD
6304 MEASUREMENT
6305 PAYMENT

6301 DESCRIPTION

This work shall consist of construction of kerb and associated drainage outlets with approved material in accordance and in conformity with lines, grades and typical cross sections and at locations as shown on the drawings or as directed by the Engineer.

6302 MATERIALS

Kerbs and drainage outlets shall be of concrete grade 30 without cement plaster and as approved by the Engineer. All other materials required e.g. cement; sand, aggregate, steel etc. shall be in compliance with the requirements in this specification.

6303 CONSTRUCTION METHOD

Kerbs and drainage outlets shall be constructed conforming to the shape and size as shown on drawings. The method of construction must comply with that of as set forth in this specification. Drainage outlets shall be provided to drain out surface water as per drawings and section 2200 of specification or as directed by the Engineer.

6304 MEASUREMENT

Kerb(s) shall be measured in number of linear metres actually constructed and accepted in conformity with size and shape as shown on drawing or as directed by the Engineer. The length however shall be measured at centreline of top of finished surface new.

Drainage outlets will be measured as the linear metres from kerb to end of outlet with the distance measured being along centreline of outlets.

6305 PAYMENT

Kerbs and drainage outlets, as measured above, shall be paid for at the contract unit rates which shall be payment in full compensation for furnishing all labour, carriage, material, backfilling, tools, equipment, excavation, cutting pavement, drainage outlets and all other incidentals necessary to complete the work. 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>6300.01 Kerb</td>
<td>Linear metre (m)</td>
</tr>
<tr>
<td>6300.02 Drainage outlets</td>
<td>Linear metre (m)</td>
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<tr>
<td>Series</td>
<td>Description</td>
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<td>7100</td>
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<td>7900</td>
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</table>
SECTION 7100: GUARD POST

CONTENTS

7101 SCOPE
This work shall consist of constructing pre-cast reinforced concrete guard posts and installing them at locations shown on the drawings or directed by the Engineer in accordance with these specifications.

7102 MATERIALS
Guard posts shall be of circular type with size and shape as shown on the drawing or as directed by the Engineer. Concrete shall be of grade 30 and shall comply with the specification for structural concrete work. No materials other than the essential ingredients i.e. cement, aggregates and water, shall ordinarily be used in the manufacture of concrete.

Reinforcement shall be mild steel bars and clean, free from loose rust, loose mill scale, and foreign coating. Bending of bars shall be done as per drawing and in a manner that will not injure the material.

Shuttering shall be of dressed softwood timber or steel plain sheets with true surfaces and edges, mortar tight and stoutly braced together.

7103 CONSTRUCTION METHOD
Concrete shall be thoroughly mixed in proportions as approved by the Engineer, satisfying its specified grade. Mixing shall be done in a mechanical mixer and be continued till all materials are uniformly distributed and an uniform colour of the entire mass is obtained. If however hand mixing is permitted by the Engineer, it shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. In such cases of hand mixing the quantity of cement shall be increased by ten (10) per cent above the amount required for specified grade. The inside faces of formwork shall be soaped or oiled to prevent adhesion of concrete, but such soap or oil shall be such as not to stain the concrete.

Reinforcements contained in the guard post shall be placed and firmly held in correct position with specified clear cover as shown on the drawing or as directed by the Engineer. The method of transporting and placing the concrete shall be approved by the Engineer. Concrete shall be kept in the forms for at least seven (7) days during which time it shall be kept moist and sheltered from the Sun. Posts shall not be erected until fourteen (14) days after casting and during this period shall not be subjected to any loading or rough handling. While striking off the formwork care shall be taken to prevent any damage to the concrete. Any damage caused during concreting, removal of shuttering and transporting the guard posts to their place of installation shall have to be made good at the contractor's own expense. While erecting the posts necessary excavation shall be done and back filled with approved material after proper compaction so that the posts stand truly vertical, in lines, grades as shown on the drawing at specified locations or as directed by the Engineer.

7104 MEASUREMENT
The Guard posts shall be measured in number of units, completed, erected in position and accepted, as determined from actual counts.

7105 PAYMENT
The number of guard posts, measured as above, shall be paid for at the contract unit rate. The contract unit rate shall include full compensation for furnishing all labour, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the guard posts, transporting, complete in place, including form work, excavating and backfilling holes, and disposing of surplus excavated material, painting with approved colour(s), as shown on the drawing and as specified in these specifications or as directed by the Engineer.
Supplying, fitting, fixing RCC Guard posts true to line, level as per drawing in correct position including painting to form horizontal alternate band in yellow and black colour (or any other colour as approved) after mending damages if any during striking off shuttering making holes in the ground, fixing the guard posts in the same hole and repacking with earth thoroughly so as to keep the guard post standing properly erect including cost of all materials carriage of RCC guard post with due care, loading into trucks and unloading at site complete in all respect as per drawing & clause of specification. The payment shall be made according to the unit price schedule and as given in the billed items.

Pay item shall be:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>No.</th>
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</thead>
<tbody>
<tr>
<td>7100.01</td>
<td>Guard Post</td>
<td>No.</td>
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</table>
SECTION 7200: KILOMETRE POST

CONTENTS

7201 SCOPE

This work shall consist of construction and erection of distance measuring posts (herein referred to as 'Kilometre post') including painting, lettering, numbering as shown on the drawing or as directed by the Engineer. The actual location of erection of these posts will be as per direction of the Engineer.

7202 MATERIALS

Kilometre posts shall be constructed with precast reinforced grade 30, Cement concrete as per drawing and as directed by the Engineer. The lettering and numbering in approved paints shall be inscribed on plaques formed by plastering on the RCC work in conformity with the drawings and specifications described hereunder or as directed by the Engineer. The materials required for constructing Kilometre posts shall comply with the requirements of Section 8500 of this specification.

7203 CONSTRUCTION METHOD

The kilometre posts shall be made with precast reinforced cement concrete conforming to the size, shape and erected in proper orientation as shown on the drawing. The method of constructing the post must be as in Section 8500 of this specification. In areas of fill or cut, where the posts are to be installed and where space available are not adequate, necessary earthwork for embedding the posts shall be built locally to provide a proper foundation. Plaque shall be formed by using mortar the dimension of which shall be decided well in advance depending on shape, size, spacing of letters and numerals. The kilometre post shall be provided at the left hand side of road away from the pavement, as shown on the drawing, independently for each direction of traffic. The sequence and weightage of script lettering shall be as per drawing or as directed by the Engineer.

7204 MEASUREMENT

The kilometre posts shall be measured in number of units, completed, erected in position and accepted, as determined from actual counts.

7205 PAYMENT

The number of kilometre posts, as measured above, shall be paid for at the contract unit rate. The contract unit rate shall include full compensation for furnishing all labour, materials (including all concrete, mortar, paint, reinforcement), tools, equipments and incidentals necessary for completing the work to the satisfaction of the Engineer.

Providing and fixing kilometre post as per drawing in correct position true to line and level including plastering, lettering, numbering and painting, if necessary, completed in all respect as directed and as per clause specification. The payment shall be made according to the unit price schedule and as given in the billed items.

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<th>Item</th>
<th>Unit</th>
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</thead>
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<tr>
<td>7200.01 Kilometre Post</td>
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</table>
SECTION 7300: ROAD MARKING

CONTENTS

7301 DESCRIPTION
7302 MATERIALS
7303 CONSTRUCTION METHOD
7304 TOLERANCE
7305 MEASUREMENT
7306 PAYMENT

7301 DESCRIPTION

This work shall consist of application of paints for road marking on the completed road surface at the locations and in accordance with the details shown on the drawings and as prescribed in these specifications or as indicated by the Engineer. Road markings, as described hereunder, are defined as lines, patterns, arrows, words or other devices applied to the carriageway or kerbs or to objects within or adjacent to the carriageway to signify the delineation of traffic path, its lateral clearance and the proximity of obstruction for safe movement, control, warning, guidance or information for road users.

7302 MATERIALS

Pavement marking paints shall be an approved quality with non reflective type of colour as shown on drawing with provision for using glass beads of approved quality in order to reflectory the road marking as directed by the Engineer. Paints shall be thoroughly and evenly matured and free from defects which affect appearance and serviceability. Before delivery of the materials to the site, the contractor shall produce to the Engineer for his approval, a certificate of origin specifying physical and chemical characteristics of constituents of paints from a recognised and approved manufacturer. Before delivery to the site or during the course of work, the Engineer may call for any tests considered necessary for the acceptance of the materials or for control of their application. All such tests shall be performed by and at the expense of the contractor and shall be considered subsidiary to road marking works. Tests shall be performed for abrasion resistant together with heat and water-resistant properties, hardness, viscosity, flash point, specific gravity etc. The extender shall be calcium carbonate from chalk, silica flour or other approved material. The proportioning of various ingredients of paints shall be such that the material, when in a molten state, shall be applied readily onto the road surface to give an even line of good definition and free of mould marks, indentations, air bubbles or other objectionable marks or discoloration.

For white marking, the pigment shall be titanium dioxide and its content shall be such as to give a minimum luminous factor as approved by the Engineer. For yellow marking the pigment shall be chromate based which is of sufficiently stable colour. The pigment content used shall however depend on the colour required by the Engineer. Only fresh and sealed containers of paints, without thinner or any other additive, unless permitted, shall be used.

7303 CONSTRUCTION METHOD

Road markings shall be applied with laying machine capable of applying the paint at the specified widths and specified rates of application. In no case shall the contractor, proceed with work until the equipment, method of application and rate of application, as established by a test section, have been agreed by the Engineer.

The edge lines shall be 100 mm wide and continuous yellow (non-refectors) in the position as shown on drawing along both edges of the carriageway except at entry/exit of intersection where a broken edge line will be used.

The centreline or lane lines shall be dashed having a 100 mm wide non-refectors white paint with 3 metre long lines with a space of 6 metres between line segments. Road markings at junctions and elsewhere shall
be to the dimensions shown on the drawings or directed by the Engineer. No road marking paint shall be applied prior to the completion of shoulder surface treatment. Road marking paint shall not be applied to a damp surface or when the relative humidity exceeds 80% or at a temperature lower than $10^\circ$ C. Markings shall be applied to bituminous surface only after sufficient time has elapsed to ensure that damage will not be caused to the painted surface by volatile substances evaporating from the bituminous surfacing. In no case shall road marking be applied without approval of Engineer or until at least 48 hours after the completion of bituminous surfacing. Before application the surface should be cleaned and dry and completely free from any soil, grease or oil, acid or any other material which will be detrimental to the bond between the paint and surface. The portion of the surface where the paint is to be applied shall be properly cleaned by means of brooms or compressed air if required. The lines, symbols, figures or marks shall be set out by means of paint spots of the same colour as the proposed final lines and marks. These spot marks shall be at such intervals as to ensure that the road markings can be accurately applied and in no case shall they be more than 1.5 m from each other. The dimension and position of marking shall be as shown on the drawing or as specified in these specifications or as directed by the Engineer. The paint shall be applied as figures, signs, letters, symbols, broken or unbroken lines or other marks as required. Where the paint is applied by means of machine, it shall be applied in one layer. Before the road marking machine is used on the permanent work, the satisfactory working of the machine shall be demonstrated on a suitable site which is not part of the permanent work. Adjustment to the machine shall be followed by further testing. Only when the machine has been correctly adjusted and uses thereof approved by the Engineer after testing, the machine then may be used on permanent works. Paint shall be applied without the addition of thinner unless permitted. In places where painting is to be done by hand, it shall be applied in two layers and the second layer shall not be applied before the first layer dried out sufficiently. The rate of application shall be as per manufacturer’s specification or as otherwise directed by the Engineer. Lines or curves, whether broken or unbroken, shall not consist of chords but shall closely follow the correct radius. Any road markings which do not comply with the requirements, shall be repaired by the contractor at his own cost. Rejected traffic marking shall be removed in such a way that the markings will not show up again.

7304 TOLERANCE

The completed paintwork shall have a neat appearance with sharply defined edges and the markings shall be within the tolerance specified below:

Lines and other markings shall not deviate from specified width by more than 5%.

The position of lines, letters, figures, arrows and other markings shall not deviate from the specified positions by more than 20 mm.

The edges of longitudinal lines shall not deviate from the true edge by more than 10 mm in 15 metre.

The length of segments of broken lines in the longitudinal direction shall not deviate from the specified length by more than 100 mm.

After the application of the paint, the road markings shall be protected against damage by traffic or other causes. The contractor is responsible for the faulty workmanship or substandard work. The paint which has been splashed or dripped on the surfacing, structures or other such surfaces shall be removed by the Contractor at his own cost.

7305 MEASUREMENT

The quantities of road marking shall be measured in the number of square metres of painted surface measured in place, completed and accepted excluding the intermittent gaps.

7306 PAYMENT

The quantities as measured above shall be paid for at the contract unit rate. The contract unit rate shall include full compensation for furnishing all materials, labour, tools, equipments and incidentals necessary for the proper completion of work as specified in these specifications and as directed by the Engineer. 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>
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</thead>
<tbody>
<tr>
<td>7300.01 Painting road marking lines</td>
<td>square metre (Sq.m)</td>
</tr>
</tbody>
</table>
SECTION 7400: ROAD SIGNS

CONTENTS

7401 DESCRIPTION

This work covers the provision and installation of traffic signs and post assemblies as shown on the drawings or as directed by the Engineer. The signs will be ground mounted and erected at the side of the road as shown on the drawings or as specified in these specifications. Prior to manufacture and fabrication of the signs, the Contractor shall submit to the Engineer for approval, detail execution drawings showing letter sizes, symbols and sign layout, sign panel dimension, post height for sign structures.

7402 MATERIALS

The various materials and fabrication thereof shall conform to the following requirements:

Concrete shall be of the grade 15 as this specification or as directed by the Engineer. Materials proportioning, mixing, slump and transporting shall be in accordance with relevant clauses of controlled concrete described elsewhere in this specification.

Necessary reinforcement for anchorage shall be mild steel bars free from rust, loose mill scale and any foreign coating.

The available best quality of film must be furnished to sign board in such away to bounce back the light beam of vehicle

Pipe posts shall be welded or seamless steel pipe. At the option of the Contractor, posts may be fabricated from structural steel, if permitted.

Sheets used for sign board shall be of aluminium alloy or extruded aluminium or any other material as approved by the Engineer and shall be welded with pipe and shall not be less than 3 mm thick or as directed by the Engineer.

Lettering, symbols shall be reflective type.

Reflective sheeting used shall consist of synthetic sheet resin or other approved non-cellulose materials or transparent plastic of colours (opaque) as specified.

7403 CONSTRUCTION METHOD

Footings for the posts shall be excavated to the dimensions shown on the drawings and backfilled with specified grade of concrete. During erection, the metal work shall be firmly anchored and protected in order that no buckling or damage is caused during erection, or by the equipment used for erection. All concreting during erection shall be compacted and top finished with a wood float, to the level shown on the drawing or as directed. The remaining backfill, if there be any, shall be compacted in layers to the standards of the surrounding earthworks. Signs shall be fixed to the posts as shown on the drawings with the specified
elevation offset and orientation. Surfaces to be reflectorised shall be effectively prepared to receive the reflective material of approved quality. The material shall be firmly fixed to the plate with an approved type of vacuum applicator and shall show no tendency to peel off or signs of shrinkage under normal wear and tear. The material shall provide an even coating over the face of the sign to be treated and shall be free from twists, cracks and folds. Complete sheets of the material shall be used wherever possible, and joints shall be kept to a minimum. Any joint if found necessary, shall be of either the butt or lap type in accordance with the manufacturer's recommendations and shall be neatly finished. When joining sheets on signs, screen processed with transparent colour, only butt splices shall be used. Cutouts to produce legends and borders shall be of materials specified by the reflective sheeting manufacturer. They shall be dry adhesive coated and shall be applied mechanically in a manner specified by the sheeting manufacturer. All panels, cut-out letters and numerals, adjacent or background or reflective sheeting shall be carefully matched for colour at the time of sign fabrication to provide uniform appearance both by day and night.

Before application of reflective sheeting, the surface must be cleaned, smoothed. The metal surface should be treated with coating of prime coat and base coat. Care should be taken before hand to test adhesion of sheeting on painted surface. Reflective sheeting may not bond properly to some types of paint and in that case the surface to be treated by specified methods as per manufacturer's recommendation. Working, handling temperature and application method for using reflective sheeting shall be in conformity with relevant manuals of particular type and grade as per guideline suggested by manufacturer.

The Contractor shall protect the completed road signs against all damage until they are finally accepted by the Engineer and shall maintain the road signs until the maintenance certificate issued. Damage and defects caused by faulty workmanship or negligence shall be made good by the contractor at his own expense and to the satisfaction of the Engineer.

7404 TYPE

All signs shall be erected vertically in positions with proper orientation with respect to traffic flow movement as shown on the drawing or as directed by the Engineer. Actual place of installation of signs will be decided by the Engineer depending on actual site condition. The type of sign to be used and its location shall be as shown on the drawing with respect to their type which has been categorised as:

- Warning Sign
- Regulatory Sign
- Advance Direction Sign
- Destination Sign
- Direction sign
- Place identification sign.

Post lengths shown on the drawing are for tendering purposes only. When progress of the work permits, the Engineer will authorise the location of each sign, with the station and offset distance from the edge of pavement. The contractor shall be responsible for the determination of post lengths to provide the vertical clearance shown on the drawing.

At least 60 (sixty) days before the erection of any sign the contractor shall supply detailed drawings, specifications and a sample sign for the Engineer's approval. Once approved the signs supplied & erected shall be equal to or better than the sample and shall conform to the drawings and specifications approved.

7405 MEASUREMENT

The quantities of road signs shall be measured by the number of signs, erected and accepted inclusive of necessary posts, foundations, backfills with concrete and earth lettering as shown on the drawing or as directed by the Engineer.

7406 PAYMENT

The number of signs, measured as above, shall be paid for at the contract unit rate. The contract unit rate shall be payment in full compensation for furnishing all labour, materials, tools, equipment, excavation, backfilling, concreting, etc. and installation of sign posts and all other incidental costs necessary to complete the work. The payment shall be made according to the unit price schedule and as given in the billed items

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<thead>
<tr>
<th>Item:</th>
<th>Unit:</th>
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<tbody>
<tr>
<td>7400.01</td>
<td>Warning Sign</td>
</tr>
<tr>
<td>7400.02</td>
<td>Regulatory Sign</td>
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<tr>
<td>7400.03</td>
<td>Direction/Place Identification Sign</td>
</tr>
<tr>
<td>7400.04</td>
<td>Destination Sign</td>
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<tr>
<td>7400.05</td>
<td>Advance Direction Sign</td>
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<tr>
<td>7400.06</td>
<td>Inform Tory Sign</td>
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SECTION 7500: RIGHT OF WAY MARKER POST

CONTENTS

7501 DESCRIPTION
7502 MATERIALS
7503 CONSTRUCTION METHOD
7504 MEASUREMENT
7505 PAYMENT

7501 DESCRIPTION

This work shall consist of furnishing and installing boundary post (herein referred to as Right of Way Marker Post) at locations as directed by the Engineer to define right of way for acquisition of land or otherwise required for the construction of road in conformity with the size and shape as shown on drawing or as directed by the Engineer.

7502 MATERIALS

Right of way marker post shall be constructed with 150 mm square reinforced concrete posts as specified in the drawing. Concrete shall be grade 25. A portion of backfilling the excavated portion shall also be done with concrete as directed by the Engineer. Cement, coarse aggregate, sand shall be proportioned by volume. Proportioning of sand shall be as per its dry volume and in case it is damp, allowance for bulking shall be made as directed by the Engineer. Quantity of water shall be just sufficient to produce a dense concrete of required workability for the job. Unless otherwise instructed, concrete used in backfill shall be grade 15.

7503 CONSTRUCTION METHOD

A setting out details first is carried out to identify the location in accordance with lines along which posts are proposed to be installed and at intervals as decided by the Engineer. Excavation shall then be carried out at approved location for making foundation of posts. The excavation shall be supported so that the ground alongside the excavation will not slide or settle. The holes then to be backfield with concrete and properly compacted up-to bottom level of concrete post. Posts must remain vertical at all times.

7504 MEASUREMENT

The Right of Way Marker Posts shall be measured in numbers of posts actually installed and accepted and include, concreting, backfilling in compliance with drawings and specifications or as directed by the Engineer.

7505 PAYMENT

The number of posts, as measured above, shall be paid for at the contract unit rate which shall be payment in full compensation for furnishing all labour, carriage, materials, tools, equipment, excavation and installation of posts and all other incidentals necessary to complete the work. The payment shall be made according to the unit price schedule and as given in the billed items.

<table>
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<tr>
<td>7500.01 Right of way marker post</td>
<td>No</td>
</tr>
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</table>
SECTION 7600: BUS BAY

CONTENTS

7601 DESCRIPTION

This work shall consist of constructing Bus-bay at locations of bus stoppage as decided by the Engineer with proper signs in accordance with these specifications and drawings or as directed by the Engineer. The length of Bus-bay will depend on storage bay length of number of buses to be pulled in plus tolerance, which shall be 15 metre minimum for each bus or as directed by the Engineer.

7602 MATERIALS

Bus-bay shall be constructed at specified location by widening the formation level and pavement along with raised kerbs for separating it from main carriageway with shape and dimension as shown on the drawing. The materials required for various items of works involved in constructing the bus-bay e.g. earthwork, pavement, kerbs etc. should be in accordance this specification.

7603 CONSTRUCTION METHOD

The various item of work involved shall be similar as specified in these specifications under different clauses for materials, pavement, embankment, kerb(s) for the roadway.

7604 PAYMENT

Bus-bay shall be constructed at locations and accepted as determined from actual counts. Earthwork, pavement work, shoulders shall be measured separately and will be paid for along with the respective items of works involved, as included in the relevant Bill of Quantities. Raised kerbs are required to form a complete bus bay unit. Drainage outlet shall be provided. Payment for kerbs and drainage outlets will be made using unit rates in the respective unit price schedule and as per billed items in the BOQ. The payment shall be made according to the unit price schedule and as given in the billed items.
SECTION 7700: MEDIAN OR LANE DIVIDER

CONTENTS

7701 DESCRIPTION

The item shall consist of providing median dividers in widened carriageways in towns and market areas for segregating up and down traffic and shall be constructed with cement concrete precast or cast-in-situ; as approved by the Engineer and to the lines, dimensions and grades shown on the drawings.

7702 MATERIALS

Median and lane divider shall be of grade 30 concrete with cement plaster and as approved by the Engineer. All other materials required that is cement sand and steel shall be in compliance with the requirements in this specification.

7703 CONSTRUCTION METHOD

Before construction of median kerbs, the contractor shall have detailed location approved by the Engineer. All concrete work shall be carried out as per drawings and this specification. After the kerbs have been completed, the median area shall be filled with sand and topped with concrete slab as per drawings.

7704 MEASUREMENT

Median or lane divider will be measured in linear metres actually constructed and accepted in conformity with size and details as shown on the drawings or as directed by the Engineer. The length of the median however shall be measured at the centreline of top of finished median.

7705 PAYMENT

Median or lane divider measured above shall be paid for at the contract unit rate which shall be payment in full compensation for furnishing all labour, carriage, material, backfilling, tools, equipment, excavation, cutting pavement and all other incidentals necessary to complete the work. The payment shall be made according to the unit price schedule and as given in the billed items.

<table>
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<tr>
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<td>7700.01 Median or lane divider</td>
<td>metre (m)</td>
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</table>
SECTION 7800: FOOTPATHS

CONTENTS

7801 DESCRIPTION
7802 MATERIALS
7803 CONSTRUCTION METHOD
7804 MEASUREMENT
7805 PAYMENT

7801 DESCRIPTION

This item shall consist of providing footpaths in towns and market places at the extremities of the carriageway for ease of movement for pedestrians and to reduce interference in the movement of vehicular traffic. Kerb and footpaths shall be constructed with cement concrete at specified locations to lines, levels and grades as specified in the drawings or as directed by the Engineer. The width of footpaths may be varied as per actual requirement at each location and as per availability of land.

7802 MATERIALS

Footpaths shall be constructed of concrete grade 30 complying with this specification.

7803 CONSTRUCTION METHOD

After the location, its length and the dimensions of the footpath and kerb with drains are fixed as per the directions of the Engineer, the method of construction for cement concrete shall be as per this specification. For footpaths the cement concrete may be cast-in-situ/precast. For precast footpath or with drain contractor shall furnish in advance the method of casting and placing the precast units of cement concrete items including kerbs in corner circular portion and details as well as dimensions of footpath slabs and get it approved from the Engineer before starting the precast concrete work. All work or footpaths shall be as per drawings.

7804 MEASUREMENT

The kerb shall be measured in linear metres actually constructed and accepted in conformity with size and dimensions shown on the drawings or as directed by the Engineer. The footpaths shall be measured in linear metres as actually constructed and accepted in conformity with size and dimensions shown on the drawings or as directed by the Engineer.

7805 PAYMENT

Kerbs and drains shall be measured and paid for at the contract unit rates in BoQ items. Payment for footpaths shall include all costs necessary to complete construction to details supplied. The payment shall be made according to the unit price schedule and as given in the billed items.

Item: 7800.01 Raised footpath
Unit: metre (m)
SECTION 7900: WEIGHBRIDGE AREA AND HUT

CONTENTS

7901 Description
    This work involves the construction of pull off area complete with reinforced concrete weigh platform slab and adjacent hut to be used for housing the weighing equipment and staff involved.

7902 Materials
    All necessary pavement materials required shall comply with this specification.

Concrete work shall be grade 30 as per this specification and reinforcing steel shall be grade 60 and as per specification.

The weighmen hut shall be 20 square metre in area and shall be of equal standard complete with fittings, furniture and security fence pre-fabricated as inspection huts specified this specification, except that they shall be permanently located at site.

7903 Construction Method
    In addition of complying with this specification the concrete platform slab shall meet the following requirements.

- It shall be 15m long by 3m wide by 200mm thick complete with 12 φ reinforcing bars both ways at 200 mm centres placed 50mm clear of bottom surface;
- Surface shall be horizontal and smoothly finished;
- Surface shall be within ±3mm tolerance and free from pond areas;
- Location shall be subject to the Engineer prior approved.

All necessary pavement materials required shall comply with this specification and shall be in location as instructed by the Engineer. Particular attention must be paid to level and cross-falls to ensure that water pond does not occur.

The hut shall be constructed complete with fittings, utilities, services and security fence as per pre-fabricated huts detailed in this specification. Location and floor level of hut relative to the weigh slab shall be as instructed by the Engineer.

7904 Measurement
    All work associated with construction of pavement area will be measured as per relevant items in the specification. The construction of the concrete platform weighs slab and the hut plus fittings utilities, services and security fence will be measured as one complete unit.

7905 Payment
    All pavement work will be paid at relevant item rate as measured. The payment shall be made according to the unit price schedule and as given in the billed items.