DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

MINISTRY OF HIGHWAYS, PORTS & SHIPPING

ROAD DEVELOPMENT AUTHORITY

CHINA DEVELOPMENT BANK FUNDED IMPROVEMENT AND REHABILITATION OF PRIORITY ROAD PROJECT 3 (PRP3)

CIVIL WORK CONTRACT NO: RDA/RNIP/PRP3/PHASE-1/PACKAGE-1

Contract Component No.	Description
RDA/RNIP/PRP3/Phase1/Package-1/C1	Kiriella - Nedurana - Eheliyagoda Road (0.00-14.75 km)
RDA/RNIP/PRP3/Phase1/Package-1/C2	Ratnapura - Palawela - Karawita Road (0.00-21.28 km)
RDA/RNIP/PRP3/Phase1/Package-1/C3	Ratnapura - Wewalwatta Road (0.00-27.5 km)
RDA/RNIP/PRP3/Phase1/Package-1/C4	Veyangoda - Ruwanwella Road (12.4-32.2 km) - Road Package
	Veyangoda - Ruwanwella Road (12.4-32.2 km) - Bridge Package

CONTRACTOR

CHINA NATIONAL AERO - TECHNOLOGY INTERNATIONAL ENGINEERING CORPORATION (CATIC - ENG)

VOLUME 3

Technical Specification - Special Provisions and

Appendix to Special Provisions

The Standard Specification

DECEMBER 2013

VOLUME 1

(a) The Contract Agreement
(b) The Letter of Acceptance
(c) The Letter of Tender
(d) Appendix to Tender

VOLUME 2

(e) The Particular Conditions
(f) The General Conditions of Contract

VOLUME 3

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TECHNICAL SPECIFICATION

Technical Specification

Part II - Special Provisions

PREAMBLE

The Special Provisions are an amplification of the Standard Specifications and contain provisions in respect of items of work not covered by or at variance with the Standard Specifications.

Where there is any ambiguity or discrepancy between the Special Provisions and the Standard Specifications, the requirements of Special Provisions shall prevail.

Where BS tests are stipulated in the Specifications the equivalent ASTM or AASHTO test method may be substituted with the approval of the Engineer.

Clause numbers herein correspond with the numbers of related articles, if any, in the Standard Specifications. The numbering of new clauses is continuous with related clauses in the Standard Specifications.

The abbreviations AASHTO, ASTM, BS and SLS shall be considered to have the following meaning:

AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society of Testing and Materials
BS	British Standard
SLS	Sri Lanka Standard

Part II – Special Provisions

CONTENTS

SERIES 100 - GENERAL

101 ABBREVIATIONS

No change

102 DEFINITIONS

No change

103 MANAGEMENT, SAFETY AND CONTROL AND TEMPORARY DIVERSION OF TRAFFIC

Delete this sub-section and substitute the following:

103.1 General

The Contractor shall provide and maintain for the period of construction, traffic control and safety devices including Traffic Sings, Barricade Boards, Traffic Cones, Lighting Devices etc., at all locations where work is in progress in accordance with Part II of the "Manual of Traffic Control Devices for Road Work Areas, Road Development Authority, Ministry of Transport and Highways (Second Edition, April 2004)".

Material and equipment temporarily stored on, or adjacent to, the existing roadway shall be so placed, and the work at all times, shall be so conducted as to cause minimum disruption to the traveling public. Warning signs and barrels will be required to separate the Contractor's material and equipment from the public.

The Contractor will not be permitted to have excavations open on both sides of the road at a particular chainage such that there is a step adjacent to public traffic which may create a danger to traffic, i.e. the excavation and backfilling with sub-base or base shall be flush with the existing road level on one side before excavation can proceed on the other side of the road.

The maximum length of one-way working controlled by stop/go boards for flagmen shall be 500 metres. This length may be further reduced if visibility is reduced at bends on increased where appropriate at the Engineer's discretion.

During construction for operations which require one way traffic the Contractor shall be responsible for the removal of broken down vehicles including vehicles damaged in accidents and shall maintain one way uninterrupted traffic flow at all times.

As an alternative or in addition to one-way working, traffic diversions may be arranged where this is feasible. Such diversions shall be approved by the Engineer in conjunction with the Traffic Police. The Contractor shall be responsible for the provision and maintenance of adequate signing for the duration of any diversion.

The Contractor shall arrange for the Traffic Police to be in attendance for traffic management.

103.2 Using Part of the Road

No change

103.3 Temporary Diversions

Delete this sub-section and substitute the following:

The Contractor shall construct temporary diversion ways wherever construction of the Works will interrupt existing public or private roads or rights-of-ways. Diversions must be constructed in advance of any interference with the existing rights-of-way, and the subsequent traffic management, safety and control shall be in accordance with the paragraphs of this Clause 103 and / or as directed by the Engineer.

When undertaking bridge widening or reconstruction, the Contractor at all times ensure that the traffic on the road section is uninterrupted. If the widening or reconstruction is on the existing alignment of the road, the new construction may require the provision of temporary by-passes for traffic. In the event of the requirement for temporary by-passes, the Contractor shall provide for such by-passes construction in his design.

Where traffic management schemes are shown in the Contract Drawings they are for guidance and bidding purposes only. It is solely the responsibility of the Contractor to plan and design the necessary traffic diversions in the most efficient way possible in order to enable him to complete the Works within the Contract Period, with the minimum disruption of normal traffic flow, and absolute minimum impact on the Works, third parties, and environment.

The standard of construction and lighting of diversions shall be suitable in all respects for the volume, size and speed of traffic using the existing way. The level of lighting shall be as indicated on the Drawings or as directed by the Engineer, and must satisfy the requirements of the concerned local authorities prior to being approved by the Engineer. The width and number of lanes shall be sufficient to maintain an acceptable traffic flow commensurate with existing conditions. In any case the minimum width of traffic lane shall be 3.5 meters. It is the responsibility of the Contractor to obtain prior permission of the relevant Local Authority to open detours and the use of local authority roads.

Permanent roads used as temporary detour roads shall be signed and marked in compliance with detour road requirements whilst under detour road status. Should this road marking and signing be of a temporary nature the Contractor shall ensure that its removal will not impair the quality of the permanent Works.

Under no circumstances will the Contractor be allowed to open any new carriageway for detour traffic with permanent road markings which are not in compliance with the accepted detour markings.

The minimum pavement construction of any diversion road, unless otherwise specified, shall not be less than 40mm of bituminous paving course on 150mm of primed granular road base, constructed in accordance with the requirements of Section 400 and 500 of the Specifications. Paving may be laid directly on primed subgrade only with the Engineer's prior approval.

The Contractor will remain responsible for the maintenance of the pavement in a satisfactory condition for as long as the diversion is required.

In urban areas, the traffic diversions shall be illuminated to a suitable lighting. In rural or other areas, where no street lighting exists, all signing shall be reflectorized and all changes in direction shall be floodlit at night to an intensity approved by the Engineer.

103.4 Traffic Safety and Control

Delete this sub-section and substitute the following:

The Contractor shall, after consultation with the Engineer, all the concerned Local Authorities and Police prepare a scheme of traffic management for carrying out the Works. Such proposals shall be submitted to the Engineer for his approval, together with written approval / no objection certificates from the concerned authorities, not less than 30 days before the planned implementation of each proposal.

The Contractor shall not commence any works affecting any public highway until all approved traffic safety measures conforming to the Engineer's prior approval have been fully implemented to the satisfaction of the Engineer.

The Contractor shall take necessary measures for the safety of traffic and third parties by providing, erecting and maintaining all signs, lamps, barriers, traffic control signals, road markings, etc. in a clean and legible condition, and shall position, re-position, cover or remove them as required by the progress of the Works. The barriers shall be strong. Red lanterns or warning lights shall be mounted on the barriers at nights and shall be kept lit till sunrise. If the Contractor fails to comply with these requirements, the Engineer shall order a third party to rectify the shortcomings and shall recover the cost of such works from the Contractor.

103.5 Measurement and Payment

Delete this sub-section and substitute the following:

a. Measurement

Arrangement for traffic during construction shall be measured per month and the quantity of work for payment during the month shall be assessed by the Engineer on the Contractor's claim.

b. Payment

Payments shall be determined by the Engineer on the proportionate completed works during a month in accordance with the Clause 103.

Pay Item	Description	Pay Unit
103 (1)	Management, Safety & Control & Temporary Diversion of Traffic, including provision of a general traffic management plan.	month
103(2)	Temporary by-passes for culverts, bridges and other structures	Provisional Sum

104 CONTROL OF WORKS

104.1 Authority of the Engineer

No change

104.2 Conformity with Plans and Specifications

No change

104.3 Construction Programming

Add the following sub-section.

The Contractor shall program his work so as to reduce as far as is practicable, disruption to all road users during construction of the Works and maintain traffic control measures for the safety of traffic at all times. To assist with compliance of this requirement the Contractor will be restricted in use of single lane traffic working as described below.

Within any 5 kilometre section of the Site the length of road available to the Contractor for major pavement construction at any one time involving single lane traffic control shall be restricted to 2 separate sections of 500 metre length each provided that the sections are separated by a minimum of 2 km of unobstructed road with two lane traffic working.

The Contractor shall not be permitted to work outside these 500 metre lengths (except on a separate 5 km, section) unless otherwise agreed by the Engineer until the full width of the road is completed up to asphalt concrete surfacing or the first seal coat where the road is to be surface dressed.

The Contractor shall provide with his time / location program and detailed construction schedule, a list of proposed 500 metre lengths with chainage location showing where be intends to commence his pavement construction. The Engineer shall approve these locations without undue delay subject to compliance with this Clause and the Contractor will then be given access to these sections. Subsequent sections shall be requested and the Engineer shall approve them in accordance with the above procedure.

Other work such as structural work for bridges or extension to culverts or chainage work or work which may be carried out without disruption to traffic, either vehicular or pedestrian, may be undertaken in a properly programmed manner outside these limits with prior approval from the Engineer.

The Contractor shall ensure that sufficient labour, equipment and material (including sub base, base course, asphalt, aggregate and seal coat chips) is available in approved stockpiles for the completion of any 500 m half width section under construction. Before any subsequent 500 metre section is made available to the Contractor, the Contractor shall demonstrate that he has sufficient labour, equipment and material available in approved stockpiles to progress the Works. If in the opinion of the Engineer, this is not demonstrated the Contractor shall not be permitted to start work on the subsequent section.

The layers to the widening section of the road shall be constructed up to the top of sub base level on one side, initially, with two or one-way traffic (as appropriate or as directed by the Engineer) using the existing road width remaining. The Contractor shall be fully responsible for traffic control.

Traffic will then be allowed to travel over the layers so placed with the Contractor responsible for the protection of the sub base (e.g. by the application of a suitable cover of base course material or by any other method approved by the Engineer). No separate payment shall be made for this protection.

Construction of the widening of the opposite side of the road to half width will then take place up to finished surface level (asphalt or first seal of a double surface treatment). Traffic will then be allowed to travel over the finished surface once approved.

Completion of the first side of the road will then take place to finished road level.

If, within any 500 metre section where the Contractor has the Engineer's permission to execute major pavement construction in stages, there are insufficient locations for embankment construction using the excavated suitable material from that section, the Contractor shall request access to adjacent sections where embankment can be constructed and the Engineer shall grant such access unless for safety reasons permission cannot be granted.

104.4 Compaction – General

Add the following sub-section.

Compaction of materials shall be carried out in layers of uniform thickness using approved compaction equipment, including combinations thereof if required by the Engineer to achieve the specified compaction.

Compaction with rollers shall commence at the edges and progress towards the centre except in superelevated and other stretches of unidirectional crossfall, 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 until 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 scarifying 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.

104.5 Mixing and Control of Moisture Content before Compaction

Add the following sub-section.

Before compaction is commenced (other than for bituminous mixes), each layer of uncompacted 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 contents and the moisture contents at which the materials are to be compacted is to be specified separately for each type of material. Accordingly, the materials may have to be wetted by adding water or dried to the required degree, along with intimate mixing of the entire mass of the materials.

104.6 Compaction Equipment

Add the following sub-section.

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

It shall be understood by the Contractor that different type of materials 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 a fleet of compaction equipment of the requisite kinds, sizes and numbers.

For compacting along narrow strips, for example in widening pavements and in restricted areas such as behind bridge abutments, appropriate sized purpose-made compacting equipment will be required and the same shall be provided by the Contractor.

All equipment shall be of modern construction, by established manufacturers, of proven efficiency, and shall be operated and maintained at all times by skilled personnel in a manner acceptable to the Engineer.

104.7 Compaction Trials

Add the following sub-section.

For demonstrating the efficacy of mixing and compaction equipment and the working methods proposed to be used by the Contractor for different kinds of materials, the Contractor shall carry out compaction trials before full-scale construction on the road and during construction throughout the course of the Contract, as required by the Engineer.

Based on results of compaction trials and construction observation, the Engineer shall reserve the right to direct the use of particular mixing and compaction equipment and methods and disallow the use of others for compacting different kinds of materials in accordance with the Specification.

104.8 Dispersal of Hauling Equipment

Add the following sub-section.

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 or windrows consistent with the loose thickness to be achieved before compaction.

104.9 Protection to Newly Constructed Layers

Add the following sub-section.

Except as permitted by the Engineer, no traffic other than construction traffic shall be allowed on any earthwork or pavement layer until a surfacing has been applied, either as a bituminous surface treatment or an asphalt concrete layer.

The approval of the Engineer shall be required before traffic is allowed to pass over newly constructed sections of road. Any defects caused by traffic passing over the construction layers shall be remedied in accordance with the Specification.

104.10 Bridge Construction Sequence

Add the following sub-section.

The Contractor shall program the construction sequences for all bridges and submit a written statement thereof for the approval of the Engineer. The bridge construction sequence shall consider, as a minimum, each phase of bridge construction with respect to traffic control the effects on the existing bridges and the completed bridges. Where the Contractor proposes to partially demolish an existing bridge to allow for phased construction, he shall demonstrate to the Engineer's approval that the partially demolished bridge is safe for use by his equipment and other road users.

The control of traffic during the construction of the bridge will be in accordance with the Specifications 103. Where the bridge construction sequence has been specified on the drawings, the Contractor shall follow the sequence specified. The Contractor may propose an alternative construction sequence provided he can demonstrate, in a written statement, that the sequence is not detrimental to the Works or road users in any way.

No work shall commence on a bridge until the written consent to the construction sequence has been given by the Engineer in compliance with Sub Clause 8.3 of the General Conditions of Contract.

104.11 Measurement and Payment

Add the following sub-section.

No separate payment shall be made for compliance of items under this section. Payments shall be deemed to be included in the contractor's rates and prices.

105 CONTROL OF MATERIALS

105.1 Sources of Supply and Quality Requirements

Delete the text entirely and substitute the following:

The Contractor shall be responsible for the provision of all materials required to construct the Works. All materials salvaged or removed from the Works remain the property of the Employer, and the Contractor shall be responsible for the cost of replacement in the event of their unauthorized use or removal.

Quarry and borrow pit areas identified by the Employer as being likely to provide material shall be inspected and tested by the Contractor and it is the Contractor's responsibility to satisfy him as to the quality and quantity of suitable material to be gained from the identified sites.

The Contractor is deemed to have checked carefully the availability of suitable material in sufficient quantities in preparing his bid and to have satisfied himself fully of the characteristics of the materials and the suitability of his equipment and methods of working on which he has based his rates and prices.

No claims relating to the quantity or quality of material at identified quarry or borrow areas shall be considered by the Employer.

The Contractor shall be responsible in obtaining at his own cost all permissions and licenses for opening up and operating all quarry and borrow areas and shall organize his method of operations so that only materials of a type and quality approved by the Engineer shall be selected for use in the Works.

The Contractor is at liberty to select and use material from his own sources provided that the requirements of this section are fully met.

105.2 Storage of Materials

No change

105.3 Handling of Materials

No change

105.4 Approval of Sources of Material

Add the following sub-section.

The sources of the materials shall be selected by the Contractor but approved by the Engineer before the materials are used on the Site. 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 sources areas.

Notwithstanding approval of sources of materials, materials brought to Site for use in the Works shall be subject to acceptance or rejection by the Engineer based on quality control tests to be performed before use in construction.

105.5 Stockpiling of Materials

Add the following sub-section.

Unless otherwise permitted by the Engineer, natural gravels won from borrow pits shall not be loaded directly from the borrow area for use in the Works but shall first be stockpiled. Such stockpiles shall be tested and approved by the Engineer before the material comprising them may be used in the Works.

All materials brought to Site shall be stockpiled and stored carefully at approved locations and in a systematic manner so as to prevent deterioration or mixing of different materials or contamination. Materials which have suffered contamination or deterioration due to improper storage shall not be used in Works and shall be removed from the stockpiling area.

The materials shall be free from foreign, organic or any other deleterious substances such as vegetation and perishable matters, or any other substance which in the opinion of the Engineer may affect placing, mixing and compaction of the material or adversely affect the future performance of the Works. Material may be tested in stockpiles by the Engineer to check suitability for use in the Works.

105.6 Temporary Stockpiling of Materials

Add the following sub-section.

Where the work program is such that materials cannot be placed directly in their required position, or where mixing of two or more materials is required to meet the requirements of the Specification for a material, the Engineer may authorize their removal into temporary stockpiles. Stockpile sites shall be to the Engineer's approval and shall be prepared by clearing and grading followed by compaction.

The material shall be stockpiled in successive layers of approved thickness over the full stockpile area to the approximate dimensions required by the Engineer and shall subsequently be reloaded and placed.

105.7 Payment

Add the following sub-section.

No separate payment shall be made for items under this section. Payment shall be deemed to be included in the Contractor's rates and prices.

106 GENERAL RULES FOR MEASUREMENT AND PAYMENT

Add the following at the end of the text:

Unless stated to the contrary, any thickness, area or volume in any items of the Works shall be measured only on finished work after compaction.

The payments for various items shown in the Bill of Quantities shall constitute full compensation for performing all of the requirements of the Contract for the items of work as specified including furnishing all necessary materials, labour, tools, equipment, supplies, testing and incidentals.

106.1 Cost of Transport of Materials

Delete the text entirely and substitute the following:

No transport distances shall be measured for payment. The cost of transport of materials is deemed to be included in the bid rates for items of work in the Bill of Quantities, which involves supply of materials.

106.2 Measurement of Pavement for Area and Volume Based Payments

No change

106.3 Scope of Rates for Different Items of Work

No change

106.4 Facilities for Verification of Measurements

No change

106.5 Selection of Pay Items

No change

106.6 Sub-divisions within Pay Items.
No change.

107 SEIVE DESIGNATION

No change to Standard Specifications.

Add the following new Sections 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118 and 119.

108 FACILITIES FOR THE CONTRACTOR AND GENERAL REQUIREMENTS

108.1 Performance Security

The Contractor shall provide a Performance Security for proper performance of the Work, in accordance with Sub-Clause 4.2 of General Conditions of Contract.

a. Measurement

Performance Security shall be measured as a Lump Sum item for the cost of providing the required Performance Security.

b. Payment

Payment shall be made as a Lump Sum and shall be payable when the Contractor has provided satisfactory Performance Security.

Pay Item	Description	Pay Unit
108.1 (1)	Allow for Cost of Providing Performance Security	Lump Sum

108.2 Insurances

The Contractor shall provide all insurances for the performance of the Work, including at least, those required under the General Conditions of Contract except where specifically allowed for under other items.

The Contractor shall take all necessary measures such as photographic and other records of the third party properties adjacent to the work which, in his opinion, may be affected during construction activities.

Insurance policies shall be maintained and valid through the period of performance of the Contract and shall be extended when and as necessary.

a. Measurement

Insurance shall be measured as a Lump Sum item for the cost of providing all the insurances required duration the period of performance of the Contract.

b. Payment

Payment shall be made as a Lump Sum and shall be payable when the Contractor has provided all acceptable and satisfactory insurances valid for the Contract period.

The Contractor shall not be entitled to any additional compensation for extending the validity if insurance policies, unless the relevant period is subject of award extension of time in accordance with Sub-Clause 8.4 of the General Conditions of Contract.

Pay Item	Description	Pay Unit
108.2 (1)	Allow for Cost of Providing Insurances	Lump Sum

108.3 Mobilization, Maintenance and De-mobilization of Contractor's Facilities and Plant/Equipment

Description

The Contractor shall make provision for erection, operation and removal at the completion of works, of his temporary installation and facilities, including offices, site laboratory, accommodation, workshops, quarries, borrow pits, batching and blending plants and restoring of temporary land for borrow pits and quarries, etc. He shall provide and maintain at his own cost sanitary facilities on site, first aid fire fighting equipment, drinking water facilities, electricity and telephone for the duration of the Contract.

The contractor shall be responsible for the security of the Site and safety of public and adjoining property and shall be liable for any claims arising from loss or damage suffered. He shall employ watchmen for this purpose.

All temporary accommodation shall be kept well maintained during the contract period and shall be available for inspection by the Engineer and/or Government Medical Officer of Health. The Contractor must comply immediately with any instruction given by the Engineer and/or Medical Officer for cleaning, disinfesting and maintenance of any building to return it to a hygienic and sanitary condition.

The Contractor shall confine his apparatus, the storage of materials and the operations of his workmen to the limits indicated by law, ordinance, permits, or direction of the Engineer. The Contractor shall erect temporary fences as required by the Engineer. The Site boundary lines shall be to the approval of the Engineer.

Description

The Contractor will be paid for the mobilization of major items of Plant/Equipment. Major items of Plant/Equipment are defined as those that cost more than 1% of the Contract Price with an overall maximum of 5% of the Contract Price.

a. Payment

Payment for temporary installation and facilities, including offices, site laboratory, accommodation, workshops, quarries, borrow pits, batching and blending plants, etc. shall be made upon their satisfactory completion.

50% of the item will be paid on arrival and erection on the site of the specified items of Plant/Equipment. The remainder will be paid on confirmation by the Engineer that the output of the Plant/Equipment complies with the requirements of the specification.

Pay Item	Description	Pay Unit
108.3(1)	Mobilization of Contractor's Facilities and Plant/Equipment	Lump Sum
108.3(2)	De-mobilization of Contractor's Facilities & Plant/Equipment	Lump Sum

108.4 Progress Photographs

A minimum of thirty-six (4 sets) photographs shall be taken by the Contractor each month to record the progress of the Works.

Photographs shall be 200 mm x 150 mm, in colour, and shall be marked with date of exposure, and location. Where conventional photography is used, the negatives shall be supplied to the Engineer.

High resolution digital photographs (minimum 3Mb pixel format) will be acceptable, in which case a 'hard copy' (CDR/W disc or equal) shall be supplied in lieu of negatives.

a. Measurement

Progress photographs shall be measured by the number of months or part thereof.

The rate shall include for:

taking the photographs;
development of the film and prints;
annotating and binding;
delivery of the specified number of prints to the Engineer / Employer;
delivery of negatives , or, in the case of digital photography, submitting or transferring electronic copies of the prints to the Engineer by means of CDR/W discs or otherwise.

b. Payment

Pay items shall be:-

Item No.	Description	Pay Unit
108.4 (1)	Progress Photographs	month

108.5 HIV-AIDS Prevention

Description

The Contractor shall conduct HIV-AIDS awareness programmes and conduct Information, Education and Consultation Communication (IEC) campaigns to all the Site staff and labour and to the immediate local communities via an approved service provider, in accordance with the requirements given in sub-clause 6.6 of Contract Data.

The Contractor shall include in the program to be submitted for the execution of the Works under Sub-Clause 8.3 of Contract Data, an alleviation program for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation.

a. Payment

Payment shall be based on the rates and sums assessed and agreed by the Engineer for the completed works to the satisfaction of the Engineer, which shall include full compensation for providing all materials, labour, tools, equipment and incidentals necessary to carry out the works in accordance with Sub-Clause 108.5.

Payment to the Contractor for preparation and implementation of this program shall not exceed the Provisional Sum indicated for this purpose.

Pay Item	Description	Pay Unit
108.5(1)	Preparation and Implementation of HIV-AIDS Prevention Program	Provisional Sum

108.6 Water Supply Arrangements

The Contractor shall make his own arrangements for the procurement, transportation, storage, distribution and application of water needed for construction and other purposes except where otherwise specified.

Only clean water free from undesirable concentrations of deleterious salts and other materials shall be used. All sources of water used shall be approved by the Engineer.

Mechanically driven and operated water bowsers with effective spray equipment shall be provided at all times to ensure that compaction can proceed without any hold up on account of watering. Where directed by the Engineer such bowsers shall also be provided to keep down dust in areas adjacent to habitations.

No payment shall be made for providing water and the cost thereof is deemed to be included in the rates and prices tendered for the various items of work for which water is needed.

108.7 Project Signboards and Plaques

The Contractor shall provide, erect and maintain Project Signboards at locations directed by the Engineer. The Contractor shall submit designs for the Engineer's consent with the following minimum characteristics:

face plate size not less than 2.5 meters by 2.0 meters;
double post supports with concrete foundations;
colour messages and logos to include project name, name of the Employer, name of the Contractor, name of the Engineer, name of the funding agencies (both Asian Development Bank and European Commission), and the anticipated completion date.

The sign boards shall conform to the requirements of Manual on Traffic Control Devices Part 1, and EU Standards.

The Contractor shall remove all signboards on completion of the Contract Period.

The Contractor shall provide and install plaques made of brass or granite or other material with messages and logos approved by the Engineer at sites decided by the Engineer.

a. Measurement

Project Signboards shall be measured as the number of signboards satisfactorily provided, installed, maintained throughout the Contract period and removed after completion of works.

Project plaques shall be measured as the number of plaques satisfactorily provided, installed, maintained throughout the Contract period.

b. Payment

Payment shall be made at the stated unit rate per signboard/plaque. The price shall be full compensation for all materials and labour required to perform the work described.

Pay items shall be :-

Item No.	Description	Pay Unit
108.7 (1)	Provide and Maintain Project Sign Boards	number
108.7 (2)	Provide and Maintain Project Plaques	number

109 INFORMATION FURNISHED BY THE EMPLOYER

Certain information contained in these Contract documents or provided separately prior to Tender by the Employer is being offered in good faith but the type of information supplied, no guarantee can be given that any or all of the information is correct or representative of the actual conditions.

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The Employer accepts no liability for the correctness or otherwise of the information supplied or for the resulting damages, whether direct or consequential, should it prove during the course of the Contract that the information supplied is either not correct or not representative. Any reliance which the Contractor places on this information shall be at his own risk and the Contractor shall be deemed to have checked the correctness of the information prior to submission of his Tender.

110 WORKMANSHIP AND QUALITY CONTROL

The Contractor is responsible for producing work which conforms in quality and accuracy of detail to the requirements of the Contract. He shall institute a quality control system and provide experienced engineers, foremen, leading hands, surveyors, materials technicians, other technicians and other technical staff, together with all transport, instruments and equipment, to ensure adequate supervision and quality control of the Works at all times.

The cost of all supervision and quality control, including testing, carried out by the Contractor shall be deemed to be included in the rates and prices tendered for the related items of work, except where otherwise specifically provided for in the Contract.

The Contractor's attention is drawn to the provisions of the various sections of the Specification regarding the minimum frequency of testing that will be required for quality control. The Contractor shall, at his own initiative, increase this frequency where necessary to ensure adequate control.

On completion of every part of the Works and submission to the Engineer for examination, the Contractor shall submit to the Engineer the results of all relevant tests and survey checks that he has carried out indicating compliance with the Specification.

For cement, bitumen, mild steel bars, high tensile steel bars, prestressing materials, bridge bearings, road marking paints, reflective paints, road studs, guard rails and such materials, the Contractor shall furnish to the Engineer the manufacturer's test certificates of the actual material to be incorporated in the Works. When required by the Engineer to carry out essential testing at a manufacturer's plants or at laboratories other than the Site laboratory, all costs involved shall be borne by the Contractor.

The methods of sampling and testing of materials shall be as stipulated in the Specification or as approved by the Engineer.

The Contractor shall be required to demonstrate the adequacy of the equipment for each operation to establish their capacity to achieve the requirements to the Specification to the satisfaction of the Engineer before commencement of the Work.

All equipment provided shall be of proven efficiency and purpose-made for its required operation and shall be operated by skilled operators and maintained at all times to perform its proper function in a safe and efficient manner acceptable to the Engineer.

111 STANDARDS

111.1 General

In the absence of any provision in the Specification on any particular issue, reference shall be made to the latest SLS, BS, ASTM or AASHTO code, in that order of preference. Where these are unhelpful, the execution and completion of the Works and relevant tests shall conform to sound engineering practice and, in case of any dispute arising out of the interpretation of the above, the decision of the Engineer shall be final and binding on the Contractor.

Where BS tests are stipulated in the Specification, the equivalent ASTM or AASHTO test method may be substituted as directed by the Engineer.

All codes of practice, standards and specifications applicable shall be the latest edition with all corrections and incorporations as at 30 days before the closing date for bid submission.

111.2 Supply of Codes of Practice, Standards and Specifications and Materials References

The Contractor shall provide the Codes of Practice, Standards and Specifications listed in Appendix 1 to this Specification. The documents provided by the Contractor shall be original publications and not Photostat copies. These shall be the latest edition with all corrections and incorporations as at 30 days before the closing date for bid submission. The documents will become the property of the Employer upon completion of the Works.

111.3 Measurement and Payment

Payment will be made for this item as a Provisional Sum. The Contractor shall verify with the Engineer the individual items required as detailed in Appendix 1 and obtain approval from the Engineer prior to purchase.

Pay Item	Description	Pay Unit
111(1)	Allow for provision of standards/technical literatures as required by the Engineer	Provisional Sum

112 WORK EXECUTED BY THE EMPLOYER OR OTHER CONTRACTORS

The Employer reserves the right to execute on Site work not included in the Contract and to employ for this purpose either his own employees or other contractors.
The Contractor shall ensure that neither his own operations nor the actions of his employees shall interfere with the operations of the Employer or his contractors on such works, and the same obligations shall be imposed on the Employer or contractors in respect of work being executed under the Contract.

The Contractor shall provide unhindered access to all parts of the Site to the Employer and authorized representatives of the Employer and of public bodies and corporations and to contractors employed by the Employer and he shall make available to such authorized persons the use of all temporary access tracks in or about the Site.

113 SERVICES

In the execution of Works by the Contractor, if any services, public or private may be damaged shall be undertaken by the Contractor for reinstatement or repair.

113.1 Existing Services

The Contractor may be ordered to carry out certain works for and on behalf of various statutory service authorities and he shall also provide, with the prior approval of the Engineer, such assistance to the various bodies as, may be authorized by the Engineer.

No removal of or alterations to any public utility shall be carried out unless ordered by the Engineer.

The Contractor shall take all reasonable precautions to protect, and shall provide temporary support to, existing services during construction and during reinstatement or repair of damaged services.

Whenever reinstatement or repair is encountered that interferes with the execution of the works and requires moving or relocation, the Contractor shall advise the Engineer who will determine the extent of the work involved.

Any pipe, cable, conduit or other known service of any nature whatsoever, which has been damaged as a result of the Contractor's operations shall be repaired and reinstated forthwith by the Contractor or by the authority concerned, at all the expense of the Contractor or the authority and to the satisfaction of the Engineer.

The Employer will not be held liable or responsible for any delay in completion of the Works under this Contract which may occur due to any damage occurring to such services in consequence of the Contractor's operations.

113.2 Measurement and Payment

a. Measurement

The work of temporary supporting and protecting public utility services during execution of the Works shall be deemed to be included in the Contractor's rates and prices and no extra payment shall be made for the same.

The amount of work involved in reinstatement or repair to damages of existing services shall be determined on Site and as instructed by the Engineer.

The Engineer may instruct the Contractor to assist in the demolition and/or rebuilding of property within or outside the Right of Way. The amount of work involved shall be determined on Site and as instructed by the Engineer.

b. Payment

Payment for repair to damages of existing services shall be made under a Provisional Sum.
Payment for demolition and/or rebuilding of property within or outside the Right of Way shall be made under a Provisional Sum.

Pay Item	Description	Pay Unit
113.1(1)	Repair to Damages of Existing Services	Provisional Sum
113.1(2)	Demolition/Rebuilding of Property	Provisional Sum

114 MAINTENANCE OF EXISTING ROADS

114.1 General Obligations

The Contractor shall take all reasonable steps to minimize nuisance during the construction of the works (see Clause 4.18 of General Conditions of Contract).

All existing highway and roads used by vehicles of the Contractor or any of his sub contractors or suppliers of materials or plant, and similarly any new roads which are part of the Works and which are being used by traffic, shall be kept clean and clear of all dust / mud / extraneous materials dropped by the said vehicles or their tyres. Similarly, all dust / mud / extraneous materials from the Works spreading on these highways shall be immediately cleared by the Contractor.

Clearance shall be affected immediately by manual sweeping and removal of debris, or, if directed by the Engineer, by mechanical sweeping and clearing equipment, and all dust, mud and other debris shall be removed entirely from the road surface. Additionally, if so directed by the Engineer, the road surface shall be hosed or watered using suitable equipment. The road surface shall be maintained in a better or similar condition at all times.

Any structural damage caused to the existing roads by the Contractor's constructional plant or equipment shall be made good at Contractor's expense.

a. Payment

All these activities shall be deemed to be included in the Contractor's rates and prices and no separate payment will be made thereof.

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

(i) The provision of temporary drainage works such as drains, open channels, banks, etc and the furnishing and operation of temporary pumps and such other equipment as may be necessary to adequately drain, protect and dewater the Works and Temporary Works. This will be in addition to any permanent drainage works specified and installed, and in addition to any temporary drainage works specifically paid for separately.

(ii) Care shall be exercised not to allow material in borrow pits to become excessively wet, to keep all completed layers properly drained, to avoid dumps of material on completed layer work that shall inhibit surface drainage or form wet spots under and around dumps, and to protect all parts of the Works against erosion by floods and rain.

(iii) Material shall not be spread on a layer that is so wet that damage could be caused to the layer during compaction of a subsequent layer when the rod is open to traffic.

(iv) When material is spread out on the road, it shall, during wet periods, be given a good cross fall and a light compaction on the surface with a steel-wheeled roller, in order to facilitate run-off during rainy weather.

(v) Fill and cut slopes shall be promptly repaired whenever damaged by surface water.

(vi) Excavations for pipe drains, culverts, service ducts and similar structures shall be adequately protected against possible ingress of water during rainstorms.

vii) All completed layer work shall be protected and maintained until the following layer is applied. Maintenance shall include immediate repair of any damage or defects which may occur and shall be repeated as often as necessary to keep the layer in tact and in good condition.

viii) Before any completed layer is primed or a following layer is constructed thereon, any damage to the existing layer shall be repaired in a manner approved by the Engineer, so that after repair, or reconstruction if necessary, it will conform in all respects to the requirements specified for that layer. All repair work shall be submitted to the Engineer for inspection before covering up.

ix) The Contractor shall inform the Engineer of damage or defects to any work before repair or maintenance and the Engineer shall instruct the extent and method of repair. The previously constructed layer shall be thoroughly cleaned of all foreign material and the Contractor shall request its inspection by the Engineer before construction of the following layer or application of a prime coat, surfacing or surface treatment. In the case of all bituminous work in particular the existing layer shall be thoroughly broomed and all dung, clay, and other deleterious material completely removed. Where necessary the surface shall be sprayed with water before, during and after brooming to remove all foreign material.

115.1 Payment

Work performed as part of the above obligations shall not be measured and paid for separately and the cost thereof is deemed to be included in the Contractor's rates and prices.

116 REMEDIAL WORK

When any part of the Works fails to conform to the Specification, or is at any stage before final acceptance damaged so that it no longer conforms to the Specification, the Engineer shall instruct its complete removal and replacement with satisfactory work. In special cases the Engineer may instruct the Contractor to apply remedial measures in order to make good any such defects or damage. The remedial measures taken shall be subject to the Engineer's approval regarding the details thereof.

In particular, remedial measures shall ensure that the final product is in full compliance with the Specification, shall not endanger or damage any other part of the Works, and shall be carefully controlled and submitted to the Engineer for examination when completed, or at any intermediate stage as may be required.

For the guidance of the Contractor an indication of what may be required in remedying the more common cases of defects or damage is given below, but the Engineer will in no way be bound to approve of or adhere to the measures indicated, as the actual remedial measures will be dictated by the circumstances of each particular case.

116.1 Earthworks

Where a cut slope has been over-excavated, reinstatement by backfilling will not normally be permitted and the entire slope may need to be re-trimmed to obtain a uniform slope.

Where the floor of a cutting has been over-excavated it will normally require backfilling and re-compaction with approved material of higher quality than the cut material. All necessary measures shall be taken to drain ground water that may accumulate in backfilled sections. Excess widths of fills will need to be trimmed to the design profile.

Where erosion has occurred on the surface of cuts or fills, the damage shall be made good by backfilling with suitable material and re-trimming. In more serious cases the slope may have to be cut back and backfilled after benching, and compacted to the required standard of compaction with suitable small equipment, followed by re-trimming.

116.2 Local Defects in Pavement Layers

The length and width of the area to be repaired by equipment shall be such as to accommodate the full width of the equipment used and of a reasonable length to ensure effective repair.
The depth to which material will have to be removed will depend on the defect and the type of material. Gravel layers will need to be broken up to a depth of at least 75 mm and crushed stone layers will usually need breaking up over their full depth. Asphalt material will normally require removal for its full depth.

116.3 Concrete

Defective concrete work will normally need the cutting back and complete removal of any weak or honeycombed sections and making good using approved bonding agents to bind fresh concrete to old concrete. Cracks, if permitted to remain, shall be injected with approved compounds and test cores taken to confirm the efficacy of the injection process.

116.4 Payment

Work performed as part of the above obligations shall not be measured and paid for separately and the cost thereof is deemed to be included in the Contractor's rates and prices.

117 EXISTING UTILITIES AND UTILITY DIVERSIONS

Description

The positions of all public and privately owned utilities must be regarded as approximate. The Contractor must verify this information and satisfy itself as to the exact nature and position of all such apparatus. The Engineer does not guarantee the accuracy of the information given on the Drawings and no warranty is given or implied.

It is the intention of the Employer that all the utilities interfering with the Work are shifted by the respective agencies prior to the commencement of the Work by the Contractor. However, it is the responsibility of the Contractor to initiate the process of getting any of the remaining utilities at Site shifted during construction in accordance with this Specification.

The Contractor shall take into account the current laws regarding the safety of utility lines, together with any amendment or additions thereto. The utility authority shall include in his cost estimate for anything in these laws considered to have monetary value / implication.

The Contractor shall take any and all measures reasonably required by any public or concerned authority for the support and full protection of all mains, pipes, cables and other apparatus during the progress of the work, and shall construct and provide to the satisfaction of the Engineer, all works necessary for the prevention of damage to utilities or interruption of services.

If any underground utility line is encountered unexpectedly, excavation shall cease, and the Engineer shall be notified immediately. Emergency work, as necessary, shall be put in hand without delay and without prejudice to the indemnity of the Employer.

If in the execution of the works, by reason of any subsidence caused by any act of neglect, or default of the Contractor, any damage to any apparatus, or any interruption of, or delay to the provision of any service is caused, the Contractor shall report it to the Engineer immediately.

The Contractor shall familiarize himself and all his employees with the dangers of working or near live sewers and at sewage treatment works, in particular to the risks of physical injury from the explosion of dangerous gases and / or bacterial infection from contact with sewage and of exposure to poisonous gases, which may be given off by the sewage. Hydrogen sulphide and methane are prevalent in the sewers and can exist in excavations where septic sewage from collection tanks is allowed to seep into groundwater. In the context of this clause, the term sewer includes irrigation mains and drains carrying ground water and / or storm water.

The Contractor shall at all times during the progress of the Works, afford facilities to properly accredited utility agencies to access all or any of their apparatus situated in or under the Site, as may be necessary for inspecting, reporting, maintaining, removing renewing or altering such apparatus in connection with the construction of the Works or any other purpose whatsoever.

The Contractor will be fully responsible for ensuring observance of the above regulations by his sub-contractors, if any.

Where any utility or service works are to be constructed under a separate contract by the Employer within the Site, concurrent with the execution of the Works, the Contractor shall cooperate with the other Contractor and be responsible to fully coordinate construction operations so as to avoid interference with either Contractor's operations.

Any public or private service for water, electricity, drainage, etc affected by the Works shall not be interrupted without the written permission of the Engineer. Such permission will be withheld until suitable approved permanent or temporary alternative services have been provided by the owner of the utility or his agents.

Before any temporary traffic diversions, detours or road closures as may be required for the construction of road crossings are constructed full liaison with all the concerned local authorities and Police Departments and their written approval / no objection certificates for same must be submitted to the Engineer prior to work commencing.

Due allowance shall be given by the Contractor, when preparing the Program of Works, to compliance with this Clause 117.

117.1 Payment

Payment shall be based on the rates and sums assessed and agreed by the Engineer for the completed works to the satisfaction of the Engineer, which shall include full compensation for providing all materials, labour, tools, equipment and incidentals necessary to carry out the works as specified above.

Pay Item	Description	Pay Unit
117.1(1)	Diversion, Protection or Removal of Electrical services	Provisional Sum
117.1(2)	Diversion, Protection or Removal of Water services	Provisional Sum
117.1(3)	Diversion, Protection or Removal of Telecommunication services	Provisional Sum

118 FACILITIES FOR THE ENGINEER AND HIS STAFF AND EMPLOYER

118.1 General

The following facilities and services for the Engineer / Employer shall be provided by the Contractor:-

- Site Office(s) with equipment and furniture including telecommunications equipment;
- Housing for the Engineer and Employer with equipment and furniture.
- Laboratory(s) with equipment, apparatus, furniture, and testing consumables;
- Surveying Equipment;
- Vehicles (including drivers) and motorcycles;
- Progress photographs;
- Project sign boards;
- Removal of facilities and equipment upon completion.

Particular requirements in respect of the above facilities and services are detailed in the following clauses and the following shall generally apply:-

1. All matters in respect of facilities or services shall be subject to the Engineer's formal approval. The Contractor shall submit details of all proposals prior to placing orders or making any arrangements.

2. All facilities shall be new except where expressly provided otherwise.

3. Buildings may be prefabricated or of indigenous construction. Rented accommodation to the same standard and in suitable locations shall also be acceptable.

4. Notwithstanding any particular requirement detailed below the buildings shall be to contemporary standards, shall comply with national building regulations and legislation and be fit for intended use.

5. All facilities and services shall be for the exclusive use of the Engineer/Employer and their staff during the period of the Contract and as further required to finalise measurement, payment etc., but shall revert to the contractor when no longer required, unless otherwise stated or directed.

6. The Contractor shall provide the Office facilities and services as soon as is practical and not later than 90 days after the date of commencement of the work. During the period prior to completion of construction or provision of the regular office accommodation the Contractor shall provide fully functional office accommodation at a suitable location mutually agreed with the Engineer.

7. The Contractor shall provide the Laboratory buildings, facilities, equipment, apparatus and services as soon as is practical and not later than 60 days after the date of commencement of the work. All the equipment shall be mobilized on site and made operational within this period so that it can be checked and approved by the Engineer well in advance of the commencement of construction work so that the testing of materials sources can be commenced as soon as possible.

8. The Contractor shall provide the survey equipment within 60 days of the date of the commencement of the works.

9. The Contractor shall supply all the vehicles as soon as is practical and not later than 60 days after the date of commencement of the work. Prior to the provision of the vehicles the Contractor shall hire and make available to the Engineer / Employer similar vehicles to the approval of the Engineer.

10. The Contractor will be responsible for ensuring that the facilities provided for the Engineer / Employer are secure at all times and shall erect fencing and employ day and night watchmen / security guards.

11. The Contractor shall provide replacement services or facilities whenever any item becomes unavailable or unusable from any cause.

12. The facilities will include the provision of land, site grading, all weather access roads, hard standing parking facilities for vehicles with water supply, hose and vehicle wash down facilities, construction of all necessary appurtenance such as drainage systems, fencing, utilities, landscaping, area development etc.

13. Where the Contractor leases land for construction of the facilities or leases premises for the provision of the facilities, the Contractor shall ensure that the terms of the lease allow the use of the land/premises for as long as they are required and shall take into account possible extension or overrun of the Contract period and use of the facilities after the issue of the Defects Liability Certificates. The terms of the lease shall incorporate provisions whereby the Contractor may assign his interests to the Employer.

14. The Contractor shall maintain all facilities for the duration of the Contract, such maintenance shall include but not be limited to:-

    (a) keeping buildings in good repair and decorative order, and free from pests, insects etc;
    (b) cleaning offices and laboratory daily;
    (c) maintaining the grounds around buildings;
    (d) supplying kitchen-ware and crockery and cleaning materials;
    (e) supplying toilet and cleaning equipment and materials;
    (f) providing power, drainage, telephone services, fax and e-mail facilities;
    (g) servicing and repairing all fittings and equipment installed, eg: air-conditioners, fans, cookers etc;
    (h) provide adequate security for offices and Engineer's laboratory.

118.2 Building Construction

The buildings shall comply with national standards in respect of:

- thermal insulation;
- fire regulations;
- structural design.

The buildings shall be capable of being maintained by air conditioning within a temperature range of 21°C to 24°C.

+5

Buildings shall also comply with the following requirements:

a) all windows shall be mosquito proofed;
b) individual office rooms shall be provided with a floor/ceiling fan;
c) kitchens and the bathrooms shall be provided with an extractor fan;
d) all rooms shall be lockable; external doors shall have double mortice locks;
e) floor coverings for the site offices shall be vinyl or ceramic tiled;
f) the laboratory floors shall be concrete painted with a sealant;
g) emergency fire exits shall be provided and shall be clearly marked;
h) each office and each laboratory shall be provided with a store room;
i) offices and laboratories shall be proved with a kitchen area, and separate toilets for men and women.

118.3 Utilities

All buildings shall be provided with a 220/240 volt electricity supply. Back up provisions shall be provided to all buildings in the form of a standby electricity generator in the event of systematic failure of the main supply. The standby electricity generator shall be of sufficient power to supply the entire peak electricity demand (including air conditioning) of each building. Power points shall be supplied in numbers and at locations to the satisfaction of the Engineer. The power supply shall be fully earthed and shall be subject to power peak protection and voltage regulation.

Buildings shall have a continuous water supply with hot and cold water in the laboratories and in all toilets and kitchens. There shall be a continuous supply of potable water, which may be provided separately through rechargeable dispensers or bottled supply.

Buildings shall be supplied with bottled gas or other fuel as appropriate for the cooking equipment provided.

The Contractor shall provide a broadband wireless internet connection to each office as indicated in the Contract, throughout the period of occupancy of each office. The internet connections shall be independent of any internet connections installed by the Contractor for its own use.

The Contractor shall be responsible for providing suitable hygienic methods for the treatment and disposal of waterborne sewage, waste water and refuse from all buildings.

The offices shall be wired for a computer Local Area Network as detailed in the Schedule of Office Equipment.

118.4 Offices, Equipment and Furnishings

The offices, equipment and furnishings to be provided are described in Appendix 2. The equipment and furnishings shall revert to the Employer at the date of issuing the Taking Over Certificate for the whole of the works, or at such other date instructed by the Engineer. The Contractor shall ensure that the equipment and furnishings are in good condition and in full working order at the time of handing over to the Employer.

a. Measurement

Offices complete with equipment and furniture as described in Appendix 2 shall be measured as the number of each type of office provided.
The Contractor shall provide all requirement mention in the sections 118.1, 118.2, 118.3 & 118.4.

b. Payment

Payment for each type of office shall include for :-

(a) provision of the site for the accommodation, whether purchased or leased;
(b) preparation of the site;
(c) provision of the buildings and fixtures;

(d) water, sanitation, heating, power and lighting services, including standby electricity generation;
(e) hard standings, access roads, footways, perimeter fencing, security lighting, ancillary works;
(f) office furnishings and equipment, fittings and protective clothing;
(g) land line telephone connection(s) and extensions where described in Appendix 2;
(h) mobile telephones, where described in Appendix 2;
(i) wireless telephones and extensions, where described in Appendix 2;
(j) cabling for computer networks(s);
(k) the provision of temporary accommodation until the permanent offices are available.

Payment for each type of office shall be made upon completion, fully equipping and furnishing and upon occupation by the Engineer's / Employers staff to the extent that they can properly perform their duties.

The sum payable for the overhead charges and profit in respect of these items shall be 15%.

Pay Item	Description	Pay Unit
118.4 (1)	Provide Main Office/Secondary office for the Engineer	Provisional Sum
118.4 (2)	Provide Office for the Employer	Provisional Sum

118.5 Maintenance of Office of the Engineer and Employer

Description

The Contractor shall maintain in good decorative and working order all the buildings and the contents thereof supplied under the Contract. The Contractor shall be responsible for supplying all power, water and telephone services including mobile telephones to all the facilities and shall meet all costs for these services as further detailed in Appendix 2 and settlement of all bills for these services.

The Contractor shall maintain all facilities for the duration of the Contract, such maintenance shall include but not be limited to:-

(i) keeping buildings in good repair and decorative order, and free from pests, insects etc;
(j) cleaning offices and laboratory daily;
(k) maintaining the grounds around buildings;
(l) supplying kitchen-ware and crockery and cleaning materials;
(m) supplying toilet and cleaning equipment and materials;
(n) providing power, drainage, telephone services, fax and e-mail facilities;
(o) servicing and repairing all fittings and equipment installed, eg: air-conditioners, fans, cookers etc;
(p) provide adequate security for offices and Engineer's laboratory.

Measurement and Payment

a. Measurement

Maintenance of each facility shall be measured on monthly basis during which the maintenance for each facility is satisfactorily provided. Maintenance shall not be measured during any period occurring between the expiration of the contract period (including awarded Extension of Time) and the date the works are certified as complete. Measurement will be made for maintenance performed after the completion of the works, during the time the facilities are required by the Engineer's staff for post-construction contract completion activities.

b. Payment

Payment for maintenance for each facility shall include all labor, materials and equipment required for satisfactory maintenance of the facilities and shall include all other costs including but not limited to supply of electricity, water and telephone facilities, cleaning, guarding, disposal of rubbish, repairing

equipment and all other work required to ensure the facilities and equipment provided are in good operational order. Payment shall be effected through a Provisional Sum including a mark up to 15%.

118.5(a) MAINTENANCE OF FACILITIES FOR ENGINEER AND EMPLOYER

118.5.1 Description and Payment

The maintenance of facilities for the Engineer and Employer, are listed, inter alia, under sub sections 118.5 (Maintenance of Office of the Engineer and Employer), 118.7 (Maintenance of Housing of the Employer and Engineer), 118.8 (ii) (Maintenance of Vehicles for the Engineer & Employer), 118.9 (Maintenance of Laboratories and Testing Equipments), 118.11 (Clerical of Technical Staff for the Engineer) and 118.12 (Stationery for the Engineer and Employer). Payment for these works shall be paid under a single item (Maintenance of Facilities for Engineer and Employer) through a Provisional Sum given in the BOQ in Bill 100A bearing Pay Item No. 118(1).

The sum payable for the overhead charges and profit in respect of this item shall be 15%.

118.6 Housing for the Employer/Engineer

Description

The housing to be provided for the Employer's and Engineer's use is described in Appendix 3. Houses which may be rented and provided shall be available and ready for use within 28 days after the Commencement Date, unless otherwise agreed by the Engineer.

In the event that the Employer/ Engineer's housing is not been provided within the prescribed period or is not to the satisfaction of the Engineer, all costs associated with the provision, operation and maintenance of the housing, after the expiration of the period will be recovered from the Contractor.

The fittings, furnishing and equipment to be provided in the houses are described in Appendix 3, and shall remain the property of the Contractor on completion of the Works.

Measurement and Payment

a. Measurement

Houses for the Employer shall be measured as the number of house provided.

b. Payment

Payment for houses shall include for:

Connection and subsequent disconnection of electrical, telephone and water services or alternative provision of same.

Provision of drainage systems for both sewerage and surface waters.
Payment for houses shall be made upon satisfactory provision of houses and upon occupation by the Employer or his staff.

The payments for houses shall represent full and final payment for the Contract Items and Contractor shall not be entitled to any further compensation irrespective of any increase to the Contract period for whatever reason.
The sum payable for the overhead charges and profit in respect of these items shall be 15%.

Pay Item	Description	Pay Unit
118.6 (1)	Provide Housing for the Employer	Provisional Sum
118.6 (2)	Provide Housing for the Engineer	Provisional Sum

118.7 Maintenance of Housing of the Employer/Engineer

Description

The Contractor shall maintain in good decorative and working order all the buildings and the contents thereof supplied under the Contract. The Contractor shall be responsible for supplying all power, water and telephone services to all the facilities and shall meet all costs for these services as further detailed in Appendix 3.

The Maintenance of the Employer's / Engineer's Houses shall include daily cleaning to the satisfaction of the Engineer and provision of toilet materials.

The Contractor shall maintain in good condition, service regularly and repair or replace as required, all items of furniture, fittings and equipment installed in the houses.

The Contractor shall provide adequate security to guard and secure the facilities on a 24 hours per day basis for the Houses.

Measurement and Payment

a. Measurement

Maintenance of each facility shall be measured on monthly basis during which the maintenance for each facility is satisfactorily provided. Maintenance shall not be measured during any period occurring between the expiration of the contract period (including awarded Extension of Time) and the date the works are certified as complete. Measurement will be made for maintenance performed after the completion of the works, during the time the facilities are required by the Employer's staff for post-construction contract completion activities.

b. Payment

Payment for maintenance for each facility shall include all labor, materials and equipment required for satisfactory maintenance of the facilities and shall include all other costs including but not limited to supply of electricity, water and telephone facilities, cleaning, guarding, disposal of rubbish, repairing equipment and all other work required to ensure the facilities and equipment provided are in good operational order. Payment shall be effected through a Provisional Sum including overhead and profit of 15%.

118.8 Vehicles for the Engineer and Employer

Description

The Contractor shall supply the vehicles (including motorcycles) described in Appendix 4. All vehicles shall be new, plain coloured and approved by the Engineer. The vehicles are for the exclusive use of the Engineer, his staff and the Employer. The vehicles shall be licensed and insured for use on the public highway with comprehensive insurance cover for any qualified driver authorised by the Engineer, together with insurance cover for all authorised passengers and for the carriage of goods or samples.

All other vehicles shall be based in Project area except Employers Vehicles.

The Contractor shall provide a competent, qualified driver for each vehicle (except motorcycles). The drivers shall hold a valid drivers licence and shall be subject to the approval of the Engineer at commencement of their duties and throughout their employment.

The Contractor shall provide fuel, oil and maintenance in conformity with the manufacturers recommendations and shall clean the vehicles inside and outside, and fuel and oil the vehicles on a daily basis.

A suitable replacement vehicle shall be provided for any vehicle that is out of service for whatever reason for longer than 24 hours.

Vehicles shall be provided for as long as they are required by the Engineers staff or Employer in connection with the Contract, including a period beyond the certified date for Completion of the Works.

Vehicles provided under the Contract may be required by the Engineer or the Employer to travel outside of the contract limits. The Contractor shall provide all fuel and oil for such journeys and shall pay the drivers an appropriate and adequate accommodation and meal allowance when such journeys involve an overnight stay.

After completion of the project the vehicle shall be the property of the Employer.

a. Measurement

i. Supply of Vehicle

Payment for this supply of vehicle which shall include the followings will be paid through a Provisional Sum with overhead of 15%.

(a) supply and delivery to the Engineer's site offices of the vehicle(s) and ancillary equipment;
(b) all necessary registration and licensing documents for full and immediate road use;
(c) initial service;
(d) provision of temporary vehicles until the permanent vehicles are available.

The over-heads and Profits for the supply shall be paid separately.

ii. Maintenance of Vehicles

The measurement for maintenance of the vehicles shall be vehicle month for each type of vehicle provided and maintained. Vehicle not provided for a full month shall be measured on a Pro rate basis.

The rate for the maintenance of vehicles shall be full compensation for :

(a) equipment ;

(b) Revenue licenses and road taxes for use on public highways as appropriate ;

(c) comprehensive insurance covering the Engineer / Employer and their authorized staff and any driver authorized by the Engineer, and for the carried of goods and samples ;

(d) provision of a suitable replacement vehicle when a regular vehicle is unavailable or unserviceable for more than 24 hours ;

(e) depreciation ;

(f) maintenance in a roadworthy condition and in conformity with the vehicle manufacture's recommendations including the provision of replacement tyres.

(g) fuel , oil , lubricants and other consumables ;

(h) cleaning inside and out on a Daily basis ;

(i) provisions of a full time driver including all overtime payments and any accommodation payments including overnight accommodation allowance when away from the duty station ;

(j) Security

Pay Items

Item No.	Description	Pay Unit
	For the Engineer	
118.8 (1)	Provide Vehicle Type 1A	P.Sum
118.8 (2)	Provide Vehicle Type 1B	P.Sum
118.8 (3)	Provide Vehicle Type 3	P.Sum
118.8 (4)	Provide Vehicle Type 4	P.Sum
118.8 (5)	Over head and profit for supply of vehicles Type 1A	% of total cost
118.8 (6)	Over head and profit for supply of vehicles Type 1B	% of total cost
118.8 (7)	Over head and profit for supply of vehicles Type 3	% of total cost
118.8 (8)	Over head and profit for supply of vehicles Type 4	% of total cost

Item No.	Description	Pay Unit
	For the Employer	
118.8 (13)	Provide Vehicle Type 1A	P.Sum
118.8 (14)	Provide Vehicle Type 1B	P.Sum
118.8 (15)	Provide Vehicle Type 2	P.Sum
118.8 (16)	Over head and profit for supply of vehicles Type 1A	% of total cost
118.8 (17)	Over head and profit for supply of vehicles Type 1B	% of total cost
118.8 (18)	Over head and profit for supply of vehicles Type 2	% of total cost

The cost for maintenance of vehicles for the Engineer and Employer shall be paid through the Provisional Sum allowed for.

118.9 Testing Laboratories, Equipment and Services

Description

The laboratories, equipment and furnishings to be provided are described in Appendix 5. The equipment and furnishings shall revert to the Employer at the date of issuing the Taking Over Certificate for the whole of the works, or at such other date instructed by the Engineer. The Contractor shall ensure that the equipment and furnishings are in good condition and in full working order at the time of handing over to the Employer. The laboratories shall be adjacent to the Resident Engineers office and laboratory shall be provided with a lockable concrete floored storeroom of 10sq.m. minimum floor area.

The Contractor shall provide a GPS which shall be 'hand held' type with built in antenna and shall have the main features described in Appendix 5. In addition it shall have an electronic compass of + or – 5 degree accuracy and barometric altimeter. The Contractor shall forward his proposal for the Engineer's approval and shall not place any order until the Engineer's approval is given.

The Contractor shall also provide a FWD (Falling Weight Deflectometer) which shall be 'portable' type with at least two geophones and GPS and shall have the main features described in Appendix 5. The Contractor shall forward his proposal for the Engineer's approval and shall not place any order until the Engineer's approval is given.

Submittals

1 Proposed testing laboratory: Provide details for the mobilization of the laboratory and equipment as part of the mobilization schedule required in accordance with these Specifications.

2. Proposed testing personnel: Accompanying the above data submit a list, together with CVs of all technical personnel the Contractor proposes to employ for testing under this Contract.

3. Schedule for testing: Prepare a master schedule of all items to be tested. By coordination with the construction schedule, and the specified testing frequencies found in the materials specifications, establish tentative dates for each such activity. Submit this data in preliminary form for the Engineer's review at the beginning of each month.

4. Test Forms: Within 60 (sixty) days from the Commencement of Works, submit proposals for standard test forms to be used on the Contract for all tests required by the Specifications, for the Engineer's approval.

Execution of Testing

Generally all calibration of equipment and testing work will be carried out by the Contractor under the direction and supervision of the Engineer.

Codes and Standards

Testing shall be executed strictly in accordance with all pertinent codes, regulations and specified standards. Some of these Standards for testing are given in Appendix 5.

Personnel

Personnel engaged for the purpose of materials testing shall be sufficiently experienced and familiar with the required material tests and shall have the prior approval of the Engineer.

Forms

For the actual testing and reporting of test results, only those test forms approved in advance by the Engineer or provided by the Engineer shall be used.

Notification

To permit the Engineer or his representative to witness any non-routine tests they desire, the Engineer shall be notified of the planned timing of the test at least one hour in advance of its execution.

Distribution

Test reports shall be promptly processed and distributed to ensure that any necessary retesting, replacement of materials, or re-compaction of materials may be carried out with the least delay to the Works.

a. Measurement

Laboratories with furniture as described in Appendix 5 shall be measured as the number of each type of laboratory provided. Payment for laboratory equipments as stated in Appendix 5 will be made through a Provisional Sum. The sum payable for the overhead charges in respect of this item shall be 15%.

b. Payment

Payment for each Type of laboratory shall Include for:-

(a) provision of the site for the accommodation, whether purchased or leased;
(b) preparation of the site;
(c) provision of the buildings and fixtures;
(d) water, sanitation, heating, power and lighting services, including standby electricity generation;
(e) hard standings, access roads, footways, perimeter fencing, security lighting, ancillary works;
(f) furnishings and equipment, fittings and protective clothing as described in Appendix 5;
(g) laboratory and field testing equipment as described in Appendix 5;

(h) all consumables required for both laboratory and site testing;
(i) delivery of all soil and materials samples from pits, quarries, suppliers or the completed works by the Contractor and at no additional cost to the Employer;
(j) land line telephone connection(s) and extensions where described in Appendix 5;
(k) mobile telephones, where described in Appendix 5;
(l) wireless telephones and extensions, where described in Appendix 5;
(m) cabling for computer networks(s);
(n) the provision of temporary accommodation until the permanent laboratories are available.

The cost of carrying out calibration of all testing instruments initially and the cost of such calibration and any additional calibrations necessary for all testing instruments during contract execution and all tests necessary for proper completion of the Works, in accordance with the various specified or implied testing requirements in the Contract Documents shall be borne by the Contractor and all such costs shall be deemed to be already included in the relevant Unit Prices for the materials concerned, except as provided below.

If any test not intended, nor specified, nor implied to be necessary, nor otherwise provided for in the Contract Documents is ordered by the Engineer, or if the Engineer orders any test to be carried out by a third party or at any place other than the site of the Works or the place of manufacture or fabrication of the materials to be tested, then the cost of these unforeseen tests shall be borne by the Employer unless the test results show the workmanship or materials not to be in accordance with the provisions of the Contract Documents, in which case the cost of the test shall be borne by the Contractor.

Payment for each type of laboratory shall be made upon completion, fully equipping and furnishing and upon occupation by the Engineer's / Employers staff to the extent that they can properly perform their duties.

Pay Item	Description	Pay Unit
118.9(1)	Provide Main Laboratory	number
118.9(2)	Provide Field Laboratory	number
118.9(3)	Provide Equipment for the Main Laboratory	Provisional Sum
118.9(4)	Provide Equipment for Field Laboratory	Provisional Sum

The cost for maintenance of the laboratories shall be paid through the Provisional Sum allowed for.

118.10 Survey Equipment

Description

The Contractor shall supply the survey equipment described in Appendix 6 for the exclusive use of the Engineer. The Contractor shall be fully responsible for the equipment, which responsibility shall include:-

a) maintenance, calibration and servicing as required;
b) repairing all defects, including accidental damage, as required;
c) replacing any lost or stolen items;
d) effecting insurance of the equipment against damage or loss.

The equipment shall be supplied and maintained for as long as it is required including the period after Completion of Construction for final measurement purposes. At the end of the contract the survey equipment and consumable shall be revert to The Employer in good condition.

a. Measurement

Survey Equipment shall be measured as items detailed in Appendix 6 satisfactorily provided as and when ordered by The Engineer.

b. Payment

Payment for Survey Equipment shall be made through provisional sum. This payment shall represent full and final payment to the Contractor for the Contract item for the complete period of use and the Contractor shall not be entitled to further compensation irrespective of any increases in the Contract period for whatever reason.

In the event the Contractor fails to maintain, repair or replace any equipment item, the Engineer shall effect such maintenance, repairs or replacement and shall deduct from due payments to the Contractor.
The sum payable for the overhead charges in respect of this item shall be 15%.

Pay Item	Description	Pay Unit
118.10(1)	Provide and Maintain Survey Equipment	Provisional Sum

118.11 Clerical and Technical Staff

Description

The Contractor shall provide the Engineer with staff to assist in the administration and supervision of the Works. The staff provided shall be experienced and be capable of performing their allotted duties. The staff shall be nominated by the Employer and the salary will be fixed by the Employer. The Contractor shall ensure the continuity of the services of the selected personnel.

In particular, laboratory and survey assistants shall be capable of assisting the Engineer's staff in material testing and survey work respectively and have at least five years experience in similar works. Draughtsman shall be conversant in Civil works and have at least 5 years experience in AutoCAD Drafting. Secretaries and the Administrators/Clerks shall be experienced in using computers/word processors and be capable of using the latest version of Microsoft Office computer software and have a good command of the English Language.

a. Measurement

The selection of supporting staff and the fixing of their salaries will be done jointly by the Employer and the Engineer.

b. Payment

Payment for staff shall be made from the provisional sum in the Bill of Quantities. Salary for each category of staff shall be agreed between the Employer, Contractor and the staff concerned prior to the appointment unit rates payable to the contractor shall include EPF,ETF etc payable by the contractor in relation to their employment plus 15% (Fifteen percent) overhead.

The cost for stationery for the Engineer and Employer shall be paid through the Provisional Sum allowed for.

118.12 Stationery for the Engineer and Employer

Description

The Contractor shall provide stationery for the Engineer and his staff and the Employer duly requisitioned by authorized personnel. Stationery shall include all consumable items and shall include paper, printing materials (e.g. printer cartridges, printer ribbons, copier toner etc.) and all general office requisites. This item excludes parts, etc., required for repair or replacement in equipment supplied by the Contractor for the offices. Provision of such parts would be included in the Contractor's obligation for maintenance of offices.

Measurement

Stationery for the Engineer and Employer shall not be measured but payment shall be based on the original invoices and receipts for stationery material ordered and received by the Office Manager/Engineer's Representative's staff.

Payment

Payment for stationery shall be the actual net invoiced price of stationery provided (with all suppliers' discounts deducted) with the mark-up of the net invoiced price added to allow for all procurement and delivery costs incurred by the Contractor. Payment of invoiced cost with the mark-up shall be full payment for stationery provided and shall be made from the provisional sum item contained in the Bill of Quantities with overhead of 15%.

The cost for stationery for the Engineer and Employer shall be paid through the Provisional Sum allowed for.

119 SETTING OUT AND CROSS SECTION SURVEY AND DRAWINGS

119.1 General

The Contractor's attention is drawn to the requirements of clause 17 of the General Conditions of Contract regarding setting out.

The Contractor shall check the condition of all permanent Ground Markers and shall satisfy himself they have not been damaged or disturbed and are true in regard to position and level. Where markers have been destroyed, damaged or displaced the Contractor shall reinstate a new marker based on the markers which remain. A new marker shall not be used unless it's true position and level has been established and the new values verified by the Engineer.

Where a marker is likely to be disturbed during construction operations the Contractor shall establish suitable reference markers at locations where they will not be disturbed during construction. No marker shall be covered, disturbed or destroyed before accurate reference markers have been established and the details of the position and levels of such markers have been submitted to the Engineer and approved by him. The Contractor's reference markers shall be of least the same quality and durability as that of the existing markers.
The Contractor shall submit to the Engineer the method of setting out he proposes to employ. To ensure beyond doubt that the complex elements of the road or structure are truly and correctly located and the Contractor shall check all setting out by a different approved method. The Engineer may at any time request the Contractor to submit proof that his setting out has been satisfactorily checked.

Accurate control of line and level shall be provided by the Contractor at all stages of construction. In respect of the road itself control shall be at 20m intervals, or such closer intervals as may be directed, on horizontal and vertical curves. Wherever necessary, but particularly on completion of the sub-grade and the base the Contractor shall re-establish stake-line pegs at sufficiently close intervals to accurately determine the edges of the base, surfacing and kerbing, guard-rails and other road elements permanently exposed to the eye.

The Contractor shall make all provisions necessary for the Engineer to check and measure the setting out of the Works and shall be in attendance to agree measurements and levels before construction works commence.

119.2 Setting Out and Cross sections

The Contractor shall set out the centre-line and establish chainage reference points which are to be marked out on site and recorded. Level Bench Markers at the minimum rate of four per kilometre and at locations of structures requiring modification shall be established and checked regularly and tied into the Permanent Ground Markers.

The Contractor will be provided with a set of cross sections at 20m intervals. The cross sections will be provided on computer disk in AutoCad 13 Format on a zip disk. The Contractor shall provide for the use of an AutoCad technician/computer operator and a suitable computer and printer to enable

the cross sections to be printed. The cross sections will show the existing ground levels and the finished road design levels (FRL) based on the design centre-line.

The Contractor shall superimpose on these cross sections, plotted out to an appropriate scale approved by the Engineer, the design cross section showing the depth of all design pavement layers, the position and extent of the existing road surfacing and any other pertinent points, including the extent of the Right of Way from standard typical cross section Drawings showing the pavement design.

The Engineer takes no responsibility for the accuracy of the computer disc information provide to the Contractor. The Contractor shall survey the original ground levels which will be jointly checked by the Contractor's and Engineer's Surveyors prior to the Engineer's approval and commencement of any construction work.

The cross section once checked and approved by the Engineer shall be the basis for measurement end payment.

The Contractor shall complete the setting out of the centre-line within four weeks following the date of the Engineer's Notice to Commence the Works. Sufficient survey and drafting staff be available to enable the full setting out of the Works and for the drawing up of cross sections to be complete such that no delay is caused to the setting out of the Works.

The Contractor shall employ on the Works sufficient qualified surveyors with at least 2 years experience in similar works and have a thorough knowledge and experience of computer methods for calculating quantities. The surveyors shall have available sufficient modern survey equipment and instruments which shall be to the Engineer's approval. Competent chairmen shall be employed to assist the Surveyor. The Contractor shall assist and supply services of his surveyor and his team to the Engineer whenever required by the Engineer or his Representatives in checking and measuring the Works.

No construction work shall commence on any section of the road until the cross sections for the whole of that section have been checked by the Contractor if he so wishes checked and approved by the Engineer and the pavement layer superimposed by the Contractor and approved by the Engineer.

119.3 Measurement

The quantity to be measured for cross-sections shall be the number of km. for which cross section are detailed on drawings and approved by the Engineer. No separate measurement for construction ground markers shall be made.

119.4 Payment

The cross-section survey measured as provided above shall be paid for at number of kilometres for which cross-section have been taken. The prices shall be full compensation for all labour, materials, equipment and incidentals required to furnish the required cross-sections and as indicated.
All other items of work associated with the setting out of the Works shall be deemed to be included in the Contactor's tendered rates including the Contractor's check if any existing ground levels and their approval.

Pay items shall be:

Pay Item	Description	Pay unit
119(1)	Cross-sectional detailing of full pavement width	Km

120 Administrative Costs for the Project Management Unit

120.1 General

The Contractor is required to reimburse on the certification of the Employer for the Administrative costs incurred in respect of different agencies or persons for services rendered such as utilities including shifting , rentals of buildings, fuel, equipment, consumables etc for the project.

120.2 Project Measurement

A Provisional Sum (PS) is to be allowed under this item in the Bill of Quantities.

120.3 Payment

Payments in respect of expenditure incurred shall be reimbursed to the Contractor inclusive of an overhead component of 15% of the reimbursed amount through the interim payment certificates upon submission of proof that such payment has been made to the relevant party through a Banker's cheque acceptable to the Employer.

Pay items shall be:

Pay Item	Description	Pay unit
120(1)	Administrative Costs of the Project Management Unit	Provisional Sum

123 Training of Engineers

123.1 Description

This work shall consist of the training of Engineers in conformity with the requirements of the Employer.

123.2 Training Requirements

The contractor shall arrange for the training of Engineers in new construction techniques adopted in China which are appropriate for use in highway projects in Sri Lanka and in conformity with the requirements of the Employer.

123.3 Payment

Payment in respect of the above expenditure including tuition fees, air fare, site visits, subsistence etc shall be reimbursed to the contractor inclusive of an overhead component of 15% of the cost through the interim payment certificates upon submission of proof that such payments have been effected as required.

Pay item shall be:

Pay Item	Description	Pay Unit
123(1)	Cost of Training of Engineers	Provisional Sum

200 SITE CLEARING

201 CLEARING AND GRUBBING

Delete the entire section and substitute the following:

201.1 Description

This work shall consist of clearing and grubbing necessary for the performance of the work covered by the Contract in accordance with the Specification.

The work shall consist of clearing and grubbing the designated areas within the right of way of all trees, dead wood, snags, vegetation, rubbish and objectionable material and shall include grubbing stumps and roots and disposing of all material resulting from the clearing and grubbing. It shall not include the demolition, removal and disposal of structures that obtrude into or encroach upon or obstruct the work, which are covered under Clause 202.

201.2 Preservation of Property

Existing roads, improvements, facilities, adjacent property, utilities, services, and trees and plants designated for preservation shall be carefully protected from injury or damage, which could result from the Contractor's operations.

201.3 Construction Methods

a. General

Generally clearing and grubbing shall be performed on the areas designated by staking or detailed in the Contract. If no areas are so designated the areas shall in principle be carried out over the entire right of way unless otherwise instructed.

b. Clearing and Grubbing

Where embankment fill is to be constructed, all topsoil shall be removed to an average depth of 150 mm. All surface objects, all trees, including stumps and roots, stumps and roots of previously felled trees, overhanging branches, except those trees and objects the Engineer directs to be left undisturbed, shall be cleared and grubbed subject to the following provisions:

(i) Outside the limits of the earthworks these are allowed to remain provided that the top of the stumps is not more than 300 mm above ground level. However, trees within these limits shall be cut so that the stumps are in line with the natural ground level as far as practicable.

(ii) In areas of embankment construction stumps and roots and solid objects shall be removed to a minimum depth of 0.5 m below the top level of the subgrade or (perpendicular) below the slopes of the embankments. The removal of these materials shall be to an extent of 1.0 m outside the embankment.

(iii) Where lined drains or ditches are to be constructed stumps and roots shall be removed to a minimum depth of 250 mm below the excavated bottom or into the shaped slope.

(iv) Where the embankment fill is more than 3.0 m high non-perishable solid objects may be permitted to remain provided that the top of such objects is not more than 0.5 m above natural ground level and the compaction of earthworks will not be hindered.

(v) In cut areas stumps and roots shall be removed to a depth of at least 0.5 m below the top of the subgrade over which the pavement is to be constructed to an extent of at least 0.5 m outside the limits of the basecourse.

(vi) All fences, buildings, structures, and encumbrances of any character, except those to be removed by others, upon or within the limits of the right of way, shall be removed by the Contractor and carefully placed on the abutting property or otherwise disposed of as indicated on the drawings or as instructed by the Engineer. Materials so removed, including any existing drain or culvert pipes, which the Engineer may order salvaged, shall be carefully removed and shall be the property of the Government.

(vii) Where, as a consequence of clearing and grubbing, fill material is required in order to restore the original ground level, it shall be acceptable fill material which shall be compacted to the density prescribed for layers at that depth below finished subgrade. Such replacement of materials shall be considered incidental to clearing and grubbing and shall not be measured for payment. Acceptable fill material for backfilling depressions or excavations shall include brick, stone and concrete debris if approved by the Engineer and this material shall be compacted in layers to achieve stable backfill to the approval of the Engineer.

c. Disposal of Cleared Material

(i) Saleable timber as designated by the Engineer shall be neatly stored in an approved accessible place within or near the right of way as directed and shall be trimmed and staked in accordance with the requirements of the appropriate Government agency to which the timber belongs.

(ii) Unsaleable timber may be used by the Contractor for his own purposes in connection with the Contract always provided that he has ascertained and complied with the requirements of the appropriate Government agencies or authorities.

(iii) All unsaleable timber except that to be used, and all brushes, stumps, roots, logs and other refuse from the clearing and grubbing operations shall be burned or be disposed by other means approved by the Engineer.

In such cases the Contractor will be solely responsible for making the necessary agreements and for paying the resulting expenses.

Piles of material for burning shall be placed either at or near the centre of the cleared area, or in adjacent open spaces where no damage to trees, other vegetation and adjacent property shall occur.

All burning shall be done in conformance with the regulations and at such times and in such a manner as to prevent the fire from spreading to areas adjoining the right of way.

(iv) Should the clearing and grubbing be done at a time when burning is not permitted, the Contractor shall pile all material which is to be burned outside the slope lines and, at a time when burning is permitted, he shall return such material to the grade and bum it.

(v) At the end of such operations the roadway and adjacent areas shall be left with a neat and finished appearance. No accumulation of burnt, half burnt or other material shall remain on or adjacent to the right of way.

201.4 Measurement

Clearing and grubbing will be measured on an area basis by the square metre, on the actual work done at site. The work of clearing and grubbing at disposal sites, material sites, and borrow pit sites shall not be paid for.

Any areas occupied by an existing asphalt, concrete or sealed road or otherwise maintained area are excluded from the designated areas and shall not be included in measurement.

Removal of trees, including stumps and roots unless otherwise specified, of girth less than 600 mm and overhanging branches of girth less than 300 mm shall be considered as included in clearing and grubbing.

Removal of trees including stumps and roots, as well as stumps and roots of previously felled trees of girth greater than 600 mm, shall be measured in numbers and separately assessed according to the size categories given below:

(a) Girth greater than or equal to 600 mm and less than 1,200 mm

(b) Girth greater than or equal to 1,200 mm and less than 2,000 mm

(c) Girth greater than or equal to 2,000 mm

Girth shall be measured at a level of 1.0 m above average ground level, or in case of stumps shorter than 1.0 m, at the highest level of the stumps.

Overhanging branches of trees of girth greater than 300 mm shall be measured as directed by the Engineer. The girth shall be the girth of cut.

201.5 Payment

The Contract unit rate specified for the work concerned shall be full compensation for furnishing all labour, materials, tools, equipment and incidentals necessary to complete all the work required by the Contract and as directed by the Engineer.

In the case of clearing and grubbing, this shall include removal and disposal of all the resulting material. In the case of removal of trees and removal of stumps of previously felled trees, this shall include felling, excavating, backfilling, handling, transporting and disposal.

Pay Item	Description	Pay Unit
201(1)	Clearing and grubbing	square metre
	Remove trees:	
201(2)	Girth 600 to 1,200 mm	number
201(3)	Girth 1,200 to 2,000 mm	number
201(4)	Girth over 2,000 mm	number
	Remove branches:	
201(5)	Girth 300 to 600 mm	number
201(6)	Girth 600 to 1,200 mm	number
201(7)	Girth over 1,200 mm	number
	Remove stumps:	
201(8)	Girth 600 to 1,200 mm	number
201(9)	Girth 1,200 to 2,000 mm	number
201(10)	Girth over 2,000 mm	number

202 REMOVAL OF EXISTING STRUCTURES

Delete the entire section and substitute the following:

202.1 Description

This work shall consist of dismantling and removing existing culverts, masonry and brickwork structures, walkways, medians, kerbs and other structures such as guard rails, manholes, catch basins, inlets and the like which are in place, but interfere with the Works and are not suitable to remain in place, and salvaging and disposing of the resulting materials. It shall include the demolition, removal and disposal of buildings or parts thereof necessary to widen the existing right of way where such has not been undertaken or completed by the Employer or the building owners.

All materials obtained from dismantling shall be the property of the Employer.

Culverts and other structures, which are within the existing right of way and which are designated to be removed, shall be removed down to the limits and extent specified hereinafter or as shown in the Drawings or as indicated by the Engineer.

Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed any adjacent pavement, structures or other items specified to be left in place. All operations necessary for the removal of any existing structure which might endanger new work shall be completed prior to the start of the new work.

Dismantling of bridges and parts of bridges for reconstruction, extension, re-decking and so on are included as separate items in the respective Bills of Quantities and are not included in this item.

202.2 Dismantling of Structures

Structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the serviceable materials to be salvaged, the part of the structure to be retained and any other properties or structures nearby.

Unless otherwise specified, the superstructure portion of culverts shall be entirely removed and other parts removed to below the ground level or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent material if required in connection with the dismantling of the structures, shall be deemed to be included in this item.

Where existing culverts are to be rehabilitated only such part or parts of the existing structure shall be removed as are necessary to provide a proper connection to the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Reinforcing bars which are to be left in place so as to project into new work as dowels or ties shall not be damaged during removal of concrete.

Pipe culverts shall be carefully removed in such a manner as to avoid damage to the pipes.

Masonry and brickwork structures shall be dismantled to the extent shown in the Drawings and as directed by the Engineer.

All concrete pavements in carriageway designated for removal shall be broken up for ease of removal and carried to stockpiles at locations designated by the Engineer.

Where existing road signs, kilometre posts, mile posts or guard stones are to be removed they shall be carefully excavated and removed including breaking of the concrete base. The serviceable materials shall be transported and stacked at locations approved by the Engineer, and the unserviceable materials shall be disposed of as directed by the Engineer.

202.3 Salvaged Materials

Materials which may be used directly in the Permanent Works shall be stockpiled separately from those which require processing for reuse. The materials selected for processing should be of such quality as will meet the Specification after breaking, screening and mixing with better quality materials if necessary. The responsibility of selecting a particular material for processing or incorporating in the Permanent Works shall lie with the Contractor.

Acceptability of the materials (after processing as the case may be) shall be determined by the Engineer and only such materials that satisfy the Specification in all respects shall be permitted for incorporation in the Permanent Works.

The materials failing to satisfy the Specification may be used in the Temporary Works or may be used in the lower layers of embankments or to fill depressions, stump holes and the like with the approval of the Engineer. The materials not required by the Contractor for incorporation in the Works, but which are of use to the Employer, shall be neatly stockpiled as directed by the Engineer.
Structural and reinforcing steel obtained from dismantling existing structures shall not be considered suitable for use in the Permanent Works and shall be stored in a neat and presentable manner in locations suitable for loading. Structures or portions thereof which are specified in the Contract for re-erection, shall be stored in separate stockpiles. Pipe culverts that are removed in good condition shall be cleaned and neatly stockpiled at points designated by the Engineer.

All the products of dismantling operations which in the opinion of the Engineer cannot be used in the Works or reused by the Employer shall be disposed of outside the right of way or may be spread in deep borrow pits, as directed by the Engineer.

The Contractor shall comply with the laws, ordinances, building regulations, etc. as prevailing in Sri Lanka. Unless otherwise permitted by the Engineer, the Contractor shall furnish, erect and maintain suitable barricades to prevent personal injury or damage to property.

202.4 Removal of Fences

The work shall consist of removal of fences at locations as instructed by the Engineer. The re-useable material shall be removed with due care and stacked and stored for re-use. The unusable material and debris shall be transported and disposed as instructed by the Engineer.

202.5 Backfilling

As instructed by the Engineer, holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials and thoroughly compacted to match surrounding areas.

202.6 Measurement and Payment

a. Measurement

The required and accepted work of dismantling and removing structures shall be measured as the cubic metre of structural material in place before demolition. Removal of fences shall be measured per linear metre.

a. Payment

The Contract unit rate specified for the work concerned shall be full compensation for furnishing all labour, materials, tools, equipment and incidentals necessary to complete all the work required by the Contract and as directed by the Engineer.

Payment shall include full compensation for carrying out the operations described including but not limited to excavation, backfilling of excavations using approved materials, preparing and shaping, handling, sorting out, salvaging, stockpiling and disposing of material.

Pay Item	Description	Pay Unit
202(1)	Dismantle & remove brick structures (*Provisional Quantity*)	cubic metre
202(2)	Dismantle & remove rubble masonry structures	cubic metre
202(3)	Dismantle & remove concrete structures (*Provisional Quantity*)	cubic metre
202(4)	Dismantle & remove dress stone masonry structures (*Provisional Quantity*)	cubic metre
202(5)	Remove fencing (*Provisional Quantity*)	metre

300 EARTHWORKS

301 ROADWAY EXCAVATION

Delete the entire section and substitute the following:

(Attention is drawn to the additional Section 307 for Channel Excavation given herein after Section 306)

301.1 Description

Roadway excavation shall consist of all the required excavation within the limits of the right of way except excavation otherwise classified. The work shall include the removal, stockpiling, multiple handling, hauling and proper utilization in the Works or disposal to spoil tips located by the Contractor and approved by the Engineer of all excavation materials, and shaping of excavation and preparation of exposed surfaces of excavation on the entire length of the roadway and approaches, in accordance with the Specification and the lines, grades, dimensions and cross-sections shown on the Drawings and as required by the Engineer.

Roadway excavation shall include the following:

(i) All excavated material indicated on the Drawings within the faces of the cross-sections, excavation of all materials for approach roads, streets, intersections and all other areas but not including excavation for ditches, channels, berm ditches, drains and flumes.

(ii) All topsoil required to be salvaged within the limits of the roads in accordance with Section 801 Topsoiling, except under embankment which exceeds 3.0 m in height.

(iii) The excavation, removal and disposal of existing road pavement within the limits of construction. The removal of structures is covered under Section 202.

(iv) Excavation for removal of slides, breakages and cave-ins.

(v) Excavation for stream and channel diversion except where covered under Section 307.

(vi) Excavation required in cuts below sub grade level or under embankment below the lowest normal limit of excavation indicated on the Drawings, or below ground line for the removal of unsuitable material, or below ground line under embankments where benching is required, or as otherwise instructed.

(vii) Excavation in existing embankments where improvements to sight distance is required.

(viii) Excavation not specified elsewhere but nonetheless required for a proper execution of the Works.

301.2 Classification of Materials

a. Soil Suitable for Fill

Soil suitable for fill shall include all suitable materials excavated in accordance with the Specification which is not otherwise specified below as hard rock, soft rock, boulders, unsuitable soil, road pavement excavation, slipped material or subgrade replacement.

b. Hard Rock

Roadway excavation classified as hard rock shall include only roadway excavation which, in the judgment of the Engineer, is not practicable without the use of pneumatic tools or drilling and blasting operations. (Blasting operations are described in Section 306). Hard rock shall not include boulders less than one cubic metre in size. Hard rock shall not include material which, in the judgement of the Engineer, can be loosened or excavated with equipment equivalent to that of the following description:

(i) Tractor Unit: Equipment with a minimum weight of 17 tonnes and net horse power rating of 150 HP or more. The tractor unit is to be in good condition and operated by experienced personnel skilled in the use of ripping equipment.

The ripper to be attached to the tractor shall be the most efficient parallelogram type recommended by the tractor or ripper manufacturer. The ripper shall have a single shank in first class condition with sharpened cutting point.

(ii) Bucket Excavator (backhoe): Equipment able to be fitted with a bucket of maximum size 0.3 cubic metre.

c. Boulders

Boulders shall comprise solid pieces of rock that are weathered on all faces (boulders) that are between 0.25 m3 and 1.0 m3 in volume. Boulders that exceed the stated volume shall be classified as Hard Rock. Boulders that are less than the stated volume shall be measured as Unsuitable Soil.

Measurement of boulders will taken as the maximum dimension along the longest axis of the boulder (length) multiplied by the area of a circle of a circumference equal to the measured girth of the boulder at its widest point.

d. Unsuitable Soil

Excavation of soil from cuts above subgrade level judged by the Contractor to be unsuitable in accordance with the Specification for use in the Works and approved as such by the Engineer. No soil shall be classified as unsuitable without the approval of the Engineer. Such unsuitable soil shall be excavated and disposed of to spoil tips as instructed by the Engineer.

Normally highly organic clays and silts, peat soils containing excess of roots, grass and other vegetable matter shall be considered unsuitable. Materials that are soft or unstable merely because they are too wet or too dry shall not be classified as unsuitable unless otherwise so classified by the Engineer.

e. Road Pavement Excavation

Excavation of or in the existing road pavement, either manually or mechanically.

f. Slipped Material

Removal of material in slips occurring in areas where the Contractor is not working and where the slip is judged by the Engineer to be beyond the control of the Contractor. All slipped materials shall be cleared and disposed of as directed by the Engineer, and shall include debris, earth, vegetation, rock and boulders.

g. Subgrade Replacement

Excavation of material below sub grade level in cut areas and below foundation level of embankments that is judged by the Engineer as unsuitable for the stability of the road pavement or road embankment or any other part of the Works. Such unsuitable material shall be excavated and disposed of to spoil tips as instructed by the Engineer. Backfill to the void created by such excavation shall be with approved material instructed by the Engineer and in a manner approved by the Engineer. Payment for backfill shall be made as for embankment Type I construction.

h. Prepare Subgrade in Cut Areas

The top 150 mm sub grade layer in cut areas shall be compacted to not less than 95% of the maximum dry density of the material at a moisture content within 2% of the optimum moisture content as determined by BS-1377 Test 13 (Modified Procter) or AASHTO T-I80. The degree of compaction shall be checked by field density measurements (BS-I377 Test 15) at the rate of one test for every 500 square metres or as instructed by the Engineer. The top of the sub grade layer shall be trimmed to line and level within the tolerances specified in Section 1601 herein.

301.3 Construction Methods

(a) All roadway excavation and embankment construction shall be performed as specified herein and in Section 304 herein, and the completed roadway shall conform to the required alignment, levels, grades and cross sections.

(b) Unless otherwise indicated in the Drawings, excavation in hard rock shall extend a minimum of 200 mm below the required subgrade level for the entire roadway width and shall be backfilled and compacted with suitable materials as indicated on the Drawings or as instructed by the Engineer.

(c) Topsoil encountered in excavation and classified as suitable for re-use shall be removed to such a depth as the Engineer may direct and be neatly stockpiled. The topsoil so stockpiled shall be made available for the Works without additional charge. No topsoil shall be disposed of without prior written approval of the Engineer.

(d) All suitable excavated materials shall be deemed to be used in constructing the roadway. Unsuitable material and roadway excavation in excess of that needed for executing the Works shall be known as spoil. Spoil shall be removed and disposed of at designated areas or spoil tips located by the Contractor and approved by the Engineer in such a manner as to present a neat appearance and to avoid obstruction to drainage or drainage to any road or road works or other property. The final condition of spoil tips shall be to the approval of the Engineer.

(e) Unsuitable material shall be excavated below sub grade level in cut and below embankment foundation level to the depth shown on the Drawings or as instructed by the Engineer. Where unsuitable material is excavated below the normal sub grade level or below embankment foundations or for benching under embankments, the excavation shall be backfilled with material and in a manner that conforms with Section 304 herein.

(f) All slopes shall be finished in a neat and workmanlike manner and to an accuracy appropriate to the material and care shall be taken that no material is loosened below the required slopes. Breakages and slides shall be removed and disposed of as instructed.

(g) In cut areas, the top of the sub-grade on which select pavement material is to be placed shall be trimmed, prepared and compacted to a minimum depth of 150 mm to not less than 95% of the maximum dry density of the material as determined by BS-1377 Test 13 (Modified Proctor).

(h) The surface of the finished sub grade shall be neat and workmanlike and shall have the form, super-elevation, levels, grades and cross-section as shown on the Drawings. The surface shall be finished to the specified accuracy to permit the construction of subsequent layers of material to the thickness, cross-section, surface tolerance and compaction specified in Section 1601 herein.

i) If the Contractor wishes to obtain material by widening cuts he shall first request permission from the Engineer and, if permission is granted, widening of cuts will be allowed within the limits indicated by the Engineer but not beyond the limits of the right of way. Such material shall be classified as borrow and will not be paid for as excavation. If widening of cuts is carried out on the order of the Engineer the cut shall be measured and paid for as Roadway Excavation.

(j) Material excavated from the existing carriageway for pavement strengthening and widening, shall, if suitable, be used either as part of the new subbase layer in the new shoulder and pavement or in embankment construction as instructed by the Engineer.

(k) All material derived from any excavation required for the Works shall be deemed to be the property of the Employer and the use of all such materials shall be in accordance with the Contract and to the approval of the Engineer.

301.4 Measurement and Payment

a. Measurement

Unless otherwise specified, all required and accepted roadway excavation shall be measured in its original position and the volume determined in cubic metres by the average end area method as computed from the original and final cross-sections of required and completed work. No allowance shall be made for bulking or shrinkage. Separate measurements shall be made for each class of material encountered.

Measurement of rock excavated below subgrade level as required in Section 301.2 herein shall be computed on the basis of excavation to the specified minimum depth below sub grade level only and no overbreak shall be included. Interim payment may be made on measured volumes of required excavation actually executed, before final shaping, provided the Contractor's intention to complete the work is clear. Excavation for removal of slides, breakages and cave-ins shall not be measured nor paid for and shall be deemed to be included in the Contractor's rates unless otherwise decided by the Engineer.

b. Payment

The quantities of roadway excavation measured as specified above will be paid for at the Contract unit rates per cubic metre for the various types as detailed below. Such rates shall include excavating, removal, stockpiling, multiple handling, haulage to embankment areas for re-use and satisfactory disposal of all roadway excavation, to designated spoil tips or to spoil tips located by the Contractor and approved by the Engineer, for shaping, dressing and completion of all surfaces and for furnishing all labour, materials, tools, equipment and incidentals necessary to complete the work. The rate for topsoil shall include stockpiling or disposal as instructed. The rates for excavation of unsuitable materials exclude backfill, which shall be measured and paid for as embankment Type I, embankment Type II, subbase or basecourse as the case may be.

The Contract unit rate specified for the work concerned shall be full compensation for furnishing all labour, materials, tools, equipment and incidentals necessary to complete the work, including compaction and trimming to specified tolerances of the top of sub grade as instructed by the Engineer.

Pay Item	Description	Pay Unit
301(1)	Roadway excavation, soil suitable for fill	cubic metre
301(2)	Roadway excavation, boulders *(Provisional Quantity)*	cubic metre
301(3)	Roadway excavation, hard rock *(Provisional Quantity)* (Normal Balsting)	cubic metre
301(4)	Roadway excavation, unsuitable soil	cubic metre
301(5)	Roadway excavation, subgrade replacement	cubic metre
301(6)	Road pavement excavation	cubic metre
301(7)	Prepare subgrade in cut areas	square metre
301(8)	Roadway excavation , soft rock	cubic metre
301(9)	Roadway excavation, hard rock (Provisional Quantity) (Control Balsting)	cubic metre

302 EXCAVATION AND BACKFILL OF STRUCTURES

302.1 Description

Add at the end of the sub-section the following:

a. Lined Drains

Excavation for lined drains shall be measured as excavation for structures and shall be measured to the dimensions of the drain as shown on the Drawings. Casting of concrete against the excavated earth faces will be permitted subject to the Engineer's approval.

Drains shall be cleared of all debris prior to backfilling and any structural concrete above the top of bed level of proposed lined drain shall be removed and disposed of as noted in Section 202 herein. Drains shall be backfilled with suitable material in layers of appropriate thickness as detailed on the Drawings or as instructed by the Engineer. No separate or extra payment shall be made for backfilling which shall be deemed to be included in the Contractor's rates.

No extra or separate payment shall be made for over-excavation and there shall be no allowance for bulking or shrinkage.

302.2 Classification of Materials

Delete this sub-section and substitute the following:

a. Excavated Materials

The classification of excavated material shall be as given in Section 301.2 herein.

b. Backfill Materials

Backfilling shall be with material approved as embankment material Type I or Type II. It shall be obtained from the structure excavation if the material is approved as suitable for backfilling. Any additional material needed shall be obtained from roadway or borrow excavation unless otherwise instructed by the Engineer.

In the event the above materials cannot be used owing to adverse weather aggregate base course or granular material may be used for which specific approval shall be obtained from the Engineer.

c. Concrete for Foundation Fill

Concrete shall conform to the general requirements of Section 1001 herein. Concrete to be placed under water shall conform to the requirements of Section 1001.10 herein. Concrete to be used as foundation fill in dry excavation shall be made with an aggregate and cement conforming to the' requirements of Section 1001.2 herein and shall be mixed and placed in accordance with Section 1001.8 herein except that minimum cement content shall be 275 kilograms per cubic metre.

d. Foundation Fill Material

Material for foundation fill shall consist of graded sand, gravel or crushed stone as shown in the Drawings or as instructed by the Engineer.

302.3 Construction Requirements

a. General

Add at the end of the sub-section the following:

After each excavation is completed the Contractor shall notify the Engineer to that effect, and no bedding material or structure shall be commenced until the Engineer has approved the depth of excavation and the characteristics of the foundation material.

b. Excavation for Foundation Above Water Table

No change

c. Excavation for Foundation Below Water Table

No change

d. Preparation of Foundation

Add at the end of the sub-section the following:

When, in the opinion of the Engineer, the foundation material is soft, contains organic matter, or is otherwise unsuitable, the Contractor shall remove the unsuitable material and insert foundation fill material, sand, rubble or concrete as specified or shown on the Drawings or instructed by the Engineer. If foundation fill material is instructed it shall be placed and compacted in layers not more than 200 mm compacted thickness or as instructed by the Engineer. The degree of compaction shall be the same as for embankment fill. Rubble used shall confirm to Section 1006.2 herein and sand used shall confirm to Section 1701 Table 2 herein.

e. Backfilling

Add at the end of the sub-section the following:

Where backfilling is required to the same level on more than one side of the structure, it shall be maintained at heights not differing by more than 400 mm on opposing sides of the structure as backfilling proceeds, unless otherwise agreed by the Engineer.

302.4 Measurement and Payment

a. Measurement

No change

b. Payment

Delete the last paragraph and substitute the following:

Dewatering, cofferdams, sheetings, shoring and bracing, and all foundation support and their subsequent removal shall be considered as incidental and included in the rates except for bridges.

Pay Item	Description	Pay Unit
302(1)	Excavation and backfill for structures with, suitable soil	cubic metre
302(2)	Excavation and backfill for structures, in unsuitable soil and backfill with suitable material	cubic metre
302(3)	Excavation in boulders for structures *(Provisional Quantity)*	cubic metre
302(4)	Excavation in hard rock for structures *(Provisional Quantity)*	cubic metre
302(5)	Excavation and Backfill for Structures in marshy Soil	cubic metre
302(6)	Construction of necessary cofferdams ect.	Lump sum / PS
302(7)	Dewatering	Lump sum / PS
302(8)	Preparation of base foundation	Lump sum / PS

303 BORROW EXCAVATION

Delete the sub-section and substitute the following:

303.1 Description

This section describes and specifies all the work necessary in obtaining borrow materials for work under the Contract, either from borrow areas inside or outside the right of way, clearing the borrow site, stripping and disposing of excess overburden, excavating selected materials for use in the Works and reinstating borrow areas.

The Contractor shall obtain approval of the Engineer in writing for use of borrow material either from within the right of way or outside the right of way prior to commencing any borrow operation.

The Employer may have identified certain borrow areas outside the right of way which are expected to provide material in compliance with the Specification. It is the Contractor's responsibility to satisfy himself that the quantity and quality of material available in such areas meets the requirements of the Specification for use in the Works. No claims in this respect, nor regarding any licensing arrangements, shall be considered by the Employer. The Contractor may use any other borrow source provided that the material supplied complies with the requirements of the Specification for the use for which it is intended.

The use, depth, location and dimensions of borrow pits within the right of way shall be subject to the approval of the Engineer. The Contractor will be deemed to have satisfied himself before entering into the Contract as to the use of borrow pits within the right of way and to have allowed in the rates for the risk of borrow pits not being permitted in areas of uncertainty. Notwithstanding any general advice given by the Employer or the Engineer before the submission of bids, borrow pits may be prohibited or restricted in dimensions and depth by the Engineer for reasons such as the stability or safety of the road or structures, interference with natural or artificial drainage or irrigation and the like.

Borrow material shall only be used where there is a deficiency of suitable material from roadway or structure excavation, or for the convenience of the Contractor when he decides after the approval of the Engineer to spoil suitable excavation material at one location and borrow material to replace it at another location.

303.2 Work Requirements

Delete the first paragraph and substitute the following:

Where the Contractor decides to use other borrow sources he shall be responsible for all negotiations with the owner of land on which his intended borrow areas are situated and these negotiations shall take place and be conducted to the satisfaction of both parties and confirmed in writing prior to the opening up of the borrow area. The Contractor shall be responsible for compensation to the owners directly in respect of royalties or loss of crops or any other compensation to which the owner is entitled and for any legal consequences arising from the borrow operation.

Whenever the Contractor elects to obtain material from a borrow area after written approval from the Engineer he shall excavate the necessary trial holes, take such samples and perform or have such tests performed as are deemed necessary by the Engineer. The Contractor shall submit the results to the Engineer in sufficient detail to satisfy him that the quality and quantity of the material available in the proposed borrow area are acceptable for the intended use, all at the Contractor's own expense. Permission to use any borrow material, including its suitability, shall be obtained in writing from the Engineer before execution of the work. It is the responsibility of the Contractor to submit a request for tests at least 21 days prior to the day the Contractor intends to remove material from the borrow area.

The Contractor shall exercise all reasonable care to avoid contamination of approved material by the inclusion of clayey or otherwise unsuitable material from the floor of the borrow pit, from overburden or from unsuitable layers.

The material in borrow pits shall be blasted, ripped and excavated in a manner that will ensure the effective breaking down of the material in the borrow pit before it is loaded. Rippable material which tends to break into large blocks shall be cross-ripped. During loading, hard oversize material which will not break down during processing on the road shall be excluded or removed during spreading.

The Contractor shall be responsible for obtaining permission of the relevant Local Authorities in writing for the use of borrow areas and access roads for haulage of borrowed material.

303.3 Measurement and Payment

Delete the sub-section and substitute the following:

a. Measurement

Borrow shall not be measured.

b. Payment

No payment will be made to the Contractor for borrow but shall be deemed to be included in the Contractor's rate for Embankment Construction. Payment under the items of the work in which the borrow material is placed shall be full compensation for the cost of searching for and finding borrow pits, for acquiring the right to occupy the sites and extract material, for the cost of any negotiations in connection with borrow pits, for the cost of obtaining right of access, for the cost of establishing and maintaining access, for any fees, licenses or royalties in connection with borrow pits, for clearing, grubbing, sloping, draining, and cleaning up of pits, for furnishing, excavation and hauling material from borrow pits and for all labour materials, tools, equipment and incidentals necessary to complete the work.

304 EMBANKMENT CONSTRUCTION

304.1 Description
No change

304.2 Materials

Add at the end of sub-section the following:

All materials which are deposited in place prior to compaction shall confirm to Section 1708.1 herein and shall be evenly spread over the whole of the designated area for the layer concerned and in such quantity that the thickness of anyone layer, when measured after compaction, shall comply with the requirements specified.

Any new layer less than 75 mm in compacted thickness shall be bonded to the previous layer by scarifying the previous layer to a depth not less than 25 mm or to such greater depth so that the total compacted thickness of the new layer plus the scarified portion of the previous layer will not be less than 100 mm.

304.3 Construction Requirements

a. Sources of Supply of Embankment Material
No change

b. Setting Out
No change

c. Removal of Topsoil
Delete this sub-section and substitute the following:

Where the height of embankment fill is more than 500 mm and less than 3.0 m, the topsoil shall be removed as described in Section 201 herein. Topsoil shall also be removed under embankments whose height is greater than 3.0 m and where topsoil is required in other locations or on the instructions of the Engineer. If the in-situ material conforms to Type II embankment material it shall be compacted to a minimum depth of 150 mm to not less than 95% of the maximum dry density of the material at moisture content within 2% of the predetermined optimum moisture content as determined by BS-1377 Test 13 (Modified Procter) or AASHTO T-I80. The degree of compaction shall be checked by field density measurements (BS-I377 Test 15) at the rate of one test for every 500 square metres or as instructed by the Engineer.

Where the height of embankment fill is less 500 mm or where the road is in cutting, the topsoil shall be removed as described in Section 201 herein. If the in-situ material conforms to Type I embankment material, it shall be compacted to a minimum depth of 150 mm below formation level, or to such depth as instructed by the Engineer, to not less than 95% of the maximum dry density of the material at moisture content within 2% of the predetermined optimum moisture content as determined by BS1377 Test 13 (Modified Procter) or AASHTO T-I80. The degree of compaction shall be checked by field density measurements (BS-1377 Test 15) at the rate of one test for every 500 square metres or as instructed by the Engineer.

d. Placing and Compaction of Embankment Material
Delete this sub-section and substitute the following:

The material placed on the road bed shall be thoroughly broken down throughout the layer by means of equipment suitable for this purpose. During such processing the layer shall be frequently bladed using a grader to bring oversize material to the surface to facilitate breaking down.

The material shall be broken down to a size not exceeding 70% of the compacted layer thickness. The compacted thickness of the layers will be dependent upon the size to which the material can be broken down by the technique used but shall in general not be greater than 225 mm.

In order that layer thicknesses are not dictated by the presence of isolated larger rocks or stones, the Engineer shall instruct that the material which cannot be broken down to the size generally achievable for the rest of the material in the layer be removed from the embankment.

Any water required before material is compacted shall be added to the material in successive applications by means of water bow47sers fitted with sprinkler bars or by means of pressure distributors all capable of applying the water evenly and uniformly over the area concerned.

The water shall be thoroughly mixed with the material to be compacted by means of motor graders or other suitable equipment. Mixing shall continue until the required amount of water has been added and until a uniform mixture is obtained. Compaction may proceed when the moisture content of the uncompacted layer is within 2% of the predetermined optimum moisture content.

If the material is too wet it shall be dried by aeration and if it is too dry the material shall be sufficiently watered prior to compaction.

Compaction shall be carried out as a continuous operation covering the full width of the layer concerned and the length of any section of a layer being compacted shall, wherever possible, be not less than 150 metres nor more than can be properly compacted with the available equipment before drying out.

The types of compaction equipment to be used and the amount of rolling to be done shall be such as to ensure that specified densities are obtained without damage to the underlying layers or to structures. During compaction the layer shall be maintained to the required shape and cross section and all holes filled and ruts and laminations shall be removed.

The Engineer may permit thicker layers than as specified above to be constructed, provided that he is satisfied that the specified densities can be obtained throughout the full depth of each layer and that the layers will be uniformly compacted by using equipment specifically suited to this purpose.

Fill shall be placed in successive layers whose planes are parallel to the final road surface, wherever this is practicable, and the construction of tapered layers shall be restricted to the bottom layers of fill where it may be unavoidable due to cross fall, tapering out of fills or super elevation of the final road surface.

Each successive layer shall be placed only after the previous layer has been tested and found satisfactory as specified in Section 304.3(e) herein.

Rolling shall commence at the edges of the layer and proceed towards the centre except at super elevated sections where the rolling shall commence at the lower edge and proceed towards the higher edge. If at any time after compaction the layer is damaged by drying out or is damaged by rain, it shall be scarified, and re compacted to the requirements of the specifications at the Contractor's expense and to the approval of the Engineer.

The Contractor shall ensure that oversize material be disposed of or utilized elsewhere in the construction of the Works. The Contractor shall exercise all reasonable care to avoid bringing onto the road material which cannot be broken down to the required size by processing on the road. This shall be avoided by proper selection in excavation in cut or in borrow. In cut such material shall be taken directly to spoil or shall be utilized as instructed by the Engineer.

Unless otherwise specified, the top 500 mm of the embankment shall be constructed using Type I material and the lower layers of the embankment shall be constructed using Type II material, as specified in Section 1708.1 herein.

e. Degree of Compaction of Embankment Fills
Delete this sub-section and substitute the following:

The top 150 mm layer of the embankment shall be compacted to not less than 95% of the maximum dry density of the material at a moisture content within 2% of the optimum moisture content as determined by BS-1377 Test 13 (Modified Procter) or AASHTO T-180. The degree of compaction shall be checked by field density measurements (BS-1377 Test 15) at the rate of one test for every 500 square metres or as instructed by the Engineer. The top of the layer shall be trimmed to line and level within the tolerances specified in Section 1601 herein.

The remainder of the embankment shall be compacted to not less than 95% of the maximum dry density of the material at a moisture content within 2% of the optimum moisture content as determined by BS1377 Test 13 (Modified Procter) or AASHTO T-180. The degree of compaction shall be checked by field density measurements (BS-13 77 Test 15) at the rate specified in Section 1602 herein.

f. Drainage and Protection of Embankments
Add at the end of sub-section the following:

All permanent drains shall be constructed at the earliest opportunity, along with any temporary drains that may be necessary to protect the road embankment, and they shall be maintained in working condition throughout the construction period.
Side drains discharging from cuts and all other drains shall be constructed in such a way that damage to embankment by erosion is avoided.

g. Finishing Operations
In the second paragraph delete the text "Where specified"

h. Quality Control
Delete this sub-section. Refer to **"Degree of Compaction of Embankment Fills"** above.

i. Not used

j. Embankment Construction under Special Conditions

(i) *Widening Existing Embankments*
Delete this sub-section and substitute the following :

Where existing embankments are to be widened, adequate bonding between the old and the new embankment shall be established by removing the topsoil and benching into the existing slope face in vertical and horizontal faces (including rock) as shown on the Drawings, and the embankment built in successive layers.

(ii) *Embankment on hill slopes*
No change

(iii) *Embankment over existing paved surfaces*
No change

(iv) *Embankment around structures*
No change

(v) *Embankment Construction over Soft Ground*
Delete this sub-section and substitute the following:

(a) Construction below the water table - Rockfill under water on top of geofabric :

Where embankment is to be constructed from below the water table level, rockfill shall be deposited in successive layers of a thickness determined by the size of rock and depth of water, to be height of 300 mm above the highest water level. Each layer shall be constructed starting at one end of the embankment under construction and placing the rock by means of a bulldozer in such a manner that the larger rock shall be placed on geofabric which has been laid out and pegged in position, and the spaces between the layer stones filled with finer material to form a dense interlocking and stable layer. The maximum size of rock shall be 250 mm. The rockfill shall be blinded with a layer of 40 mm graded aggregate sufficient to fill all voids in the upper layer of the rockfill. Rockfill shall be compacted by heavy vibratory rollers until there is no visible movement of the rockfill under the equipment.

(b) Construction above the water table - Pioneer layer on soft unstable ground on geofabric :

Where embankment fill is to be constructed over very wet or soft ground that displays excessive movement under normal compaction equipment and haulage trucks, thereby precluding the effective compaction of the bottom layer, the Engineer may direct that a pioneer layer be constructed on the unstable ground. This layer shall be constructed over geofabric which has been laid out and pegged, by end dumping and spreading successive loads of suitable rockfill or granular material in a uniform layer of thickness sufficient to provide a stable working platform for the construction of further embankment layers which shall be compacted to a controlled density. Light hauling equipment shall be used to place the material, and the layer shall be compacted by the use of compaction equipment that will provide the most effective compaction without over-stressing the roadbed. Pioneer layers need not be compacted to a controlled density.

The compacted volume of material used may be determined on the basis 70% of the loose volume in trucks as an alternative to taking cross sections before and after construction.
Pioneer layers shall be paid for under the appropriate embankment construction rate.

304.4 Measurement and Payment

a. Measurement
No change

b. Payment

Add the following at the end of sub-paragraph (vii):

(vii) Compaction and trimming to line and level of the sub grade layer.

Pay items and pay units shall be as follows:

Pay Item	Description	Pay Unit
304(1)	Trim, level and compact original ground	square metre
304(2)	Embankment construction, Type I	cubic metre
304(3)	Embankment construction, Type II	cubic metre
304(4)	Boulder packing for soft ground treatment	cubic metre
304(5)	Embankment construction, Type 1 with available suitable soil	cubic metre
304(6)	Embankment construction, Type II with available suitable soil	cubic metre

305 TRENCH EXCAVATION FOR UTILITY SERVICES

No change

306 EXPLOSIVES AND BLASTING OPERATIONS

No change

307 CHANNEL EXCAVATION

307.1 Description

This work consist of excavation for all channels, drains, ditches and the like both inside and outside the right of way where shown on the drawings or as instructed by the Engineer. The work shall include the proper utilisation and hauling or disposal of all excavated materials, backfilling where required, constructing, shaping and finishing all earthwork involved in conformity with the required alignment, levels, grades and cross-sections.
All drainage works in any section shall be constructed to the satisfaction of the Engineer before approval is given to commence pavement operations.

307.2 Classification of Materials

Materials excavated shall be classified as noted in Section 301.2 herein.

307.3 Construction Methods

All materials suitable for embankment construction removed from excavations shall be deemed to be used in the formation of embankments. Only material in excess of that required for execution of the Works shall be disposed of as instructed by the Engineer.

Material deemed not suitable for embankment or topsoil shall be disposed of at designated locations or to spoil tips located by the Contractor and approved by the Engineer or as instructed by the Engineer.

The channels, drains, ditches and the like shall be excavated to the alignment, levels, grades and cross sections, required on the Drawings or as instructed by the Engineer. Any excavation beyond the limits required shall not be paid for.
Clearing, cleaning and de silting of culverts shall be paid for under Section 1303 herein.

307.4 Measurement and Payment

a. Measurement

Channel or unlined drain excavation shall be measured as channel excavation and classified in accordance with Section 301.2 herein.

Quantities of channel excavation shall be measured in cubic metres determined by the average end area method computed from the original and the final cross-sections of the authorised and completed excavations. No allowance shall be made for bulking and shrinkage.

b. Payment

The payment shall be full compensation for all excavation, dewatering, backfilling where required, multiple handling, hauling and otherwise properly using and disposing of materials in spoil tips, for establishing and maintaining access to channels and for all labour, materials, tools, equipment and incidentals.

Pay Item	Description	Pay Unit
307(1)	Channel excavation, soil suitable for fill	cubic metre
307(2)	Channel excavation, boulders (*Provisional Quantity*)	cubic metre
307(3)	Channel excavation, hard rock (*Provisional Quantity*)	cubic metre
307(4)	Channel excavation, unsuitable soil	cubic metre
307(5)	Channel excavation, Soft Rock	cubic metre

400 SUBBASES, BASES AND SHOULDERS

401 SOIL SUBBASES

Delete the heading and replace with:

401 SUBBASES

401.1 Description

Delete this sub-section and substitute the following:

This work shall consist of placing and compacting of subbase material in layers on an existing pavement or prepared sub grade in accordance with lines, levels, grades, dimensions and cross-sections shown on the Drawings and as instructed by the Engineer.

401.2 Materials

Delete this sub-section and substitute the following:

The material shall be obtained from approved sources in borrow or cut or from such other sources of supply as may be specified or approved for use from time to time. The material used shall be aggregate, natural soil, or material obtained by blending two or more soils or by blending soil and sand or soil and crusher dust. Such blending is referred to as mechanical stabilisation.

The Contractor's attention is drawn to the scarcity of naturally occurring subbase material and he shall make due allowance for mixing of materials in mechanical stabilisation in accordance with Section 401.3 herein.

Material for subbase shall be as specified in Section 1708.2 herein.

401.3 Mechanical Stabilization (blending)

No change

401.4 Construction Requirements

a. Preliminaries

No change

b. Placing and Compaction of Subbase Material

Add the following:

The subbase shall be constructed after checking that the underlying layer conforms to the specified requirements and has been approved by the Engineer. Immediately before placing the material, the underlying layer shall be checked by the Contractor for any damage or deficiencies, which shall be made good as instructed by the Engineer.

The subbase material shall be placed, spread, broken down, watered and compacted and oversize material shall be removed all in accordance with the requirements of the specifications. There shall be no separate payment for removal of oversize material.

All materials which are deposited in place prior to compaction shall be evenly spread over the whole of the designated area for the layer concerned and in such quantity that the thickness of anyone layer, when measured after compaction, shall comply with the requirements specified.

Any water required before material is compacted shall be added to the material in successive applications by means of water bowsers fitted with sprinkler bars or by means of pressure distributors all capable of applying the water evenly and uniformly over the area concerned.

The water shall be thoroughly mixed with the material to be compacted by means of motor graders or other suitable equipment. Mixing shall continue until the required amount of water has been added and a uniform homogeneous mixture is obtained. Thereafter compaction may proceed.

The field moisture content shall be within 2% of the predetermined optimum moisture content at the time of compaction. If the material is too wet it shall be dried by aeration and if it is too dry the material shall be sufficiently watered prior to compaction.

Where an existing subbase layer is to be improved by the addition of a layer of material less than 100 mm thick, the existing surface shall be scarified to a depth instructed by the Engineer, mixed with the imported material to form a homogeneous layer of minimum depth 100 mm, recompacted to the dry density specified for the layer and formed to the lines and levels shown on the Drawings or as instructed by the Engineer.

Where a subbase is to be laid over an existing pavement, the existing pavement shall be fully scarified to enable the existing bituminous layer and aggregate greater than 100 mm in size to be removed. In removing the bituminous layer the Contractor shall ensure that as much of the adhering existing aggregate as possible is dislodged and left remaining to be mixed with the subbase to be added.

Where instructed by the Engineer, existing material considered of poor quality shall be removed and disposed of. Extra subbase material shall then be added to the existing pavement material and thoroughly mixed either in place or alongside the area to be strengthened. Compaction and surface finish shall be carried out as specified in Section 401 herein.

DGAB work may also be carried out in areas where earth sub base work is difficult to be carried out owing to wet conditions/ inclement weather. The Engineer's written approval shall be obtained before commencement of work under this option.

c. Degree of Compaction of Subbase

Delete this sub-section and substitute the following:

The subbase shall be compacted to not less than 98% of the maximum dry density of the material as determined by BS-1377 Test 13 (Modified Proctor) or AASHTO T-180.

d. Quality Control

Delete this sub-section and substitute the following:

The quality control of material and work shall be carried out in accordance with Section 1601 herein. The degree of compaction shall be checked by field density measurements (BS-1377 Test 15) at the

rate of one test for every 500 square metres subject to a minimum of two tests for any completed section of work or as instructed by the Engineer.

e. Finishing Operations
No change

f. Protection of Subbase
Delete this sub-section and substitute the following:

The Contractor shall protect and maintain the subbase at his own expense. Maintenance shall include the immediate repair of any damage or defects which may occur and shall be repeated as often as is necessary to keep the subbase continuously intact. Repairs shall be done in such a manner that will ensure restoration to an even and uniform surface and may involve scarifying, watering and re-compacting.

401.5 Measurement and Payment

a. Measurement

Delete this sub-section and substitute the following:
Subbase shall be measured by the cubic metres of material compacted in place and accepted. Measurement shall be based on the cross-section of the subbase shown in the Drawings and the actual length measured horizontally along the centreline of the surface of the road or, in case of edge widening, along the centreline of the widened section.

b. Payment
Delete after paragraph three and insert the following:

The payment for subbase will be based on the Contract unit rate for the completed work of the subbase which shall include full compensation for providing all materials labour, tools, equipment and incidentals necessary to carry out the construction works in accordance with the Specification.

Pay Item	Description	Pay Unit
401(1)	Sub base as compacted in position	cubic metre

402 STABILIZED SOIL SUB-BASES AND BASES

Delete sub section 402.3 Construction Requirements and replace with the following:

402.3 Construction Requirements

(a) General

Stabilized soil subbase and bases shall be constructed by the stationary plant method unless otherwise specified and approved by the Engineer.

(b) Quantity of Stabilizer in the Mix

The quantity of lime or cement to be added to the soil shall be that specified in the contract or as directed by the Engineer based on laboratory tests depending on the strength requirements of the stabilized mixes and shall not exceed 5% and 8% respectively, unless otherwise specified.

(c) Strength Requirements of Stabilized Soil

The strength of lime and cement stabilized soils shall be measured in terms of the CBR of the material at 98% maximum dry density obtained by the modified compaction test BS-1377 Test 13 or AASHTO T-180. The CBR value shall be determined by the CBR test as specified in section 1804. The samples shall be tested for the CBR value seven days after casting which period shall include three days of moisture curing and four days soaking in water.

The CBR value required shall be specified in the contract or by the Engineer depending on whether the stabilized material is to be used as a subbase or base. In the case of subbase the CBR shall not be less than 30 % and in the case of bases the CBR shall not be less than 80%.

(d) Mixing of Soil, Stabilizer and Water

Equipment, tools, machines used in the performance of the stabilized subbase, base shall be subject to the approval of the Engineer and shall be maintained in satisfactory working condition at all times.

The soil, stabilizer and water shall be mixed at an approved central mixing plant by either continuous-flow or batch type mixer.
The mixing plant shall be of approved type, coordinated and operated so as to produce a mixture within mix design requirements and shall be of sufficient capacity.

The plant shall be equipped with feeding and metering devices that add the materials – soil, stabilizer and water - into the mixer in specified quantities. The plant shall be capable of pulverizing the soil adequately and mixing the materials thoroughly and sufficiently to obtain a uniform mixture.

(e) Transporting, Placing and Compaction of Stabilized Soil Mixture

The mixture shall be transported to paving area in trucks or other approved equipments having clean bed.

The mixture shall be placed on moist subgrade/or subbase without segregation at a rate that will produce a uniform compacted layer confirming to the required grade and cross-section using a suitable spreader.

The stabilized soil mix shall be compacted at or near the optimum moisture content using a 8-10 tonne smooth wheeled roller or any other roller approved by the Engineer.

The moisture content of the material shall be checked at the time of compaction at the frequency specified in Table 1602 – 1 or as directed by the Engineer.

The rolling shall commence at the edges and proceed towards the center longitudinally except at super elevated sections, where the rolling shall commence at the lower edge and proceed towards the higher edge.

In the case of cement stabilized mixes, care shall be taken to complete the rolling within 1 ½ hours on addition of water or such smaller period as directed by the Engineer.

(f) Degree of Compaction of Stabilized Subbase and Base

The stabilized soil subbases and bases shall be compacted to not less than 98% of the maximum dry density of the material as determined by BS-1377 Test 13or AASHTO T-180.

(g) Quality Control

The quality control of material and work shall be carried out in accordance with Section 1601 herein. The degree of compaction shall be checked by field density measurements (BS-1377 Test 15) at the rate of one test for every 500 square meters subject to a minimum of two tests for any completed section of work or as instructed by the Engineer.

(h) Finishing Operations

The compacted subbase or base shall be finished to levels, grades and cross sections shown on the drawings or as directed by the Engineer, subject to the requirements of section 1601.

(i) Curing and Protection

The stabilized subbase or base shall be cured by keeping the surface continuously moist by the contractor by either sprinkling water at frequent intervals or by other approved means for a period of seven days or for a period specified by the Engineer.

Until the construction of the subsequent pavement layers or surfacing the contractors shall protect the stabilized subbase or base from damage caused either by storm water or by traffic or by any other means. Any damage caused shall be made good and where such damage may be attributed to the negligence of the contractor the repair shall be at his own expense.

403 SINGLE SIZED AGGREGATE BASES

No change

404 WATER BOUND AND DRY BOUND MACADAM BASES

No change

405 DENSE GRADED AGGREGATE BASES

Delete the entire section and substitute the following:

405.1 Description

This work shall consist of providing a dense graded aggregate base, on a prepared subbase or existing paved surface, in accordance with the Specifications and to the lines, levels, dimensions and cross sections shown in the Drawings.

405.2 Materials

The aggregate shall be graded crushed rock of nominal size 37.5 mm, conforming to the general requirements of Section 1701.3(a) herein and grading requirements of Table 1701-5 of Section 1701.3 (b) herein.

The aggregate shall be derived from a parent rock that is hard, sound, durable and unweathered. It shall consist of hard durable particles of fragmented rock from a quarry approved by the Engineer, and shall be free of dust, organic matter, clay and silt or any other deleterious matter. The crushed stone shall preferably non-plastic, and in no case shall the PI exceed 6%. The minimum soaked CBR value of material in the base course shall not be less than 80% at the specified insitu density.

405.3 Construction Requirements

a. Preparation of Existing Surface

Where the basecourse is to be laid over a prepared subbase, the surface shall be brushed free of dust and extraneous matter and, when instructed by the Engineer, watered before laying the basecourse.

Where the basecourse is laid over an existing bituminous pavement, the surface shall be lightly scarified or punctured to permit drainage through the surface where, in the opinion of the Engineer, the surface shape is not adequately crowned, and cleaned of any scarified material before laying the basecourse. During this operation the Contractor shall not damage the underlying pavement layer. Any damage to the existing underlying layer which results due to careless scarification shall be rectified forthwith by the Contractor to the approval of the Engineer at the Contractor's own cost.

b. Spreading and Rolling

The basecourse shall be spread uniformly and without segregation over the prepared surface of an underlying layer which complies with the specified requirements for the layer concerned, or over the surfacing of an existing pavement, and in quantities sufficient to ensure that after compaction the completed layer will comply with all requirements of layer thickness, levels, cross-section and density.

Aggregate shall be spread such that the minimum thickness of each layer after compaction shall be not less than 100 mm. The maximum thickness will depend on the type of compaction equipment used and on the specified layer thickness but shall not normally exceed 200 mm compacted thickness unless otherwise agreed or instructed by the Engineer.
In order to minimize segregation, the basecourse shall be kept wet during transport and spreading. The dumps of material shall be spread out to a flat-surfaced layer with a thickness suitable for mixing. Thereafter the required amount of water shall be added and the material thoroughly mixed with a motor grader or other suitable approved means until a uniform homogeneous mixture is achieved. The required amount of water and moisture content shall be determined by carrying out field trials but shall normally be within 2% of the predetermined optimum moisture content at the time of compaction. The material deposited on the prepared existing surface may be spread and shaped by any method which will not cause the segregation of coarse and fine particles. The Contractor shall ensure that joints in consecutive pavement layers do not coincide. All areas of segregated coarse and fine material shall be corrected by re-mixing or removing and replacing with well graded material to the approval of the Engineer. The basecourse material shall be compacted using approved vibratory compaction equipment whose vibrators shall function correctly in accordance with the manufacturer's instructions.

After mixing the material shall be graded to achieve the specified thickness with due allowance made for decrease in thickness due to compaction such that after compaction the surface of the aggregate base is within the specified level tolerance. The material shall then be thoroughly compacted by means of approved equipment so that the specified density is obtained throughout the whole layer.

The rolling shall be carried out by a series of overlapping longitudinal passes working from the edge towards the centre, except on superelevated sections where the rolling shall proceed from the lower edge to the higher edge.

The finally compacted layer shall be firm and stable with a closely knit mosaic like surface texture of exposed aggregate free from surface laminations, portions exhibiting segregation of the fine and coarse aggregates, corrugations or other defects that may be detrimental to the performance of the layer. The surface shall be brushed to ensure a surface free from excess fines and loose aggregate.

Where, in the opinion of the Engineer, the completed surface of the base is unacceptable, the surface shall be rectified in a manner approved by the Engineer.

The aggregate base shall be compacted to not less than 98% of the maximum dry density of the material as determined by BS-1377 Test 13 (Modified Proctor) or AASHTO T-180.

c. Field Density Testing

The degree of compaction shall be checked by field density measurements (BS-1377 Test 15 or AASHTO T -191) at the rate of one test for every 500 square metres subject to a minimum of two tests for each section or as directed by the Engineer.

d. Finishing Operations and Quality Control

The dense graded aggregate base shall be finished to the requirements of Section 1601.The control on the quality of materials and works shall be exercised in accordance with the Section 1602.
On completion of the base the Contractor shall remove all windrows to facilitate proper drainage of the finished surface.

e. Aftercare

The Contractor shall protect and maintain the completed base layer at his own expense until the surfacing is applied. Maintenance shall include the immediate repair of any damage or defects which may occur and shall be repeated as often as is necessary to keep the layer continuously intact and in good condition. Repairs shall be done in such a manner that will ensure restoration to an even and uniform surface. Traffic shall not be allowed directly on any unprimed base layer unless instructed or authorized by the Engineer.

The completed base shall be primed as soon as possible after approval from the Engineer.

405.4 Measurement and Payment

a. Measurement

Dense graded base shall be measured by the cubic metres of material compacted in place and accepted. Measurement shall be based on the cross-section of the base shown in the Drawings and the actual length measured horizontally along the centre line of the surface of the road or, in case of edge widening, along the centre line of the widened section.

b. Payment

Payment will be based on the Contract unit rate for the completed work of the dense graded base which shall include full compensation for providing all materials, labour, tools equipment and incidentals necessary to carry out the construction works to the Specification, and shall include light scarification of the existing road surface where such is directed by the Engineer.

Pay Item	Description	Pay Unit
405(1)	Dense graded aggregate base	cubic metre

406 PENETRATION MACADAM BASES

No change

407 BITUMEN BOUND BASES

No change

408 RECONSTRUCTION OF AGGREGATE BASES

Delete the heading and replace with:

408 RECONSTRUCTION OF EXISTING PAVEMENT

Delete the entire section and substitute the following:

408.1 Description

This work consists of the reconstruction of the existing bitumen surfaced pavement which requires strengthening and/or reshaping generally in confined areas, in patches or at locations instructed by the Engineer.

Work shall be carried out by scarifying the existing pavement to the depth instructed by the Engineer, addition of approved imported aggregate and thorough mixing with existing pavement material by grader or by hand or other approved methods in to ensure an unsegregated, homogeneous material.

408.2 Materials

Material for the reconstruction of existing pavements shall be aggregates which conform to the single sized aggregates or the graded aggregates as shown in Tables 1701.4 and 1701.5 of Section 1701.3(b) herein or as instructed by the Engineer.

The aggregate shall consist of hard durable particles of fragmented rock from a quarry approved by the Engineer, and shall be free of dust, organic matter, clay and silt or any other deleterious matter.

408.3 Construction Requirements

a. Reconstruction of Existing Pavement

The existing pavement shall be sufficiently scarified to enable the existing bituminous layer to be removed. In removing the bituminous layer the Contractor shall ensure that as much of the adhering existing aggregate as possible is dislodged and left remaining to be mixed with the aggregate to be added.

Where instructed by the Engineer, existing material considered of poor quality shall be removed and disposed of. Extra aggregate shall then be added to the existing pavement material and thoroughly mixed either in place or alongside the area to be strengthened. Compaction and surface finish shall be carried out as specified in Section 405 herein. Where graded aggregate of 37.5 mm maximum size is used, the added aggregate shall be in such quantities that after compaction there shall be a minimum aggregate thickness at any place of 100 mm and the maximum compacted thickness shall not exceed 150 mm unless otherwise specified or agreed by the Engineer.

Once mixed the material shall be compacted to not less than 98% of the maximum dry density of the material as determined by BS-1377 Test 13 (Modified Proctor) or AASHTO T-180.

b. Field Density Testing

The degree of compaction shall be checked by field density measurements (BS-1377 Test 15 or AASHTO T -191) at the rate of one test for every 100 square metres.

c. Finishing Operations and Quality Control

The reconstructed pavement shall be finished to the requirements of Section 1601 herein.

The quality of the material shall be controlled in accordance with Section 1602 herein.

d. Aftercare

The Contractor shall protect and maintain the completed pavement layer at his own expense until the following layer is applied. Maintenance shall include the immediate repair of any damage or defects which may occur and shall be repeated as often as is necessary to keep the layer continuously intact and in good condition. Repairs shall be done in such a manner that will ensure restoration to an even and uniform surface.

408.4 Measurement and Payment

a. Measurement

The reconstructed aggregate layer shall be measured by the cubic metres of material compacted in place and accepted by the Engineer. Measurement shall be based on the dimensions as instructed by the Engineer.

Scarifying and removal of bituminous pieces shall be measured in square metres of surface area.

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b. Payment

The payment will be based on the Contract unit rate for the completed work of the reconstructed layer which shall include full compensation for providing all materials other than those specified in the Payment Item, labour, tools, equipment and incidentals necessary to carry out the construction works to the Specification.

Pay Item	Description	Pay Unit
408(1)	Scarify and remove existing bitumen layer	square metre
408(2)	Reconstruction using graded aggregate base	cubic metre

409 SHOULDER CONSTRUCTION

Delete the heading and substitute the following:

409 SHOULDERS

409.1 Description
No change

409.2 Materials
Add the following as item (iii) at the end of item (ii).

The aggregate shall be graded crushed rock of nominal size 37.5 mm, conforming to the general requirements of Section 1701.3(a) herein and grading requirements of Table 1701-5 of Section 1701.3 (b) herein.

409.3 Construction Requirements

a. General
No change

b. Placing and Compaction of Shoulder Material

Delete the last paragraph and substitute the following:

Where shoulder filter drains are to be constructed, unless otherwise instructed by the Engineer each shall comprise a 200 mm wide x 200 mm deep excavation into the completed and compacted earthen shoulder, the excavation being backfilled with 150 mm deep layer of porous material wrapped in geotextile on all four sides and both ends, topped off with 50 mm of compacted earthen shoulder material. The porous material shall conform to the requirements of Section 1708.8 herein unless otherwise directed by the Engineer. The geotextile wrapping shall conform to Section 1710 herein.

c. Degree of Compaction of Shoulders
No change

d. Quality Control
No change

e. Finishing Operations
No change

Construction requirements for dense graded aggregate shoulder are similar to the construction requirements for dense graded aggregate base given in Clause 405.3, herein.

409.4 Measurement and Payment

Delete this sub-section and substitute the following:

a. Measurement

Earthen and dense graded aggregate shoulder construction shall be measured in cubic metres as the completed and approved work based on the lines, levels and dimensions in the Drawings.

The construction of shoulder filter drains shall be measured as trench excavation, the supply and placing of geotextile, including an adequate overlap, the supply, placing and compaction of porous material based on the lines, levels and dimensions in the Drawings or as instructed by the Engineer.

b. Payment

The payment will be based on the Contract unit rate for the completed work which shall include full compensation for providing all materials, labour, tools, equipment and incidentals necessary to carry out the construction works to the Specification. There shall be no separate measurement for topping off shoulder filter drains with shoulder material, nor for tidying up after the construction of such drains.

Pay Item	Description	Pay Unit
409 (1)	Earthen shoulder as compacted in position	cubic metre
409 (2)	Dense graded aggregate shoulder as compacted in position	cubic metre
409 (3)	Trench excavation for cross shoulder drain	cubic metre
409 (4)	Porous material for cross shoulder drain	cubic metre
1710 (1)	Geotextile for cross shoulder drain	square metre

500 SURFACE APPLICATIONS, SURFACE DRESSING AND SURFACING

Delete the heading and substitute the following:

500 SURFACE APPLICATIONS

501 PRIME COAT

501.1 Description

No change

501.2 Materials

Delete this sub-section and substitute the following:

a. Prime Material

The prime coat shall consist of medium curing cutback bitumen (25-45% cutback) complying with Section 1702.1 herein from a source approved by the Engineer, or a medium curing cutback bitumen MC-30, MC- 70 or MC-250 complying with Section 1702.2 herein from a source approved by the Engineer. The application rate of cutback bitumen and percentage of cutback to be used shall be instructed by the Engineer on Site after field trials. These field trials shall be carried out by the Contractor as instructed by and under the supervision of the Engineer and the cost thereof shall be deemed to be included in the prime coat rates. The object of the trials is to achieve the optimum penetration and efficacy of the prime coat.

The rate of spread of bituminous material for the prime coat shall be 1.0 litre per square metre and the permissible tolerance is 0.1 litre per square metre. The application rate to be determined by tray tests.

The preparation of cutback bitumen for prime coat shall be carried out in accordance with Transport Research Laboratory TRRL Research Report RR140, "Preparation of Cutback Bitumens" (by Hitch and Steward).

b. Mineral Aggregate for Blinding

The blinding layer, if any, shall be crushed rock or river sand having a grading within the limits of Table 501-1 herein. The aggregate shall be clean, hard and free from excessive dust. It shall contain no clay, loam or other deleterious material.

Table 501-1 : Grading Envelope for Sand for Prime Coat

SIEVE SIZE (mm)	% PASSING (By mass)
4.75	100
2.36	80 – 100
1.18	60 – 95
.60	30 – 80
.30	20 – 55
.075	10 – 30

501.3 Construction Requirements

Delete this sub-section and substitute the following:

a. Weather Limitations

The prime coat shall be applied only when the existing surface is dry or sufficiently low in moisture to assure uniform distribution of the bituminous material, when the atmospheric temperature is above 15°C, and when the weather is not foggy or rainy or rain, in the opinion of the Engineer, is imminent. The temperature requirements may be waived, but only when so instructed by the Engineer.

b. Preparation of Surface

The layer to be primed shall be cleaned of all loose and deleterious material by means of a rotary broom or hand brooms or other approved means. The brushing force shall be sufficient to dislodge all adhering material without damaging the pavement surface. Scale, clay and other foreign material shall be removed by hand where instructed. The exposed surface shall be kept moist up to the time of spraying. If the moisture content is too high to permit full penetration of the prime coat in the opinion of the Engineer the Contractor shall delay prime coat application until the moisture content is satisfactory for full penetration as instructed by the Engineer.

The surface shall be prepared in this manner to expose a hard tight mosaic of large aggregate in the base course. Hardened impervious films or layers of compacted fine material over the larger aggregate shall be removed by appropriate methods which shall avoid damaging the underlying surface as approved by the Engineer.

Before any prime material is sprayed the layer to be primed shall be checked for compliance with the surface and other requirements specified. Any sections not complying with the Specification shall be corrected and remedial measures taken to the satisfaction of the Engineer before priming operations are permitted.

c. Application of Prime Coat

Prime coat shall be applied at the instructed rate after trials and temperature defined in Table 501.2 by means of a bitumen distributor for large areas and by hand lance and nozzles for small and inaccessible area so as to achieve an even distribution of the prime coat over the surface. At the start and end of each run building paper or other approved material shall be spread over the surface to ensure a clean joint between adjacent runs and to protect adjacent surfaces and also to permit the distributor to build up sufficient speed so that at the start of each run the distributor shall be travelling at the correct speed for the instructed application rate. The distributor shall be functioning properly in accordance with the manufacturer's instructions with all spray nozzles functioning and delivering prime coat at the same evenly distributed rate. There shall be no leakages or drips of oil, diesel or bituminous material from the distributor.

The Contractor shall carry out tests for uniformity of traverse distribution of binder in accordance with depot tray tests (reproduced from BS 1707:1989) Appendix F of Overseas Road Note 3 – A Guide to Surface Dressing in Tropical and Sub-tropical countries.

The total width of primed surface shall be 300 mm wider than the specified width of the final surfacing and the edges of the prime shall be parallel to the centre line of the road.

The prescribed prime coat application rate may be achieved by two or more repeated applications when necessary to avoid flow of prime coat on steep crossfalls or gradients.

Any areas deemed by the Engineer to be deficient in prime coat after passage of the distributor shall be made good by spraying with a hand-lance.
Road furniture such as kerbs, post boxes, sidewalks, utility poles, manhole covers and the like, shall be protected from prime coat spray with adhesive paper or similar material. Any items not properly protected and in consequence damaged or affected by the spray will be made good at the Contractor's expense. Such making good shall extend to replacing the affected item entirely if, in the opinion of the Engineer, the existing item cannot be cleaned or remedied to his satisfaction.

Spray record sheets containing details of ambient temperature, spraying temperature, areas sprayed and quantities of materials used shall be submitted by the Contractor on a daily basis for approval by the Engineer.

***Table 501-2:* Spraying Temperatures for Prime Coat**

PRIME COAT TYPE	TEMP (°C)
MC 30 or 45% cutback bitumen	40 - 70
MC 70 or 35% cutback bitumen	55 - 90
MC 250 or 25% cutback bitumen	75 - 110

d. Aftercare

Following the prime coat application, the primed, unblinded surface shall be allowed to cure for a minimum of 24 hours without being disturbed so as to allow the prime coat to penetrate the surface fully, unless full penetration and curing has taken place in the opinion of the Engineer in a shorter period. If after 24 hours the prime coat has not sufficiently cured to permit trafficking without being picked up, and the Contractor wishes to open the section to traffic, the Engineer shall either instruct that the area be left for a further period until the prime coat has fully penetrated and aired to allow traffic to pass or permit the Contractor to place mineral aggregate for blinding applied at a rate of 250 square metre per one cubic metre of mineral aggregate and in the places instructed to blot up the excess bitumen.

As soon as the primed surface has cured sufficiently or mineral aggregate for blinding has been applied to allow traffic to pass over the road without the prime coat being picked up, the road shall, where practicable, be opened to public traffic for a period of 14 days or less if agreed by the Engineer. During this period the primed area under traffic shall be maintained and all damage caused by traffic shall be repaired as instructed by the Engineer at no extra cost. Thereafter the Contractor shall maintain the primed surface and shall protect the surface until the application of surfacing by taking suitable precautions including for example supplying and spreading a protective layer of chippings or blinding at no extra cost.

e. Quality Control

Samples of the bituminous material that the Contractor proposes to use, together with a statement as to its source and character shall be submitted and approved before use of such material. The Contractor shall require the manufacturer or producer of the material to furnish material subject to this and all other pertinent requirements. Only satisfactory materials, so demonstrated by service tests, shall be acceptable.

The Contractor shall furnish vendor's certified test reports for each consignment of bituminous material supplied. The reports shall be delivered to the Engineer before permission is granted for use of the material. The furnishing of the vendor's reports shall not be interpreted as basis for final acceptance. All such test reports shall be subject to verification by testing samples of materials received.

Control of the quality of materials and work shall be exercised in accordance with Section 1602 herein. .

501.4 Measurement and Payment

No change

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
501(1)	Bituminous prime coat (MC 30 at 1 litre/m^2)	square metre
501(2)	Extra over for MC 30	litre
501(3)	Bituminous prime coat using CSS-1 at l liter per m^2	square metre

502 TACK COAT

No change, except following addition to sub-paragraph (c) Application of Binder.

c. Application of Binder

Add at the end of the second paragraph, "Application rate of binder to be determined based on tray tests".

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
502(1)	Bituminous tack coat (CRS 1at 0.3 litre/m^2)	square metre
502(2)	Extra over for CRS 1	litre

503 HOT BITUMEN APPLICATIONS

No chan

504 SAND SEALING

No change

505 SEAL COAT TREATMENTS (SURFACE DRESSINGS)

Delete this section and substitute the following:

505.1 Description

Surface dressing shall be the process of spraying the surface to be dressed with bituminous binder, covering the binder with natural or crushed stone cover aggregate and rolling the resulting surface. The Contractor shall familiarize himself with the contents of the British Transport and Road Research Laboratory Overseas Road Note 3, "A Guide to Surface Dressing in Tropical and Sub-Tropical Countries" (hereinafter referred to as TRRL-ORN 3). Much of the specification for Seal Coat Treatment is based on TRRL-ORN 3, including the design of the surface dressing, and knowledge of the principles of the surface dressing process is essential to the Contractor.

The requirement for a single or double surface dressing shall be specified on the Drawings.

505.2 Materials

a. Binders

The bitumen binder shall consist of penetration grade bitumen, cutback bitumen or bitumen emulsion, as specified in the relevant item of the Bill of Quantities.

Bitumen binder shall comply with Section 1702.1 herein from a source approved by the Engineer. The penetration grade shall be 80/100 unless otherwise specified in the relevant item of the Bill of Quantities. .

Cutback bitumen binder shall comprise penetration grade 80/100 bitumen and cutter which shall be diesel or kerosene or a mixture of both prepared on Site. The type and proportion of cutter, if required, shall be instructed by the Engineer on Site in the range. 1-10% after design of the surface dressing in accordance with the procedures set out in Chapter 5 of TRRL-ORN 3. The preparation of cutback bitumen shall be carried out in accordance with TRRL Research Report RR104 "Preparation of Cutback Bitumens" (Hitch and Stewart).

Approval of the source of supply of bitumen shall be obtained from the Engineer prior to delivery of the material. The Engineer will require test certificates to confirm compliance with the specified requirements and may require samples for independent testing prior to issue of such approval. No bituminous material other than that represented by samples and test certificates submitted shall be used by the Contractor except with the written consent of the Engineer and the material shall comply in all respects with the requirements herein. Blending of bituminous materials from different refineries shall not be permitted without the knowledge and approval of the Engineer.

Problems have been experienced with bitumen in some parts of Asia that relate to bitumen chemistry, in particular to undesirably high paraffin wax contents. Some penetration grade bitumens may comply with standard specification requirements but perform badly in service due to high paraffin wax content or some other compositional factor. Bitumen proposed for use shall be tested to establish the following:

(a) Viscosity characteristics at 60°C and 135°C.
(b) Rolling Thin Film Oven Test (RTFOT results indicate the resistance of bitumen to hardening under the influence of heat and air).
(c) Paraffin wax content (DIN test procedure).

Bitumen emulsion binder shall conform to the requirements of Section 1702.3 of Standard Specification.

b. Cover Aggregate

Cover aggregate shall be obtained from a source approved by the Engineer and shall be natural screened gravel or crushed hard rock or stone, clean and free from adhering dust, achieved by washing and drying, or any other detrimental substance that could impair the adhesion of bitumen and shall conform to the requirements of Section 1701.3 herein.

Cover aggregate shall be pre-coated using cutback bitumen penetration grade 80 -100 in the ratio of 30% to 70% bitumen to cutter unless otherwise instructed by the Engineer.

Pre-coating material shall be thinly and evenly applied by means of a fine pressure spray to a moving stream of aggregate or by mixing with the aggregate in an approved mixing plant so that all particles are fully coated but do not contain excess material. The coating shall be such that no material will drip from a particle of aggregate suspended between the fingers. Mixing in stockpiles will only be permitted of the Contractor can demonstrate compliance for mixing to the approval of the Engineer.

Aggregate shall not contain sufficient moisture to cause uneven distribution of the pre-coating material and shall not be used in the work until the moisture has evaporated and the pre-coating material has adhered effectively to the aggregate.

Pre-coating of aggregate shall not be carried out when rain is imminent unless the aggregate is subsequently covered or unless the mixing of an adhesion agent in the pre-coating material has been authorized by the Engineer.

In areas subject to dusty conditions, pre-coated aggregate shall not be stockpiled for any period longer than is necessary for moisture to dry out. When there is a visible coating of dust on the particles the Engineer may direct that portions of the stockpiles be pre-coated again.

Stockpiling of aggregates will be permitted only at locations approved by the Engineer. A separate stockpile shall be made for each nominal size of aggregate at each location.

The site of the stockpile shall be cleared of all vegetation and debris, graded and drained, and where the Engineer deems it necessary, the area shall be surfaced with a 100 mm compacted layer of approved material to prevent contamination of the lower layer of cover aggregate.

Unless otherwise approved by the Engineer each stockpile shall be built at least two metres high by tipping in layers not more than one metre deep over the whole area of the stockpile. The Contractor shall supply and place planking or other material required in connection with movement of vehicles over and about the stockpiles.

The bottom 50 mm layer of cover aggregate or any contaminated aggregate shall not be used in the work.

Stockpiles shall be kept dry from rainfall or ingress of water by covering with approved waterproof membranes and maintaining ground drainage to avoid seepage of ground water into stockpile.

c. Adhesion Agents

Before starting surface dressing, the Contractor shall carry out tests under the supervision of the Engineer to determine the adhesion qualities of the aggregate and binder to be used. These adhesion tests will include, but not be limited to, the Immersion Tray Test described in Appendix 3 of TRRLORN 3. If, in the opinion of the Engineer, the tests and trials indicate the need, the Engineer shall instruct the use of a proprietary adhesion agent as an admixture to the bitumen binder to be applied along with pre-coating to the cover aggregate.
The Contractor shall supply and apply the specified adhesion agent in the quantities and in the manner instructed by the Engineer and in accordance with the manufacturer's instructions. The Contractor shall pre-coat cover aggregates only when instructed by the Engineer.

505.3 Construction Requirements

a. Bitumen Distributors

Operation

Distributors shall be of constant volume or preferably constant pressure type, self-propelled, equipped with pneumatic tyres and have a minimum binder capacity of 4,000 litres and each machine shall require the approval in writing of the Engineer for use in constructing the Works.
Approval will depend on fulfilling the following requirements:

(a) Distributors shall be equipped with low range speedometer (fifth wheel) in good working condition, so located to be visible to the driver to enable him to maintain accurately the constant speed for spraying binder at the uniform specified rate. They shall befitted with either a calibrated pressure gauge which accurately records the pressure of the bitumen at the spray bar for constant pressure distributors, or a binder pump delivery meter for constant volume distributors. Binder pumps shall be capable of maintaining constant pressure or constant volume during spray runs.

(b) Distributors shall be fitted with burners in combination with a circulating pump capable of maintaining the bitumen without overheating within the specified temperature range and an accurately calibrated thermometer for indicating the spraying temperature of the bitumen.

(c) The spray bar shall be capable of applying bitumen binder to a minimum width of 2.30 meters with provision for application of lesser widths by closing jets. The spray bar shall have the capability of being raised and lowered to specified heights above the road and of being adjusted so that it is parallel with the road surface. The distributors shall be so designed to allow the circulation of hot binder through the spray bar when not spraying.

(d) Spray bars shall be fitted with either slotted spray jets or preferably whirling spray jets, whose essential features are the ability to spray binder uniformly at the specified rate of spray, such that the speed of the distributor can be matched by the following chipping spreader during its normal chip spreading operation. If whirling spray jets are fitted the spray bar shall be protected by a hood to reduce wind interference. Distributors shall be fitted with hand-lances with nozzle spray attachments for spraying small, inaccessible areas and to correct deficiencies in the spray rate.

(e) Prior to surface dressing operations, distributors shall be checked for leakages from spray jets and any other sources and these shall be eliminated. Distributors shall then be calibrated by a method approved by the Engineer and under his supervision, to establish uniformity of lateral spray of bitumen to within +/-10% permitted variation at any point on the surface from the mean spray rate. This calibration includes setting the spray bar height above the surface to be sprayed, in accordance with the manufacture's instructions, so as to ensure that the designed overlap of jets is achieved. All spray jets shall be functioning so that each jet requirement has been achieved. Calibration shall be undertaken in accordance with the manufacturer's instructions or in accordance with TRRL-ORN 3, Section 6.3, "Distributor Speed Control and Calibration", to establish the relationship between spray rate and road speed for constant pressure distributors and in addition, bitumen pump delivery rate and spray bar width for constant volume distributors. The distributors shall be capable of achieving a mean spray rate measured by the TRRL-ORN 3 Method B, which shall not vary by more than +/- 5% from the specified spray rate.

(f) The Contractor shall carry out tests at frequencies as specified by the Engineer for uniformity of traverse distribution of binder in accordance with depot tray tests (reproduced from BS 1707:1989) Appendix F of Overseas Road Note 3 – A Guide to Surface Dressing in Tropical and Sub-tropical countries.

Safety and Maintenance

Bitumen heating, pumping and spraying operations shall be entrusted only to personnel who have been adequately trained and who are competent in the use of the equipment. Unauthorized personnel shall not be allowed to remain in the vicinity during the above operations. Authorized personnel shall be provided with, and be required to wear, suitable protective clothing, such as overalls, heat-proof gloves, safety boots, helmets and goggles.

Special care is needed when changing the type of binder being used in the distributor. When changing from hot binders to bitumen emulsions, all residual binder in the tank and spraying system shall be drained completely and the spraying system flushed using diesel. When changing from emulsions to hot binders, all emulsion shall be drained and flushed from the distributor in order to avoid foaming when hot binder is loaded. When it is necessary to load hot binder after using the distributor for spraying cutback bitumen, the cutback bitumen shall be drained completely and the manhole left open for some time to allow solvent vapour to escape.

The spray bar shall be emptied of binder by blowing with air, or by diesel flushing when spraying is suspended for lengthy periods and at the end of each day's work.

The binder shall be introduced into the distributor at a temperature equal to or just above the spraying temperature after preheating in separate tanks fitted with burners and circulating pumps for this purpose. The capacity of the decanters or preheating tank shall be sufficient to preheat the binder required for the full day's work.

The distributor burners shall be used only to make relatively small adjustments to the binder temperature and shall not be used to raise the binder from ambient to spraying temperature. In no circumstances shall distributor burners be operated during the spraying operation, or when the level of binder in the tank is less than 150 mm over the top of the flues, or when the distributor is moving. The need for end of day maintenance of the distributor is emphasized to reduce fire risk and to ensure its adequate performance when next used for binder application.

Maintenance of all equipment for the surface dressing operation shall be under the control of a competent senior mechanic, approved by the Engineer and fully experienced in the maintenance of all equipment and in the calibration of the bitumen distributor.

The Contractor 'shall provide all necessary traffic control equipment and shall inform the Engineer at least 14 days before commencing the surface dressing Work, of his detailed arrangements for traffic control. After review the Engineer will inform the Contractor in writing of his approval, subject to any modifications to the Contractor's arrangements which he requires for traffic and convenience of the public.

b. Workmanship

Preparation of Surface

Surface dressing operations shall not commence until the Engineer has inspected and approved the primed base course. Major defects or damage shall be rectified by complete reworking of the base course after removal and disposal of the defective primed base course.

However if the surface to be treated contains small but limited holes or depressions, which in the opinion of the Engineer require treatment, such irregularities shall be repaired by removal of all loose and defective material and replacement with a patching mixture compatible with the surrounding surface or other material approved by the Engineer, which shall be compacted to produce a tight surface conforming with the adjacent area. Irregularities which impair the riding qualities shall be corrected as instructed by the Engineer.

Immediately prior to the application of binder, all loose dust and detrimental material shall be removed by sweeping and blowing by air compressor. If necessary, adhering mud and other material shall be removed by hand using wire brushes and water. Road furniture such as kerbs, post boxes, sidewalks, utility poles, manhole covers and the like, shall be protected from the bitumen spray with adhesive paper or similar material. Any items not properly protected and in consequence damaged or affected by the spray will be made good at the Contractor's expense. Such making good shall extend to replacing the affected item entirely if, in the opinion of the Engineer, the existing item cannot be cleaned or remedied to his satisfaction.

c. Application of Binder

The specified bitumen binder, cut back if instructed by the Engineer, its application rate and spraying, temperature shall be instructed by the Engineer on Site after design of the surface dressing, in accordance with the procedures set out in Chapter 5 of TRRL-ORN 3. The range of spraying temperature for binders is given in TRRL-ORN 3 Appendix 7 and is normally within 140-200°C.

The Contractor shall present his detailed program and arrangements and methods for the planning and execution of the surface dressing process to the Engineer for approval at least 28 days before he intends to commence this Work. The Contractor's authorized representative shall be responsible for preparation of the programs and arrangements and the Contractor shall not commence surface dressing until the Engineer has approved his program.

The Contractor shall base his program on TRRL-ORN 3, Section 7, "The Surface Dressing Process", Sub-Sections 7.1, "Planning" and 7 .2. "The Surface Dressing Operation", by selecting the activities appropriate to his particular work program. The Contractor shall appoint a surface dressing overseer approved by the Engineer who shall be fully competent to organize and implement the surface dressing operation and fully experienced in operating all essential equipment.

All operations associated with the surface dressing process shall be described in the Contractor's arrangements and shall include but not be limited to:

(a) method of bitumen supply, decanting, cutting back where required, heating and storing, transfer to distributor, including lists of equipment and capacities, and

(b) location and method of production of cover aggregates and pre-coating with type and output of equipment, including crushers where appropriate, and

(c) method of performing the surface dressing process including type and capacity of all main and ancillary items of equipment along with workforce details.

The Contractor shall provide, one day in advance, his following day's surface dressing work program, including his expected spray lengths and widths for each run with details of the quantity of cover aggregate available in approved chip spreaders standing by at the commencement of the spray run. Spraying shall not commence until sufficient cover aggregate is in this position to cover the area programmed for spraying.

The distributor shall be filled with preheated bitumen binder on the same day, shortly before start of binder application. The distributor spray bar and jets shall be preheated by circulating hot binder and the jets operated for at least 10 seconds for testing. This operation shall be carried out before each spray run, off-road onto trays, or at a location where no environmental damage will be created. Jets shall be inspected by the Engineer for shape, direction, blockage or any other defects which shall be corrected before spraying is permitted. At the end of each spray run the distributor shall be driven off-road to avoid binder drippage on the pavement surface. Binder drippage from any location which may contaminate the road surface shall be sufficient for the Engineer to order removal of the offending source from the roadway until repairs are completed.

As a temporary emergency measure, drip protection of the pavement surface shall be provided by use of buckets, trays etc. These shall be available for use at all times, along with equipment for removal of binder spillages on the pavement surface, to the approval of the Engineer.

The Contractor shall carry out a trial section of surface dressing at a location instructed by the Engineer to demonstrate to the Engineer that his surface dressing operation is capable of constructing the surface dressing in accordance with the Specification. The trial length shall be minimum 200 metre using full spray bar width with full width application of cover aggregate. If the trial section of surface dressing complies with the Specification, the Contractor shall receive payment for the work in accordance with the Contract as if it were Permanent Works. If the trial section of surface dressing fails to comply with the Specification, the Contractor shall carry out further trials until his surface dressing operation complies with the Specification. No payment will be made for trial sections that do not comply with the Specification.

When the Engineer is satisfied that the Contractor is capable of constructing surface dressing that complies with the Specification after trial section or sections, the Contractor will receive permission to commence surface dressing as Permanent Works on the road pavement.

Application of binder shall only be undertaken when the surface is dry or slightly damp, but in no circumstances when wet. If in the opinion of the Engineer rainfall is likely before the application of binder or cover aggregate or the temperature or the pavement surface has time to fall below the specified minimum temperature of 15°C, the Engineer will instruct the Contractor to delay surface dressing work until weather conditions are satisfactory. Areas damaged by rainfall shall be rectified by the Contractor without additional payment, in a manner instructed by the Engineer.

If in the opinion of the Engineer the ambient temperature is too cold for surface dressing, the Contractor shall delay this operation until the temperature increases to the specified minimum level of 15°C.

Blotting paper or other approved protective material shall be used at the start and finish of each spray run of sufficient width (not less than 600 mm) to enable the distributor to reach its calibrated road speed with spray jets open before discharging binder onto the pavement under treatment. Ends of previous surface treatment runs shall be trimmed back to clean, straight transverse edges and these shall form the start point for subsequent runs, with completed work suitably protected as described above. Spray runs shall be such that the areas sprayed could be covered with aggregate at the specified rate and compacted before the binder hardens. Normally the maximum time duration between the spraying and the first pass of the roller shall not exceed 3 minutes. Spray runs will be limited to 100 metres length initially until the Contractor demonstrates his ability to plan and execute longer lengths. Spray widths shall be calculated allowing for 150 mm longitudinal overlap with adjoining passes and for the width that the following chipping spreader is able to cover. Longitudinal sprayed butt joints will not be permitted. The Contractor shall submit his spray width and length proposals to the Engineer for approval.

During spraying all passing traffic shall be stopped. If spray jets block, or the chipping spreader stops, or any other event occurs which may affect the surface treatment process, then the spray bar operator immediately shall stop spraying. When the defective equipment or operation is rectified, spraying may restart with the Engineer's approval.

The distributor shall be dipped and the binder temperature recorded before and after each spray run and spray length and width recorded on approved Record Sheets. The hot application rate shall be calculated and recorded and checked against the specified rate. The calculated actual rate shall not vary by more than +/- 5% from the specified rate. The actual quantity of binder sprayed corrected to 15.6°C shall be calculated.

At least eight clean pre-weighed metal spray trays shall be available for sampling the spray rate for each spray run, to be used in accordance with TRRL-ORN 3, Section 6.3, Method B, if so instructed by the Engineer.

To ensure that the spray runs are parallel with the road pavement the road centreline or edgeline shall be marked every 25 metres and a string line laid out for the distributor driver to follow with the guide bar attached to his side of the cab.

Where a second surface dressing is specified, the first surface dressing shall be left open to traffic for a minimum period of 21 days and preferably a longer period before applying the second surface dressing unless special approval is obtained from the Engineer for a shorter period. Surplus chippings shall be removed by firm hand-brooming or power-brooming before applying the second surface dressing.

The spraying widths shall be so selected that the centreline joint of the second surface dressing is offset from that in the first surface dressing by a minimum 300 mm.

Hand-pouring pots or hand-lances shall be used to touch up carefully any parts of the first surface missed by the distributor or chipping spreader, or for the treatment of areas in which the distributor cannot operate and in this case only, chippings may be applied by an approved manual method.

Areas damaged by excess bitumen or spillages of diesel or other deleterious material shall be repaired by careful cutting out and removal followed by careful hand-poured or hand-lance application of binder and chipping in a manner approved by the Engineer.

The second surface dressing shall be undertaken when the first surface has been approved by the Engineer after all surplus chippings are removed, repairs carried out and the surface thoroughly cleaned as specified. The procedures to be followed are those specified herein.

d. Application of Cover Aggregate

The cover aggregate shall be applied at the rate instructed by the Engineer on Site in square metres of coverage per cubic metre of loose aggregate after design of the surface dressing, in accordance with procedures set out in Chapter 5 of TRRL-ORN 3.

The cover aggregate shall be applied immediately after the binder is applied and with the approval of the Engineer may be applied slightly damp if not pre-coated to depress dust and help adhesion. Aggregate applied to sprayed bitumen emulsion shall, however, be dry.

The cover aggregate shall be applied using approved mechanical spreaders, which shall be tailgate mounted on tipper trucks, pushed spreaders or self-propelled spreaders, specifically manufactured for the purpose and they shall preferably be metered. They shall be capable of uniformly spreading cover aggregate at the instructed rate such that they can deliver the rate specified whilst travelling at the same speed as the binder distributors during spraying.

The bitumen binder surface shall be covered with cover aggregate closely packed in one layer so that adjacent chippings are touching and no bitumen binder is *left* uncovered.

A sufficient number of loaded spreaders shall be available at the start of binder application to provide cover aggregate over the whole area programmed for spraying. The Contractor shall not commence spraying unless sufficient loaded spreaders are in place. Aggregate spreading by manual methods will not be permitted except in circumstances where:

(a) mechanical spreaders cannot operate effectively or safely, or
(b) additional aggregate (back-up work) is required, or

(c) breakdown of mechanical spreaders occurs during the spreading operations before stoppage of spraying, or
(d) minor surface repairs are instructed.

The spreader shall follow the distributor at an interval not exceeding 10 metres for hot binder work

and not exceeding 5 metres when using bitumen emulsion binder. A back-up vehicle or other approved means shall be constantly in attendance during surface dressing, from which additional aggregate may be hand-applied to ensure complete and rapid coverage.

Where an adjoining pass of the distributor is required, no aggregate shall be applied to the binder over a 150-200 mm strip so as to permit subsequent overlap.

Under no circumstances will general brooming of the chipped surface be permitted. Aggregate spillage shall be removed with care and excess aggregates may be brushed *off* carefully after a minimum of 3 days under traffic, after approval of the Engineer.
The cover aggregate shall be rolled with pneumatic multi-tyred power rollers. Pneumatic-tyred rollers shall have a wheel load in the 1,000-2,000 kilogram range. Tyre pressures and sizes shall be in accordance with the manufacture's recommendations and shall be the same on each axle and tyres shall be smooth and in good condition to provide uniform rolling of chippings. The roller shall follow directly behind the spreader and shall continue to roll at a speed of approximately 8-10 kilometres per hour so as to provide minimum 6 passes over the entire treated area. Each pass shall overlap the previous pass by minimum half width of roller rolling shall be continued until all cover aggregate particles are firmly bedded. Tyres shall be in good condition and be kept clean and smooth to avoid pick-up of bitumen and chippings.

e. Quality Control

Bitumen

The Contractor shall obtain a manufacturer's test certificate clearly cross-referenced to each bitumen consignment purchased for use in the Works confirming compliance of that consignment with the Specification. The Contractor shall not use any bitumen until the test certificates are received for that batch. The Contractor shall sample in the presence of the Engineer at least every 100 tonnes and every batch of bitumen after delivery to the Site in sufficient quantity to carry out one set of tests for compliance of the bitumen with the Specification. Testing will be carried out at a laboratory in Colombo and the Contractor shall arrange for transport of the samples in sealed containers to the laboratory.

Bitumen Binder shall comply with the requirement of Section 1702 herein.

Cover Aggregate

The Contractor shall sample, in the presence of the Engineer, initially one set of 3 representative specimens for each source of supply and subsequently when warranted by changes in the quality of aggregates for Aggregate Crushing Value or Los Angeles Abrasion Value and at least every 50 cubic metres for grading and particle shape (flakiness and elongation). Additional samples shall be taken for testing where visible changes in the properties of the cover aggregates are observed by the Engineer. Cover aggregate shall comply with the requirements of Section 1701.3 herein.

Surface Finish

The surface finish shall confirm to the requirements of the Contract on alignment and surface regularity in accordance with Section 1601 herein.

f. Measurement

The quantity of binder measured for payment of bitumen emulsion or bitumen grade 80/100 pen and, if applicable, cutter shall be the actual number of litres at 15.6°C used in the accepted Work as instructed by the Engineer on Site. The conversion of binder material from the spraying temperature at the time of measurement to the volume at 15.6° C shall be carried out according to ASTM D 1250-56. ASTM - IP Petroleum Measurement Tables. The measured quantity shall be calculated as the product of the area sprayed and the application rate instructed by the Engineer or the actual quantity sprayed on the area and accepted, whichever is the lower.

If cut-back bitumen is used as binder, the quantity of binder measured for payment shall be separated into bitumen grade 80/100 pen and cutter in the proportion instructed by the Engineer for cut-back bitumen. The quantities of Bitumen grade 80/100 pen and cutter so calculated shall be paid separately at the rates in the relevant items in the Bill of Quantities.

The quantity of adhesion agent measured for payment shall be the actual quantity in litres at 15.6°C used as instructed by the Engineer. The Contractor shall inform the Engineer 24 hours in advance of his intention to apply the adhesion agent in the manner and quantity instructed by the Engineer so that joint measurement of the quantity used for be agreed. If the Contractor fails to inform the Engineer no payment will be made for adhesion agent.
The quantity of cover aggregate measured for payment shall be the number of cubic metres used as instructed by the Engineer on Site. The measured quantity shall be calculated as either the product of the area which received cover aggregate and the application rate instructed by the Engineer or the actual quantity used and accepted, whichever is the lower.

g. Payment

Payment shall be made at the contract unit rates as per the net quantities of materials instructed by the Engineer or actually used and measured for the surface dressing works, per litre for supplying and applying (a) bitumen grade 80/100 pen (b) cutter, (c) bitumen emulsion and (d) adhesion agent (Provisional Item); and per cubic metre for supply and application of cover aggregate. These prices shall be full compensation for furnishing all materials and for all preparation, delivering and application of these materials and for all labour, equipment, tools and incidentals required for completing the surface dressing.

Pay Item	Description	Pay Unit
505 (1)	Bitumen grade (80-100)	litre
505 (2)	Kerosene/diesel or other approved cutter	litre
505 (3)	20 mm chips	m^3
505 (4)	10 mm chips	m^3
505(5)	14mm chips	m^3
505(6)	6.3mm chips	m^3

506 ASPHALTIC CONCRETE SURFACING

Delete the text of this Section and substitute the following:

506.1 Description

This work shall consist of furnishing materials, mixing at a central mixing plant, and spreading and compacting asphaltic concrete wearing, binder course on an approved base course as and where shown on the Drawings and as instructed by the Engineer. The wearing course will be typically of 50 mm thickness or as otherwise specified.

506.2 Materials

Materials used shall conform to the following requirements unless otherwise specified:

(a) The bitumen binder shall be a 60-70 penetration grade bitumen in accordance with Section 1702.1 herein.

(b) The coarse aggregate shall be of nominal maximum size 20 mm and shall conform to the general requirements of Section 1701.3 herein.

(c) The fine aggregate shall conform to the general requirements of Section 1701.3 herein.

(d) Filler, where separately used in the mix, shall be cement, hydrated lime, crusher fines or other inert material in accordance with Section 1706 of Standard Specification.

When the coarse and fine aggregate are combined, along with filler where required, the combined grading requirements shall be as given in Section 506.3 herein as applicable to Wearing Course Mix, Type 1.

The Contractor shall control the production of coarse aggregate, fine aggregate and filler for asphaltic concrete at the crushing and screening plant such that the grading of aggregates in stockpiles shall be uniform and consistent throughout the period of asphalt production and paving operations. Regular sampling of stockpiles by the Contractor shall be carried out to demonstrate the uniformity and consistency of grading of the aggregate production to the satisfaction of the Engineer. If significant changes occur to the aggregate grading during crushing and screening this will immediately effect the grading of the asphaltic concrete mix produced by the asphalt plant rendering it out of compliance with the approved job mix formula. Therefore the Contractor shall take immediate steps to rectify the irregularity in aggregate production and, if such occurs, submit a new job mix formula based on the changed aggregate gradings for the approval of the Engineer.

506.3 Mix Requirements

a. Combined Grading of Aggregate and Binder Content

The grading requirements for the combined aggregate and the binder content shall be as given in Table 506.1(a) Type 1 for Binder Course and Types 1, 2, 3, 4 or 5 of Table 506.1(b) for the Wearing Courses. Type 3 is recommended in conformity with the design of pavement. However, the Contractor may select the most suitable mix according to the site conditions and layer thickness required for his constructions. The selection of the optimum mix shall be subject to the approval of the Engineer.

The sieve sizes used herein are of ASTM designation. However equivalent BS sizes as given in Table 107-1 of Section 107 herein, may be used with the prior approval of the Engineer.

***Table 506.1(a)*: Aggregate Grading, Binder Content and Thickness Requirements for Binder Courses**

Mix Classification	**Binder Course Type 1**
Thickness mm Max. Min.	 75 35
Sieve Size (mm)	
25.0	100
19.0	88 – 100
12.5	-
9.5	54 – 80
4.75	34 – 56
2.36	21 – 38
1.18	15 – 33
0.60	10 – 26
0.30	06 – 20
0.15	03 – 13
0.075	01 – 17
Percentage binder content by Total weight of mix	3.5 – 5.5

***Table 506.1(b)*: Aggregate Grading, Binder Content and Thickness Requirements for Wearing Courses**

MIX CLASSIFICATION		WEARING COURSE TYPE				
		Type 1	Type 2	Type 3	Type 4	Type 5
Layer Thickness	Max	75	45	75	75	60
(mm)	Min	35	25	40	35	30
Sieve Size *(mm/μm)*:						
25.0				100		100
19.0		100	100	90-95	100	93 - 100
12.5		80 - 100	80-100	-	79 - 90	-
9.5		65 - 93	73-93	56-80	60 - 80	59 - 94
4.75		45 - 73	52-69	35-65	40 - 65	38 - 69
2.36		35 - 58	32-50	23-49	27 - 48	25 - 48
1.18		26 - 48	25-43	-	20 - 40	20 - 40
600		18 - 38	19-35	-	15 - 35	15 - 32
300		13 - 28	14-27	5-19	10 - 25	10 - 23
150		8 - 20	9-18	-	07 - 17	4 - 15
75		4 -12	5-10	2-8	05 - 09	3 - 12
Percentage binder content by total weight of mix		4.0 – 6.5	3.5-6.5	3.5-60	4.0 – 6.5	4.5 - 6.5

b. Mix Characteristics

The mix characteristics as determined by the Marshall mix design procedure shall be as given in Tables 506-2(a) and 506-2(b) for binder courses and for wearing courses respectively for low, medium or high traffic depending on whether the cumulative number of standard axles, for the design life of the surfacing, is less than 10,000 or between 10,000 and 1,000,000 or greater than 1,000,000 respectively.

In the determination of the above, laboratory samples shall be prepared and tested as specified in Section 1802.4(a) herein.

The wearing course mix shall be determined by using Table 506-2(b), high traffic category.

***Table 506-2(a)* : Binder Courses**

DESCRIPTION	TRAFFIC		
	Low	Medium	High
Marshall stability (kN)	Not less than 2.25	Not less than 4.5	Not less than 7.0
Marshall flow (0.25 mm)	8 to 20	8 to 18	8 to 16
Air voids in mix (%)	3 to 7	3 to 7	3 to 7
Voids in mineral aggregate (%)	Not less than 14	Not less than 14	Not less than 14

***Table 506-2(b)* : Wearing Courses**

DESCRIPTION	TRAFFIC		
	Low	Medium	High
Marshall stability (kN)	Not less than 2.25	Not less than 3.33	Not less than 7.0
Marshall flow (0.25 mm)	8 to 20	8 to 18	8 to 16
Air voids in mix (%)	3 to 5	3 to 5	3 to 5
Voids in mineral aggregate (%)	Not less than 14	Not less than 14	Not less than 14

506.4 Job Mix Formula

The Contractor shall submit to the Engineer in writing at least 14 days before the start of the work, the job mix formula proposed to be used by him for the work based on trial mix designs carried out in accordance with "Mix Design Methods for Asphalt Concrete (MS-2)" published by the American Asphalt Institute, or similar approved method which shall give the following details:

(a) A single percentage of aggregate passing each specified test sieve.

(b) A single percentage of binder content by total weight of total mix.

(c) A single temperature at which the mix is emptied from the mixer which shall exceed 145°C.

(d) A single temperature at which the mix is to be delivered to the paver on the road which shall exceed 135° C.

In addition the Contractor shall give the sources, locations of all materials and the details of the mix design based on requirements given in Table 506-2(a) and (b).

The Engineer shall check the proposed job mix formula for compliance with the Specification and shall approve the same when compliance is achieved.

All mixes produced shall conform to the job mix formula approved by the Engineer within the ranges of tolerances given in Table 506

Table 506-3: Job Mix Tolerance for Single Test

PARAMETER	TOLERANCE
Aggregate passing 12.5 mm sieve and larger	± 8%
Aggregate passing 9.5 mm and 4.7 mm sieves	± 6%
Aggregate passing 2.36 mm and 1.18 mm sieves	± 6%
Aggregate passing 600 μm and 300 μm sieves	± 5%
Aggregate passing 150 μm sieves	± 4%
Aggregate passing 75 μm sieves	± 2%
Binder content percent weight of total mix	± 0.4%
Temperature of mixture when emptied from mixer	± 10°C%
Temperature of mixture when delivered on road	± 10°C%

If a change in the materials or source of materials is proposed, or a change in the grading of the coarse and fine aggregate or filler occurs, a new job mix formula shall be submitted and approved before the mix containing the new material is delivered to Site.

When unsatisfactory results or changed conditions make it necessary the Contractor, if required, shall submit a new job mix formula to the Engineer for approval.

506.5 Construction Requirements

a. Preparation of Existing Surface

(a) Where asphaltic concrete surfacings are laid over newly constructed aggregate bases, prior to construction, the surface shall be cleaned of extraneous matter and applied with a prime coat as per Section 501 herein.

(b) Where asphaltic concrete surfacings are laid on existing pavements, the surfaces of such pavements shall be corrected to the required width and profile as instructed. All potholes, ruts, depressions and damaged edges, shall be corrected as given in Sections 1102 and 1103

herein. Areas requiring reshaping and strengthening shall be corrected as per Section 408 herein.
On these corrected surfaces, where required, a tack coat shall be applied as per Section 502 herein.

(c) Where the mix is laid over cement concrete pavements or bridge decks, joints and cracks shall be cleaned and filled with bituminous material as approved, and any unevenness of the surface shall be corrected as required. A tack coat as per Section 502 shall then be applied to the surface.

b. Weather Limitations

The bituminous mix shall not be laid during rainy weather or when the surface on which it is laid is damp or wet.

c. Limitations Due to Equipment etc.

No work shall be carried out when there is insufficient equipment for hauling, spreading, compaction and finishing or insufficient labour to ensure progress at a rate compatible with the output of the mixing plant to ensure a continuous paving operation.

d. Thickness of Compacted Mix

Tolerances for the wearing coarse thickness shall be in accordance with Section 1601 herein.

e. Surface Regularity

Surface regularity shall be in accordance with Table 1601.1 herein.

f. Mixing Plant and the Preparation of Mix

An approved mixing plant of the automatic batch type or of the continuous type shall be used for the preparation of the mix, which shall have the capacity sufficient to supply the paver continuously. The asphalt mixing plant shall generally comply with and be operated in accordance with the "Asphalt Plant Manual (MS-3)" published by the American Asphalt Institute.

The mixer shall be capable of accurately batching the aggregates, filler and binder and mixing same thoroughly so that the mixed material on discharge from the mixer is uniform in composition and that all aggregate particles are completely coated.

Batch type plants, shall be equipped with suitable means for accurately weighing of each bin size of aggregate and the filler. The scales of such weighing mechanisms shall be calibrated at the frequencies as instructed by the Engineer using standard weights. The Contractor shall always have at hand sufficient weights for such calibration.
In continuous type plants the gate openings of the aggregate shall be calibrated by an approved process of weighing test samples. The bitumen feed line shall have a bypass arrangement in order that the meter can be calibrated. These calibrations shall be carried out at frequencies instructed by the Engineer.

The mixing plant shall be capable of heating the aggregate and the binder separately to the appropriate temperatures. When wet aggregate is used, the plant shall have an added capacity to dry the aggregate before heating.

The binder and mineral aggregate shall be heated separately to temperatures between 140-170°C and 150-170°C respectively. The materials shall be mixed at temperatures within absolute limits of

145°C and 170°C even allowing for tolerances. The plant shall if situated in or close to an urban area, or if otherwise required by the Government, the plant be equipped with an approved dust collector so constructed as to waste or return uniformly to the elevator all or any part of the material collected.

The mixing plant shall be capable of loading the mix into transport vehicles in such a manner that segregation does not occur.

In addition the plant shall be provided with the following :

(a) Covered protected ladders or stairways with secure hand rails in adequate number which shall be placed at all points required for accessibility to all operations.

(b) Covering devices for pulleys, belts and drive mechanisms and other moving parts.

(c) Ample and unobstructed space on the mixing platform.

(d) A clear and unobstructed passage at all times in and around the tipper loading space which shall be kept free from drippings from the mixing platform.

(e) Insulated flexible pipe connections to carry hot bitumen from the heated storage tanks to the mixer.

g. Transport of Mix

The mix shall be transported from the mixing plant to the point of use in suitable purpose made tipping trucks.
The trucks shall be in good mechanical condition at all times. They shall have clean and smooth metal beds, that have been sprayed with water or lime solution or any other detergent solution approved by the Engineer, to prevent the mix from adhering to the beds. The amount of sprayed fluid shall however be kept to a practical minimum. All precautions shall be taken to avoid segregation of mixed materials and to ensure that they do not become contaminated with dust or foreign matter.

Any truck causing excessive segregation of bituminous material by its spring ,suspension or other contributing factors, or that shows oil leaks in detrimental amounts or that causes undue delays shall, upon instruction of the Engineer, be removed from the Works until such conditions are corrected.

Each load shall be covered with a properly fastened canvas or other suitable material of such size as to protect the mix from the weather or dust. In order that the mix shall be delivered to the Site within the specified temperature range, during cold weather or during long hauls, properly fastened insulating covers shall be used.

Loading and transporting shall be co-ordinated such that spreading, compacting and finishing shall be completed during daylight hours unless adequate illumination, as approved by the Engineer, is provided by the Contractor. Working during darkness will not be permitted.
The mix shall be delivered to the paver at the site at a minimum temperature of 135° C.

h. Paving Plant and Laying of the Mix

The mix shall be laid immediately after transporting, by means of approved mechanical self-powered pavers. They shall be capable of spreading, finishing and providing initial compaction to the mix so that, the surfacing can be finished to the required lines, grades, levels, dimensions and cross-sections intended, either over the entire width or over such other partial widths as may be practicable. The paving operation shall generally be carried out in accordance with the "Asphalt Paving Manual (MS8)" published by the American Asphalt Institute.
The pavers shall be equipped with receiving hoppers and spreading screws of the reversing type to place the mix evenly in front of adjustable steering devices and shall have reverse as well as forward

travelling speeds. They shall also be furnished with a vibrating screed (levelling) unit equipped with suitable burners or heaters and tamping bars or vibration attachments all operating in accordance with the manufactures instructions.

The pavers shall be able to confine the edges of the pavement to true lines without the use of stationary side forms. They shall include blending or joint levelling devices for smoothing and adjusting longitudinal joints between lanes. The pavers shall be fitted with a longitudinal leveling beam of 3m length.

The pavers shall be fitted with automatic electronic sensors to achieve the cross-sectional shape and level tolerances prescribed and shall be so designed and operated as to place the required thickness and weight per square metre of material.

A fully trained and experienced operator shall be in direct charge of the paver at all times. The pavers shall be operated so as to avoid dragging of the material.

The bituminous mix, after spreading, finishing and initial compaction by the paver, shall have a smooth surface free of irregularities causes by dragging, tearing or gouging.

During construction, if it is seen that the paver in operation leaves on the surfacing tracks or indented areas or other objectionable irregularities or segregation of mix that cannot be satisfactorily corrected by normal operations, the use of such a paver shall be discontinued forthwith and another satisfactory paver shall be provided by the Contractor.

In narrow widths and in restricted areas where the paver cannot operate, the mix may be manually laid, in which case, care shall be taken to avoid segregation. Manually laid strips shall be rolled at the same time as the paver laid work and allowance shall be made for extra compaction of these strips using appropriate approved purpose made compaction equipment. Any defects in the laid surface shall immediately be rectified before rolling commences and there shall be no unnecessary scattering back by hand of material on paver laid work.

i. Not used

j. Compaction Procedure

Immediately after the mix has been spread as struck off, the surface shall be checked and any irregularities adjusted. Rolling shall commence as soon as the material will support the roller without undue displacement or cracking. The mix shall then be thoroughly and uniformly compacted by rolling, according to the sequence of rolling as given below:

(a) Transverse joints.
(b) Longitudinal joints, where applicable.
(c) Outside edge.
(d) Initial or breakdown rolling.
(e) Second or intermediate rolling
(f) Finish or final rolling.

Normally the first rolling of all joints and edges and the initial or breakdown rolling, shall all be done with static weight (tandem or three wheeled) or vibratory steel-wheeled tandem rollers and the second or intermediate rolling with pneumatic-tyred rollers. Use of any other rollers for the above purposes shall be with the prior approval of the Engineer. During initial or breakdown rolling, the direction of travel of the roller shall be such that the powered or driving wheel passes over the uncompacted mix first, before the driven wheel. The second intermediate rolling shall follow the initial or breakdown rolling as closely as possible while the bituminous mix is still plastic and at a temperature that will result in maximum density. The final rolling shall be accomplished with static weight tandem or vibratory steel-wheeled tandem rollers (without vibration) while the material is still warm enough for removal of roller marks.

In general the type roller or roller combination to be used shall be proposed by the Contractor for the approval of the Engineer before starting the work and the rollers shall satisfy the requirements given in Section 506.5(k) herein.

The speed of the rollers shall not exceed the limits given in Table 506-4 herein and shall be at all times be slow enough to avoid displacement of the hot mix.

***Table 506-4:* Roller Speeds**

TYPE OF ROLLER	SPEED (km/hr)		
	Breakdown	Intermediate	Finish
Steel-wheeled	3	5	5
Pneumatic-tyred	5	5	8
Vibratory	5	5	-

During stages of initial, intermediate and final rolling, rolling shall commence at the low side of the spread and progress towards the higher side parallel to the centre line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by either removing or by adding fresh material. The rolling shall be continued till the entire surface has been compacted adequately and the roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one half of the proceeding pass. The roller wheels shall be kept damp if required to avoid the material sticking to the wheels and being picked up. However, the quantity of water used for this purpose shall be the minimum required and shall not form puddles on the area under compaction.

When using a vibratory roller for the compaction of a surfacing the vibration shall be turned off before the roller stops when reversing direction, and turned on after it starts in the new direction.

Vibratory rollers shall not be used for surfacing of thickness less than 50 mm, unless otherwise approved by the Engineer.

The breakdown and the intermediate rolling shall be carried out at temperature not less than 135°C and 115°C respectively.

The final rolling shall be completed before the temperature of the mix falls below 90°c.

Rollers shall not be allowed to stand on newly laid material until 6 hours has elapsed after completion of the compaction of the surfacing.

When the bituminous mix is spread in areas that are inaccessible to rollers; such as near kerbs and manholes etc., compaction shall be achieved by hand tampers, mechanical tampers, or small vibrating plate compactors to the approval of the Engineer. In such locations spreading and compacting shall be carried out promptly before the mix cools below a minimum of 120°c.

The density of all samples taken from the compacted surface course shall not be less than 98% of the Marshall Density at the point appropriate to the locations. The sample densities shall be determined as given in Section 1802.4(c) herein.

k. Requirements of Compacting Equipment

(a) General

Generally, with each paver a minimum of three rollers shall be provided by the Contractor. On small projects involving a total of less than 5,000 tonnes of material the minimum requirements shall be one tandem roller.

All rollers shall be self-propelled, capable of being reversed without backlash and equipped with power steering, dual controls allowing operation from either the right or left side. They shall have water tanks with sprinkler systems to ensure even wetting of rollers or tyres.

The rolling surface of the wheels of a steel wheel roller shall be checked for wear. If grooves or pits have worn into the rolling surface, the roller shall not be used on the work area.

Each roller shall have a calibration chart showing the relationship between depth of ballast and weight and giving the tare weight of the roller. Each roller shall be in a good condition and shall be operated by a competent and experienced driver.

(b) Steel-wheeled Rollers

Steel-wheeled rollers (tandem or three wheeled) shall weigh not less than 8 metric tonnes. The minimum rolling pressure of the rear wheels of each three wheeled roller or at least one roller of each tandem roller shall be 35 kN per metre of roller width. The use of three wheel rollers is to be avoided for compaction of AC wearing course.

(c) Pneumatic-tyred Rollers

Pneumatic-tyred rollers shall have not less than 7 wheels (3 wheels on the front axle and four on the rear) fitted with smooth tread compactor tyres, of equal size and construction, capable of operating at inflated pressures upto 850 kN per square metre. The wheels shall be able to move up and down independently of one another. Wheels shall be equally spaced along both axle lines and arranged so that tyres on one axle line tract falls midway between those on the other with an overlap. The tyres shall be kept inflated to the manufacturer's specified operating pressures with variation not exceeding 36 kN per square metre. Means shall be provided for checking and adjusting the tyre pressures on the job at all times. For each size and type of tyre used, each roller shall have charts or tabulations showing the relationship between wheel load, inflation pressure and tyre contact pressure, width and area. Each roller shall be equipped with means of adjusting its total weight by ballasting so that the load per wheel can be varied from 1,500 to 2,500 kilograms. In operation the tyre inflation pressure and the wheel load shall be adjusted, as required by the Engineer, to meet the requirements of each particular application in general the compaction of any course with a pneumatic-tyred roller shall be accomplished with contact pressures as high as the material will support.

(d) Vibratory Rollers

Generally vibratory rollers shall be equipped with automatic vibration control which cuts out the vibratory system before the machine comes to a halt.
The minimum operating weight of the roller shall be 6 tonnes, the minimum drum width 0.9 m, the minimum linear drum applied force 44 kN per metre and the minimum frequency of vibration 33 Hz (200 cycles/min).

l. Joints

Both longitudinal and transverse joints in successive courses shall be staggered so as not to be one above the other. As far as practicable, longitudinal joints shall be arranged so that the joints in the top course shall be at the location of the line dividing the traffic lanes, and the transverse joints shall be staggered at a minimum of 250 mm and be straight.

Longitudinal and transverse joints shall be made in a careful manner so that well bonded sealed joints are provided for the full depth of the course. No mixture shall be placed against previously rolled material unless the edge is trimmed vertically to line and the vertical edge applied with a very thin coating of binder just before additional mix is placed against the previously compacted material.
Paving shall be as nearly continuous as possible and rollers shall pass over the unprotected end of freshly laid mix only when authorized by the Engineer. In all such cases provision shall be made for a properly bonded and sealed joint with the new surface for the full depth of the course as specified

above. Before placing mix against them, all contact surfaces of kerbs, gutters, manholes, etc., shall be given a thin uniform coating of hot bitumen and the joints between these structures and the surface mix shall be effectively sealed by the subsequent spreading, finishing and compaction operations.

m. Miscellaneous Requirements

The Contractor shall provide suitable means for keeping all small tools clean and free from accumulations of bituminous material. He shall provide and have ready for use at all times enough tarpaulins or covers, as may be directed by the Engineer, for use in any emergency such as rain, chilling wind, excessive dust or unavoidable delay, for the purpose of covering or protecting any material that may have been dumped and not spread. Generally the hot mix shall be discharged directly from the asphalt delivery trucks into paver receiving hopper unless the Engineer approves dumping and spreading by hand in difficult areas not accessible by paver when spreading and compaction shall be carried *out* promptly at a minimum mix temperature of 120°c.

n. Aftercare

Sections of the newly finished work shall be protected from traffic of any kind until the mix has sufficiently hardened. Also traffic shall normally not be permitted over newly laid surfaces at least for 12 hours after laying or until the temperature of the newly laid surfacing has achieved the ambient temperature.

In the event any binder course is constructed initially the surface so formed shall be maintained in its finished condition until the surface course is placed thereon, and any damage caused shall be made good by the Contractor. If the damage could be attributed to the negligence of the Contractor is it shall be corrected at his own expense.

o. Surface Finish and Quality Control

Asphaltic concrete surfacing shall be finished to the requirements given in Section 1601 herein.
The Contractor shall exercise control on the quality of materials and works in accordance with Section 1602 herein.

All core samples shall be obtained by the Contractor, prior to allowing traffic on the finished asphalt surface.

506.6 Measurement and Payment

a. Measurement

Asphalt Concrete in wearing course:
Shall be measured by square metres of mix furnished, spread, compacted, completed and accepted. Measurement of the asphalt laid and compacted shall be of the area and thickness as shown on the Drawings, described in the Specifications or instructed by the Engineer.

Deficiencies in thickness of the wearing course shall, unless an overlay is constructed at the Contractor's expense, result in a proportion only of the wearing course area being measured for payment. Proportions shall be determined in accordance with the thickness deficiencies and area proportions described below.

Thickness of asphalt concrete wearing course shall be determined by average caliper measurement of cores, rounded upwards to the nearest mm.

Paved sections to be measured separately shall consist of each 300 metre section in each traffic lane. The last section in each traffic lane shall be 300 metre plus the fractional part of 300 metres remaining. Other areas such as intersections, entrances, crossovers, ramps, etc. shall be measured as one section and the thickness of each shall be determined separately. Small irregular unit areas may be included as part of another section.

One core shall be taken from each section by the Contractor at approved locations and in the presence of the Engineer. When the measurement of the core from any paved section is not deficient by more than 5 mm from the specified thickness, the core will be deemed to be of the specified thickness as shown on the Drawings.

When the measurement of the core from any paved section is deficient by more than 5 mm but not more than 15 mm, 2 additional cores spaced at not less than 100 metre shall be taken and used together with the first core to determine the average thickness of such section.

When the measurement of the core from any paved section is less than the specified thickness by more than 15 mm, the average thickness of such section shall be determined by taking additional cores at not less than 5 metre intervals parallel to the centerline in each direction from the affected location until, in each direction, a core is taken which is not deficient by more than 15 mm. Exploratory cores for deficient thickness will not be used in average thickness determinations.
Any deficiencies in the total thickness of wearing courses shall be subject of a proportional reduction in the area of wearing course measured for payment. Alternatively, the Contractor shall construct all at his own expense, a wearing course overlay, of practicable in the judgment of the Engineer. Any such overlay shall be a minimum of 40 mm compacted thickness and to the specified standard of the course it is overlaying.

Where the average total thickness of wearing course is deficient by more than 5 mm but not more than 15 mm, adjustments shall be made in the area measurements as follows.

Deficiency in Total Thickness of Wearing Courses

Deficiency in Thickness as Determined by Cores (mm)	Proportion of Wearing Course Area Measured for Payment
0.0 to 5.0	100%
5.1 to 10.0	80%
10.1 to 15.0	60%

Asphalt Concrete in Binder / Correction Course:
Measurement of the asphalt laid and compacted shall be within the tolerances specified in Section 1601 herein and based upon the lines, levels, thicknesses and areas shown on the Drawings or as instructed by the Engineer.

The number of tonnes of asphalt shall be determined by digital printout weigh slips from an automatic batching plant. Alternatively, if such a plant is not used by the Contractor, the number of tonnes shall be measured by weigh slips, independently checked and certified by the Engineer, from truck scales approved by the Engineer. Such truck scales shall be mounted on solid foundations which will ensure their remaining plumb and level. They shall be inspected, calibrated and sealed by the Department of Weights and Measures or other agency in Sri Lanka approved by the Engineer at least once every six months, or more frequently as instructed by the Engineer.

The weigh slip, from whichever source, shall record the gross, tare and net weights of the truck, and the time, date, truck identification and destination of the asphalt.

The dimensions of the asphalt laid will be checked by the Engineer, both during lying and after laying and compaction, and the tonnage thus calculated will be checked against the weigh slips. In the event

of any discrepancy between the two, and making due allowance for permitted tolerances, the measurement based upon the Engineer's dimensional checks will prevail.

b. Payment

Payment for asphalt surfacing will be made at the Contract unit rate for the item as measured above. The price shall be full compensation for furnishing all materials, for mixing and placing of the mixed material and for providing all plant, machinery, equipment, tools, labour and incidentals necessary to complete the work to the Specification.

Pay Item	Description	Pay Unit
506(1)	Asphalt Concrete in Wearing Course 50 mm compacted thickness	square metre
506(2)	Asphalt Concrete in Binder/Correction Course	metric tonne

600 UNPAVED ROADS

601 GRAVELLING OF EARTH ROADS AND RESURFACING OF GRAVEL ROADS

No change

602 PRIMING OF GRAVEL ROADS

No change

603 MAINTENANCE OF EARTH AND GRAVEL ROADS

No change

700 DRAINAGE CONSTRUCTION

701 ROADSIDE AND LEAD AWAY SURFACE DRAINS

701.1 Description

Delete this sub-section and substitute the following:

This work shall consist of:

(i) the construction of roadside and lead-away surface drains, unlined or lined, and covered where required, to dimensions, grades and in positions shown on the Drawings or instructed by the Engineer.

(ii) Provision of built-up access to premises as shown on the Drawings or as directed by the Engineer.

The construction of built-up access to premises shall be done within the least possible time without causing much inconvenience to the owners of premises and the road users. Contractor should inform the owners of the premises well in advance that his intension to cut open the entrances or demolish the existing structure to replace with a new entrance structure. The Contractor shall provide temporary crossings over the cut open drains or demolition of existing structures as a temporary measure for the use of owners of premises and their vehicles.

701.2 Materials

Add at the end of this sub-section:

(e) The cover slabs shall be precast and meet the requirements of Section 1705 herein.

701.3 Construction Requirements

a. Cutting and Formation of Earth Drains

Add at the end of the first paragraph:

The excavation shall be carried out as detailed in Section 307 herein.

b. Lined Drains

Delete paragraphs two, three and four and substitute the following:

Where the lining is of precast concrete sections they shall be in concrete Grade C 25, laid to line and level on a prepared bed of sand, dry mortar, approved soil, concrete or other material as indicated in the Drawings or instructed by the Engineer. Unless otherwise instructed, the joints shall be filled using 1:3 cement mortar.

In-situ construction with concrete Grade C 25 or C 20, random rubble masonry, brick work or block work shall be carried out as shown in the Drawings or as instructed. Where specified, or where found necessary, they shall be surface lined with 1:3 cement mortar and smoothed as instructed. Bricks, blocks or other material used shall be subject to the approval of the Engineer.

Rubble paving with mortar jointing, where specified, shall be carried out using selected rubble, hammer dressed as necessary, to ensure proper embankment of the rubble and also to obtain a reasonable smoothness to the surface finish after the jointing with 1:3 cement mortar is completed.

Add at the end of the sub-section the following:

c. Cover Slabs

Where it is required for the lined drains to be covered, unless otherwise instructed, the slabs shall be of precast concrete of Grade C 25, and reinforced as indicated in the Drawings.

701.4 Measurement and Payment

Delete the text entirely and substitute the following:

a. Measurement

The excavation for lined drains shall be measured and paid as provided in Section 302 herein. The excavation for unlined drains shall be measured and paid as provided in Section 307 herein.
Measurement of lining of drains shall be in cubic metres. Plastering shall be measured in square metres. Reinforcement and Formwork for concrete shall be measured separately in kilograms and in square metre respectively.

b. Payment

Delete the pay items and pay units and substitute the following:

Pay Item	Description	Pay Unit
	Concrete:	
1001(1)	Grade C 15	cubic metre
1001(2)	Grade C 20	cubic metre
1001(3)	Grade C 25	cubic metre
1001(4)	Grade C 30	cubic metre
1006(1)	Random rubble masonry	cubic metre
1006(2)	Plastering 1:3 cement sand mix, 16 mm thick	square metre
	Precast concrete cover slab:	
701(1)	600x500x50 mm for bridge duct	square metre
701(2)	800x500x50mm for kerb inlet	square metre
701(3)	600x500x100 mm for drain	square metre
701(4)	800x600x100 mm for drain	square metre
701(5)	800x600x125 mm for drain	square metre
701(6)	1800x750x150 mm Gr. 25 concrete	square metre
701(9)	450x450x1500mm precast drain	metre
701(10)	600x600x1500mm precast drain	metre
701(11)	1000x800x1500mm precast drain	metre
1002 (1)	Tor - Steel reinforcement	kilogram
1008 (1)	Formwork smooth finish	square metre
1008 (2)	Formwork rough finish	square metre

702 SUB-SURFACE DRAINS (UNDERDRAINS)

702.1 Description

No change

702.2 Materials

Delete paragraph two of part (a) and substitute the following:

Unless otherwise instructed, the perforated pipe to be installed shall be 150mm PVC (Type 600) pipe. The pipe shall be drilled with 4 rows of 8 mm diameter holes at 150 mm centres on the bottom half of the perimeter of the pipe.

702.3 Construction Requirements

Underdrains

Add the following:

The permeable material shall be laid and lightly compacted in layers not exceeding 300 mm. 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 or other deleterious material shall be removed and replaced by the Contractor at his own expense.

Where specified or ordered by the Engineer, geotextile filter as specified in Section 1710 herein shall be installed as shown on the Drawings. Filter fabric shall not be exposed to direct sunlight and shall be protected from mechanical damage during installation and construction.

702.4 Measurement and Payment

a. Measurement

Add the following:

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

b. Payment

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
702(1)	160 mm dia. PVC (Type 600) Pipe	metre
702(2)	Graded aggregate, maximum size 37.5 mm	cubic metre
1710(1)	Provide and place geotextile filter	square metre

703 MANHOLES, CATCHPITS AND INLETS

703.1 Description

No change

703.2 Materials

Delete the first paragraph and substitute the following:

Concrete for precast units or for in situ construction shall be Grade C25. Materials for rubble, brick or block masonry shall be as specified in Sections 1006 and 1007 herein respectively.

703.3 Construction Requirements

Delete paragraphs 3 to 5 and substitute the following:

Precast units, reinforced or unreinforced, shall be manufactured using concrete Grade C 25. The installation of precast units shall be to required lines and on prepared beds of sand, dry mortar, approved soil, concrete or other material as indicated in the Drawings or as instructed by the Engineer.

In situ construction of catchpits and manholes shall be carried out using concrete rubble masonry, brick masonry or block masonry, as specified or instructed on Site. The concrete used shall be of Grade C 25. Rubble masonry, brick or block masonry shall conform to the requirements of Sections 1006 and 1007 herein respectively.

In situ construction of inlets shall be carried out using concrete of Grade C 20.

703.4 Grade Adjustment of Existing Structures

Add the following at the end of second paragraph:

Due allowance shall be given by the Contractor in grade adjustment of existing manholes, when preparing the Program of Works to compliance with the Clause 703. The work on grade adjustment of existing manholes shall no way interrupt the program of work on pavement construction. If the Contractor fails to adhere to this condition, the Engineer shall order a third party to carry out those works that have not been done by the Contractor and recover the cost of such works from the Contractor.

703.5 Measurement and Payment

a. Measurement

No change

b. Payment

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
703(1)	Grade adjustment of existing manhole	Provisional Sum

704 UNDER GROUND PIPE DRAIN

704.1 Description

No change

704.2 Materials

No change

704.3 Construction Requirements

No change

704.4 Completion of bedding and Surrounding of Pipes

No change

704.5 Backfilling of Trenches

No change

704.6 Measurement and Payment

a. Measurement

Delete text and substitute the following:

The quantity to be measured shall be the number of metres of specified PVC pipe placed. The above measurement, unless otherwise specified, will include excavations, shoulder material surround and backfill compacted and accepted in place.

Payment

This work measured as provided above shall be paid for at the Contract unit price per metre length of PVC pipe specified, complete in place.

Pay Item	Description	Pay Unit
704(1)	Inlet to lined drain PVC pipe (Type 600) 100 mm dia.	metre.

705 DRAINAGE BACKFILL BEHIND EARTH RETAINING STRUCTURES

705.1 Description

No change

705.2 Materials

a. Aggregate backfill

No change

b. Filter medium

Delete the second paragraph and substitute the following:

The aggregate and filter medium shall be free of organic material, clay or other materials which will adversely affect the free drainage of water.

705.3 Construction Requirements

Delete paragraph 2 and 3 and substitute the following:

The aggregate backfill shall be placed along the wall and to a stable configuration and dimensions as indicated on the Drawings or as instructed. The material shall be hand packed using a hand tamper.

The filter medium of graded aggregate shall be placed and compacted along the sloping face of the aggregate backfill to a thickness not less than 200 mm. The material shall be and compacted using a hand tamper.

705.4 Measurement and Payment

a. Measurement
Delete the last sentence.

b. Payment
Add the following:

There shall be no separate payment for the impervious layer and payment shall be deemed to be included in the Contractor's rates.

Pay Item	Description	Pay Unit
705(1)	100 mm crushed stone backfill material	cubic metre
705(2)	37.5 mm maximum size crushed stone – filter material	cubic metre

706 WEEPHOLES FOR EARTH-RETAINING STRUCTURES

706.1 Description
No change

706.2 Materials

Delete this sub-section and substitute the following:

Unless otherwise instructed by the Engineer, weepholes shall be made of PVC pipe (Type 600) of 75 mm inside diameter .

706.3 Construction Requirements

No change

706.4 Measurement and Payment

a. Measurement

Delete the second sentence of the paragraph

b. Payment

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
706 (1)	Weephole, 75 mm dia. PVC pipe (Type 600)	metre
706 (2)	Rain water outlets/ducts, 160 mm dia. PVC pipe (Type 600)	metre
706 (3)	50 mm dia. PVC drain pipe	metre

707 PIPE CULVERTS / PRECAST BOX UNITS

707.1 Description

Delete this sub-section and substitute the following:

This work shall consist of supplying, jointing, bedding reinforced concrete pipes/ precast box units of the required type, size diameter and length in the construction of culverts. The scope of work includes the construction of new culverts, and the extension and modification of existing drainage structures.

The work also includes the construction of headwalls, wing walls, aprons, catch pits and other ancillary items necessary for completion. All work shall be carried out to lines and levels and dimensions shown in Drawings or as instructed by the Engineer.

707.2 Materials

Delete paragraph 1 and substitute the following:

Unless otherwise instructed at Site, the concrete for pipe bedding and similar works shall be concrete Grade C 20 or as specified in the Drawings.
PC box units shall be concrete grade C25.

707.3 Construction Requirements

a. Excavation

Add the following at the beginning of this sub-section:

The Contractor shall take all necessary precautions to safeguard the stability of all trench excavations and ensure that the safety of no person shall be placed in jeopardy by his operations or working methods.

Surface drainage shall be controlled by the construction of temporary earth berms and drainage channels to prevent stormwater from entering the working area. No separate payment shall be made for such temporary drainage measures.

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 width of excavation shall be equal to the nominal internal diameter of the pipe/ or size of box units plus 500 mm on each side, Where pipe/ box culverts consist of two or more rows of pipes/ box next to each other the minimum spacing between each pipe shall be 300 mm or half the outside pipe diameter, whichever is the greater, up to a maximum of 900 mm.

Delete paragraph 4 and substitute the following two paragraphs:

Where rock or other unyielding material is encountered it shall be removed below the foundation level for a depth of 300 mm, or 40 mm for each metre of fill over the top of the pipe whichever is greater, but not to exceed 0.75 of the inside diameter of the pipe.

Where the soil encountered at the designed grade is unstable, soft or spongy, such material under the pipe and for a width of 500 mm on each side of the pipe shall be removed to a depth instructed by the Engineer, and replaced by sand or other selected material as instructed by the Engineer to provide an adequate support for the pipe. When instructed by the Engineer, the Contractor shall construct a blinding layer of concrete to provide a suitable working floor.

b. Bedding of Pipes

Add the following at the beginning of this sub-section:

Construction of culverts shall begin at one end, the position of which shall be fixed as shown on the Drawings or as instructed by the Engineer. The end of the last whole unit, the top of which breaks through the fill slope, shall normally determine the position of the other end of the culvert. However, in the case of skew culverts or culverts with a cover less than 500 mm at the shoulder, the Engineer may instruct that the end unit be cut to the length and skew required.

Any units which deform or crack, or which are not constructed to the required lines, levels and grades, or which become displaced in the process of work or during the Defects Liability 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 have been installed.

The Contractor shall exercise due care not to damage, overstress or displace any prefabricated culvert with his own traffic or compaction equipment and shall provide additional cover over the culverts to ensure that the culvert is adequately protected from construction equipment.

Where culverts are constructed on gradients exceeding 1:4 particular care shall be taken to protect excavations against stormwater damage and the trenches shall be excavated to firm ground. The trenches shall be backfilled with selected gravel or concrete if it is necessary to over-excavate in order to obtain a firm floor.

After first completing the outlet structure, the culvert units shall be laid in the normal manner, starting from the lower end' and placing successive units firmly against each other to prevent subsequent movement. The lowest unit shall be securely cast into the outlet structure and thrust and anchor blocks shall be constructed as required according to the Drawings.

Backfilling of trenches or around the pipes shall begin at the lower end and be carried out in horizontal layers.

(i) Concrete Bedding

Delete this sub-section and substitute the following:

The pipes/ boxes shall be bedded in a continuous cradle of Concrete Grade C 20 and the concrete shall extend up the sides of the pipes to dimensions as shown on the Drawing. The screed shall be of Concrete Grade C 15 to a thickness of 50 mm. The cradle shall be such that the pipe can be seated fully in it and the pipe shall be laid on the concrete bedding before the concrete is set.

As shown on the Drawings or instructed by the Engineer pipes shall be fully encased in Concrete Grade C 20 (reinforced or unreinforced) of minimum thickness of 200 mm. Temporary supports shall be provided near the pipe ends to support the pipes during the placing of the concrete. The concrete

shall be placed in such a way that all spaces under the pipe are completely filled. Poker vibrators shall be used to ensure that all spaces under and around the pipe are properly filled with concrete. Concrete casing shall be cast in one continuous operation until completed.

(ii) Granular Bedding

Delete this sub-section and substitute the following:

Granular bedding when required shall be provided by bedding the pipe/ box in a trench of depth 100 mm plus 0.3 times the external dimension of the pipe/ box. The granular bedding shall be sand or any other selected fill and shall be accurately shaped by a template to fit the lower part of the pipe/ box. The selected granular bedding shall surround the pipe up to a height of 100 mm above the top of the pipe. In appropriate circumstances the Engineer may permit compaction of sand bedding by hydraulic compaction (flooding) subject to approval of trials carried out by the Contractor.

707.4 Jointing

Add the following at the beginning of this sub-section:

Where partial demolition is required for extension work to existing structures, the contact face of the existing structure shall be cut to predetermined lines and levels, loose and fragmented material removed and projecting steel cleaned and bent or cut as instructed by the Engineer. Where no partial demolition but only extension is required, the contact area of the existing structure shall be roughened and cleaned of all dirt and loose particles.

Where dowels are required they shall be installed with an approved type of epoxy resin grout in holes drilled into the existing structure in accordance with details shown on the Drawings or as instructed by the Engineer.

New concrete shall be bonded to old concrete by using a cement paste or slurry or an approved type of bonding agent.

PC Box Units shall be jointed as directed by the Engineer.

707.5 Backfilling

Add the following:

The material used for the backfilling of those portions of culverts subject to traffic loads shall be selected material of at least subbase quality or such lower quality as the Engineer may permit.

The backfilling material shall be thoroughly tamped in under the flanks of the culverts to provide a uniform bedding to the Engineer's satisfaction. Adequate cover over the culvert shall be provided before the Contractor routes his construction equipment across it. Hydraulic compaction of backfilling may be permitted in appropriate circumstances after successful trials.

707.6 PC Box Units, Head walls, Wingwalls and other ancillary works

Delete" Class B of section 1001" of this paragraph and substitute the words "Grade C 25 concrete".

707.7 Measurement and Payment

Delete this section and substitute the following:

a. Measurement

Pipes/ boxes shall be measured as supplied, laid and jointed in metre length. No separate measurements shall be taken for ancillary works required in laying and jointing of concrete pipes: trench excavation and backfill, concrete/granular bedding, concrete around joints/connection to existing pipes, formwork, cement slurry and steel reinforcement.

Measurement for excavation and backfill and construction of headwalls, wing walls, etc. shall be taken for payment under specified respective sections.

Measurement of items of work required in the construction of headwalls, wing walls, etc. shall be taken separately for payment. These measurements shall include Grade C 15, C 20 and C 25 concrete, tor steel reinforcement, steel dowels, random rubble masonry, plastering, smooth and rough formwork, crushed stone backfill and filter materials behind headwalls, wing walls, etc. and weep holes.
If sand is used as a material to increase bearing capacity of the foundation or to replace unsuitable soil in the foundation excavations with the approval of the Engineer, shall be measured for payment.

Payment

The rate for laying and jointing of concrete pipes shall include trench excavation and backfill, concrete bedding, concrete screed, jointing, concrete around joints/connection to existing pipes/ boxes, formwork, cement slurry, concrete pipes and collars and steel reinforcement.

The rate for laying and jointing of pre-cast box units shall include trench excavation and backfill, jointing, concrete around joints/connection to existing pipes, formwork, cement slurry, pre-cast box units and steel reinforcement.
Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
707(1)	Laying and jointing of pipes,600 mm diameter (single row)	metre
707(2)	Laying and jointing of pipes,600 mm diameter (double row)	metre
707(3)	Laying and jointing of pipes,900 mm diameter (single row)	metre
707(4)	Laying and jointing of pipes,900 mm diameter (double row)	metre
707(5)	Laying and jointing of pipes,900 mm diameter (four rows)	metre
707(6)	Laying and jointing of pipes,1200 mm diameter (single row)	metre
707(7)	Laying and jointing of pipes,1200 mm diameter (treble row)	metre
707(8)	Sand fill	cubic metre
707(9)	Laying and jointing Pre-cast box units,600x600x1650 mm	number
707(10)	Laying and jointing Pre-cast box units,900x900x1650 mm	number
707(11)	Laying and jointing Pre-cast box 1000x1000 mm	metre
707(12)	Laying and jointing Pre-cast box 1500x1000 mm	metre
707(13)	Laying and jointing Pre-cast box 2000x1500 mm	metre
1001(1)	Grade C 15 concrete	cubic metre
1001(2)	Grade C 20 concrete	cubic metre
1001(3)	Grade C 25 concrete	cubic metre
1001(4)	Grade C 30 concrete	cubic metre
1002(1)	Tor steel reinforcement	kilogram
1002(2)	20 mm Stainless Steel dowels at 500 mm c/c	kilogram
1006(1)	Random rubble masonry	cubic metre
1006(2)	Plastering 1:3 cement sand mix, 16 mm thick	square metre
1008(1)	Formwork smooth finish	square metre
1008(2)	Formwork rough finish	square metre
705(1)	100 mm crushed stone backfill material	cubic metre
705 (2)	37.5 mm maximum size crushed stone – filter material	cubic metre
706(1)	Weep holes, PVC pipe 75 mm diameter (Type 600)	metre

800 INCIDENTAL CONSTRUCTION

801 TOPSOILING

801.1 Description

Delete this sub-section and substitute the following:

This work shall consist of the supply of topsoil furnished and transported from approved sources or stockpiles and spread in conformity with these specifications at locations shown on Drawings or as instructed by the Engineer. Generally where topsoil is stockpiled adjacent to the Works, embankment slopes shall be topsoiled in accordance with the Engineer's instructions.

801.2 Materials

No change

801.3 Construction Requirements

Add to paragraph 2 :

Where ordered by the Engineer the area to be topsoiled shall be roughened by hand scarifying, or by other means approved by the Engineer, to ensure the stability of the topsoil on the area.

Delete paragraph 3 and substitute the following:

After the Engineer has approved the prepared and graded areas, topsoil shall be spread to a depth which after settlement shall not be less than 75 mm or as instructed by the Engineer. Spreading shall not be done when the ground or the topsoil is excessively wet or in a condition considered detrimental to the work. The topsoil layer shall be levelled off and raked.

801.4 Measurement and Payment

Delete this sub-section and substitute the following:

a. Measurement

The quantities to be paid for shall be the number of square metres of topsoil of 100 mm loose thickness completed in place and accepted.

b. Payment

The quantities of topsoil will be paid for at the contract unit price which shall be full compensation for furnishing, transporting and spreading material to the required thickness, levelling it off to a smooth surface, for removing any stones as specified, and for roughening the surface to be topsoiled and shall including all labour equipment tools and incidentals necessary to complete the work.

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
801(1)	Furnish, spread and compact topsoil	square metre

802 GRASSING

802.1 Description
No change

802.2 Materials
No change in the text of paragraphs (a) Grass Seeds (b) Grass Springs (e) Mulch and (f) Water.

Substitute text of paragraphs (a) Grass Sods (d) Fertilizer with the following:

c. Grass Sods

Grass sods shall be free from noxious weeds and diseases and shall contain a minimum of 50 mm of topsoil.

d. Fertiliser

The type of fertiliser to be used shall be agricultural lime, super phosphate or limestone ammonium-nitrate, or any other fertiliser approved by the Engineer.

The Contractor shall have the top 150 mm of the prepared surfaces tested to determine the amount and type of fertiliser required for establishing proper growth conditions for the grass. The fertiliser shall be evenly applied over all surfaces where grass is to be planted and shall then be thoroughly mixed with the soil to a depth of 150 mm either mechanically or manually.

802.2 Construction Requirements

Delete paragraph 3 and substitute the following:

Seeding shall be done just before or during the rainy season or as instructed by the Engineer. The method of seeding and application of fertiliser, water and mulch shall be subject to the approval of the Engineer.

Delete paragraph 6 and substitute the following:

Sodding shall be done just before or during the rainy season or as instructed by the Engineer. The Contractor shall notify the Engineer not less than 7 days before cutting of sods begin. Sods will be approved by the Engineer, in their original position before cutting and delivery to Site. Areas to be sodded shall be given a layer of topsoil 75 mm thick unless, due to the presence of suitable subsoil, the Engineer orders that the topsoil be omitted.

The areas to be sodded shall be thoroughly watered beforehand so that they are wet to a depth of at least 150 mm when sodding is to be done.

802.4 Measurement and Payment

a. Measurement
No change

b. Payment
Add the following:

Payment shall include for pre-watering and watering the sods, replanting dead areas, supply and placing of timber stakes, supply and applying of fertilizer and for all other incidentals that may be required to establish an acceptable cover and to maintain the grass.

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
802(1)	Grass sodding	square metre

803 PLANTING TREES, SHRUBS, VINES, ETC.
No change in the entire text of this section.

804 RIPRAP PROTECTION FOR EMBANKMENT SLOPES

804.1 Description
No change

804.2 Materials

a. Dumped Riprap

Delete this paragraph and substitute the following:

Stones used for dumped riprap shall be hard, durable, angular in shape and resistant to weathering and water action. Round stones and broken concrete will not be acceptable. The stones shall be at least 500 mm in maximum dimension and more than 100 mm minimum dimension and be well graded between these two limiting dimensions.

804.3 Construction Requirements
No change

804.4 Measurement and Payment
No change

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
804(1)	Dumped Rip Rap	cubic metre

805 GABION WALLS

805.1 Description
Add the following:

This section covers the construction of gabion walls, Reno mattresses and aprons for the construction of retaining walls, lining of channels, revetments and other anti-erosion structures. Generally gabions shall be flexible, galvanised steel wire mesh cages packed with rock.

805.2 Materials

Delete this sub-section and substitute the following:

Unless otherwise specified the material used shall meet the following requirements:

(a) Double twisted hexagonal mesh made of zinc coated mild steel conforming to BS-I052/1980, BS 443/1982.

(b) Binding and connecting wire of 3.0 mm diameter galvanised to the same standard as the mesh wire.

(c) Broken rock for filling baskets shall preferably be of sizes normally varying from about 100 mm in minimum dimension to 300 mm in maximum dimension and they shall be clean, hard and durable, free from weathered pieces and extraneous matter. The rock shall be well graded between the two limiting sizes.

(d) Where indicated on the Drawings or ordered by the Engineer, a layer of filter fabric, or approved equivalent material shall be placed on the prepared surface prior to the placing of the gabions. The material shall be placed as instructed in vertical strips with a minimum overlap of 300 mm and shall be properly fastened to prevent any movement or slipping during the placing of gabions

805.3 Construction Requirements

In paragraph 2 delete "or rubble masonry".

Delete paragraph 3 and substitute the following:

The concrete shall be of Grade C 15 for unreinforced base layer and Grade C 20 for reinforced base layer.

To the end of paragraph 4 add the following:

Baskets shall, where appropriate, be maintained square and with vertical sides during filling. Internal tie wires shall be inserted and baskets shall be tensioned.

Delete paragraph 5 and substitute the following.

The wire baskets for gabions shall be made out of double twisted hexagonal mesh. The width of gabion boxes will be 1.0-2.0 metres or as instructed by the Engineer. The length shall be multiples of 1.0 metre subject to a maximum of 4.0 metres. The gabions will have diaphragm walls at 1.0 metre intervals.
The general specifications of gabions are as follows:

THICKNESS (mm)	MESH TYPE (cm x cm)	WIRE DIA. (mm)	STONE SIZE (mm)	D50 (mm)
500	10 x 12	2.70	120 - 250	190
1000	10 x 12	2.70	120 - 250	190

Add the following:

Mattresses, which are generally only used as single layer aprons in revetments or at the entrance or exit to culverts to prevent scour and minimize erosion, shall be sub-divided by diaphragms into cells having a width of 600 mm or 1.0 m as specified or instructed by the Engineer.
The cut edges of all mesh used in the construction of gabions, except the bottom edge of diaphragms and end panels, shall be selvedged with galvanized wire having a diameter of at least 0.5 mm more than that of the mesh wire. The diaphragms and end panels shall be selvedged on the top and vertical sides only.
Sufficient binding and connecting wire shall be supplied with the gabion cages to perform the wiring operations in accordance to these specifications. The diameter of the wire shall be at least 3.2 mm.
The methods of assembly shall be in accordance with the manufacturer's instructions but the Contractor shall ensure that sufficient connecting wire braces are provided to prevent deformation of the cages as they are being filled with stone.
It is essential that the corners of the gabion cages be securely wired together to provide a uniform surface and to ensure that the structure does not appear as a series of blocks or panels.

Particular care shall be exercised in filling visible faces of gabion boxes, for which only selected stone of adequate size shall be used and be so prepacked that a fair faced finish is obtained. The filling of boxes shall be done in stages in order to prevent deformation and bulging.

The filling of mattresses shall be carried out by spreading random stones on the first layer and using selected stones for the top layer so as to present a dry stone-pitched surface.

805.4 Measurement and Payment

a. Measurement

Delete paragraph 2.

b. Payment

No change

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
805(1)	Gabions	cubic metre

806 PAVED SIDE WALKS

806.1 Description

No change

806.2 Materials

Delete the first sentence and replace with the following:
The concrete used for precast slab construction and cast in-situ concrete shall be Grade C 25 concrete.

806.3 Construction Requirements

Delete (c) and substitute the following:

The precast concrete slabs as indicated in the drawings shall be laid to line and level on a prepared bed course material. The bed course material shall be spread and uniformly compacted on an approved solid foundation to a thickness of not more than 50 mm. Unless otherwise instructed by the Engineer, the slabs shall be laid side by side to a close fit (gap should not be more than 10 mm) and the joints filled with 1:3 cement sand mortar.

806.4 Measurement and Payment

a. Measurement

Delete this sub-section and substitute the following:

The quantity to be measured shall be the number of square metres of finished surface irrespective of the type of paving. The above measurement, in the case of precast concrete slab paving, unless otherwise specified, will include excavations, preparation of the bed surface, 50 mm thick sand bed fill, precast concrete - Grade 25 slabs and slab jointing with cement sand mortar.

In the case of asphalt concrete surfacing, the finished area shall be measured in square metres of mix furnished, spread, compacted to lines, levels, thickness and areas shown in the Drawings.

b. Payment

The payment will be at the Contract unit rate for work measured as above which shall be full compensation for all labour, materials, tools equipment and other incidentals required for completion of the work.

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
806(1)	Precast concrete slab (450x450x50mm) paving	square metre
806(2)	Asphalt concrete surfacing to 50 mm compacted thickness	square metre

807 PRECAST CONCRETE KERBS AND CHANNELS

807.1 Description
No change

807.2 Materials

In the first sentence delete "A or B" and replace with "C 25".

807.3 Construction Requirements

In the third paragraph delete " class B" and replace with "C 20".

807.4 Measurement and Payment
No change

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
807(1)	Standard kerb	metre
807(2)	Flat/Edge kerb	metre
807(3)	Drop kerb	metre
807(4)	Bridge kerb	metre
807(5)	Lower kerb	metre

808 GUARD RAILS AND WALLS, GUARD STONES, AND GUIDE POSTS

808.1 Description
No change

808.2 Materials

In the first sentence delete "A or B" and replace with "C 25".

Add the following at the end of paragraph (f):

(g) Steel railway lines salvaged from railway or Road Development Authority stores.

808.3 Construction Requirements

a. Guard Rails

Delete this section and substitute the following:

Guard rails shall be pre-cast concrete using precast components as shown on drawings or as directed by the Engineer.

Railings made from concrete Grade C30 exactly with the dimensions of sections indicated in drawings in a manner that will result in smooth continuous tight rail closely conforming to the line and grade of the highway or as indicated in the Drawings. Laps in railings shall be parallel to the direction of flow of traffic.

The holes for the posts shall be or sufficient size to permit proper setting of the posts and to allow sufficient room for backfilling and tamping. The holes shall be spaced to suit the standard length of guardrail supplied.

The guard rail complete shall be erected true to line and level and the holes shall be backfilled with concrete Grade C 20 only after the Engineer has signified his approval. When the backfilling is complete and the bracing removed the posts must be rigid and vertical and the guard rail true to line and level and firmly fastened to the posts.

Contractor shall erect precast concrete guard rails as indicated on the Drawings or as otherwise directed by the Engineer.

b. Guard (Parapet) Walls and Guard Stones

Delete paragraph 1 and substitute the following.

Guard walls shall be masonry, or reinforced concrete precast or cast in situ to dimensions given in the Drawings.

Guard stones shall be reinforced concrete, precast or cast in-situ complete with painting, all as shown on the Drawing or as ordered by the Engineer. The concrete shall be Grade 20. Forms used for concreting in situ shall be wood, metal, or suitable material and shall extend the full depth of the concrete.

Delete paragraphs 4 and 5 and substitute the following:

Compaction of the concrete placed in the forms shall be by vibration. Forms shall be left in place for 24 hours or until the concrete has set sufficiently so that they can be removed without injury to the concrete placed. The finished concrete shall be kept moist for a minimum of 7 days. The method of curing shall be subject to the approval of the Engineer.

c. Guide Post

Delete paragraph 1 and substitute the following:

Guide posts shall be reinforced concrete precast or cast in situ to dimensions as given on the Drawing or as ordered by the Engineer.

d. W Beam Barriers / Guard Rails

1. Description

This work shall consist of furnishing and installing the specified type or types of guardrail at locations indicated on the Drawings or as directed by the Engineer.

The work shall include all required posts, rails, cables, fixtures and fastenings, beams anchorages and attachments as well as aligning and painting, if required and all the processes necessary to complete the work.

2. Materials

2.1 Posts

Steel posts shall conform to the requirements of BS 7818.

Timber posts shall conform to the requirements of AASHTO Standard specification M168 and shall be of the species and grade and treated as required in the Contract.

2.2 Concrete and Reinforcement

Concrete shall conform to the requirements of section 1001 as appropriate. Reinforcement shall conform to the requirements of section 1002 of the specification.

2.3 Guardrail

The Guardrail shall be zinc coated corrugated sheet steel beam rail elements according to AASHTO M 180 and as per drawing.

Type of Guardrail : Type 1 : Zinc coated, 550g/sq.m
Class of Guardrail : Class A , Base metal nominal thickness, 2.67mm
Shape : W- beam as shown on the Drawing.

The Guardrail shall be zinc coated steel of thickness not less than 10 or 12 gauge as shown on the drawings. The steel shall elongate not less than 12 percent in a 50mm gauge length under tensile tests. Rail elements shall meet the strength requirements of table below. Other specification shall follow requirements in AASHTO M 180.

Table

		Beam Strength			
Ultimate Tensile strength N/sq.mm		Traffic face up Load Max. Deflection		Traffic face down Load Max Deflection	
Gauge	Minimum	Kg	mm	Kg	mm
12	560	680	50	540	50
12	560	910	75	720	75
10	700	910	50	720	50
10	700	1360	75	1080	75

The beam strength shall be determined with the rail element freely supported on a clear span of 3.65 metres and the load shall be applied through and 80mm wide flat surface at the centre of the span. Rails and joints between rails shall both be tested. When the joint is tested it shall be at the centre of the span.

"Traffic face up" means the load is applied to the traffic face. "Traffic face down" means the load is applied to the other face. Terminal sections shall meet the requirements for rail except the beam strength test.

2.4 Bolts and Nuts

Bolts and Nuts shall be galvanized in accordance with AASHTO Standard specification M111 and all connections shall be able to withstand a side pull in any direction of 2,200 kilograms. If the contract documents indicate that galvanizing is required, all steel except reinforcement for reinforced concrete shall be galvanized.

2.5 Protective Coating

Following fabrication, cutting drilling or welding all guardrail components shall be galvanized to the requirements of BS EN ISO 1461.

3. Construction Methods

3.1 Posts

Posts shall be set vertically in position and to the lines and levels shown on the Drawings, Post holes shall be back filled with approved material well tamped in layers of not more than 100mm thickness. If driving of posts is permitted the type of posts shall have substantially the same dimensions as the body of the posts. Damage to posts in driving will be cause for rejection.

3.2 Guardrail

Rails shall be erected in a manner that will result in a smooth continuous taut rail closely confirming to the line and grade of the highway or as shown on the drawings.

3.3 Painting

All metal work not galvanized shall be given one shop coat of zinc chromate paint or a rust inhibiting primer of a type approved by the Engineer and two field coats of white or alluminium paint. Untreated timber shall be given three coats or paint of the kind indicated in the contract documents. Painting shall otherwise be in accordance with section 5.5.

4. Measurement

The quantity to be measured for payment shall be the length in metres of rail and terminal sections measured from centre to centre of end posts for each continuous installation, including supply and installation of all posts and supports, painting and galvanizing, reflector etc.

5. Payment

This work measured as provided above will be paid for at the Contract unit prices for guardrail. The price and payment will be full compensation for furnishing and installing all materials, including reflectors, end anchorages, labour, equipment, tools and incidentals necessary to complete the work.

808.4 Measurement and Payment

a. Measurement
No change

b. Payment

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
808 (1)	Guard stone as per Drawing	number
808 (2)	W Beam Barriers/ Guard Rail	Metre
808 (3)	Guard Rails in foot walks	Metre

809 FENCING

No change

810 ROAD MARKINGS

810.1 Description

Delete this sub-section and substitute the following:

The work shall consist of the applications of road markings including the installation of road studs on the finished paved areas of road in accordance with the "Government Gazette Notification dated 13.03.1987" published by the Government of the Democratic Socialist Republic of Sri Lanka.

810.2 Materials

Delete all types of materials except reflectorised thermoplastic material. Thermoplastic material shall have been manufactured in accordance with BS 873 of Part IV.

Before delivery of materials to Site the Contractor shall forward certificates of origin specifying the physical and chemical characteristics and the constituents of the paint from the manufacturer. Before delivery, and during the work, the Engineer may call for tests necessary to determine the efficacy of the paint application. All such tests shall be performed at the expense of the Contractor and shall be considered subsidiary to the work.

The material shall be laid to a thickness of not less than 2.5 mm or more than 6 mm unless specifically authorized by the Engineer.

Use of Beads: A layer of glass beads shall be superimposed in the surface of the hot thermoplastic immediately after laying, to give an immediate reflectivity. The superimposed beads shall be of the same quality as that incorporated in the reflectorized thermoplastic but may be smaller in size, but not more than 20% shall pass through 212µmm sieve. Beads shall be applied at a rate of 250 – 450 grammes per square metre such that the combined total weight of the beads incorporated and superimposed in thermoplastic shall be between 20% and 26% by weight of the material.

Road Studs

The road studs shall be of a type to the approval of the Engineer and shall have reflecting amber and white colours. Studs of other colours may be installed locally as directed by the Engineer.

They shall be installed in accordance with the manufacturer's instructions and in relation to direction of traffic flow, on centre line and edges as shown on the drawings or as directed by the Engineer. The reflecting road studs shall comply with BS 873 Part IV. The colours of studs used in the areas of road marking shall have the same colour of the road marking.

810.3 Construction Requirements

Add the following at the end of sub-section (d):

e. Equipment

The road marking equipment shall be purpose made of approved type and manufacture and be capable of painting the markings to a uniform width within the tolerances specified without the paint running or splashing. The equipment shall be capable of painting lines of different widths by adjustment of the spray jets on the machine or by means of additional equipment attached to the machine.

The machine shall be capable of spraying at a speed of not less than 5.0 kilometres per hour.

f. Setting Out

The road marking lines, symbols, figures or marks shall be set out by means of paint spots of the same colour as that of the proposed final lines and marks. Normally spots of approximately 10 mm in diameter spaced at 1.5 m intervals shall be sufficient. After spotting, the positions of the proposed road markings are to be indicated on the road. These premarkings shall be approved by the Engineer before starting any painting operations. The positions of any road studs shall be marked out on the road and shall be approved by the Engineer before they are fixed in position.

g. Tolerances

The width of lines and other markings shall not deviate from the specified width by more than 5%. The position of lines, letters, figures, arrows, reflective road studs and other markings shall not deviate from the true position specified by more than 20 mm. The alignment of any edge of a longitudinal line shall not deviate from the true alignment by more than 10 mm in 15 m. The lengths of segments of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

h. Rectification of Faulty Workmanship

If any material not complying with the requirements is delivered to site or used in the Works, or if any sub-standard work is carried out, such material or work shall be removed, replaced or repaired as required by the Engineer, at the Contractor's own cost. Rejected traffic markings and paint that has been splashed or has dripped onto the surfacing, kerbs, structures or other such surfaces shall be removed by the Contractor at his own cost, in such a way that the markings or spilt paint will not show up again later.

810.4 Measurement and Payment

a. Measurement

Delete this sub-section and substitute the following:

Road markings shall be measured by the actual length in linear metres for the specifed widths completed and accepted. Reflecting road studs shall be measured in number supplied, installed and accepted.

b. Payment

Pay items and pay units will be as the follows:

Pay Item	Description	Pay Unit
Centre line:		
810 (1)	Continuous	square metre
810 (2)	Intermittent	square metre
Edge line:		
810 (3)	Continuous	square metre
810 (4)	Pedestrian crossing	square metre
810 (5)	Road studs	number

811 ROAD SIGNS

811.1 Description

Delete this sub-section and substitute the following:

The work shall consist of provision and erection of permanent road signs complete with posts, sign frames and necessary accessories in accordance with the Specification, the Drawings and the "Manual on Traffic Control Devices" of the Road Development Authority or as instructed by the Engineer.

Project Information Sign

It shall also include the provision, installation and maintenance of a project information sign at the start and end of each of the project roads. The sign shall be as described in the Drawings, or as otherwise directed by the Engineer. Before ordering the signs, the Contractor is to confirm with the Engineer the size, colours, layout and wording of the signs.

811.2 Materials

e. Preservatives, Paints and Finishes

Delete paragraph 3 and substitute the following:

The reflective material to be supplied shall be high intensity grade sheeting (High Performance Wide Angle Retro-reflective Sheeting) and shall be in accordance with ASTM D-4956-90, "Standard Specification for Retro-reflective Sheeting for Traffic Control".

The material shall be supplied with a pressure-sensitive or heat applied adhesive backing protected by a removable liner and shall be of the correct type for the backing surface to which it is to be applied.

f. Reflective Beads

Delete this text and refer "use of beads" under the sub-section 810.2 herein.

811.3 Construction Requirements

a. Mounting Posts

Delete paragraph 1 and substitute the following:

Posts for mounting standard types of road sign shall be as indicated in the Drawings or as otherwise directed by the Engineer.

811.4 Measurement and Payment

a. Measurement

No change

b. Payment

No change

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
	Reflective road sign :	
811(1)	Single pole, sign area up to 0.5 m2	number
811(2)	Double pole, sign area up to 2.0 m2	number
811(3)	Chevron warning sign	number
811(4)	Flag Type Sign	number

Add the following new Section 812

812 BUS BAYS

812.1 Description

The work shall consist of constructing of bus bays at existing locations of bus stops/halts, locations as shown on the Drawings or as instructed by the Engineer in accordance with these specifications.

812.2 Materials

The materials used for various items of work such as road pavement, sidewalk, kerbs, road markings etc. shall be in accordance with the relevant part of the specifications.

In addition cement blocks of size 215x110x75 for paving manufactured to specification approved by the Engineer.

812.3 Construction Requirements

The various items of work involved shall be in accordance with the relevant part of the specifications.

812.4 Measurement and Payment

a. Measurement

Quantities to be measured shall be as specified under various items of work involved in the construction of bus bays.

b. Payment

The individual items of work involved shall be paid as provided for in the relevant part of the specifications.

Pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
812(1)	Cement Blocks 215x110x75 mm	square metre

Add the following new Section 813

813 CONCRETE KERB INLETS

813.1 Description

This work shall consist of the construction of kerb inlets to lines, levels and grades as shown on the Drawings or as indicated by the Engineer.
The dimension of the inlets shall be as shown on the Drawings or as instructed by the Engineer.

813.2 Materials

Concrete for precast or cast in place units and concrete for kerbs shall be of concrete Grade C 25 as per section 1001.
The other material used shall meet the requirements of the following, unless otherwise specified:

(a) Reinforcement steel to SLS-375 or CS-26.

(b) Bed course material shall consist of sand, gravel, crushed stone or other approved material of 10mm maximum size.

(c) Cement mortar for jointing to Section 1703.2 herein.

813.3 Construction Requirements

The Construction requirements shall be the same as for Section 807.3 herein for the installation of kerbs.

813.4 Measurement and Payment

a. Measurement

Kerb inlet furnished, accepted and placed shall be measured by the number.

b. Payment

The payment will be based on the Contract unit rate for the item which shall include full compensation for supplying and installing the kerb inlet. The rate shall also include the cost of all materials, labour, equipment tools and other incidentals necessary to complete the works to the Specification.

Pay Item	Description	Pay Unit
813(1)	Kerb inlet	number

Add the following new Section 814

814 HANDRAILS, UPRIGHTS AND END PILASTERS

814.1 Description

This work shall consist of the construction of handrails, uprights and pilasters at the locations and to the dimensions, lines and levels shown on the drawings or as instructed by the Engineer.

Handrails and uprights, which are meant essentially to protect vehicles and pedestrians from falling off the edge of bridge decks, shall be positioned away from the carriageway edge so as not to interfere with the normal movements of traffic.

End pilasters shall be positioned at the ends of the handrails behind the movement joints, in each corner of the bridge decks.

814.2 Materials

Concrete used for the casting of handrails, uprights and end pilasters shall be of Grade 25 as given in Section 1001 and as specified.

The other material used shall meet the requirements of the following unless otherwise specified:-

a. Reinforcing steel to SLS 375, CS 26 or BS 4449
b. Cement mortar for jointing to sub-section 1703.2
c. Bitumen joint fillers shall be of the approved varieties.

814.3 Construction requirements

a. Handrails and Uprights

Handrails and uprights shall consist of pre-cast concrete post and rail jointed with in-situ concrete and mortar joints. Their assembly and erection shall be as shown in the Drawings or as instructed by the Engineer. Concreting of posts and rails shall be in accordance with Section 1001 and reinforcement in accordance with Section 1002.

Posts shall be set vertical in pockets filled with concrete as shown on the Drawings or as instructed by the Engineer.

Rails shall be set parallel to the bridge deck or as instructed by the Engineer. Jointing between rails and between posts and railing shall only be carried out after the posts have set. Joint mortar and in-situ concrete shall be trowelled to a neat finish.

No Site drilling or cutting of pre-cast posts and rails shall be permitted without the prior approval of the Engineer.

b. End Pilasters

End pilasters shall be pre-cast or cast in-situ using concrete of the specified grade. Their assembly and erection shall be as shown on the Drawings of as instructed by the Engineer. Forms for the concrete shall be wood, metal or suitable material and shall extend to the full depth of the concrete.

All forms shall be free from wrap and of sufficient strength to resist the pressure of the concrete without displacement. All forms shall be clean and coated with an approved oil before concrete is placed and compacted. Reinforcement shall be maintained in its correct position during concreting.

Concrete shall be proportioned, mixed and placed in accordance with the grade of concrete specified. Compaction of the concrete placed in the forms shall be by vibration or other acceptable methods. Forms shall be left in place for 24 hours or until the concrete has set sufficiently so that they can be removed without deformation to the concrete placed. The finished concrete shall be kept moist for a minimum of 7 days. The method of curing shall be subject to the approval of the Engineer.

814.4 Measurement and Payment

a. Measurement

Unless otherwise specified, handrails and upright shall be measured by the length in metres of the handrails and pilasters by the number of each.

b. Payment

The unit rate of each item of work shall be for the full compensation for all labour, equipment, tools, materials and incidentals necessary to complete the work as specified.

The pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
814(1)	Handrails and uprights	metre
814(2)	End Pilasters	number

Add the following new Section 815

815 KILOMETRE POSTS, BOUNDARY MARKERS AND BOLLARDS

815.1 Description

This item shall consist of :

(a) Replacing missing or damaged kilometre posts with new ones. This work shall consist of precasting, transporting and fixing concrete kilometre posts in accordance with the type drawings of the Road Development Authority, complete with all necessary lettering and painting, as specified at locations directed by the Engineer.

(b) Reposition existing kilometre post. This work shall involve the removal of existing kilometre posts, transferring the same and carefully and re-fixing at new location as directed by the Engineer.

(c) Maintain and paint existing kilometre posts. This work shall consist of repainting route marking and lettering on existing kilometre posts in place, or as directed by the Engineer, including scraping and removing old paint and application of any treatment given to the face of the posts, sand papering and making up any damage with cement mortar prior to painting.

(d) Maintain and paint existing RDA right of way boundary markers. This work shall consist of repainting existing right of way marker posts in place, or as directed by the Engineer, including scraping and removing old paint and application of any treatment given to the face of the posts, sand papering and making up any damage with cement mortar prior to painting.

815.2 Materials

The new kilometre posts shall be constructed of concrete Grade 30, and the concrete bases in which they are set shall be of concrete Grade 20. For quality control, trial mix, sampling and testing, materials, tools and equipment and construction methods shall be as stated in Section 1001 herein. Cement paint shall confirm to requirements of SLS-590 and enamel and emulsion paints shall conform to requirements of SLS-539 and 557 respectively.

815.3 Construction Methods

Unless otherwise mentioned or shown in the drawings the kilometre posts, where new or the old one, shall be mounted on a concrete base and the posts shall be surrounded with concrete of Grade 20 of minimum thickness of 150 mm and finished and flushed with ground.
The route number and the appropriate kilometre shall be formed and painted as shown in the type drawing of RDA. The exposed surface of the posts shall be finished smooth and areas not required for lettering shall be applied with one coat of primer and two coats of weatherproof emulsion paint, of colour and quality approved by the Engineer. The posts (new or old) shall be transported and erected at the various locations as directed by the Engineer.

815.4 Measurement and Payment

a. Measurement

Measurement shall be in numbers at locations approved and accepted by the Engineer

b. Payment

The work measured shall be paid for at the Contract unit rate as detailed below. The payment shall be full compensation for all labour and materials involved in casting, handling, transporting and incidentals necessary to complete the work including excavation for removing and re-fixing, concrete base with surrounding materials erection, clearing, scraping, sanding, painting, lettering etc. all complete.

Pay Item	Description	Pay Unit
815(1)	Provide, install and paint new kilometre post	number
815(2)	Reposition existing kilometer post	number
815(3)	Paint existing kilometre post	number

900 RIGID PAVEMENTS

901A CEMENT CONCRETE PAVEMENT – MACHINE ORIENTED CONSTRUCTION

901A.1 Description

The work shall consist of construction of un-reinforced, jointed, plain cement concrete Pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and Cross-sections shown on the Drawings or as directed by the Engineer. The work shall include furnishing of all plant and equipment, materials and labour and performing all operations in connection with the work, as approved by the Engineer.

There are two distinctive methods of construction specified in these Specifications; they are machine and manual oriented. In this section, machine oriented method of construction is described.

The design parameters, viz., thickness of Pavement slab, grade of concrete, joint details etc. shall be as stipulated in the Drawings.

Where Pavements are reinforced, the requirements are given in special provision.

901A.2 Materials

Materials used shall conform to the requirements of the following, unless otherwise specified.

(a) Cement to Section 1703. The cement shall be subjected to acceptance tests prior to its use.

If the soil around has soluble salts like sulphates in excess of 0.5 percent, the cement used shall be sulphate resistant and shall conform to BS 4027 : 1997.

(b) Water used for mixing and curing of concrete shall be clean and free from injurious amounts of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in SLS 522.

(c) Coarse and fine aggregate shall conform to requirements of Sub section 1701.2.

(d) Admixtures - Use of admixtures conforming to Section 1704, shall be permitted in order to improve workability of the concrete or increasing the setting time, on satisfactory evidence that they will not have any adverse effects on the properties of concrete with respect to strength, volume change, and durability and have no deleterious effect on steel reinforcements. The details of the admixture and the quantity to be used must be furnished to the Engineer in advance to obtain his approval before use. Satisfactory performance of the admixtures shall be established through the laboratory concrete trial mixes and trial pavings.

(e) Mild steel bars for dowels and tie bars shall conform to the requirements of CS 26.

(f) Polythene sheeting and other materials used as separation membranes between the Sub-base and concrete slabs and any special materials used for curing of concrete shall be approved by the Engineer prior to their use.

(g) Pre-moulded expansion joint filler boards which are proposed for use only at some abutting structures like bridges and culverts shall be of 20-25 mm thickness within a tolerance of ±1.5 mm and of a self expanding cork seal or firm compressible material and complying with the requirements of BS Specification Clause No. 2630 or British Highway Agency, Vol. I Clause 1013. It shall be 25 mm less in depth than the thickness of the slab within a tolerance of ±3 mm and provided to the full width (between the side forms). The filler boards shall be in suitable lengths which shall not be less than one lane width. Holes to accommodate dowel bars shall be accurately bored or punched out to give a sliding fit on the dowel bars.

(h) The joint sealing compound shall be of hot poured elastic mastic type or cold poly sulphide type having flexibility, resistance to age hardening and compibility. If the sealant is of hot poured type it shall conform to BS2499 and cold applied sealant shall be in accordance with BS 5212 (part 1).

901A.3 Concrete mix requirements and testing for quality

(a) Mix Design for Concrete

Consequent to approval of all the materials to be used in the concrete by the Engineer, the Contractor shall submit the mix design based on weighed proportions of all ingredients for the approval of the Engineer. The mix design shall be submitted at least 2 weeks prior to the paving of a trial section and the design shall be based on laboratory trial mixes using approved materials.

The target mean strength for the design mix and minimum cement content shall be determined as indicated in Table 1001-4 of Section 1001.4. The mix design shall be based on the flexural strength of concrete. Casting, curing and testing of cubes shall be carried out as given in Sub section 1001.12 and for beams the procedure given in BS 1881 shall be followed. Unless otherwise specified, a target mean strength value (flexural or crushing) of at least 20 percent in excess of the minimum value shall be achieved during preliminary testing, with respect to the design of mixes.

(b) Concrete Strength and Compliance Testing

During the mix design in the laboratory, correlation between flexural and compressive strengths of concrete shall be established on the basis of at least thirty tests on samples. However, quality control in the field shall be exercised on the basis of flexural strength. It shall be ensured that the materials and mix proportions remain substantially unstressed during the daily concrete production. The water content shall be the minimum required to provide the agreed workability for full compaction of the concrete to the required density as determined by the trial mixes or other means authorized by the Engineer. In this exercise, the maximum free water cement ratio shall be taken as 0.50.

The ratio between the 7 and 28 day strengths shall be determined for the mix to be used in the slab in advance, by testing pairs of beams and cubes at each stage for at least six batches of trial mixes. The average strength of the 7 day cured specimens shall be divided by the average strength of the 28 day specimens for each batch, and the ratio 'R' shall be determined. The ratio 'R' shall be expressed to three decimal places.

if during the construction of the trial section or during normal working, the average value of any 4 consecutive 7 day test results falls below the required 7 day strength as derived from the value of 'R', then the cement content of the concrete shall, without extra payment, be increased by 5 percent by weight or by an amount agreed by the Engineer. The increased cement content shall be maintained at least until the four corresponding 28 day strengths have been assessed for its conformity with the requirements as per Clause 9813.2. Whenever the cement content is increased, the concrete mix shall be adjusted to maintain the required workability.

(c) Workability

At the point of placing the concrete the workability shall be adequate for the concrete to be fully compacted and finished without undue flow.

The required workability for the concrete mix for the paving plant used shall be established by the Contractor with the approval of the Engineer. The quality control of workability at the site shall be determined by the slump test as per Sub section 1803.2(g).

The requirement of workability for the batching plant and pavers shall be determined by carrying out slump tests during paving trials. Such requirements shall be determined for each season and also when the time for transport from the batch plant to the paver and the type of paver are altered. A slump value can be taken as 30 + or – 15 mm for paving works. But this could be modified depending on the site requirements with the approval of the Engineer. Initially slump test shall be carried out on every truck or dumpers, transporting freshly mixed concrete from the mixing plant to the paving site. Subsequently this frequency can be reduced to alternate trucks / dumpers with the approval of the Engineer.

(d) Design mix

The Contractor shall carry out trials of design mixes in the laboratory with the materials obtained from the approved sources to be used. Trial mixes shall be made in the presence of the Engineer or his assistant, who is an engineer and the design mix shall be approved by the Engineer. Trial mixes shall be repeated, if necessary, until the mix proportions that will produce a concrete complying in all respects with these Specifications, and conforming to the requirements of the design/Drawings have been obtained.

The mix proportions as determined by laboratory trial mixes may be adjusted if necessary during the construction of the trials. Thereafter, neither the materials nor the mix proportions shall be altered in any way except with the approval of the Engineer in writing.

Any alterations/ change in the source of materials or mix proportions proposed by the Contractor during the course of work shall be assessed by making laboratory trial mixes and the construction of a further trial unless approval is given by the Engineer for minor adjustments like minor fluctuations in the grading of aggregate or compensation for moisture content of aggregate.

901A.4 Construction Requirements

(a) Sub-base

The concrete Pavement shall be laid over the Subgrade or Sub-base constructed in accordance with the relevant Drawings. If the Subgrade or Sub-base is found damaged at some places or it has cracks wider than 10 mm, it shall be repaired before laying a separation layer, with fine cement concrete (1 part of cement and 3 parts of 10 mm nominal sized graded aggregate) for concrete Sub-bases or as per Section 1101 with premixed patching materials for bitumen surfaced Sub-bases or with soil Sub-base material as per Section 401 for gravely soil Surfacing. Prior to laying of concrete it shall be ensured that the separation membrane as per Sub section 901A.4 (b) is placed in position and the same is free from damage and cleaned of dirt or other extraneous materials.

(b) Separation Membrane

A separation membrane shall be placed between the concrete slab and the Sub-base. Separation membrane shall be an impermeable plastic sheeting of 125 microns thick and laid flat without creases. Before placing the separation membrane, the Sub-base shall be swept clean of all the extraneous materials using an air compressor. Wherever overlap of plastic sheets is necessary, it shall be at least 300 mm and any damaged sheeting shall be replaced at the Contractor's expense. The separation membrane shall be fixed to the lower layer with concrete nails.

(c) Joints

The type and location of joints shall be as shown in the Drawing or as approved by the Engineer. Joints shall be constructed depending upon their functional requirement as detailed in the ensuing paragraphs. The location of the joints shall be transferred accurately at the site and mechanical saw cutting of joints done as per stipulated dimensions. It shall be ensured that the full required depth of cut is made from edge to edge of the Pavement. Transverse and longitudinal joints in the Pavement and Sub-base shall be staggered so that they are not coincident vertically and are at least 1m and 0.3 m apart respectively. Sawing of joints shall be carried out with diamond studded blades soon after the concrete has hardened to take the load of the sawing machine and personnel without damaging the texture of the Pavement. Sawing operation shall not be started within 6-8 hours or as approved by the Engineer, according to the climatic conditions.

(c)(i) Transverse joints

Transverse joints shall be contraction and occasionally expansion joints constructed at the spacing indicated in the Drawings. Transverse joints shall be straight within the following tolerances along the intended line of joints which is the straight line transverse to the longitudinal axis of the carriageway at the position proposed by the Contractor and in agreement with the Engineer, except at road junctions or roundabouts where the position shall be as indicated in the Drawings / Plans:

(a) The best fit straight line through the joint grooves as constructed from the intended line of the joint shall not be more than 25 mm.

(b) Deviations of the edges of the joint groove from the best fit straight line of the joint shall not be greater than 10 mm.

(c) Transverse joints on each side of the longitudinal joint shall be in line with each other and of the same type and width. Transverse joints shall have a sealing groove that shall be sealed in compliance with Sub section 901A.4 (c).

(d) Deviations of the filler board in the case of expansion joints from the intended line of the joint shall not be greater than ± 20 mm

(e)(ii) Contraction joints

Contraction joints shall consist of a mechanical sawn joint groove, 3 to 5 mm wide and 1/4 to 1/3 (± 5 mm) depth of the slab or as stipulated in the Drawings and dowel bars complying with Sub section 901 A.4(d) and as detailed in the Drawings.

The contraction joints shall be cut as soon as the concrete has undergone initial hardening and is hard enough to take the load of joint sawing machine without causing damage to the slab and as stated in 901A.4(c).

(c)(iii) Expansion joints

The expansion joints shall consist of a joint filler board complying with Sub section 901A.2 (g) and dowel bars complying with Sub section 901A.4(d) and as detailed in the Drawings. The filler board shall be positioned vertically with the prefabricated joint assemblies along the line of the joint within the tolerances given in Sub section 901A.4(c) (i) and at a such depth below the surface that will not impede the passage of the finishing straight edges or oscillating beams of the paving machines. The adjacent slabs shall be completely separated from each other by providing joint filler board. Space around the dowel bars and between the Sub-base and the filler board shall be packed with a suitable compressible material to block the flow of cement slurry through such spaces.

(c)(iv) Transverse construction joint

Transverse construction joints shall be placed whenever concreting is suspended for more than 30 minutes or is completed after a day's work. These joints shall be provided at the regular location of contraction joints using dowel bars. The joint shall be made butt type. At all construction joints, steel bulk heads shall be used to retain the concrete while the surface is finished. The surface of the concrete laid subsequently shall conform to the grade and Cross-sections of the previously laid Pavement. When positioning of bulk head/stop-end is not possible, concreting to an additional 1 or 2 m length may be carried out to enable the movement of joint cutting machine so that joint grooves may be formed and the extra 1 or 2 lengths is cut out and removed subsequently, after concrete has hardened.

(c)(v) Longitudinal joint

The longitudinal joints shall be saw cut as per details of the joints shown in the Drawing. The groove may be cut after the final set of the concrete. As indicated in the Drawing, joints shall be sawn to at least 1/3 (± 5 mm) the depth of the slab.

Tie bars shall be provided at the longitudinal joints as per dimensions and spacing shown in the Drawings and in accordance with Sub section 901A.4(d)(ii).

(d) Steel at joints

(d)(i) Dowel bars

(d)(i)a Dowels shall be round mild steel bars in accordance with section 901A.2(g) with details/dimensions as indicated in the Drawing and free from oil, dirt, loose rust or scale. They shall be straight, free of irregularities and burring restricting slippage in the concrete. The sliding ends shall be sawn or cropped cleanly with no protrusions outside the normal diameter of the bar. The dowel bar shall be supported on cradles/dowel chairs in pre-fabricated joint assemblies positioned prior to the construction of the slabs or mechanically inserted with vibration into the plastic concrete by a method which ensures correct placement of the bars and full re-compaction of the concrete around the dowels.

(d)(i)b Dowel bars shall be positioned at mid depth of the slab within a tolerance of ± 20 mm, unless shown otherwise on the Drawings and centred equally about intended lines of the joint within a tolerance of ± 25 mm. They shall be aligned parallel to the finished surface of the slab and to the centre line of the carriageway and to each other within the following tolerances:

(i) **For bars supported on cradles prior to the laying of the slab:**

a. No steel bar of the cradle assembly shall be continuous across the joint.

b. All bars in a joint shall be within ± 3 mm per 300 mm length of bar

c. Two-thirds of the bars shall be within ± 2 mm per 300 mm length of bar

d. No bar shall differ in alignment from an adjoining bar by more than 3mm per 300mm length of bar in either the horizontal nor vertical planes

(ii) **For all bars inserted after laying of the slab:**

a Twice the tolerance for alignment as indicated in (a) above

(d)(i)c The assembly of dowel bars and supporting cradles, including the joint filler board in the case of expansion joints when fixed in position shall have the following degree of rigidity:-

(i) For expansion joints, the deflection of the top edge of the filler board shall be not greater than 13 mm, when a load of 1.3 kN is applied perpendicular to the vertical face of the joint filler board and distributed over a length of 600mm by means of a bar or timber packing, at mid depth and midway between individual fixings or 300 mm from either end of any length of filler board, if a continuous fixing is used. The residual deflection shall be not more than 3mm after removal of the load.

(ii) The joint assembly fixings to Sub-base shall not fail under the 1.3kN load applied for testing the rigidity of the assembly but shall Fail before the load reaches 2.6 kN.

(iii) The fixings for contraction joint shall not fail under 1.3 kN load and shall fail before the load reaches 2.6 kN when applied over a length of 600 mm by means of a bar or timber packing placed as near to the level of the line of fixings as practicable.

(iv) Fixings shall be deemed to fail when there is displacement of the assemblies by more than 3 mm with any form of fixing, under the test load. The displacement shall be measured at the nearest part of the assembly to the centre of the bar or timber packing.

Dowel bars, supported on cradles in assemblies, when subject to a load of 150N applied at either end and in either the vertical or horizontal direction (upwards and downwards and both directions horizontally) shall conform to be within the limits given below:

(a) Two-thirds of the number of bars of any assembly tested shall not deflect more than 2 mm per 300 mm length of bar

(b) The remainder of the bars in that assembly shall not deflect more than 3 mm per 300 mm length of bar.

(d)(i)d Dowel bars shall be covered by a thin plastic sheath for at least two-thirds of the length from one end for dowel bars in contraction joints or half the length plus 50 mm for expansion joints. The sheath shall be tough, durable and of an average thickness not greater than 1.25 mm. The sheathed bar shall comply with the following pull-out tests as given below:

(i) Four bars shall be taken at random from stock and without any special preparation shall be covered by sheaths as required in this Clause. The ends of the dowel bars which have been sheathed shall be cast centrally into concrete specimens 150 x 150 x 600 mm, made of the same mix proportions to be used in the Pavement, but with a maximum nominal aggregate size of 20 mm and cured for 7 days. At 7 days a tensile load shall be applied to achieve a movement of the bar of at least 0.25 mm. The average bond stress shall not be greater than 0.14 MPa to achieve this movement.

For expansion joints, a closely fitting cap 100 mm long consisting of waterproofed cardboard or an approved synthetic material like PVC or GI pipe shall be placed over the sheathed end of each dowel bar. An expansion space at least equal in length to the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar by using compressible sponge. To block the entry of cement slurry between dowel and cap, the relevant area shall be taped.

(d)(ii) Tie bars

Tie bars in longitudinal joints shall be deformed steel bars of strength 410 MPa complying with Snb section 901A.2(c) and in accordance with the following requirements. The bars shall be free from dirt, loose rust, scale and oil.

a Tie bars projecting across the longitudinal joint shall be protected from corrosion for 75mm on each side of the joint by a protective coating of bituminous paint as approved by the Engineer. When the tie bars are used, the coating shall be dry.

b During the construction of the slab, the tie bars in longitudinal joints shall be inserted into rigid assemblies with adequate supports and fixings to remain firmly in position. As an alternate method, tie bars at longitudinal joints may be mechanically or manually inserted into the plastic concrete from above by vibration using a method which ensures correct placement of the tie bars and re-compaction of the concrete around the same.

e Tie bars shall be positioned to remain within the middle third of the slab depth as indicated in the Drawings and approximately parallel to the surface and approximately perpendicular to the line of the joint, with the centre of each bar on the intended line of the joints within a tolerance of 50mm, and with a minimum cover of 30mm below the groove of the joint.

901A.4(e) Weather and Seasonal Limitations

Concreting during rainy season and when rain is imminent, a sufficient supply of tarpaulin or other waterproofing cloth shall be provided along the length of the construction site. Prior to rain, all freshly laid concrete that had not been covered for curing purposes shall be adequately protected. Any concrete damaged by rain shall be removed and replaced. If the damage is limited to texture, it shall be repaired in accordance with the instructions of the Engineer.

When concreting in hot weather, no concreting shall be carried out when the concrete temperature is above 30°C. Furthermore, in adverse conditions like high temperature, low relative humidity, excessive wind velocity, imminence of rains etc., tents on mobile trusses shall be provided over the freshly laid concrete for a minimum period of 3 hours as directed by the Engineer. The temperature of the concrete mix on reaching the paving site shall not be more than 30°C. To bring down the temperature, chilled water or ice flakes shall be made use of, if necessary.

No concreting shall be carried out when the concrete temperature is below 5°C and reducing.

(f) Side forms, Rails and Guide wires

(f)(i) Side forms and rails:

The side forms shall be of mild steel with depth equal to the thickness of the concrete slab or slightly less to accommodate the surface irregularity of the Sub-base. The forms can be placed on series of steel packing plates or shims to take care of irregularity of Sub-base. They shall be sufficiently robust and rigid to support the weight and pressure caused by paving equipment. Side forms for use with wheeled paving machines shall incorporate metal rails firmly fixed at a constant height below the top of the forms. The forms and rails shall be firmly secured in position by using not less than 3 stakes/pins per each 3m length so as to prevent movement in any direction. Forms and rails shall be straight with a tolerance of 3 mm in 3m and when in place shall not settle in excess of 1.5mm in 3m, while paving is being carried out. Forms shall be cleaned and oiled immediately before use. The forms shall be bedded on a continuous bed of low moisture content lean cement mortar or concrete and set to the line and levels shown on the Drawings within tolerances of ±10mm and ±3mm respectively. The bedding shall not extend under the slab and there shall be no vertical step between adjacent forms of more than 3mm. The forms shall be installed by the Contractor for the approval of the Engineer and prior to 12 hours on the day before the construction of the slab and shall not be removed until at least 12 hours after concreting.

During construction, sufficient forms shall be used and set to the required alignment and levels for at least 200m length of Pavement in advance of the paving operations, or the anticipated length of concrete slab to be laid within the next 24 hrs. whichever is longer.

(f)(ii) Use of guide wires – slip form paving

Guide wire shall be provided along both sides of the slab, where slip form paving is proposed. Each guide wire shall be at a constant height above and parallel to the required edges of the slab as described in the Drawing with a vertical tolerance of ±3mm. Additionally, one of the wires shall be kept at a constant horizontal distance away from the required edge of the Pavement as indicated in the Contract Drawing with a ±10mm lateral tolerance.

The guide wires shall be supported on stakes at intervals of not more than 8m apart by connectors capable of fine horizontal and vertical adjustment. The guide wire shall be tensioned on the stakes so that a 500 gram weight shall produce a deflection of not more than 20mm when suspended at the mid point between any pair of stakes. The ends of the guide wires shall be anchored to fixing points or a winch, but not to the stakes.

The stakes shall be positioned and the connectors maintained at their correct height and alignment from 12 hours on the day before concreting takes place until 12 hours after finishing of the concrete. The guide wires shall be erected and tensioned on the connectors at any section for at least 2 hours prior to concreting.

The Contractor shall submit to the Engineer for his approval of line and level, the stakes and connectors which are ready for use in the section of road to be constructed within 12 hours on the working day before the day of construction of slab. Any deficiencies noted by the Engineer shall be rectified by the Contractor who shall then reapply for approval of the affected stakes. Work shall not proceed until the Engineer has given his approval. While concreting is in progress, the Contractor shall ensure that the stakes and guide wires are not affected by the construction equipment.

(g) Construction

Before the commencement of the work, the Method statement for carrying out the work, detailing all the activities including indication of the time-cycle, equipment, personnel etc., shall be approved by the Engineer. The above shall include the type, capacity and make of the batching and mixing plant, the hauling arrangement and paving equipment used for construction.

(g)(i) Batching and mixing:

Batching and mixing of the concrete shall be done at a central batching and mixing plant with automatic controls, located at a suitable place with sufficient space for water tanks and stockpiling of the required cement and aggregates. This shall be, however, situated at a distance approved by the Engineer after considering the transporting arrangements available with the Contractor, requirements of the mix, climate etc.

Mix proportioning of materials except for water shall be carried out in the batching plant by weight, with each of these materials being weighed separately and water being measured by volume. Wherever graded aggregate of uniform quality cannot be obtained as required in the mix design, the grading of aggregates shall be controlled by appropriate blending of various sizes of aggregate. The capacity of batching and mixing plant shall be at least 25 per cent higher than the proposed capacity of the equipment for laying / paving.

(g)(ii) Paving equipment and the compaction of the concrete

The placing of concrete shall be carried out by using an approved fixed form or slip form paver with independent units designed to (i) spread, (ii) consolidate, screed and float-finish and (iii) texture and cure the freshly placed concrete in one complete pass of the machine. The paving equipment shall also place the concrete in such a manner that a minimum of hand finishing will be necessary and so as to provide a dense and homogeneous Pavement in conformity with these Specifications and Drawing. The pavers shall be equipped with electronic controls with sensors to control the line and grade from either or both sides of the paver.

The paver vibrators shall operate at a frequency of 8300 to 9600 impulses per minute under load at a maximum spacing of 600 mm. Variable vibration settings shall also be provided in the paver.

(g)(iii) Concrete saw

The Contractor shall provide adequate number of concrete saws with sufficient number of diamond-edge saw blades. The saw machine shall be either electric or petrol/diesel driven type. A water tank with flexible hoses and pump shall be made available on priority basis, for this activity. The Contractor shall have at least one standby saw in a good working condition. The concreting work shall not commence if the saws are not in working condition.

(g)(iv) Hauling and placing of concrete

Fresh concrete mix from the central batching and mixing plant shall be transported to the paver by means of trucks/tippers of sufficient capacity and approved design in sufficient numbers to ensure a constant supply of concrete to the pavers. Covers shall be used for protection of concrete from the weather. The trucks/tippers shall be capable of maintaining the mixed concrete in a homogeneous state and discharging the same without segregation and loss of cement slurry. The feeding to the paver shall be regulated in such a manner that the paving is done in an uninterrupted manner with a uniform speed throughout the day during concreting.

(g)(v) Placing of concrete

The concrete mixed in central mixing plant shall be transported to the site without delay. The concrete which, in the opinion of the Engineer, has been mixed too long before laying shall be rejected and shall be removed from the site. The total time taken from the addition of the water to the mix, until the completion of the surface finishing and texturing shall not exceed 120 minutes when concrete temperature is less than 25°C and 90 minutes when the concrete temperature is between 25°C to 30°C Trucks/tippers delivering concrete shall not run on plastic sheeting nor shall they run on completed slabs until after 28 days of placing the concrete. The paver shall be capable of paving the carriageway in a single pass and lift, as shown in the Drawings.

Where fixed form pavers are to be used, forms shall be fixed in advance as per Sub section 901A.4(f) of the Specifications. Before any paving is done, the section of site shall be shown to the Engineer, in order to verify the arrangement for paving and checking of dowels, tie-bars etc., as per the relevant clauses of these Specifications. The mixing and placing of concrete shall progress only at such a rate as to permit proper finishing, protecting and curing of the concrete slab.

The temperature of the concrete shall be in all cases, measured at the point of discharge from the delivery vehicle.

The addition of water to the surface of the concrete to facilitate the finishing operations shall not be permitted except with the approval of the Engineer when it shall be applied as a mist by means of equipment approved by the Engineer.

The paving machines shall be provided with approved covers to protect the surface of the slab under construction from direct sunlight or hot wind and rain, if considered necessary by the Engineer.

While the concrete is still plastic, its surface shall be brush textured in compliance with Sub section 901A.8 (b) and the surface and edges of the slab cured by the application of a sprayed liquid curing membrane in compliance with section 901A.4(i) After the surface texturing, but before the curing compound is applied, the chainage of the concrete slab shall be marked on the surface at intervals of 100 m.

Immediately after the side forms are removed, edges of the slabs shall be corrected wherever irregularities have occurred by using fine concrete composed of one part of cement and 3 parts of fine aggregate and 10mm graded aggregate under the supervision of the Engineer.

When the requirements of Sub section 1601.3 for surface regularity fails to be achieved on two consecutive working days, then normal working shall cease until the cause of the excessive irregularity has been identified and corrected.

(g)(vi) Construction including compaction by fixed form paver

The fixed form paving train shall consist of separate powered machines, which spread, compact and finish the concrete in a continuous operation.

The freshly mixed concrete shall be discharged without segregation into a hopper spreader, which is equipped with means for controlling its rate of deposition on to the Sub-base. The spreader shall be operated to place concrete upto a level requiring a small amount of striking off by the distributor of the spreader. The distributor of spreader shall place the concrete to a level slightly proud of the requirement level to ensure that the vibratory compactor thoroughly compacts the layer. If necessary, poker vibrators shall be used adjacent to the edges of the concreting work. The vibratory compactor shall be set to strike off the surface very slightly high so that it is reduced to the required level by the oscillating beam. The machine shall be capable of being rapidly adjusted for changes necessitated by changes in slab thickness or cross fall. The final finisher shall be able to finish the surface to the required level and smoothness as specified, care being taken to avoid bringing up of excessive mortar to the surface by over working the mix.

(g)(vii) Construction including compaction by slip form paver

The slip form paving train shall consist of power machine, which spreads, compacts and finishes the concrete in a continuous operation. The slip form paving machine shall compact the concrete by internal vibration and shape it between the side forms with either a conforming plate or by vibrating and oscillating finishing beams. The concrete shall be deposited without segregation in front of slip form paver across the whole width and to a height which at all times is in excess of the required amount. The deposited concrete shall be struck off to the necessary average and differential surcharge by means of the strike off plate or a screw auger device extending across the

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whole width of the slab. The equipment for striking off the concrete shall be capable of being rapidly adjusted for changes necessitated by change in thickness or cross fall of the slab.

The conforming plate and finishing beams level shall be controlled automatically from the guide wires installed as per Sub section 901A.4(f) by sensors attached at the four corners of the slip form paving machine. The alignment of the paver shall be controlled automatically from the guide wire by at least one set of sensors attached to the paver. The alignment and level of ancillary machines for finishing, texturing and curing of the concrete shall be automatically controlled relative to the guide wire or to the surface and edge of the concrete Pavement.

Such paving machines shall have vibrators of variable output, with a maximum energy output of not less than 2.5kW per metre width of slab per 300mm depth of slab for a laying speed up to 1.5m per minute or pro-rata higher speeds. The machines in all situations shall be of sufficient mass to provide adequate reaction during spreading and paving operations on the traction units to maintain forward movements during the placing of concrete.

When the edges of the slip formed slab slump to the extent that the surface of the edge of the slab does not comply with the requirements of Sub section 1601.2, then special measures approved by the Engineer shall be taken to support the edges to the required levels and work shall be stopped until such time as the Contractor can demonstrate his ability to slip form the edges to the required levels of the concrete slab.

(g)(viii) Construction by hand guided method:

Areas in which hand guided methods of construction are required shall be approved by the Engineer in writing in advance. Such work may be permitted only in restricted areas in small lengths.

The work shall be carried out in accordance with the provisions of Sub Section 901B.3(f)(i).

The acceptance criteria regarding level, thickness, surface regularity texture, finish, strength of concrete and all other quality control measures shall be the same as those of work done by machine.

(h) Surface texture

After the final regulation of the slab and before the application of the curing membrane, the surface of concrete slab shall be brush-textured in a direction at right angles to the carriageway longitudinal axis.

The texture of the brushed surface shall be applied uniformly across the slab in one direction by the use of a wire brush not less than 450 mm wide with a preference for wider brushes. The brush shall be made of 32 gauge tape wires grouped together in tufts spaced at 10mm centres. The tufts shall contain an average of 14 wires and initially be 100mm long. The brush shall have two rows of tufts. The rows shall be 20mm apart and the tufts in one row shall be opposite the centre of the gap between tufts in the other row. When the shortest tuft wears down to 90mm long, the brush shall be replaced.

The texture depth shall be determined by the sand patch test. This test shall be carried out at least once for each day's paving and whenever the Engineer considers it necessary at times after construction as given below in the next paragraph.

Five individual measurements of the texture depth shall be taken at intervals of at least 2m, anywhere along a diagonal line across a lane width between points of 50m apart along the Pavement, No measurement shall be taken within 300mm of the longitudinal edges of a concrete slab constructed in one operation.

Texture depth shall not be less than the minimum required when measurements are taken as given in Table 901A-1 nor greater than a maximum average of 1.25mm.

Table 901A-1 Texture Depth

Time of Test	Number of measurements	Required Texture depth (mm)	
		Specified value	Tolerance
1. Between 24 hours and 7 days after the construction of the slab or until the slab is first used by vehicles	An average of 5 measurements	1.00	± 0.25
2. Not later than 6 weeks before the road is opened to regular traffic	An average of 5 measurements	1.00	+ 0.25 - 0.35

After the application of the brushed texture, the surface of the slab shall have a uniform appearance as determined by the Engineer.

Where the texture depth requirements are found to be deficient, the Contractor shall make good the texture across the full lane width over a length as directed by the Engineer, by re-texturing the hardened concrete surface in a manner approved by the Engineer.

(i) Curing

Immediately after the surface texturing, the surface and the exposed sides of the slab shall be cured by the application of approved resin based aluminised reflective curing compound, which hardens into an impervious film or membrane when sprayed using a mechanical sprayer.

Curing compounds shall contain sufficient flake aluminium in finely divided dispersion to produce a complete coverage of the sprayed surface with a metallic finish. The curing compounds shall become stable and impervious to evaporation of water from the surface of the concrete within 60 minutes of application and shall be of approved type. The curing compounds shall have a water retention efficiency index of 90 per cent in accordance with BS 7542.

The curing compound shall not react chemically with the concrete and the film or membrane shall not crack, peel or disintegrate within three weeks after application. Prior to application, the curing compound shall be thoroughly agitated. The rate of spread shall be in accordance with the manufacturer's instructions that can be checked during the construction of the trial length and subsequently whenever required by the Engineer. During spaying the mechanical sprayer shall be incorporated

with an efficient mechanical device for continuous agitation and mixing of the compound.

During adverse weather conditions, in addition to spraying of curing compound, the fresh concrete surface shall be protected for at least 3 hours by covering the finished concrete Pavement with tents, as directed by the Engineer. After three hours, the Pavement shall be covered by moist hessian and the same shall then be kept damp for a minimum period of 14 days after which time the hessian may be removed. The hessian shall be kept continuously moist. All damaged/torn hessian shall be removed and replaced by new hessian, regularly.

The Contractor shall at his expense replace any concrete damaged as a result of incomplete curing or cracked concrete on lines other than those at joints.

(j) Trial Section

The trials of sections decided by the Engineer, shall be constructed at least one month in advance of the proposed commencement of concrete paving work. At least one month prior to the construction of the trial section, the Contractor shall submit for the Engineer's approval, a detailed method statement giving description of the proposed materials, plant, equipment and construction methods. All the major equipment like paving train, batching plant, tippers etc., proposed in the construction are to be approved by the Engineer before their procurement. No trials of new materials, plant equipment or construction methods, nor any development of them shall be permitted either during the construction of trial length or in any subsequent paving work, unless they form part of further, approved trials. These trial lengths shall be constructed away from the carriageway but with at least a Sub-base layer below the same.

The Contractor shall demonstrate the use of materials, plant, equipment and methods of construction that are proposed for concrete paving, by first constructing a trial length of slab, at least 60m but not more than 300m long for mechanised construction and at least 30m long for and manual methods. If the first trial is unsatisfactory, the Contractor shall have to demonstrate his capability to satisfactorily construct the Pavement in subsequent trials.

The trial section shall be constructed in two parts over a period comprising at least part of two separate working days, with a minimum of 30m constructed each day for mechanised construction or a minimum of 15m on each day for hand guided construction. The trial length shall be constructed at a similar rate to that which is proposed for the main work.

Transverse joints and longitudinal joints of each type that are proposed for jointed un-reinforced concrete slabs in the main work shall be constructed and assessed in the trial length. If in the trial length the construction of longitudinal joint is not demonstrated, at least the first 150m of longitudinal construction joint for mechanised paving in the main work, shall be considered as the trial length for these joints.

The trial length shall comply with these Specifications in all respects. The tolerances for surface regularity, level, thickness and strength shall conform to the requirements given in Sub section 1601.3.

(k) Preparation and sealing of joints

(k)(i) Preparation and sealing of joint grooves

All transverse joints in surface slabs shall be sealed using sealant described in Sub section 901.2(h). Joints shall be sealed before 14 days after construction.

(k)(ii) Preparation of joint grooves for sealing

Joint grooves usually are not constructed to provide the minimum width specified in the Drawings when saw cut joints are adopted. They shall be widened subsequently by sawing before sealing. Depth/width gauges shall be used to control the groove dimensions.

If rough arises develop when grooves are made, they shall be ground to provide a chamfer approximately 5mm wide. If the groove is at an angle upto 10 degree from the perpendicular to the surface, the overhanging edge of the sealing groove shall be sawn or ground perpendicular. If spalling occurs or the angle of the former is greater than 10 degree, the joint sealing groove shall be sawn wider and perpendicular to the surface to encompass the defect upto a maximum width, including any chamfer, of 35mm for transverse joints and 20mm for longitudinal joints. If the spalling cannot be so eliminated then the arises shall be repaired by an approved thin bonded arris repair using cementitious materials.

All grooves shall be cleaned of any dirt or loose material by air blasting with filtered, oil-free compressed air. If the need arises the engineer may instruct the cleaning of the grooves by pressurised water jets. Depending upon the requirement of the sealant manufacturer, the sides of the grooves may have to be sand blasted to increase the bondage between sealant and concrete.

The groove shall be cleaned and dried at the time of priming and sealing.

Prior to sealing the temporary seal provided for blocking the ingress of dirt, soil etc., in the grooves shall be removed. A highly compressible heat resistant paper backed de-bonding strip as per Drawing shall be inserted in to the groove to serve the purpose of breaking the bond between sealant and the bottom of the groove and to plug the joint groove so that the sealant may not leak through the cracks. The width of debonding strip shall be more than the joint groove width so that it is held tightly in the groove. In the case of longitudinal joints, heat resistant tapes may be inserted to block the leakage through bottom of the joint of the concrete slab.

(k)(iii) Sealing with sealant

During the application of sealant, an appropriate primer shall also be used if recommended by the manufacturer and it shall be applied in accordance with their instructions. The sealant shall be applied within the minimum and maximum drying times of the primer recommended by the manufacturer. When the naturally occurring temperature in the joint groove to be sealed is below 7°C, priming and sealing with applied sealant shall not be carried out.

When hot applied sealant is used it shall be heated and applied from a thermostatically controlled, indirectly heated preferably with oil jacketed melter and pourer having recirculating pump and extruder. For large road projects, sealant shall be applied with extruder having flexible hose and nozzle. The sealant shall not be heated to a temperature higher than the safe heating temperature and not for a period

longer than the safe heating period, as per specified by the manufacturer. The dispenser shall be cleaned out at the end of each day in accordance with the manufacturer's recommendations and the reheated material shall not be re-used.

The sealant of the cold applied type with chemical formulating like polysulphide may be used. These shall be mixed and applied within the time limit specified by the manufacturer. If primers are recommended they shall be applied neatly with an appropriate brush. The Movement Accommodation Factor (MAF) shall be more than 10 per cent.

As the sealant applied at contraction phase of the slabs would result in bulging of the sealant over and above the slab, the Contractor in consultation with the Engineer shall establish correct temperature and time for applying the sealant. A thermometer shall be hung on a pole in the site for facilitating control during the sealing operations.

Sealant shall be applied, slightly to a lower level than the slab with a tolerance of 5 ± 2 mm.

During sealing operation, it shall be seen that no air bubbles are introduced in the sealant either by vapours or by the sealing process.

Manufacturer's certificate shall be produced by the Contractor for establishing that the sealant is not more than six months old and stating that the sealant complies with the relevant standard as in Sub section 901A.2(b). The samples shall meet the requirements of AASHTO M 282 for hot applied sealant or BS 5212: (Part-1) for cold applied sealant.

(f) Surface finish and quality control

The concrete Pavement shall be finished to the requirements given in Section 1601.

The control on the quality of materials and works shall be exercised in accordance with Section 1602.

901A.5 Opening to Traffic

No vehicular traffic shall be allowed to run on the finished surface of a concrete Pavement within a period of 28 days of its construction and until the joints are permanently sealed. The road may be opened to regular traffic after completion of the curing period of 28 days and after sealing of joints is completed including the construction of shoulder, with the written permission of the engineer.

901A.6 Measurement & Payment

(a) Measurement

Cement concrete Pavement shall be measured as a finished work in cubic meters and accepted by the Engineer. The volume to be paid for will be calculated on the basis of thickness and plan areas shown on the project Drawings and adjusted for the deficiency in thickness. No additional measurements shall be taken for extra thickness of the slab.

The unit for measurement for concrete Pavement shall be the Cu.m of concrete placed, based on the net plan areas for the specified thickness shown on the Drawings or directed by the Engineer. No deduction shall be made in measurement for openings, provided that the area of each is less than 0.5 sq. metre.

(b) Payment

Payment for Cement Concrete Pavement

Machine oriented construction shall be made at the Contract unit rate for the item as measured above. The price shall be full compensation for carrying out all provisions of this Specification and shall include the provision of all materials including polythene film, concrete, stock piling, mixing, transport, placing, compacting, finishing, curing together with all form work and including testing and submission of test certificates and records. It shall also include the full costs of contraction, expansion, construction and longitudinal joints. In addition it shall include joint fillers, keys, caulking rods, debonding strips, sealant primer, joint sealants, dowel bars and tie rods.

The full payment will be made for this item only after 28 days strength of the concrete is found to be satisfactory.

The Pay Items and Pay Units shall be as follows: –

Pay Item	Description	Pay Unit
901A(1)	Concrete Pavement - Machine oriented method of construction (state thickness)	Cu.m

Note

Refer Sub section 106.6 regarding sub divisions of pay items.

901B CEMENT CONCRETE PAVEMENT – MANUAL ORIENTED CONSTRUCTION

901B.1 Description

This work shall consist of the construction of un-reinforced cement concrete Pavements where manual techniques, supplemented by suitably improvised equipment, are used for the placing and compaction of concrete.

Where work of a large scale is envisaged necessitating the use of specialised techniques of construction, either of the fixed-form type or of slip-form type, Section 901A for Machine Oriented Construction shall be referred to.

Where the Pavements are reinforced, the requirements are given in special provisions.

The work shall be carried out in accordance with the lines, levels, grades, dimensions and Cross-sections as shown in the Drawings or as instructed by the Engineer.

901B.2 Materials

Materials used shall conform to the requirements of the following, unless otherwise specified.

(a) Cement to Section 1703.

(b) Water for mixing and curing to SLS 522.

(c) Coarse and fine aggregate to Sub section 1701.2.

(d) Admixtures to Section 1705.

(e) Polythene sheeting and other materials used as separation membranes between the sub-base and concrete slabs and any special materials used for curing of concrete shall be approved by the Engineer prior to their use.

(f) Sand bitumen mix or any other joint filler as approved.

901B.3 Concrete mix requirements and testing for quality

(a) Maximum size and grading of aggregate

The aggregate shall be of nominal maximum sizes 37.5mm as specified and the combined aggregate, normally obtained by mixing of coarse aggregate and fine aggregate, shall be within the grading limits given in Sub section 1701.2, unless allowed otherwise after carrying out suitable trial mixes.

(b) Mix Design for Concrete

The mix design shall be carried out in accordance with Sub section 901A.3(a).

(c) Concrete Strength and Compliance Testing

The measurements of concrete strength shall comply with provisions of Sub section 901A.3 (b).

Unless otherwise specified, in the design of mixes a target average strength value (flexural or crushing) of at least 20 percent in excess of the minimum value shall be achieved during preliminary testing.

(d) Workability

The requirements of workability shall comply with the provisions of Sub section 901A, modified to cater for manual work and as approved by the Engineer.

901B.4 Construction Requirements

(a) Slab dimensions and joints

(i) Widths and thicknesses

Slab widths shall normally be 3.0 to 3.7m, corresponding to the widths of a traffic lane. In any case the slab width shall not exceed 4.5m without the approval of the Engineer.

Slab thicknesses shall normally vary between 150mm and 250mm depending on Subgrade conditions and traffic. However, thicknesses greater than 200mm shall be adopted only where so specified or directed.

(ii) Transverse Joints

Transverse joints shall normally be contraction joints and they shall be expansion joints only where so indicated in Drawings or directed by the Engineer.

They shall be spaced between 4 to 6m depending on the slab thicknesses.

Contraction joints shall be created by making crack inducers in the slab at the top or at the bottom as specified. Top crack inducers shall be made, as indicated in Drawings or as directed, either by moulding a groove in fresh concrete or by sawing a narrow cut in the hardened concrete to depths of ¼ to ⅓ of the thickness of the slab. Where bottom crack inducers are provided there shall be a corresponding shallow groove on the top as well. These top grooves shall later be filled with a suitable mix of sand and bitumen or any other approved joint filler.

Where specified the contraction joints shall be dowelled across and normally these dowels shall be spaced at about 300mm apart. They shall be M.S rods 20 to 25mm in diameter and about 500mm in length and coated with a film of bitumen, a resin based varnish or a plastic sheath, to protect them against corrosion and to facilitate sliding in the concrete.

They shall normally be installed at mid-depth in the slab and parallel to the surface and the centre line of the road either by vibrating in during concreting or by positioning on a suitable metal frame prior to concreting. Where joint spacing is relatively small and the traffic is relatively low the number of dowels may be suitably reduced or they may be totally eliminated, with the approval of the Engineer.

Expansion joints where specified shall be made with the required space maintained uniformly across the slab and dowelled where necessary according to details given in Drawings or established by the Engineer. They shall be subsequently in-filled with a bitumen sand mix or any other approved material.

(iii) Longitudinal joints

Normally there shall be a longitudinal joint at the centre of a two lane road or at the separation lines of lanes in a multilane road, and they shall be formed with or without a key, and with or without tie bars, as specified

A key where specified shall be formed to details given in Drawings or established by the Engineer.

Tie bars shall be of the size and length specified and shall be inserted at the spacing given in Drawings or by the Engineer. The top of these joints shall be suitably grooved and in-filled with a sand bitumen mix or any other joint filler as approved.

(b) Sub grade requirements

The concrete pavement shall be placed on an improved Subgrade or on a Sub-base of approved type and thickness. The Sub-base may be of natural soil conforming to Section 401 or of stabilized soils conforming to Section 402. The Sub-base may

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also be of graded granular material similar to that of graded aggregate Base to Section 405.

(c) Separating membrane

Prior to laying of the concrete Pavement the surface of the approved Subgrade or Sub-base shall be cleared of extraneous material and over-laid with a separating membrane of polythene sheeting of the specified thickness, unless otherwise specified.

(d) Laying of Formwork

The formwork within which the concrete is to be laid shall then be positioned and fixed to line and level and to the required lengths.

Unless otherwise directed, the formwork in addition to the requirements of Section 1008 shall be of steel, and shall be made to L-shape section using steel plates of minimum thickness 6mm. The height of the formwork shall be equal to the thickness of the Pavement and the Base width shall be at least equal to 75 percent of the height.

The forms shall be placed on the Base, and over the separating membrane, with full bearing on it, to the required alignment of the Pavement edge. They shall be held down in place by means of steel stakes one at each end of each length of forms and at intermediate points not greater than 1.5m apart. Each form shall be firmly fixed to the adjoining form by suitable edge fasteners which could easily be removed, but will hold them firmly preventing any lateral movement when the concrete is placed and compacted.

(e) Manufacture and Transport of Concrete

As a first step in the manufacture of concrete the Contractor shall ensure that the production capacity of the mixing plant suits the laying equipment and the concreting rate.

The mixing of concrete shall conform to the requirement of Sub section 1001.8.

In the transport of the mix, care shall be exercised to minimize segregation and also delay.

When concrete is transported from within the site or from a mixing place in the vicinity of the site, ordinary trucks or dumpers with suitable tipping arrangements may be used. Preferably, they should be of low bed type and of small capacity, where manual methods of placing and compaction are adopted. Such transport may be done using even wheel barrows provided a sufficient number are employed and an efficient method of tipping the concrete at the required places is arranged.

In central plant mixing the concrete shall normally be transported using suitable truck mixers or truck agitators. In such circumstances the details of transport equipment and the time duration of transport, laying and finishing operations shall be as specified in the Contract or as established by the Engineer.

(f) **Laying Operations**

The placing compaction and finishing operations of concrete shall normally be made labour intensive, except in large scale work where specified equipment shall be used.

(i) Manual method of laying and compaction

Laying of concrete manually shall use a suitably improvised method of placing the concrete in a uniform and sufficient manner without segregation to suit the desired rate of concreting.

The work shall be carried out by skilled personnel as per methods approved by the Engineer.

For compaction, suitable poker vibrators, plate vibrators and vibrating beams shall be used. Internal pokers shall be at points not more than 500 mm apart over the whole area of the slab, or drawn continuously across the slab in front of the vibrating beams.

The vibrating beams shall be metal with a contact face at least 50 mm wide. They shall be rigid or supported by a frame or truss without sag across the width of slab being paved. The beams shall be supported on rails or forms or an adjacent slab and shall be moved forward at a steady speed of 0.5 m to 2 m per minute. The whole area of the slab shall be regulated by two passes of a scraping edge not less than 1.8 m wide.

To improve the method of placing of concrete an improvised box hopper spreader may be used. Under suitable conditions, use may be made of an asphalt finisher.

(ii) Machine laying, compaction and finishing

For large scale work, where the Pavement needs to meet higher quality criteria. Particularly for evenness, and where higher rates of laying are specified, use of specific concreting equipment such as a concreting train on fixed forms or a small sized slip form pavers (of paving width not exceeding 5.0m) shall be used. In such instances, however, the provisions of Section 901A for Machine Oriented Construction shall be applied.

(g) Finishing Operations

The surfaces shall be textured as per Sub section 901A.4 (h). Where necessary transverse grooves shall be formed by using a vibrating beam or such other mechanism approved by the Engineer. Use of additives to roughen the surface shall be with the prior approval of the Engineer.

(h) Curing of Concrete

Curing of the laid concrete shall be carried out for a minimum period of 14 days as provided for in Sub section 1001.11.

(i) **Surface Finish and Quality Control**

The cement concrete Pavement shall be finished to the requirements given in Section 1601.

The control on the quality of materials and works shall be exercised in accordance with Section 1602.

901B.5 Measurement & Payment

(a) **Measurement**

Concrete Pavements shall be measured as finished work in position in Cu.m or in Sq.m of surface area. Joints shall be measured separately in linear metres as specified.

(b) **Payment**

Payment shall be based on the Contract unit rate for each item of completed and accepted work, which shall include full compensation for materials, labour, equipment, transport, hire charges and incidentals necessary to complete the work.

The Pay items and Pay Units shall be as follows :-

Pay Item	Description	Pay Unit
901B(1) or 901B(2)	Concrete Pavement Concrete Pavement (state thickness)	Cu.m Sq.m
<u>and the following</u>		
901B(3)	Joints (state type)	Linear metres

<u>Note</u>
Refer Sub section 106.6 regarding sub divisions of pay items.

1000 BRIDGES AND OTHER STRUCTURES

Delete this entire section and substitute the following:

1001 CONCRETE FOR STRUCTURES

1001.1 CONCRETE GRADES

Delete Table 1001-1 and Table 1001-5 and replace by the following paragraph:

Concrete Classes shall be replaced by concrete grades defined per BS 5328 as follows

TABLE 1001-1 Concrete Grades

Grade	Characteristic Strength (N/mm2)
C 15	15
C 20	20
C 25	25
C 30	30
C 40	40
C 50	50

The maximum size of coarse aggregate shall be 20mm for all grades except for grade C 15 for which 40 mm shall be permitted.

1001.2 Minimum Cement Content and Water /Cement Ratio

The minimum cement content and water / cement ratio for different grades of concrete shall be as follows:

Type of Concrete	Minimum cement content (kg / m3)	Maximum free water/cement ratio
Unreinforced	275	0.65
Reinforced	300	0.60
Prestressed	325	0.55

The cement content shall not exceed 550 kg / m3

1001.3 Volume Proportioning of Concrete

Volume proportioning (Batching) shall not be permitted for structural concrete except for grade 20 and under.

1001.4 Workability of Concrete

The concrete shall be of suitable workability for full compaction to be obtained. The following table shall replace Table 1001-6. The slump shall be measured in accordance with BS 1881.

Use of Concrete	Nominal Slump	Permitted Deviation
Reinforced Concrete in slabs, beams, walls, precast components and columns	75 mm	± 25
Reinforced Concrete in slabs, beams, walls, precast components and columns containing congested reinforcement	125 mm	± 25

1001.5 Chloride and Sulphate Content

The Chloride and Sulphate contents in concrete from all sources shall conform to values shown in the Table below:

Type or Use of cement	Maximum total Chloride content expressed as Chloride ions by mass of cement	Maximum total acid soluble sulphate content expressed as SO_3 by mass of cement
Prestressed concrete or steam cured reinforced concrete	0.1 %	4 %
Concrete made with Sulphate resisting Portland cement to BS 4027	0.2 %	4 %
All other	0.3 %	4 %

1001.6 Trial Mixes

The Contractor shall prepare trial mixes having workability, strength, and surface finish criteria, to satisfy the Engineer regarding these qualities. The trial mixes shall be made and compacted in the presence of the Engineer; using the same type of plant and equipment as will be used for the works. The concreting plant and means of transport employed to make the trial mix and to transport them representative distances shall be similar to the corresponding plant and transport to be used in the Works.

From each trial mix, test cubes shall be taken as follows. For each mix a set of six cubes shall be made from each of three consecutive batches. Three from each set of six shall be tested at an age of 28 days and three at an earlier age approved by the Engineer. The cubes shall be made, cured, stored, transported and tested in compression in accordance with BS 1881. The tests shall be carried out in a laboratory approved by the Engineer.

From the same mix as that from which the test cubes are made, the workability of the concrete shall be determined by the Slump Test in accordance with BS 1881 or other method approved by the Engineer. The remainder of the mix shall be cast in a wooden mould and compacted. After 24 hours the sides of the mould shall be struck and the surface examined in order to satisfy the Engineer that an acceptable surface can be obtained with this mix

A trial mix for a particular grade shall be accepted when the average strength of the nine cubes, tested at 28 days exceeds the specified characteristic strength by the current margin minus 3.5N/sq.mm. In addition the consistency shall be to the satisfaction of the Engineer.

The characteristic strength of the various classes of concrete shall be determined as soon as the first 30 test results of each class become available.

The characteristic strength shall be calculated by the equation:

$$X_0 = \overline{X} - kS$$

Where:

X_0 : characteristic strength,

$\overline{X}$: mean or average of the series of results

The value of k shall be taken as 1.64.

S : standard deviation given by the equation:

$$S = \{\Sigma (X - \overline{X})^2 / (N - 1)\}^{1/2}$$

Where X : the individual result, N : the total number of results

When a proposed mix has been approved, no variations shall be made in the mix proportions, or in the type, size, grading zone or source of any of the constituents without the consent of the Engineer who may require further trial mixes to be made before any such variation is approved.
Until the results of trial mixes for a particular grade have been approved by the Engineer, no concrete of the relevant grade shall be placed in the works.

When the Contractor intends to purchase factory-made precast concrete units, trial mixes may be dispensed with provided that evidence is given to satisfy the Engineer that the factory regularly produces concrete, which complies with the Specification. The evidence shall include details of mix proportions, water-cement ratios, slump and strengths obtained at 28 days.

1001.7 Sampling and Testing

The Contractor shall take samples of the concrete for testing. The number frequency and location shall be decided by the Engineer.

Unless otherwise requested by the Engineer, cube tests shall be made at the rate of 1 set of cubes per 10 cu.metres of concrete. The times of day at which samples are taken shall be chosen at random. At least one sample shall be taken on each day that a particular grade is used.

The procedure for sampling and making cubes and testing shall be carried out strictly in the manner described in BS 1881.In addition, the Engineer may order at his own discretion, additional samples of concrete to be cured at the job site, in order to verify actual strengths obtained.

For cubes tested at an age of 28 days the cube strength shall conform to the following requirements:

(a) The average strength determined from any group of four consecutive test cubes shall exceed the specified characteristic strength by at least 0.5 times the current margin

(b) Each individual test result shall be greater than 85% of the specified characteristic strength.

If the average strength of any group of four consecutive test cubes fails to meet the first requirement (a) then all concrete mixed in all batches from the first batch to the last batch from which samples were taken to make the test cubes, together with all the intervening batches shall be deemed not to comply with the strength requirements.

If only one cube fails to meet the second requirement (b) then that result may be considered to represent only the particular batch of concrete from which that cube was taken.

The Contractor shall take such remedial action as the Engineer may order, including the removal of the relevant concrete, and shall, before proceeding with the concreting, submit for the Engineer's approval details of the action proposed to ensure that the concrete complies with the requirements of the Specification.

1001.8 Materials

(a) Portland Cement
Cement shall conform to the provisions of the following British Standards or the corresponding Sri Lanka Standard:

BS 12 Ordinary Portland Cement (ordinary and rapid hardening)
BS 146 Portland - blast furnace cement
BS 4027 Sulphate-resisting Portland cement
BS 1370 Low heat Portland cement

The Contractor shall provide suitable means of storing and protecting the cement against dampness. Fully covered storage areas with floors protected from rising dampness shall be provided. Bagged or bulk cement which has become partially set or which contains lumps of caked cement shall be rejected. The use of cement reclaimed from discarded or used bags will not be permitted.

(b) Water

The water used in mixing or curing concrete shall be tested by methods described in BS 3148. All water shall be clean and free from salt, oil or acid, vegetable or other substance injurious to the finished product. Sources of water shall be maintained at such a depth and the water shall be withdrawn in such a manner as to exclude silt, mud, grass or other foreign materials. Water from the sea or tidal rivers shall not be used.

Potable water supplied by the National Water Supply and Drainage Board shall normally be acceptable.

(c) Admixtures

Admixtures shall not be used without the written approval of the Engineer. The Contractor shall submit technical data of any admixtures he proposes to use to the Engineer at least 28 days prior to the date of placing orders for such giving particulars of the structure on which he intends to use such admixtures.

Admixtures containing Calcium Chloride in any form are not permitted.

(d) Aggregate

Unless otherwise specified or agreed by the Engineer aggregate shall comply with the requirements of BS 882, (aggregates from natural sources for concrete, including granolithic).

(i) Fine Aggregate

The grading of fine aggregate when determined by a test according to BS 882 shall be within the limits of one of the grading zones given in the Table below: .
The fine aggregate shall be described as fine aggregate of the grading zone into which it falls - e.g. BS 882, Grading Zone C, M, F or Overall.

GRADING LIMITS FOR FINE AGGREGATE

Sieve Size	Percentage by mass passing BS Sieve			
	Overall limits	Additional limits for grading		
		C	M	F
10.00 mm	100	-	-	-
5.00 mm	89 to 100	-	-	-
2.36 mm	60 to 100	60 to 100	65 to 100	80 to 100
1.18 mm	30 to 100	30 to 90	45 to 100	70 to 100
600 μm	15 to 100	15 to 54	25 to 80	55 to 100
300 μm	5 to 70	5 to 40	5 to 48	5 to 70
150 μm	0 to 15[1]	-	-	-

[1] *Increased to 20 % for crushed rock fines, except when they are used for heavy duty floors*

NOTE: Individual sands may comply with the requirements of more than one grading. Alternatively, some sands may satisfy the overall limits but may not fall within any one of the additional limits C, M or F. In this case and where sands do not comply with the above table an agreed grading envelope may also be used provided that the supplier can satisfy the Engineer that such materials can produce concrete of the required quality.

(ii) Coarse Aggregate

The grading of coarse aggregate, when determined by a test according to BS 882 shall be within the limits of one of the gradings given in Table below and the nominal maximum size of aggregate shall be 20 mm for reinforced concrete and 40 mm for un-reinforced concrete.

For the control of Alkali-Silica reaction non-reactive aggregates shall be used. Provided they are not contaminated with opal, tridymite or cristobiline or contain more than 20% (by weight) of chert, flint or chalcedony. The following types of aggregate are considered to be non-reactive Dolerite, Dolomite, Feldspar, Gneiss, Granite, Limestone, Schist and Tuff. On no occasion shall the amount of equivalent sodium oxide exceed 3.0kg in any cubic metre of concrete.
The Engineer will permit hand broken stone to be used as coarse aggregate for Grade C 15 concrete.

GRADING LIMITS FOR COARSE AGGREGATE

Sieve size (mm)	Percentage by mass passing BS Sieve for nominal sizes Single-sized aggregate	
	20 mm	5 mm)
50	-	-
37.5	100	-
20.0	85 to 100	-
14.0	0 to 70	-
10.0	0 to 25	100
5.0	0 to 5	45 to 100
2.36	-	0 to 30

All aggregates shall be stored in such a way that they shall be kept free from contact with deleterious matter. Aggregates of different sizes shall be stored separately and in such a way as to avoid segregation in each stockpile.

The Contractor shall provide copies of the results of routine control tests carried out by the aggregate producer and obtain the Engineer's approval prior to placing orders.

(iii) Reinforcement
All reinforcement shall comply with the requirements of Section 1002.

(vi) Waterstops
Waterstops shall be manufactured by the extrusion of an Elastomeric plastic compound consisting of virgin polyvinylechloride will meet the following performance requirements:

Tensile Strength	12.2 Mpa (Min)
Elongation at break	250% (Min)
Water soluble matter content	0.15% (Max)
Softness number	38 to 80

1001.9 Equipment and Tools

General
Equipment and tools necessary for handling material and performing the work, and satisfactory to the Engineer as to design, capacity and mechanical condition, shall be at the site of work before work is started.

If any equipment is not maintained in full working order or if the equipment as used by the Contractor proves inadequate to obtain the results prescribed, such equipment shall be improved or other satisfactory equipment substituted or added at the direction of the Engineer.

Mixers

(a) General - All concrete shall be mixed in batch mixers manufactured in accordance with BS 1305 or tested in accordance with BS 3963. It may be mixed at the site of construction, at a central plant or in transit. Each mixer shall have attached to it in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum.

(b) Mixers at site of construction - Mixers at the 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. The mixer shall be equipped with a suitable charging hopper, water storage, and a water-measuring device, accurate within 1%. Controls shall be so arranged that the water can be applied only while the mixer is being charged.

The discharge lever shall lock automatically until the batch has been mixed the required time after all materials are in the mixer. Suitable equipment for discharging the concrete in the form shall be provided. The mixer shall be cleaned at suitable intervals. The pick-up and throw over blades in the drum shall be replaced when they have lost 10% of their depth.

1001.10 Placing Concrete

(a) General - Concrete shall be placed in such a manner as to avoid segregation and the displacement of reinforcing bars and shall be spread in horizontal layers where practicable. Concrete shall be placed where necessary inside forms by hand shovels and in no instance shall vibrators be so manipulated to transport concrete inside formwork. Care shall be taken to prevent mortar from spattering on forms and reinforcing steel and from drying ahead of the final covering with concrete. Where spattering has occurred the forms and steel shall be cleaned with wire brushes or scrapers before concrete is placed around steel or in forms. Troughs, pipes or short chutes used as aids in placing concrete shall be positioned in such a manner that segregation of the concrete will not occur. All chutes, troughs, and pipes shall be kept clean and free from coating of hardened concrete or mortar.

Concrete shall be thoroughly compacted by vibration, unless otherwise agreed by the Engineer, during the operation of placing, and thoroughly worked around the reinforcement, tendons or duct formers, around embedded fixtures and into corners of the formwork to form a solid mass free of voids. When vibrators are used to compact the concrete, vibration shall be applied continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner that does not promote segregation of the ingredients.

Particular care shall be taken when concreting bridge decks of substantial thickness to avoid layering of concrete, and the whole thickness shall be placed in one pass. In deck slabs where void formers are used, adequate means to prevent flotation shall be employed and care taken to ensure adequate compaction of the concrete placed beneath the void formers.

Vibration shall not be applied by way of the reinforcement. Where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided as far as is practicable.

Concrete shall not be subject to disturbance between 4 hours and 24 hours after compaction except with the agreement of the Engineer. Wherever vibration has to be applied externally, the design of formwork and disposition of vibrators shall ensure efficient compaction and the avoidance of surface blemishes.

There shall be no excess water on the top surface on completion of compaction.

Concrete shall not be dropped freely over a vertical distance of more than 1.20metres.

Concrete shall be placed continuously throughout each section of the structure or between joints if shown on the Drawings or as directed by the Engineer. If, in an emergency it is necessary to stop placing concrete before a section is completed, bulkheads shall be placed as the Engineer may direct and the resulting joint shall be deemed a construction joint, the treatment for which is given in Clause 4.5(g).

(b) Concrete Columns - Concrete in columns or bents shall be placed in one continuous operation unless otherwise permitted by the Engineer.

(c) Concrete Slab and Girder Spans - Concrete in T-Beam or deck girder spans having spans of 12 metres or less shall be placed in one continuous operation unless otherwise stated on the Drawings. Concrete preferably shall be deposited by beginning at the centre of the span and working towards the ends.

Concrete in slab spans shall be placed in one continuous operation and in one layer for each span, unless otherwise stated on the Drawings.

Concrete in girders spanning more than 12 metres may be placed in two operations; the first operation being the placing of concrete in the girder stems to the bottom of the slab haunches or the bottom of the slab whichever is applicable. The top surface of the previously placed concrete shall be jetted with air or water to remove laitance and all loose material and no further roughening shall be carried out. A period of at least 24 hours shall elapse between the completion of placing concrete in the girder and the commencement of placing concrete in the slab. The Contractor shall check all falsework for shrinkage and settlement and shall tighten all wedges to ensure minimum deflection of all formwork.

(d) Walls, Piers, etc - Where walls, piers, columns, struts, posts and other such structural members allow horizontal construction joints, concrete shall not be placed on top of other concrete which has not been allowed to set for 12 hours or more.

Work shall not be discontinued within 450mm of the top of any face, unless provision has been made for a coping less than 450mm thick, in which case, if permitted by the Engineer, the construction joint may be made at the underside of the coping.

(e) Culverts - The slabs of box culverts shall be placed for their full depth in one layer and allowed to set not less than 12 hours before any additional work is done on them. For culverts of exceptional length under high embankment details of construction joints are shown on the Drawings. The entire length of slabs between indicated construction joints shall be placed for their full depth or layer and allowed to set for not less than 12 hours before any additional work is done on these lengths.

Before concrete is placed in sidewalls, bottom slabs shall be cleaned of all shavings, sticks, sawdust and other extraneous material.

The Contractor shall submit to the Engineer for approval his proposals for pouring culvert walls before commencing culvert construction. Concrete shall not be placed in layers more than one metre high relative to the concrete already placed. Deposition shall proceed in a systematic manner.

(f) Depositing Concrete Under Water - Concrete shall not be deposited in water except with the approval of the Engineer and with his immediate supervision and in this case the method of placing shall be by tremie and as defined below.

Concrete deposited in water shall contain 10% by weight extra cement to that approved by the Engineer for the grade of concrete used. To prevent segregation, it shall be carefully placed in a compact mass, in its final position, by means of a tremie tube or pipe, or a bottom dump bucket and shall not be disturbed after being deposited. Special care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. The method of depositing concrete shall be so regulated as to produce approximately horizontal surfaces.

Concrete seals shall be placed in one continuous operation. When a tremie tube or pipe is used it shall consist of a tube or pipe not less than 250mm in diameter. All joints in the tube shall be watertight. The means of supporting the tremie tube shall be such as to permit free movement of the discharge end over the entire top of the concrete and to permit it being lowered rapidly when necessary to choke off or retard the flow. The tremie tube shall be filled by a method that will prevent washing out of

the concrete. The discharge end shall be completely submerged in concrete at all times and the tremie shall be kept full.

When concrete is placed with a bottom dump bucket, the bucket shall have a capacity of not less than one half cubic metre and the top of the bucket shall be open. The bottom door shall open freely downward and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited and when empty be withdrawn slowly until well above the concrete. The slump of the concrete used shall be maintained between 100 and 200 mm.

Dewatering shall proceed only when the concrete seal is considered strong enough to withstand any pressures to be exerted upon it. This time will be decided by the Engineer.

All laitance or other unsatisfactory material shall be removed from the exposed surface by scraping, jetting, chipping or by other means, which will not injure the seal unduly.

(g) Construction Joints - a concreting schedule shall be prepared for each completed structure and the Engineer shall approve the locations of construction joint on this concreting schedule. These locations shall not be altered, unless in case of emergency, when construction joints shall be positioned as directed by the Engineer.

At horizontal construction joints, gauge strips 20 to 30mm square shall be placed inside the forms along all exposed surfaces to give the joints straight lines. Before placing fresh concrete, the surfaces of all construction joints shall be hammered with a sharp hand tool until the aggregate is exposed, cleaned and a small quantity of neat cement slurry added. At the same time forms shall be checked to see that they are tight against the concrete already in place. Concrete in substructures shall be placed in such manner that all horizontal construction joints will be truly horizontal.

Where vertical construction joints are necessary, reinforcing bars shall extend across the joint in such a manner as to make the structure monolithic. Special care shall be taken to avoid construction joints through wing walls.

(h) Precast Concrete Units - When the method of manufacture has been approved, no further changes shall be made without the approval of the Engineer

The Contractor shall inform the Engineer in advance of the date of commencement of manufacture and casting of each type of unit.

A copy of all 28-day cube test results relating to the work shall be sent to the Engineer as soon as they become available.

(i) Concrete shall not be pumped or discharged via Aluminium alloy conduits or chutes. Concrete shall not be subject to disturbance between 4 hours and 24 hours after compaction except that re-compaction of the upper layers of deep lifts to prevent or annul settlement cracking may be carried out.

1001.11 Curing

All concrete surfaces shall be kept wet for at least 7 days after placing. Bridge deck and footwalk slabs shall be covered with wet burlap immediately after final finishing of the surface. This material shall remain in place for the full curing period or may be removed and replaced with sand when the concrete has hardened sufficiently to prevent marring. In both cases the materials shall be kept thoroughly wet for the entire curing period. All other surfaces if not protected by forms shall be kept thoroughly wet, either by sprinkling or by the use of wet burlap until the end of the curing period. If timber forms are allowed to remain in place during the curing period, they shall be kept moist at all times to prevent the opening of joints.

The Contractor's proposals for the use of liquid membrane curing compound shall be subject to the approval of the Engineer.

1001.12 Removal of Formwork and Falsework

Time of removal – The minimum period before striking forms shall be as shown in Table below subject to mandatory Engineer's approval. The Engineer's approval shall not relieve the Contractor of responsibility for the safety of the work. Blocks and bracing shall be removed at the same time as the forms and in no case shall any portion of the forms be left in the concrete.

MINIMUM PERIOD BEFORE STRIKING FORMWORK

Vertical forms of abutments, wing walls, columns, beams and similar components	24 hours
Soffit forms to deck slabs (props left in)	8 days
Props to deck slabs	14 days
Soffit formwork to beams (props left in)	8 days
Propos to beams	14 days

Forms used on exposed vertical faces shall remain in place for periods, which shall be determined by the Engineer.

Falsework and forms under slabs, beams, girders and arches shall remain in place for 14 days after the day on which placing of concrete was completed. When high early strength cement is used, forms for all structures may be removed after less than 14 days but only with the written approval of the Engineer who will decide the time for removal as a result of tests. Formwork and falsework for the whole of suspended span bridges and other special structures shall remain in place until such time as the Engineer will decide after all concrete has been poured.

(b) Patching - As soon as the forms are removed, all wire or metal devices used for securing the formwork which project from or appear on the surface of the finished concrete shall be removed or cut back at least 25mm from the finished surface of the concrete. All holes and pockets so formed shall be filled with cement mortar mixed in the same proportions as the fine aggregate to cement of the concrete mix used for that particular section of the structure, after the surface to be patched has been thoroughly cleaned and wetted to receive the patch.

(c) Cause for rejection - Excessive honeycombing shall be sufficient to cause rejection of portions of the structure containing this honeycombing. The Contractor, on receipt of written orders from the Engineer, shall remove and rebuild such portions of the structure to Engineer's requirements.

1001.13 Finishing Concrete

All concrete surfaces exposed in the completed work shall comply with the requirements of (c) below except where the Drawings indicate otherwise.

(a) Concrete Decks - Immediately after placing concrete, concrete decks shall be struck off templates to provide proper crowns and shall be finished smooth to the correct levels. Finish shall be slightly but uniformly roughened by brooming. The finished surface shall not vary by more than 3 mm from a 3 metre straight edge placed parallel to the centre line of the roadway and 3 mm from a transverse template cut to the true cross section of the roadway.

(b) Kerb and Footwalk Surface - Exposed faces of kerbs and footwalks shall be finished true to lines and grades. The kerb surface shall be wood floated to a smooth but not slippery finish. Footwalk surfaces shall be slightly but uniformly roughened by brooming.

(c) Bridge Bearing Shelves, Pile Caps, and Tops of Walls - Exposed faces shall be struck off with a straight edge and floated to true grade with a steel trowel using firm pressure to produce a dense, smooth uniform surface free from trowel marks. Under no circumstances will the use of mortar topping for concrete surfaces be permitted.

1001.14 Loading

No superstructure load shall be placed upon finished bents, piers, or abutments until the Engineer so directs but in no case shall any load of any kind be placed until the Contractor has completed curing. The Contractor shall not place any temporary loads on deck slabs. Bridge deck slabs shall be opened to traffic only when so directed by the Engineer and generally not sooner than 28 days after the placing of the concrete has been completed.

1001.15 Measurement and Payment

a. Measurement

Concrete shall be measured by the number of cubic metres complete in place and accepted. In computing quantities the dimensions used shall be those shown on the Drawings or ordered in writing by the Engineer but the measurement shall not include any concrete used for the construction of temporary works. No deduction from the measured quantity shall be made for holes, pockets, sockets and the like not exceeding 0.15 cubic metres each in volume, reinforcement or individual fillets, chamfers, splays, drips, rebates, recesses, grooves and the like of 100mm total girth or less when measured over the faces in contact with the formwork.

b. Payment

Concrete work measured as provided above for the grade or grades of concrete specified, shall be paid for at the Contract unit price per cubic metre for concrete as detailed below. The payment shall be full compensation for furnishing, testing, placing and curing all materials, including labour, tools, equipment, etc., incidental thereto including the provision and construction of drainage falls and systems and weepholes, the forming of holes, pockets and sockets and the like not exceeding 0.15 cubic metres each in volume, forming construction joints and unformed surfaces. Separate payment will not be made for testing of concrete mixes the cost of which shall be included in the rate for concrete works.

Pay Item	Description	Pay Unit
1001(1)	Grade C 15 Concrete	cubic metres
1001(2)	Grade C 20 Concrete	cubic metres
1001(3)	Grade C 25 Concrete	cubic metres
1001(4)	Grade C 30 Concrete	cubic metres
1001(5)	Grade C 40 concrete	cubic metres

Add new section as follows:

1001A DRY PACK REPAIR OF WIDE CRACKS

Cracks wider than 10 mm in masonry walls shall be repaired by packing until adequate compaction has been attained of 1: 3 cement mortar with water cement ratio not exceeding 0.35 into the crack space with trowel edge or similar tool after removing all loose material and washing away the crack space with cement slurry.

Measurement

If this item of work is done under, 1302(1): Cleaning and repairing of built up drainage system, there shall be no separate measurement taken for the work done. But, the work done shall be measured in cubic metres of material used, in the case of repairs to bridges.

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Payment

In the case of Cleaning and repairing of built up drainage system, the cost of this item of work is included in the pay item 1302 (1). In the case of repairs to bridges, this item of work is paid separately.

Pay Item	Description	Pay Unit
1001A(1)	Dry pack repair of wide cracks	cubic metre

1001B REPAIRS TO SPALLED CONCRETE

The material for patching shall be one-component or two-component Polymer modified cementitious mortar.

All loose material shall first be removed by light hammer until sound concrete has been reached. Boundary areas where signs of concrete carbonation are visible shall be removed by cutting with mechanical saw in order to obtain an area of concrete with reasonably straight edges. The corroded reinforcement bar shall be cleaned by water jet to ensure that hidden faces of steel too are cleaned of rust.

A Zinc-rich galvanic action- inhibitor shall be applied by brush to cleaned reinforcement bars.

A priming coat containing the Polymer, water and cement in suitable proportions shall be then applied on the prepared surface.

Patching the exposed reinforcement bars shall then be carried out by trowel-application of a one-component or two-component polymer modified cementitious mortar containing a minimum of 400 kg of ordinary Portland cement and fine aggregate (sand) of C or M grading.

The polymer modified mortar shall be applied to a thickness so as to result in clear cover to reinforcement of 25 mm.

The patching mortar shall be suitably cured.
The patching mortar shall be compatible with the galvanic-action inhibitor.
The 24 hour strength of the patching mortar shall not be less than 20 N /mm2
The sub-contractor shall take all health and safety precautions in carrying out these works.

Measurement

If this item of work is done under, 1302(1): Cleaning and repairing of built up drainage system, there shall be no separate measurement taken for the work done. But, the work done shall be measured in cubic metres of material used, in the case of repairs to bridges.

Payment

In the case of Cleaning and repairing of built up drainage system, the cost of this item of work is included in the pay item 1302 (1). In the case of repairs to bridges, this item of work is paid separately.

Pay Item	Description	Pay Unit
1001B(1)	Repair spalled concrete	cubic metre

1002 STEEL REINFORCEMENT FOR CONCRETE STRUCTURES

1002.1 Description
No change

1002.2 Materials
Delete sub-sections (d) and (e), and substitute the following:

(d) Hot-rolled and cold-worked steel bars shall comply with BS-4449 except that no bar shall contain a flash weld.

(e) Hard-drawn mild steel wire shall comply with BS-4482.

Add additional sub-section as follows:

(f) Steel fabric reinforcement shall comply with BS-4483 and shall be delivered to Site in flat mats or pre-bent.

1002.3 Construction Requirements

a. Protection and Storage
No change

b. Cutting and Bending

Add to end of paragraph the following:

The bars shall be cut and bent within the tolerances given in BS-4466. The Contractor shall be responsible for the correct fit of the bars and achieving required cover as given on the Drawings or established by the Engineer.

Any bar that has already been bent shall not be re-bent at the location of the original bend without the approval of the Engineer.

c. Placing and Fixing of Reinforcement

Delete the last sentence of the first paragraph "Lap splicing shall be....." and substitute "Laps and joints shall be made only where shown on the Drawings or with the approval of the Engineer."

1002.4 Measurement and Payment
No change

The pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
1002(1)	Tor Steel reinforcement	kilogram
1002(2)	Supply & install 20 mm dia. Stainless steel dowels	kilogram
1002(3)	Mild Steel reinforcement	kilogram

1003 PRESTRESSING FOR STRUCTURES

1003.1 Description
No change

1003.2 Materials

Delete section (b) and substitute the following:

(b) Steel for reinforcement of structures or structural units to SLS-375, CS-26 or BS-4449.

1003.4 Construction Requirements
No change

1003.5 Measurement and Payment
No change

1004 PILE FOUNDATIONS FOR STRUCTURES

No change in the sections 1004.1, 1004.2, 1004.3 and 1004.4

1004.5 Construction Requirements of Cast in situ Piles (Bored Piles)

a. Excavation
In the paragraph 4 delete "100 mm" and substitute "75 mm".

1005 WELL FOUNDATIONS FOR STRUCTURES

1005.1 Description
No change

1 005.2 Materials

Delete section (b) and substitute the following:

(b) Steel for reinforcement to SLS-375, CS-26 or BS-4449.
No change in the sections 1005.3 and 1005.4

1006 RANDOM RUBBLE MASONRY
No change

The pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
1006(1)	Random rubble masonry	cubic metre
1006(2)	Plastering, 1:3 cement sand mix, 16 mm thick	square metre
1006(3)	Pointing, 1:3 cement sand mix	metre

1007 BRICKWORK AND BLOCKWORK FOR STRUCTURES
No change

1008 FORMWORK FOR STRUCTURES
No change

The pay items and pay units will be as follows:

Pay Item	Description	Pay Unit
1008(1)	Formwork smooth finish	square metre
1008(2)	Formwork rough finish	square metre

1009 BRIDGE EXPANSION JOINTS

No change in sections 1009.1, 1009.2, 1009.3 (a) and (b) and 1009.4

1009.3 Construction Requirements

(b) Joints provided with steelwork

Add the following at the end of the section.
Where proprietary expansion joints are used in bridge decks, the storage and installation of joints, jointing materials, sealants and other associated items shall be in accordance with the manufacture's recommendations.

Different joint systems shall not be combined at one end of a deck except with the approval of the Engineer,

1009.4 Measurement and Payment
No change

1010 BRIDGE BEARING

No change in sections 1010.1, 1010.2, 1010.3, 1010.4 and 1010.5, except the following:

1010.2 Type of bearings and materials

Add additional fifth paragraph as follows:

Where mechanical pot type bearings are specified on the Drawings, the bearing shall be supplied and installed in compliance with the Specification Clauses of BS 5400: Part 9 : Section 9.2:1983 including Appendix A Guidance sub-clauses 7.2(b) and (c), and tables therein.

1011 RECONSTRUCTION / WIDENING OF BRIDGES

1011.1 Description

The work shall consist of abutments, piers, wingwalls, decks, capping beams, handrails, uprights, end pilasters, bridge kerbs, ducts, bearings, expansion joints, rainwater outlets, weepholes, precast coverslabs, approach slabs, dowels, foundations, siol improvement works for foundations, painting, jointing and welding work at locations as shown on the Drawings or as instructed by the Engineer in accordance with these specifications.

1011.2 Materials

The materials used for various items of work as given above shall be in accordance with the relevant part of the specifications.

1011.3 Construction Requirements

The various items of work involved shall be in accordance with the relevant part of the specifications.

1011.4 Measurement and Payment

a. Measurement and Payment

Items of work completed in accordance with the relevant parts of the specifications, from finished level to foundation level as shown on the Drawings shall be paid as a lump sum.

Items of work completed in accordance with the relevant parts of the specifications, below the design foundation level as shown on the Drawings shall be paid as a provisional sum. Payment shall be based on the rates and sums assessed and agreed by the Engineer for the completed works to the satisfaction of the Engineer, which shall include full compensation for providing all materials, labour, tools, equipment and incidentals necessary to carry out the works as specified above.

1012 NOT USE

1013 BITUMINOUS SEALING FELT UNDER BEAMS AT ENDS TO PREVENT GROUIT LEAK ON TO CAPPING BEAM

1013.1 Description

This work shall consists of forming bituminous sealing felt underneath the beam ends, as per Drawings to prevent grout leak on to capping beams at beam ends according to these Specifications or as instructed by the Engineer.

1013.2 Material

Material used shall meet the requirements of the following unless otherwise directed by the Engineer.

Binder shall conform to the requirements of section 1702. Coarse sand shall conform to the requirements of Section 1701.5.

1013.3 Construction Requirements

Bituminous sealing felt shall be formed by mixing bitumen and sand at appropriate proportions and at a suitable temperature to form a flexible filler and laid underneath the beam ends as indicated in the Drawings to prevent grout leaks on the capping beam.

1013.3/1Tests & Standards of Acceptance

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1013.4 Measurement & Payment

(a) Measurement

The bituminous sealing felt will be measured for payment in Linear metres provided in the finished work as per Drawings or as directed by the Engineer and as accepted by the Engineer.

(b) Payment

This work measured as provided above shall be paid for at the Contract unit price for this item. Such price and payment constitute full compensation for all material, labour, tools, equipment and incidentals needs to complete all Works. The completed Work included, Work associated with the structure and indicated in the Drawings, Bill if quantities or elsewhere in the Specification.

The Pay Item & Pay Unit shall be as follows.

Pay Item	Description	Pay Unit
1013(1)	Bituminous sealing felt on Capping beams of abutment	Linear metres

1014 BITUMINOUS SEALING FELT UNDER APPROACH SLAB AT CAPPING BEAM ENDS TO PREVENT BITUMEN RUNNING ON TO CAPPING BEAM

1014.1 Description

This work shall consists of forming bituminous sealing felt under approach slabs as per Drawings' to prevent grout leak on to capping beams, according to these Specifications or as instructed by the Engineer.

1014.2 Material

Material used shall meet the requirements of the following unless otherwise directed by the Engineer.
Binder shall confirm to the requirements of Section 1702. Coarse sand shall conform to the requirements of Sub section 1701.5.

1014.3 Construction Requirements

Bituminous sealing felt shall be formed by mixing bitumen & sand at appropriate proportions and temperature from a flexible filler to and laid so as to indicated in the Drawings underneath beam ends as per Drawings to prevent grout leak on the capping beam.

1014.3/1 Tests & Standards of Acceptance

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1014.4 Measurement & Payment

(a) Measurement

The bituminous sealing felt will be measured for payment in Linear meter provided in the finished work as per Drawing or as directed by the Engineer and as accepted by the Engineer.

(b) Payment

This work measured as provided above shall be paid for at the Contract unit price for this item. Such price and payment constitute full compensation for all materials, labour, tools, equipment and incidentals needed to complete all works. The Drawings, Bills of Quantities of elsewhere in the Specification.

The Pay Item & Pay unit shall be as follows.

Pay Item	Description	Pay Uint
1014(1)	Bituminous sealing felt under the Approach slabs	Liner metres

1015 NOT USE

1016 FORMING OF SERVICE DUCT IN DECK

1016.1 Description

This work shall consists of forming the above duct to the given dimension in deck as per Drawing and to these Specifications or as instructed by the Engineer.

1016.2 Material & Formwork

Material used for forming the duct shall be in accordance with the Specification.

1016.3 Construction Requirements

The formwork for providing the ducts shall be such as to given a smooth finish after formation of the duct. The provision for placing the relevant concrete cover slabs shall also be made in the duct formed as per Drawings, Specifications, etc and workmanship shall be such that the slabs when placed on the same are seated properly to provide an even Pavement, for pedestrian use.

1016.3/1 Tests & Standards of Acceptance

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1016.4 Measurement & Payment

(a) Measurement

The service duct formed in place will be measured in Liner meters and as accepted by the Engineer.

(b) Payment

This work measured as provided above shall be paid for at the contract unit price for this item. Such price and payment constitute full compensation for all materials, labour, tools, equipment and incidentals needed to complete all works. The completed work includes Work associated with the structure and indicated in the Drawings, Bill of Quantities or elsewhere in Specification.

The Pay Item & pay Unit shall be as follows.

Pay Item	Description	Pay Unit
1016(1)	Forming of service duct in the deck. (State the depth & width)	Linear metres

A 5

1017 COVER SLABS FOR SERVICE DUCTS

1017.1 Description

This work shall consist of finishing above size of reinforced concrete cover slabs for service ducts inclusive of light reinforcements and shuttering as per Specifications and Drawings or as directed by the engineer.

1017.2 Material

Cement concrete shall conform to the requirements of Class B Grade 25/20 concrete of section 1001 of these Specifications. Steel reinforcement shall conform to the requirements of Section 1002 of these Specifications.

1017.3 Construction Requirements

These slabs shall be cast as per Drawings and specifications. It shall be clearly noted that the above cover slabs shall be placed on the service ducts to form an even Pavement for pedestrian walks. Therefore, it is important that the cover slabs when laid shall given an even surface to achieve the above purposes mentioned.

In view of above, the casting and laying of cover slabs shall be carried out on the direct supervision of the Engineer or his authorized representative. Also, the concrete shall be placed to lines, levels and grades as indicated in the Drawings.

1017.3/1 Tests & Standards of acceptance

The materials shall be sorted in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1017.4 Measurement & Payment

(a) Measurement

The cover slabs will be measured for payment by the number provided in the finished work and as accepted by the Engineer.

(b) Payment

This work measured as provided above shall be paid for at the Contract unit price for this item. Such price and payment constitute full compensation for all materials, labour, tools, equipment and incidentals needed to complete all Works. The completed Work included, Work associated with the structure and indicated in the Drawings, Bills of Quantities or elsewhere in the Specifications.

The Pay Item & Pay Unit shall be as follows.

Pay Item	Description	Pay Unit
1017(1)	Cover slabs for forming of service duct in The deck (State the thickness, length and width)	Number

+5

1100 MAINTENANCE OF CARRIAGEWAY

1101 Cold Mix for Patching

Delete the heading and replace with:

1101 Filling Pot-holes and Patch Repairs

Delete the sub-section and replace the following:

1101.1 Description

The Contractor shall maintain the road to the satisfaction of the Engineer until a Taking-Over Certificate in respect of the works has been issued. This work shall include repair of pot-holes and patching along existing carriageway. The location type and area of the repair works shall be as directed by the Engineer. Repair shall be carried out with a bituminous mix either produced at plant site or at the site itself with manual method of mixing and placed at site in the pot holes or in patches after trimming the pot-holes or depression to proper shape and depth, side painting with tack coat and compacting the layer.

The Contractor will be paid for the work measured as described in sub clause 1101.4. However no payment will be made for patching which is carried out at locations which according to the Construction Programme of work should have already being completed.

1101.2 Materials

The grading of aggregates and bitumen content of the mix used for such patch repair shall be in accordance with sub section 507.2 of Standard Specification.

1101.3 Construction Requirements

Preparation of the Area for Pot-holes and Patch Repair

The areas to be patched shall be agreed with the Engineer. They shall be cut/trimmed either with saw hammer or hand tools like chisels, pick-axes etc., such that the areas are in the shape of rectangles or squares. The edges shall be cut vertically upto the level where the lower layer is suitable without any loose material. The areas shall be thoroughly cleaned with compressed air or any appropriate method approved by the Engineer to remove all dust and loose particles. The areas shall be tacked or primed with cutback or emulsion depending upon whether the lower layer is bituminous or granular in nature. The sides, however, are to be painted with hot tack coat material using a brush or spray. The prime coat and tack coat shall conform to Clauses 501 and 502 of these Specifications, respectively.

In the event, the Contractor fails to maintain certain sections of road in good condition acceptable to the Engineer, then the Engineer shall order a third party to carry out those maintenance work on such sections of road. The Engineer shall recover the cost of such works from the Contractor.

Backfilling Operations

The mix to be filled shall be either a hot mix or a cold storable mix (using bituminous cut back or emulsion). It shall be placed in thickness not more than 100 mm (loose). It shall be compacted in layers with roller/plate compactor/handroller/rammer. While placing the final layer, the mix shall be spread slightly proud of the surface so that after rolling, the surface shall be flush with the adjoining surface.

If the area is large, the spreading and levelling shall be done using hand shovel and wooden straight edge. During the process of compaction with roller or other means, the surface level shall be checked using a 3 m straight edge.

1101.4 Measurements for Payment

a. Measurement

Filling of pot-holes and patch repairs shall be measured in square metre.

b. Payment

Contract unit rate for filling for patch repairs shall be in full compensation for :

(i) Handling and Plugging the patch repair material.

(ii) Excavation as required and disposing of the materials within all lifts and lead

(iii) furnishing all materials required;

(iv) works involved in trimming, tacking, priming with cutback or emulsion;

(v) all labour, tools, equipment and incidentals to complete the work in accordance with Specifications.

(vi) Carrying out the work in part widths of road where directed by the Engineer.

Pay Item	Description	Pay Unit
1101(1)	Filling pot-holes and patch repairs with Cold mix (MC 30), 20 mm & less in depth	square metre
1101(2)	Filling pot-holes and patch repairs with Cold mix (MC 30), 75 mm & less in depth	square metre
1101(3)	Filling pot-holes and patch repairs with Cold mix (MC 30), deeper than 75 mm	square metre

1200 MAINTENANCE OF SHOULDERS AND ROAD SIDE

No amendments

1300 MAINTENANCE OF DRAINAGE SYSTEM

1301 CLEARING AND RESHAPING OF EARTH DRAINS

1301.1 Description

No change

1301.2 Work Requirement

No change

1301.3 Measurement and Payment

a. Measurement

No change

b. Payment

The rate for payment shall include full compensation for material, labour, equipment, transport needed to carry out the work and the disposal of debris and incidentals required for the work.

Payment under this sub-section will be made only once for each earth drainage. Thereafter, any further clearing and reshaping work necessary shall be deemed to be covered by the rates of various items of work in the Bill of Quantities.

Pay Item	Description	Pay Unit
1301 (1)	Clear and reshape earth drains	metre

1302 CLEANING AND REPAIRING OF BUILT-UP DRAINAGE SYSTEMS

1302.1 Description

No change

1302.2 Materials

Delete "Class B 1:2:4 (20 mm) mix" in sub-section (a) and replace with "Grade C 20"

No changes to sub-sections (b) and (c).

1302.3 Work Requirement

Add the following at the end of this Sub Section.

Dry pack repair of wide cracks and repairs to spalled concrete shall be done as described in sections 1001A and 1001B respectively.

1302.4 Measurement and Payment

Delete the sub-sections and substitute the following:

a. Measurement

Unless otherwise specified measurement for cleaning and repairing of built-up drains shall be in metres.

b. Payment

The rate for payment shall include full compensation for material, labour, equipment, transport needed to carry out the work and the disposal of debris and incidentals required for the work.

Payment under this sub-section will be made only once for each drainage structure. Thereafter, any further clearing, desilting or repair work necessary shall be deemed to be covered by the rates of various items of work in the Bill of Quantities.

Pay Item	Description	Pay Unit
1302 (1)	Clean, desilt & repair built-up (lined) drains	metre

1303 CLEARING, DESILTING AND REPAIRING OF CULVERTS

1303.1 Description

No change

1303.2 Materials

Delete "Class B 1:2:4 (20 mm) mix" in sub-section (a) and replace with "Grade C 20"

No changes to sub-sections (b) and (c).

1303.3 Work Requirement

Add the following at the end of this Sub Section.

Dry pack repair of wide cracks and repairs to spalled concrete shall be done as described in sections 1001A and 1001B respectively.

1303.4 Measurement and Payment

Delete the sub-sections and substitute the following:

a. Measurement

Unless otherwise specified measurement for cleaning, desilting and repairing of culverts shall be in number of each type of culvert.

b. Payment

The rate for payment shall include full compensation for material, labour, equipment, transport needed to carry out the work and the disposal of debris and incidentals required for the work.

Payment under this sub-section will be made only once for each culvert. Thereafter, any further clearing, de silting or repair work necessary shall be deemed to be covered by the rates of various items of work in the Bill of Quantities.

Pay Item	Description	Pay Unit
1303(1)	Pipe culvert	number
1303(2)	Other culvert type	number

1400 MAINTENANCE OF BRIDGES AND CAUSEWAYS

No amendments

Add the following new section:

1407 REPAIRS TO STEEL COMPONENTS OF BRIDGES

1407.1 Painting of steel deck beams in steel composite bridges

Steel composite bridges are defined as those with a concrete deck supported on the soffit by a series of steel joists. The work included in this section consists of the furnishing of all labour, materials, apparatus, scaffolding, and all appurtenant work in connection with painting, in accordance with these specifications.

Workmanship

(a) Thoroughly wash the steel beams with water jet to remove grease and dirt;
(b) Remove heavy layers of rust by chipping (for example with a blunt putty knife) without exerting too much pressure so as to damage steelwork;
(c) Clean steelwork manually or by power tool to surface preparation grade SP 2 to BS 7079 so that when viewed without magnification under artificial light, the surfaces shall be free from visible oil, grease and dirt and poorly adhering rust, paint coatings and foreign matter;
(d) Apply one coat of epoxy Zinc Phosphate or Iron Oxide primer
(e) Apply One coat of Coal tar epoxy or other bituminous paint;
(f) The contractor shall take all precautions to protect the environment and to comply with all applicable Environmental Regulations in force during cleaning and painting. In particular, suitable measures shall be taken to not to pollute the stream with debris from cleaning or paint. Suitable screens shall be provided.

Payment

Payment under this Sub-Section will be made only once for each bridge. Thereafter, any further repair work necessary shall be deemed to be covered by the rate quoted for this item of work.

Pay Item	Description	Pay Unit
1407(1)	Painting of steel deck beams	square metre

1407.2 Painting of steel parapets of bridges

The work included in this section consists of the furnishing of all labour, materials, apparatus, scaffolding, and all appurtenant work in connection with painting, in accordance with these specifications.

Workmanship

(a) Thoroughly wash the steel beams with water jet to remove grease and dirt;
(b) Clean steelwork manually or by power tool to surface preparation grade St 2 to BS 7079 so that when viewed without magnification the surfaces shall be free from visible oil, grease and dirt and poorly adhering rust, paint coatings and foreign matter;
(c) Apply one coat of Zinc Phosphate epoxy primer;
(d) Apply one coat of NB Zinc Phosphate modified Alkyd paint.

Payment

Payment under this sub-section will be made only once for each bridge. Thereafter, any further repair work necessary shall be deemed to be covered by the rate quoted for this item of work.

Pay Item	Description	Pay Unit
1407(2)	Painting of steel Parapets	square metre

Add the following new section:

1408 REPAIRS FOR BRIDGES

1408.1 Description

The work shall consist of dry pack cracks in masonry, patch spalling concrete in bridge decks, re-instate damages to decking plates, expansion joint sand drainage outlets, paint steelwork parapets, re-instate damaged plaster in substructures, re-point stone masonry, repair kerbs and channels, repair bridge masonry parapets, raise masonry head walls, re-instate parts of damaged head walls or parapets, re-instate scour damaged wing walls and abutments, repair handrails, uprights and end pilasters, repair damaged aprons, repair porous filters and weepholes, clean disfigured concrete surfaces and apply one coat of cement slurry, painting work, de-silt stream and clear vegetation.

1408.2 Work Requirement

Dry pack cracks in masonry
This item of work shall be carried out as described in section 1001 -17 herein.

Patch spalling concrete in bridge decks
This item of work shall be carried as described in section 1001 – 18 herein.

Re-instate damaged plaster in substructures and re-point stone masonry
This item of work shall be carried as described in section 1006 of Standard Specifications.

Paint steelwork parapets
This item of work shall be carried as described in section 1407 herein.

Re-instate scour damaged wing walls, abutments,etc.
Re-instatement with random rubble masonry, comply with section 1006 of Standard Specifications.
Re-instatement with cement concrete, comply with section 1001 herein.

Raise masonry head walls
This item of work may be done either using random rubble work or cement concrete work, complying with the specifications of random rubble and cement concrete works as given above.

Payment
Items of work completed in accordance with the relevant parts of the specifications shall be paid as a lump sum.

Pay Item	Description	Pay Unit
	Repairs to bridges	

50

Add the following new section:

1409 STEEL FOR BRIDGE WORKS

1409.1. Description

Structural steelwork shall be as described in the Drawings and these Specifications.
Unless otherwise described, Workmanship, Inspection and Testing, Handling, Transport and Erection, Supply Measurement and Weighing of Structural Steelwork shall comply with the Specification Clauses of BS 5400:Part 6: 1999 as amended by these Specifications.

British Standards have been specified as standards for materials and workmanship, however the contractor may employ materials manufactured to other internationally-accepted standards or Sri Lankan standards subject to Engineer's approval, which shall require submission of full documentation including test certificates for properties required by the relevant British Standard, carried out at an ISO 9001 - accredited laboratory by suitably qualified people.

Workmanship standards may be substituted with internationally-accepted workmanship standards not in conflict with the provisions of BS 5400 Parts 4, 7, 8 and 9.2, subject to the Engineer's approval.

1409.2. Surface Preparation and Protection against Corrosion

Surface preparation shall be as specified in the Drawings

1409.3 Setting Out and Camber

a) The steelwork dimensions given on the drawings are based on a mean temperature of 30°C. The Contractor shall make adjustments as necessary to achieve the correct dimensions at this temperature.
b) The design final camber of the main girder top flange under the effect of all permanent loads is parallel to the highway alignment profile.
c) The dead load camber stated on the drawing allows for the following effects:
   - Steelwork dead load
   - Concrete dead load
   - Superimposed dead load (including enclosure, if any)
   - Shrinkage modified by creep.
d) The camber fabrication tolerance on the girders shall be zero to (span length)/ 1500 residual upward camber.
e) The Contractor shall ensure that the steelwork is fabricated to a tolerance on length such that the base plate o fall bearings are within +/- 25mm longitudinally and +/- 5mm transversely of the position shown on the drawings.

1409.4. Steel material

The Contractor shall provide test certificates issued by an ISO 9001-accredited laboratory for each consignment or lot intended for use on works to enable the Engineer to satisfy himself that the consignment or lot material conforms with the relevant British Standard.

a) Steel shall be to the Grade shown on the drawings to BS EN 10025: 1993 unless otherwise stated. The contractor shall provide test certificates issued by an ISO 9001-accredited laboratory for each consignment or lot intended for use on works to enable the Engineer satisfy himself that the consignment or lot conforms with the relevant British Standard.
b) Rimming steel shall not be used (option 3 of BS EN 10025)
c) Steel shall comply with Clause 7.3.3.1 of BS EN 10025 (option 5)
d) Plates shall comply with the improved deformation properties perpendicular to the surface of BS EN 10164 (Option 10) where shown on the drawings and where the total weld throat at cruciform, T or corner joints exceeds 30mm.

e) The Engineer shall be afforded the opportunity of inspecting the steel and witnessing tests at the manufacturers works (option 13).
f) Specific inspection and testing shall be carried out for all steel products according to the requirements of Clauses 8.2 to 8.9 of BS EN 10025. The inspection document shall comprise the inspection certificates as defined in Clause 4.3.2.3.1 of Euronorm 21 (option 12).
g) Testing of mechanical properties shall be by cast (option 14).
h) Specific marking is required (option 16).
i) The tolerance on thickness shall be half the total thickness tolerance over or under the specified thickness i.e. Class D to BS EN 10025.
j) Copies of purchase orders for all steel, bolts washers etc, shall be sent to the Engineer at the time of placing the order.
k) The Contractor shall be responsible for ensuring that the ultrasonic testing of steel sections and plates is carried out including all necessary handling. The Engineer shall be afforded the opportunity of witnessing such tests. Test reports showing the results of ultrasonic lamination testing and the method used shall be submitted to the Engineer prior to fabrication work proceeding.

1409.5 Drawings & Methods Statements

a) The Contractor shall submit fabrication drawings for a particular bridge, incorporating all the information required in paragraph b) at least 6 weeks prior to starting fabrication of steelwork for that bridge. The Contractor shall not start fabricating steelwork until the relevant fabrication drawings have received the consent of the Engineer.
b) The Contractor shall submit the following information on or with the fabrication drawings:
    i) position of all plates, sections, stiffeners, welds, bolts, holes, shear connectors and temporary attachments including thickness, size, type and orientation;
    ii) lengths of plates, with due allowance, separately identified and supported by calculations, for shrinkage and curvature caused by the method of fabrication;
    iii) cambers which should allow for the dead load cambers, highway alignment and curvature of beams caused by the method of fabrication;
    iv) where the Contract Drawings does not specifically indicate the shear connectors in the vicinity of a splice plate, the Contractor shall indicate on his fabrication drawings the arrangement of shear connectors which shall maintain the total number of connectors required and comply with the maximum connector spacing specified in the relevant design code;
    v) method statements relating to weld preparations, assembly, control of distortion, corrosion protection treatment and testing and inspection: and
    vi) identify of all sub-contractors including those appointed for flame cutting and profiling, machining, non-destructive testing, destructive testing, painting, galvanizing, bending, site welding, site erection, site painting etc.
c) The decks have been designed on the basis of the construction sequences given in the drawings. If the Contractor wishes to adopt an alternative sequence, he shall submit calculations with his fabrication drawing submission to demonstrate that the stress and deflections in the structure comply with the relevant design standards and, if necessary, revise the dead load cambers.
d) The Contractor shall maintain and submit a record of the source of each plate, section, welding consumable and bolt, including test certificates.
e) At least 6 weeks prior to erection, the Contractor shall submit and obtain approval for an erection method statement incorporating the requirements shown in the Drawings and these Specifications, which shall include the following information:
    i. health and safety statement including procedures relating to safe working practices;
    ii. sequence and programme for erection of steelwork, completion of correction protection and concreting of deck slab;

iii. details of lifting arrangements including calculations relating to allowable ground pressure for crane supports, details of cranes and lifting tackle to be used including manufactures safe working load tables;
iv. procedures for site bolting welding and corrosion protection;

f) calculations relating to all props, supports and bracing required to maintain the stability of steelwork at all stages of erection;
g) details of access to be provided for erection, bolting, welding, corrosion protection and inspection by the Engineer, and
h) drawings detailing crane and steelwork positions during erection, lifting tackle and temporary props, supports and bracing.

1409.6 Fabrication General

a) All holes shall be drilled; punching will not be permitted.
b) All sharp corners shall be 3mm radiused.
c) Load indicating bolt heads or washers shall not be used unless agreed upon in advance with the Engineer.
d) Each section of steelwork shall be marked on the top surface at both ends to indicate the required location. Hard stamping will not be permitted.
e) Cambering shall be to a smooth continuous curve.

1409.7. Welding General

a) Welding shall be by the metal arc processes and comply with the requirements of BS 5135.
b) Welding electrodes shall be of matching chemical composition to be parent metal.
c) Peening of welds will not be permitted.
d) Shear connector weld shall be in accordance with BS 5135.
e) Welding symbols are in accordance with BS 499.
f) Butt welds in flanges and webs shall be dressed flush by grinding in the direction of stress.
g) The Contractor shall make shop and site welded splices such that the fatigue life of the steelwork, calculated in accordance with BS 5400 Part 10, is in excess of 120 years.
h) Unless otherwise shown on the drawings gaps at joints to be fillet welded shall not exceed 1 mm average (measured over 1m or length of weld, whichever is smaller), 2mm maximum.
i) The position of any shop butt weld to be to the approved of the Engineer.
j) Temporary backing strips shall not be used facilitate the production of butt welds.
k) Documentation shall be maintained to enable welds to be traced to the welder who made them.

1409.8. Welding – Procedure Trials and Production Tests

a) The Contractor shall provide written welding procedures for all welds. Details, method and sequence for carrying out the site-welded splices shall be included in the procedures.
b) The Contractor shall submit documentary evidence of weld procedure trials, which have demonstrated that he can make satisfactory welds with the submitted welding procedures. The procedure trials and written procedures shall be compatible in all respects. The procedure trials shall have been witnessed by an independent authority.
c) The Contractor shall carry out procedure trails for any weld where he is unable to submit documentary evidence of a successful weld procedure trial.
d) The Contractor shall provide welder approval test certificates for the welders employed for fabrication. The welding covered by the test certificates must be similar to the welding for the fabrication under taken by that welder.

e) 1 in 5 pairs of 'run-off' plates for all butt welds shall be production test plates. In addition to the tests set out in BS 5400 Part 6 Clauses 5.5.1, the weld metal and head affected zone shall be tested to ensure compliance with Clause 5.4.1.2 of BS 5400 Part 6 assuming an applied principal tensile stress at the ultimate limit state greater than 100 N/sq m.

f) The Contractor shall submit written procedures for flame cutting and shearing.

g) The Contractor shall submit documentary evidence of successful flame cutting or shearing procedure trails, which have demonstrated that the flame cutting and shearing techniques comply with the requirements of BS 5400 Part 6 Clause 4.3.3 (a). The procedure trails shall have been witnessed by an independent authority.

h) If the Contractor is unable to submit documentary evidence of successful flame cutting or shearing procedure trails, he shall carry out procedure trails in accordance with BS 5400 Part 6 Clause 4.7.3.

i) In addition to the requirements of BS 5400: Part 6 Clause 4.3.3 (a) to (f) flame cut edges shall be ground or machined to remove all visible signs of drag lines and glass like surfaces.

j) The Contractor shall submit a written procedure, which demonstrates how he will comply with BS 5135 Clause 17. This procedure shall include: -
   i. method of checking that the surfaces to be welded are completely dry;
   ii. method of checking that the parent mental is at a temperature above 0°C;
   iii. method of warming the steel to remove any moisture or ensure that the parent metal temperature is above 0°C;
   iv. method of ensuring that the welding area is protected from rain, snow, wind and draughts, including the screening to be used and;
   v. method of measuring the speed of air currents at the welding area.

k) The Contractor shall submit written procedures for the bending of plates. Radius of bend plate thickness, rate at which the bend shall be formed, minimum temperature of steel and details of machinery and formers used to form the bend shall be included in the procedure.

l) The Contractor shall carry out a plate procedure trail on the thickest plate to be bent in accordance with BS 5400: Part 6 :Clause 5.4.1 with the centre of the being taken as equivalent to the centre of the weld. The hardness of the zone affected by the bend shall not exceed 350 HV 30 as given in BS 427. Charpy V-notch impact tests shall be carried out to demonstrate the energy absorption requirement of BS 5400:Part 6: Clause 5.4.1(a) (1).

1409.9. Welding – Non-Destructive Testing

a) All non-destructive testing and inspection shall be carried out by an Independent Inspector approved by the Engineer but employed by the Contractor as described below at not less than 48 hours after welding. The Engineer may be present during this testing.

b) The Contractor shall supply the following to the Engineer:

   i. the names and qualifications of all NDT personnel to be employed in the Contract, including those employed by sub-contractors; all NDT personnel shall hold qualifications gained through recognized national or international certification schemes;
   ii. the NDT procedures to be used including any technique sheets; and
   iii. calibration records for all equipment used during NDT.

   All NDT reports shall be submitted to the Engineer within seven days of testing.

c) All slag residue and weld splatter shall be removed from the welds and adjacent surfaced prior to inspection.

d) All welds shall be visually inspected to BS EN 970.

e) The Inspector shall carry out Magnetic Particle Inspection to BS 6072 for the following:
   i. all full penetration butt welds,
   ii. 100% of length for important welds e.g. cruciform welds taking large tensile forces,
   iii. large bearing stiffeners,
   iv. bracing stiffener to top flange welds,
   v. bar shear connector to top flange welds,
   vi. loop to bar shear connector welds.
   vii. 1 in 10 intermediate stiffeners.
   viii. 10% of length for web to flange longitudinal welds.
   ix. 20% of length for other welds.

f) The Inspector shall carry out ultrasonic inspection to BS 3923 for:
   i. all full penetration butt welds;
   ii. 100% of length of cruciform fillet welds where the leg length exceeds 10mm
   iii. 20% of length of fillet welds on bearing stiffeners and non-bearing stiffeners transferring large shears, where the leg length exceeds 10mm.
   iv. 5% of length of all other fillet welds where the leg length exceeds 10mm

   Examination shall be to quality level 2A, and in addition to the requirements of BS 3923, an original hard copy of the results, complied using A-scan techniques, shall be submitted to the Engineer.

g) Before the start of each day's welding, 3 No studs shall be welded to a plate of the same thickness as the flange plate and tested in accordance with BS 5400 Part 6 Clause 5.4.4(b). If any of these studs fail, further sets of 3 No. studs shall be welded and tested until satisfactory results are obtained before any studs are welded to the girders.

h) All stud shear connectors shall be tested using the hammer ring test.

i) 5 no. studs on each longitudinal girder shall be selected by the Engineer for a bend test in accordance with BS 5400:Part 6: Claus 5.5.4 (b). The Contractor shall ensure that the direction of test does not interfere with the fixing of reinforcement.

j) All bent plates shall be subject to hardness tests. For plates 25mm and less in thickness, 5 No readings shall be taken on the axis of the bend on each main face of the plate and 2 No readings at each edge of the plate. For plates over 25mm thick, 10 No and 2 No readings respectively shall be taken.

1409. 10 Welding – Defect Acceptance Levels

a) The following defects arising from the visual inspection are unacceptable:
   i. stray – arcing spots;
   ii. any undercut perceptible to the naked eye at the toes of transverse welds within 50 mm of weld ends or returns; intermittent undercut up to 0.3 mm deep will be permitted at other locations on transverse welds;
   iii. any undercut perceptible to the naked eye at the comers of plate or section elements at weld ends, returns or adjacent to longitudinal weld toes;
   iv. any local undercut at the toes longitudinal welds in excess of 1.0 mm deep;
   v. any intermittent or continuous undercut at the toes of longitudinal welds, in excess of 0,5mm deep
   vi. Irregular weld appearance and poor profile, in particular fillet weld throat thicknesses in excess of 0.9 times or less than 0.7 times the specified leg length and butt weld reinforcement profiles which do not blend smoothly with the parent metal surface, and which for in-plane joints have thicknesses in excess of 3 mm for nominal throat thickness up to and including 25 mm, and in excess of 5 mm for nominal throat thickness in excess of 25mm;
   vii. Planarity misalignment of butt welds not in accordance with BS 5400 Part 6 clause 4.2.4.2;
   viii. Surface defects including cracks, worm holes, porosity and overlap;
   ix. Under sized welds; and

x. Any undercut or lack of fusion to stud shear connector welds.

b) For the Magnetic Particle Inspection and Ultrasonic testing, the weld acceptance levels relating to butt welds shall be in accordance with BS 4870 Part 1 Table 5

c) The following defects arising from the Magnetic Particle Inspection and Ultrasonic testing of fillet and partial penetration butt welds are unacceptable.
   xi. cracking, lamellar tears, worm holes and surface porosity;
   xii. planar defects;
   xiii. internal porosity with a maximum pore size in excess of 25% of the weld throat or 4mm, whichever is the smaller;
   xiv. internal porosity in excess of 3% of the weld area examined ; and
   xv. slag inclusions exceeding 10mm in length for transverse welds or 5 times weld throat for longitudinal welds.

d) All welds containing unacceptable defects shall be rectified or retested.

e) If more than 10% of welds relating to a particular weld procedure show unacceptable defects, the rate of testing for that weld procedure shall be increased to 100% including previously produced welds.

f) If any planar defects are found on fillet welds, the rate of testing for that weld procedure shall be increased to 100% including previously produced welds.

g) If, at 100% testing more than 10% of weld relating to a particular weld show unacceptable defects, the Contractor shall submit a revised weld procedure for approval and shall carry out a weld procedure trial.

h) For the purpose of this clause a 'weld' is defined as:

   i. the actual length of weld tested if less than 1m.
   ii. for tested weld lengths in excess of 1 m, the weld shall be sub-divided into the minimum number of equal weld lengths less than 1 m in length, each weld length being a 'weld' for the purpose of this clause

i) All stud shear connectors failing the hammer ring test or the bend test shall be replaced.

j) If a stud connector fails the test, 10 no. further studs on the same girder shall be bend tested.

k) If any of the further studs fail the test, the Contractor shall submit a revised weld procedure trail. For each bend test failure, the Contractor shall increase the number of stud shear connectors on that girder by 10%, the extra connectors being placed in positions to be agreed by the Engineer.

l) All hardness test readings on bent plates shall be less than 350HV 30 as given in BS EN ISO 6507, plates with hardness readings in excess if 350 HV 30 shall be rejected.

1409.11. Bolted Connections

a) The design coefficient of friction at the interface of the HSFG bolted connections is 0.5.

b) Unless noted otherwise, bolts shall be High Strength Friction Grip bolts, general grade for the main beam connections.

c) Splice interfaces shall be degreased prior to assembly. Bolts shall be tightened using the part turn method.

d) Bolted splices shall be completed, including final tightening of bolts and sealing of splice, within 14 days of the initial formation of the splice. The Contractor shall ensure that moisture is not trapped within the splice.

e) On bridge decks, bolts to the bottom flanges of the main longitudinal girders shall have their heads on the underside of the flange and bolts to the webs shall have their head on the external face of the connection.

f) Each deck main beam section shall be fully spliced to the preceding section before the subsequent section is erected. Slackening of the splices will not be permitted once tightened.

1409.12. Trial Erection

a) On completion of the shop fabrication and prior to blast cleaning, the contractor shall trial erect all steelwork in the presence of the Engineer to enable fit and dimension to be verified. The steelwork shall be supported at bearing locations set to the correct relative levels and with the diaphragms. Cross girders and cross bracing positioned and all splices tightened with temporary bolts sufficient to bring all splice plates to maximum 0.5 mm gaps.
b) Trial erection may be carried out in sequential portions longitudinally provided that there is an overlap between portions.
c) The tolerances of the girders in the assembled structure shall comply with Table 5 of BS 5400: Part 6. The Contractor shall provide the Engineer with a copy of measurements taken during the Trial Erection. The following measurements shall be taken:
   i. checks in accordance with BS 5400 Part 6 Table 4 except that all member types 1 and 2 to be checked shall be selected at random by the Engineer, and
   ii. levels at all bearing locations at bottom of taper plate and top of main beam level at all support, mid span and quarter span points.

1409.13. Permanent Erection

a) The Contractor shall erect the superstructure steelwork in such a manner that it remains stable and in the correct position throughout all stages of construction. In addition to any other temporary bracing to prevent buckling of beam top flanges under self-weight and during deck slab concreting.
b) Unless otherwise noted on the drawings, casting of the concrete shall not commence until all steelwork has been fully assembled; all splices completed and all permanent bearings incorporated into the works.
c) All damage to areas of corrosion protection shall be made good in accordance with Section 5.13.

Measurements from the trial erection shall be repeated after all dead loads have been applied to ensure compliance with specifications herein.

1500 MAINTENANCE OF ROAD SIGNS AND MARKINGS

No change

1600 QUALITY CONTROL OF WORK

Add the following new paragraph:

1601A QUALITY CONTROL PLAN

The Contractor shall prepare a Quality Control Plan which shall detail quality control procedures such as to demonstrate that the requirements of Clause 4.9 of the Conditions of Contract in respect of quality are met. The Quality Control Plan shall provide a formal framework for the approval of the Works by the Engineer.

In particular the Quality Control Plan shall include:

1 Quality control procedures in respect of the selection and control of materials, distinguishing between approval testing and compliance testing;

2 Quality control procedures in respect of construction operations, identifying procedures for production control and procedures for survey control;

3 Procedures for the Contractor and Engineer to approve construction works.

In preparing the Quality Control Plan the Contractor shall take into consideration the requirements and obligations of the Engineer in respect of checking and inspection of the Works.

The Contractor shall appoint a Quality Control Manager who shall be responsible for ensuring that the quality control procedures set out in the Quality Control Plan are adhered to. The Quality Control Manager shall have independent control of all quality control activities.

1601 CONTROL OF ALIGNMENT, SURFACE REGULARITY AND PAVEMENT LAYER THICKNESS

1601.1 General

Add the following:

The Contractor shall allow for the time taken to .carry out testing of materials in his method and program of working, and no delays shall be considered relating to any materials testing.

As a guide, the Contractor should allow a period of at least 24 hours after the completion of a layer of fill, subgrade, subbase or basecourse for testing for compliance with the compaction requirements.

Any material, whether naturally occurring, placed, fabricated or manufactured by others which is intended for incorporation in the Works will be subject to quality control testing before approval is given for its use.

Any material or product which fails to receive approval shall be immediately removed, replaced or otherwise treated to the approval of the Engineer. Any unapproved material or product subsequently covered over or incorporated in the Works shall be removed at the Contractor's expense as instructed by the Engineer.

1601.2 Horizontal Alignment

At the end of this sub-section add the following:

The corresponding tolerances for the edges of the shoulders and the lower layers of the pavement shall be + 25 mm with no negative tolerance.

1601.3 Longitudinal Profile

Delete the first paragraph and substitute the following:

The level of sub grade and different pavement courses as constructed shall not vary from the design level calculated at any point with reference to longitudinal and cross-section profile of the road shown on the Drawings or as instructed by the Engineer beyond the tolerances mentioned below:

Sub grade	:	+ 25 mm / -10 mm
Subbase	:	+ 20 mm / -10 mm
Basecourse	:	+ 15 mm only
Asphalt surfacing	:	+ 10 mm only

1601.4 Surface Regularity of Subgrade and Pavement Layers

Delete Table *1601-1* and substitute the following:

***Table 1601-1* : Tolerance of Surface Regularity**

TYPE OF CONSTRUCTION	LONGITUDINAL PROFILE WITH 3 m STRAIGHTEDGE				TRANSVERSE PROFILE
	Maximum permitted undulation	Maximum number of undulations permitted in any 300 metre length exceeding:			Maximum permissible variation from specified profile under camber template
	mm	18 mm	12 mm	10 mm 5 mm	mm
Subgrade	24	30			15
Subbase	15		30		10
Basecourse	12			30	8
Surface Dressing	12			20	8
Asphalt Surfacing	8			30	6

Surface regularity requirements in respect of both the longitudinal and transverse profiles shall be simultaneously satisfied.

1601.5 Rectification

Where the surface regularity of subgrade and the different pavement courses falls outside the specified tolerances, the Contractor shall rectify these in the manner described below and to the approval of the Engineer.

Subgrade

Where the surface is high, it shall be trimmed and suitably compacted to achieve the tolerances. Where the surface is low, the deficiency shall be corrected by scarifying the existing layer and adding fresh material. The degree of compaction and the type of material to be used shall conform to the requirements of Section 1708.1 herein.

Subbase

The same as for sub grade except that the degree of compaction and the type of material to be used shall conform to the requirements of Section 1708.2 herein.

Aggregate Basecourse

Where the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary, and recompacted. The area of treatment at any place shall not be less than 5 metres long and 2 metres wide. The degree of compaction and the type of material to be used shall conform to the requirements of Section 405.2 herein.

Bituminous Wearing Course

For wearing courses, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. The area of treatment shall not be less than 5 metres long and not less than one lane wide.

1602 QUALITY CONTROL TESTS ON MATERIALS DURING CONSTRUCTION

Delete paragraph 2 and Table 1602-1 and substitute the following:

***Table 1602-1* : Quality Control Tests and their Frequencies**

TYPE OF MATERIAL	TYPE OF TEST	QUANTITY OF MATERIAL or part thereof for which minimum of one test set is to be carried out
Fill for Embankment.	- Particle size analysis	1,000 cum
	- Atterb'erg limits	1,000 cu m
	- Compaction	100 cu m
	- 4-day soaked CBR [set of 3 specimens for each sample]	1,000 cu m
Select Fill for Subgrade and for Granular Layers	- Particle size analysis	1,000 cu m
	- Atterberg limits	1,000 cu m
	- Compaction	100 cu m
	- 4-day soaked CBR [set of 3 specimens for each sample]	1,000 cu m
Aggregate for Subbase	- Particle size analysis	
	- Atterberg limits	200 cu m
	- Compaction	200 cu m
	- 4-day soaked CBR [set of 3 specimens for each sample]	100 cu m 500 cu m
Aggregate for Basecourse	- Particle size analysis	300 cu m
	- Compaction	50 cu m
	- Water absorption	500 cu m
	- Aggregate impact value	300 cu m
	- Los Angeles abrasion value –	300 cu m
	- Flakiness index	1,000 cu m
	- Bulk specific gravity	As required
Cement Stabilized Base Course	- Particle size analysis	200 cu m
	- Atterberg limits	200 cu m
	- Compaction	100 cu m
	- 4-day soaked CBR [set of 3 specimens for each sample]	500 cu m
Bituminous Surface Treatment	- Particle size analysis	200 cu m
	- Water absorption	400 cu m
	- Aggregate impact value	200 cu m
	- Los Angeles abrasion value	200 cu m
	- Flakiness index	400 cu m
	- Bulk specific gravity	As required
	- Soundness	As required
Apshaltic Concrete	- Particle size analysis (coarse aggregate)	200 cu m
	- Particle size analysis (fine aggregate)	100 cu m
	- Water absorption	400 cu m
	- Aggregate impact value	200 cu m
	- Los Angeles abrasion value	200 cu m
	- Flakiness index	As required
	- Bulk specific gravity	As required
	- Soundness	As required
	- Clay and silt content	As required
	- Acceptance testing of filter material	As required
	- Degree of Compaction	500 sq m

A fresh series of construction control tests shall be undertaken every time there are changes in the sources of the materials or in the appearance of the materials as visually assessed by the Engineer.

Additional numbers and type of construction control tests shall be carried out if it is considered necessary to do so by the Engineer for monitoring the variability of materials brought to work site or stockpiled by the Contractor.

Moisture content test before compaction of materials shall be carried out on a layer by layer basis for each compaction panel on the following scale:

***Table 1602-1 b* : Moisture Content Testing**

TYPE OF MATERIAL	AREA OF LAYER under compaction which a minimum of one moisture content test is to be done
Fill for embankment	500 sq m
Select fill for subgrade	400 sq m
Granular materials for subbase	250 sq m
Aggregate for basecourse	250 sq m

A moisture content test shall be repeated whenever the moisture content of the material changes due to drying or wetting or if there is uncertainty (for example, due to variability) in the results of earlier tests.

1603 MATERIAL TESTING

The physical properties and engineering characteristics of the materials mentioned in the Specification shall be established through appropriate tests on representative samples collected in such a manner and at such a frequency as specified and instructed by the Engineer. The tests shall be carried out in accordance with test methods mentioned in the Specification after taking into account the appropriateness of the test methods for particular applications under consideration.

1700 MATERIAL DETAILS

1701 AGGREGATES

1701.1 Aggregates for Bed Course Materials

a. For sidewalks, kerbs and channels and pipes
No change

b. For filter blankets

Add the following at the end:
The gradation of the filter material shall satisfy the following requirements:

(a) (D15 of filter) / (D15 of base material) = 5 to 40 provided that the filter does not contain more than 5% of material finer than 0.075 mm.
(b) (D15 of filter) / (D85 of base material) = 5 or less.
(c) The particle size curve of the filter should be roughly parallel to that of the base material.

1701.2 Aggregate for Cement Concrete

Add at end of paragraph 2 :

Aggregate from marine sources will not be approved. The aggregate shall be free of salt and organic matter. The permissible maximum salt content shall be as follows:

MATERIAL	SODIUM CHLORIDE	SOLUBLE SULPHATES
Fine Aggregate	0.10%	0.25%
Coarse Aggregate	0.05%	0.25%

Add at end of paragraph 4 :

The flakiness index of the coarse aggregate when determined by the sieve method described in BS-812 shall not exceed 35%.

Delete paragraph 5 and substitute the following:

Where the concrete is to be used for wearing surfaces or for concrete of grade greater than Grade 40, the 10% fines value of the aggregate shall not be less than 100 kN or, in the alternative, its Aggregate Impact Value shall not exceed 30.

1701.3 Aggregate for Construction and Maintenance of Bases and Surfacing of Flexible Pavements

General Requirements
Delete paragraphs 2 to 5 and substitute the following:

The coarse aggregate shall conform to the following requirements:

Basecourse Aggregates

1. The Ten Percent Fines value in accordance with BS-812 shall not be less than 110 kN.
2. The ratio of TFV of 24 hour soaked sample to dry sample shall not be less than 75%.
3. The Aggregate Impact value (AIV) determined as specified in BS-812 shall not be more than 30%.

4. The flakiness index of the coarse aggregate when determined by the sieve method described in BS-812 shall not exceed 35%.
5. The Aggregate Crushing Value (ACV) as determined by testing in accordance with BS-812 Part 3 shall not exceed 35%.
6. The crushed stone shall preferably be non-plastic, but in no case shall the PI exceed 6%.
7. The minimum soaked CBR value of material in the basecourse shall not be less than 80% at the specified in-situ density.

Coarse Aggregate Used for Asphalt Concrete

1. The Los Angeles Abrasion Value (LAAV) as determined by AASHTO T -96 test shall not be more than 40%.
2. The Aggregate Impact value (AIV) determined as specified in BS-812 shall not be more than 30%.
3. The flakiness index of the coarse aggregate when determined by the sieve method described in BS-812 shall not exceed 35%.
4. The water absorption of the aggregate shall not be more than 2%.
5. When subject to bitumen coating and stripping as per AASHTO T-182 test the coated area of the aggregate shall not be less than 95%.
6. The loss on the Sodium Sulphate soundness test (5 cycles) AASHTO TI04 shall not exceed 12%.

Cover Aggregate Used for Bituminous Surface Treatment

1. The Los Angeles Abrasion Value (LAAV) as determined by ASSHTO T -96 test shall not be more than 40%.
2. The Aggregate Crushing Value (ACV) when tested in accordance with BS-812 shall not be more than 25%.
3. The flakiness index determined by the sieve method described in BS-812 and elongation index determined by the sieve method described in BS-812 – 105.2 :1999, each shall not exceed 25% for 20 mm chips and 30% for 10 mm chips.
4. The loss on the Sodium Sulphate soundness test (5 cycles) AASHTO T-I04 shall not exceed 12%.
5. The dust content of the aggregate determined shall not exceed 1.5%.

Fine Aggregates Used for Bases and Surfacings

Fine aggregate (aggregate substantially passing the 4.75 mm sieve) used for bases and surfacings shall either be crushed fines or river sand. The fine aggregate shall be non-plastic, clean and free from any organic matter. Where crusher fines are used they shall be derived from rock meeting the requirements of coarse aggregate and surfacings.

Fine Aggregate Used for Asphalt Concrete

The silt and clay content of fine aggregate determined in accordance with BS 812 shall not exceed 3%.

Delete Table 1701-5 and substitute the following:

Table 1701-5: Grading of Graded Aggregate used for Base Course and for Maintenance Work

SIEVE SIZE (mm / m)	PERCENTAGE PASSING 37.5 mm	28mm	20 mm
		100	
37.5	95 - 100	100	
28	-	-	100
20	60 - 80	70 - 85	90 - 100
10	40 - 60	50 - 65	60 - 75
5	25 - 40	35 - 55	40 - 60
2.36	15 - 30	25 - 40	30 - 45
425	7 - 19	12 - 24	13 - 27
75	5 - 12	5 - 12	5 - 12

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Delete Table 1701-8 and substitute the following :

Table 1701-8: Grading of Single-sized Aggregate for Seal Coat Treatment

SIEVE SIZE (mm)	PERCENTAGE PASSING 20mm	14mm	10mm	5mm
28	100			
20	85 - 100	100		
14	0 - 25	85 - 100	100	
10	0-7	0 - 25	85 - 100	100
6.3		0-7	0 - 20	85 - 100
5			0 - 10	
3.35				0 - 20
2.36	0-2	0-2	0-2	0 - 10
.075	0 - 1.5	0 - 1.5	0 - 1.5	0 - 1.5

1702 BINDER

1702.1 Penetration Grade Bitumen

Add the following:

Table 1702-1 a : Requirements of Penetration Grade Bitumen *60/70*

PROPERTY	REQUIREMENT Min	Max
Penetration 25°C, 100 gm sees, 1/10 mm	60	70
Softening point	48	56
Specific gravity	1.01	1.06
Loss on heating for 5 hours at 163°C		
- Loss in weight (%)	-	1.0
- Loss in penetration (%) of original value	75	-
Ductility at 25°C (cm)	100	-
Solubility in carbon disulphide (%)	99	-
Flash point (°C)	232	

Each consignment of bitumen delivered to Site must be accompanied by a certificate of testing, as per BS-3690 or AASHTO, from the supplier. Any extra test instructed by the Engineer whose result proves that the material is out of specification will be carried out at no extra cost.
Penetration of residue from loss on heating test at 25°C, 100 gill, 5 sec (AASHTO T -49) as compared with the penetration before heating shall not be less than 80.

1703 CEMENT

Insert after paragraph 4 :

Cement shall be brought to Site in quantity not exceeding three months requirements. Each consignment of cement delivered to Site shall be accompanied by a certificate of testing as per BS or SLS. Any extra test instructed by the Engineer whose result proves the material to be out of specification shall be carried out at no extra cost. If for any reason the period of storage of consignment of cement exceeds three months, a representative sample of the cement shall be re-tested to confirm its suitability before use at no extra cost.

No change in sub-sections 1703.1and 1703.2.

1704 CONCRETE ADMIXTURES
No change

1705 CONCRETE PRECAST UNITS

Delete second sentence and replace with the following:

Grade C 25 concrete shall be used with the approval of the Engineer only on the jobs of small scale, where the units are cast at sites of limited facilities.

After paragraph four insert the following:

The Engineer may permit precast units to be supplied from a reputed manufacturer. Prior to procuring of units for installation in the works, sample of the units together with documented test results and literature from the manufacturer shall be forwarded to the Engineer for his approval. The Engineer shall order tests to be undertaken at no extra cost where insufficient results are available.

1706 FILLER FOR ASPHALT CONCRETE
No change

1707 PAINTS
No change

1708 EMBANKMENTS AND SUBBASE MATERIALS

1708.1 Embankment Material

a. Embankment

Delete (a) Type I Embankment Material and (b) Type II Embankment Material and substitute the following:

Table 1708-1: Material Characteristics for Embankment – Type I and Type II

PROPERTY	TEST METHOD	SPECIFICATION LIMIT	
		EMBANKMENT Type I	EMBANKMENT Type II
Liquid Limit (LL) (%)	AASHTO T89	≤ 50	≤ 55
Plasticity Index (PI) %	AASHTO T 90	≤ 25	≤ 25
Maximum Dry Density (MDD) (Modified Proctor Test), kg/m3	AASHTO T180/BS 1377 Part 4	≥ 1,600	≥ 1,500
4-day soaked CBR at 95% MDD (%)	T-193	≥ 7	-

1708.2 Sub Base Material

Delete this sub-section and substitute the following:

The materials used for the sub base shall be naturally occurring or blended gravels and sands or mixtures thereof and shall not include highly plastic clays, peat or other organic soils or any soil that is contaminated with topsoil, vegetable and other deleterious matter.

The completed sub base shall contain no aggregate having a maximum dimension exceeding two thirds of the compacted layer thickness.

The material shall have the following characteristics:

Table 1708-2: Material Characteristics for Sub Base – Type I

PROPERTY	TEST METHOD	SPECIFICATION LIMIT
Liquid Limit (LL) (%)	AASHTO T89	≤ 45
Plasticity Index (PI) %	AASHTO T 90	≤ 15*
Maximum Dry Density (MDD) (Modified Proctor Test), kg/m3	AASHTO T180/BS 1377 Part 4	≥ 1,750 kg/m3
4-Day Soaked CBR at 98% MDD (%)	AASHTO T193	≥ 30

* If the Plasticity Product (PP=PI* % passing 0.075 mm sieve) does not exceed 300, soils up to PI 18% may be allowed.

Table 1708 – 3: Grading Requirements

SIEVE SIZE (mm)	% PASSING
50	100
37.5	80 – 100
20	60 – 100
5	30 – 100
1.18	17 – 75
0.3	9 – 50
0.075	5 - 25

1709 TIMBER
No change

1710 GEOFABRIC / GEOTEXTILE

The geotextile / geofabric to be used under rockfill or pioneer layers, or as specified elsewhere in the Specifications or as shown on the Drawings or as instructed by the Engineer, shall be the non-woven, polypropylene / polyester / polyethylene fibers thermally bonded type. The material shall be such that it has adequate tensile strength and sliding resistance to prevent development of tension cracking on the surface of the embankment. The characteristics of the fabric in accordance with the relevant testing procedure shall be as follows:

Table 1710-1 : Geofabric General Properties

PROPERTY	RANGE	VALUE	TEST
Unit weight	Not less than	245 gm/m2	ASTMD 3776
Thickness	Minimum	2.3 mm	ASTMD 1777
Tensile Strength	Not less than	14.9 kN/m	ASTMD 4595
Puncture	Not less than	600 N	ASTMD 4833

Additional Properties as a Separator

PROPERTY	RANGE	VALUE	TEST
Permeability	Not less than	0.02 sec^{-1}	ASTMD 4491
Pore size	Maximum	0.6mm	ASTMD 4751

Additional Properties as a Filter

PROPERTY	RANGE	VALUE	TEST
Permeability	Not less than	0.5sec^{-1}	ASTMD 4491
Pore size	Maximum Average Roll Value	0.43mm	ASTMD 4751

Additional Properties as a Paving fabric (Reinforcement)

PROPERTY	RANGE	VALUE	TEST
Melting Point	Not less than	150°C	ASTMD 276

The Contractor shall verify the suitability of the material to meet the specified requirements and forward the manufacturer's / supplier's certificate of conformity to the Engineer for approval prior to the provision of the material for the Works.

Pay Item	Description	Pay Unit
1710 (1)	Geotextile	square metre

1800 TESTS FOR QUALITY CONTROL OF MATERIALS AND WORKS
No change

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Appendix to the Special Provisions

APPENDIX 1

LIST OF STANDARDS

The Contractor shall provide for the use of the Engineer technical publications, standards and codes of practice, in the media stipulated by the Engineer. In all cases original publications of the edition currently in force are assumed. The type of publications requested may include:

- Sri Lankan Standards
- British Standards
- AASHTO publications
- ASTM publications
- FIDIC publications
- HMSO publications
- TRL publications

The publications shall become the property of the Employer upon completion of the Contract.

APPENDIX 2

SITE OFFICES, EQUIPMENT AND FURNITURE

The site offices shall be provided, furnished and equipped in accordance with the following schedules.

Main Office

DESCRIPTION	No.
A. Offices	
The Main Office of gross floor area 180sq.m. in close proximity to the Contractor's Main Site Office.	1
Office rooms	7
Conference rooms	1
Bathrooms – male	2
Bathrooms – female	1
Kitchen	1
Store room	1
Lunch room	1
B. Furniture	
Office desks, L shape, 150x75cm with 130x45 cm computer credenza and each having at least 3 drawers, one of which is lockable.	2
Office desks, L shape, 120x70cm with 120x45 cm computer credenza and each having at least 3 drawers, one of which is lockable.	4
Office desks, 120x70cm and each having at least 3 drawers, one of which is lockable.	15
Computer desks.	12
Executive chairs, gas lift height adjustment, arm rests.	2
Typist chairs, gas lift height adjustment, arm rests.	31
Visitor's chairs.	10
Steel filing cabinets with four drawers.	4
Book shelves, 1m. x 2m. with 3 shelves and lockable cupboard at base.	7
Storage cabinets 1mx2m, two door, lockable.	2
Conference table to sit 12.	1
Conference room chairs.	12
Office table with glass top	2
Bulletin board 0.9x0.6m.	4
Bulletin board 1.2x0.8m.	2
White marker board 1.2mx0.8m.	1
Office safe 0.125cu.m secured to the building.	1
Waste paper baskets	8
Coat stands	4
Plan chest – AO Type – 5 drawers.	1
Window blinds/curtains to all windows.	1 set
C. Equipment	
Personal Computer, 2.93 GHz Processor, 2GB DDR3 RAM, 320GB SATA Hard Drive, DVD/RW SATA, Modem, 101 Key English USB Key Board, 4xUSB 2.0 Ports, VGA Card, 17" TFT Flat Screen Monitor, Optical Mouse with licensed Windows 7 Professional.	8
Uninterrupted Power Supply, On line Unit 1 kVA with sealed maintenance free battery and 60 minutes backup time.	8
LAN (24 hub) wiring loops for desktop computers and printers	1
Broadband wireless internet connection linked to the office LAN with capacity to provide internet services to all computers on network.	1
A3/A4 Ink jet colour printer.	1
A4 laser jet printer.	2
Computer software, licensed copies of MS Project – latest available version.	2
Computer software, licensed copies of AUTOCAD 2005 or latest available version.	2
Telephone lines at least one capable of international direct dialing.	3
8 phone exchange with handset in each office.	1
Mobile cellular phones with SIMM cards.	4

Plain paper fax machine, with multi function as printer and scanner.	2
Heavy duty photocopier with laser/digital technology, minimum 50 copies per minute, magnification of +25 to 400%, original print area A3 and paper size A3 to A6, resolution 600dpi minimum, continuous copying of 999 pages maximum, scan memory of 100MB minimum, capable of network printing and supplied with stand.	1
Digital camera; minimum 4 MP with 3x optical zoom.	1
Mechanical comb binding machine.	1
Heavy duty Stapler	1
Kitchen equipment including refrigerator (300 litre) with separate deepfreeze, electric kettle, 36 place tea set, 12 place dinner set, cutlery, kitchen disposal bin, kitchen table and work surfaces, four ring gas cooker with grill and two gas bottles, double sink unit with draining board, wall and base kitchen units.	1 set
D. Safety Equipment	
Safety helmets.	30
Water/ windproof jacket and over trousers.	30
Motorcycle crash helmets.	15
Fire extinguishers - one per room	8
First aid box – stocked.	1

Office for the Employer

DESCRIPTION	No.
A. Offices	
Office of the Employer of gross floor area 150sq.m. minimum each located close to the Contractor's Main Site Office.	1
Office rooms	4
Conference rooms	1
Bathrooms – male	2
Bathrooms – female	1
Kitchen	1
Store room	1
Lunch room	1
B. Furniture	
Office desks, L shape, 150x75cm with 130x45 cm computer credenza and each having at least 3 drawers, one of which is lockable.	1
Office desks, L shape, 120x70cm with 120x45 cm computer credenza and each having at least 3 drawers, one of which is lockable.	1
Office desks, 120x70cm and each having at least 3 drawers, one of which is lockable.	2
Computer desks.	2
Executive chairs, gas lift height adjustment, arm rests.	1
Typist chairs, gas lift height adjustment, arm rests.	5
Visitor's chairs.	4
Steel filing cabinets with four drawers.	2
Book shelves, 1bx2x with 3 shelves and lockable cupboard at base.	4
Storage cabinets 1mx2m, two door, lockable.	1
Conference table.	1
Conference room chairs.	12
Office table with glass top	1
Bulletin board 0.9x0.6m.	2
Bulletin board 1.2x0.8m.	1
White marker board 1.2mx0.8m.	1
Office safe 0.125cu.m secured to the building.	1
Waste paper baskets	5
Coat stands	2
Plan chest – AO Type – 5 drawers.	1
Window blinds/curtains to all windows.	1 set
C. Equipment	
Laptop Computers, Intel® Core™ i3 (370M) Processor, 15.6" HD Anti- Glare LED Display (1366x768), 2GB DDR3 SDRAM, 160GB HDD, DVD-ROM, DVD+/-RW, PCMCIA slot, Network slot, Integrated modem, 4xUSB 2.0 ports, integrated wireless LAN, with licensed Windows 7 professional, Windows 7 Home Premium.	1
Personal Computer, 2.93 GHz Processor, 2GB DDR3 RAM, 320GB SATA Hard Drive, DVD/RW SATA, Modem, 101 Key English USB Key Board, 4xUSB 2.0 Ports, VGA Card, 17" TFT Flat Screen Monitor, Optical Mouse with licensed Windows 7 Professional.	2
Uninterrupted Power Supply, On line Unit 1 kVA with sealed maintenance free battery and 60 minutes backup time.	3
LAN (8 hub) wiring loops for desktop computers and printers	
Broadband wireless internet connection linked to the office LAN with capacity to provide internet services to all computers on network.	1
A4 laser jet printer.	1
Computer software, licensed copies of MS Project – latest available version.	1
Computer software, licensed copies of AUTOCAD 2010 or latest available version.	1
Telephone lines at least one capable of international direct dialing.	2
8 phone exchange with handset in each office.	1
Mobile cellular phones with SIMM cards.	2
Plain paper fax machine, with multi function as printer and scanner.	1
Heavy duty photocopier with laser/digital technology, minimum 50 copies per minute, magnification of +25 to 400%, original print area A3 and paper size A3 to A6, resolution 600dpi minimum, continuous copying of 999 pages maximum, scan memory of 100MB minimum, capable of network printing and supplied with stand.	1
Digital camera; minimum 4 MP with 3x optical zoom.	1

Mechanical comb binding machine.	1
Heavy duty Stapler	1
Kitchen equipment including refrigerator (300 litre) with separate deepfreeze, electric kettle, 24 place tea set, 12 place dinner set, cutlery, kitchen disposal bin, kitchen table and work surfaces, double sink unit with draining board, wall and base kitchen units.	1set
D. Safety Equipment	
Safety helmets.	6
Water/ windproof jacket and over trousers.	6
Fire extinguishers - one per room	10
First aid box – stocked.	1

APPENDIX 3

HOUSING FOR THE EMPLOYER

The house for the Employer shall be provided, furnished and equipped in accordance with the following schedules:

DESCRIPTION	No.
House of gross floor area 120sq.m.	1
Living/Dining Room	1
Verandah	1
Office Room	1
Bed Room	2
Attached Toilets/Bathroom	2
Kitchen	1
Pantry	1
Servant's Accommodation	1
Servant's Toilet	1
Verandah	
Verandah Table , 2.0 m x 1.0 m	1
Veranda Chair	4
Living/Dining Room	
Lounge Suite, 1 No. 3 Seater, 3 No. 1 Seater, 1 No. coffee table and 2 No. side tables.	1
Dining Table, Formica topped 2.0 m x 1.2 m	1
Dining Room Chairs Cushioned	4
Book case, 1.0m x 2.9 m x 0.35 x 3 shelves	1
Occasional table	1
Writing Desk, 1.5m x 0.75 m	1
Chairs	2
Book case , 1.0x2.0x0.35x3 shelves	1
Bed Rooms	
Beds, Double with mattress and two pillows	2
Bedside Cabinet	2
Dressing Table with mirror and stool Chest of Drawers 1.0 m high with 6 drawers	2
Wardrobe with fittings 2m high, 1.0m wide, 0.35 deep, with shelves and two doors	2
Bedside Lamp	2
Mattress covers	4
Pillow Cases	8
Mosquito Nets double	2
Waste paper basket	2
Pantry	
Store shelves	Set
Electric Iron and ironing board	Set
Pantry Cupboards	Set
Glass Cabinet	1
Refrigerator 8 cu.ft Capacity	1
Water Filter, 8 litre capacity	1
Sink Unit with draining board, with cold water taps and waste water outlet	1
Kitchen	
Kitchen Cupboards	Set
Kitchen Table	1
Chairs	2

Sink Unit with draining board with cold water taps and waste water outlet	1
Electric or Gas Cooker with 3 – heater rings, grill and Oven complete (with two gas cylinders if gas).	1
Electric Kettle 2 – litre capacity	1
Cooking utensils complete set for 6 persons	Set
Crockery complete set for 6 persons	Set
Cutlery complete set for 6 - Persons	Set
Tea Service complete set for 6 - Persons	Set
Plate Rack	1
Servant Accommodation	
Beds single with mattress and two pillows	1
Wardrobe with fittings 2m high, 1.0m wide, 0.35m deep, with shelves and two doors	1
Armless Chairs	1
Occasional Table	1
Bedside Lamp	1
Mattress covers	2
Pillow Cases	4
Mosquito Nets single	1
General	
Rugs complete Set	1
Doormats complete Set	1
Curtains complete Set	1
Cleaning Equipment complete Set	1
Toilet	
Cleaning Equipment complete Set	1
Kitchen	
Cleaning Equipment complete Set	1

APPENDIX 4

VEHICLES FOR THE ENGINEER AND EMPLOYER

Vehicles shall be provided in accordance with the following schedules.

For the Engineer:

VEHICLE TYPE	BASIC SPECIFICATION
Type 1A	4 wheel drive double cab pickup, 1800cc (minimum) diesel engine, air conditioned, 4 seats, 5 speed transmission with high/low ratio transfer gear, 4 door with cover to load platform.
Type 1B	2 wheel drive double cab pickup, 1800cc (minimum) diesel engine, air conditioned, 4 seats, 5 speed transmission with high/low ratio transfer gear, 4 door with cover to load platform.
Type 2	2 wheel drive car, 1800cc (minimum) diesel engine, air conditioned, 4 seats, 5 speed transmission, driver and passenger airbags, 4 doors.
Type 3	2 wheel drive passenger van, 2000cc (minimum) diesel engine, air conditioned, 9 seats (minimum), 4 doors.
Type 4	150cc four stroke petrol engine motorcycle

For the Employer:

VEHICLE TYPE	BASIC SPECIFICATION
Type 1A	4 wheel drive double cab pickup, 1800cc (minimum) diesel engine, air conditioned, 4 seats, 5 speed transmission with high/low ratio transfer gear, 4 door with cover to load platform.
Type 2	2 wheel drive car, 1800cc (minimum) diesel engine, air conditioned, 4 seats, 5 speed transmission, driver and passenger airbags, 4 doors.

APPENDIX 5

LABORATORIES FOR THE ENGINEER

1. General

The Laboratory shall be furnished and maintained with all equipment, apparatus and supplies necessary to permit proper execution of all standard tests required by the Specifications. Lists of specific laboratory equipment described in the Specifications are intended as an aid to the Contractor and should not be construed as a binding list or as a recommendation to purchase from a specific manufacturer. The Contractor shall submit to the Client for his approval, a complete listing of the equipment, apparatus and supplies available in the laboratory.

The quality control of materials used in road construction projects requires specialized test equipment. The laboratories shall be equipped with all necessary test equipment to control the materials to be used on the Project. The test equipment shall be in good condition and calibrated in accordance with the requirements of standards and testing specifications.

The Contractor shall provide all equipment needed for the correct execution of the test according to the AASHTO, ASTM, BS and SLS standards mentioned. The equipment shall be of an acceptable quality approved by the Engineer.

2. List of Laboratory Equipment

The following listing of test equipment is given as a check list of likely required items and is related to the construction control specified for the Project. The equipment listed and the number of individual items is a minimum requirement. Many of the items are easily broken or otherwise rendered unusable and replacement shall be readily available, so that the control testing of critical construction is not interrupted. The equipment at all times remains the property of the Contractor or its sub-contractor and on completion of the Works shall be handed over to the Employer.

3. Asphalt Laboratory

The Specifications state that all asphalt delivered must have the supplier's test certificate giving the parameters of the asphalt. Failure to produce these certificates may mean that the Contractor has to test the asphalt at his own expense. This test could also be required on any disputed asphalt. The asphalt tests which may be required are as follows:

a) Softening point
b) Ductility
c) Loss on heating
d) Drop in penetration after heating
e) Solubility in carbon disulphide
f) Ash content
g) Specific gravity
h) Penetration

The laboratory equipment provided by the Contractor for testing of Asphaltic materials and mixtures is at the discretion of the Contractor but given the limited properties of Asphalt involved in the project, appropriate external sources may be sought.

Asphalt Mix Design by the Marshall Method has to be carried out in the laboratory prior to getting approval for the mix design. Re-checking the mix design several times would be necessary. Further new mix designs are called for where the quality of aggregate changes.

The laboratories for the Engineer shall be provided, furnished and equipped in accordance with the following schedules.

Main Laboratory

DESCRIPTION	No.
A. Main Laboratory	
Laboratory of gross floor area 100sq.m. located adjacent to the Resident Engineers Office with area divided into a) office, b) soils and materials lab, c) concrete lab, d) bitumen lab, and where required e) asphalt lab.	1
Bathroom	1
Kitchen	1
Storeroom	1
B. Furnishings and Equipment	
Office desks 120x70cm and each having at least 3 drawers, one of which is lockable.	4
Computer desks.	2
Typist chairs, gas lift height adjustment, arm rests.	6
Bench Stools	6
Steel filing cabinets with four drawers.	2
Book shelves, 1m.x 2m. with 3 shelves and lockable cupboard at base.	1
Storage cabinets 1mx2m, two door, lockable.	1
Laboratory benches sufficient for all testing equipment	As reqd.
Laboratory sinks with cold tap (minimum)	2
Bulletin board 0.9x0.6m.	1
White marker board 1.2mx0.8m.	1
IBM Compatible PC, 2.4Ghz processor, 256 Mb DDR RAM, 40Gb Hard Drive, DVD-CD /RW, Modem, 101 Key English Key Board, 2 x USB ports, VGA card, 17" flat screen monitor, Microsoft Mouse, with licensed MS Windows XP and MS Office Professional	2
Uninterrupted Power Supply, On line Unit 1 kVA with sealed maintenance free battery and 60 minutes backup time.	2
Notebook computer, 2 GHz processor, 14.1" (minimum) TFT display, 256 MB SDRAM, 40 GB HDD, DVD-CD/RW drive, PCMCIA slot, network slot, integrated modem, 2 x USB ports, integrated wireless LAN, with licensed MS Windows XP, Microsoft Office Professional.	1
A4 laser jet printer with hub	1
C. Safety Equipment	
Safety helmets.	6
Water/ windproof jacket and over trousers.	6
Motorcycle crash helmets.	4
Fire extinguishers - one per room	7
First aid box – stocked.	1
D. General Laboratory Equipment	
Geographic Positioning System (GPS)	1
Rubber mallet	5
Steel scoops	8
Flasks 4 Nos. 100 ml, 4 Nos. 250 ml, 4 Nos. 500 ml, and 4 Nos. 1000 ml Measuring Cylinders - 4 Nos. 500 ml, 4 Nos. 1000 ml., 4 Nos 250 ml	16 12
Vernier Calipers – 150 mm	1
Steel ruler – 300 mm	4
Sample splitter – 50 mm (with accessories)	2
Sample splitter – 12 mm (with accessories)	2
Aluminium trays 24 x 40 cm	12
Electric forced draught oven – capacity 0.15 cu.m.	3
Solution balance capacity 20 kg, graduation 1 gramme	2
Filed scale balance capacity – 35 kg	2
Triple beam balance capacity 10 kg accuracy 0.1 gramme	2
Triple beam balance capacity 3 kg accuracy 0.01 gramme	2
Triple beam balance capacity 2610 grams	2
Triple beam balance capacity 311 grams	2
Electronic balance 1000 gm capacity accurate to 0.01 grams	1

Filed scale balance capacity – 35g	2
Triple beam balance capacity 10 kg accuracy 0.1 gramme	2
Triple beam balance capacity 3 kg accuracy 0.01 gramme	2
Triple beam balance capacity 2610 grams	2
Triple beam balance capacity 311 grams	2
Electronic balance of 1000 gm capacity, accurate to 0.1 gram with a tare correction of not less than 100 gramme.	3
Glass plates – 400 x 600 x 6 mm	4
Linear shrinkage moulds – 250 mm	4
Spatulas – 150 mm	10
Sets Crowbar, pick and spade	4
175 mm diameter porcelain bowl together with a rubber head – pestle.	3
Hot plates as approved by Engineer	3
Sets accessories for all apparatus, trays, hand gloves, consumables, chemicals, sampling tools all complete.	3
Suitable set of tools.	3
Thermometer (mercury in glass) – 0 – 110°C	3
Thermometer (mercury in glass) – 0 – 250°C	3
Metal thermometer – 0 – 250° (in metal casing) 60 cms in length	3
Thermometer glass – 0.50°C	3
Sand absorption cone and tamping road	1
Bulk density measure – 30 litre capacity	1
Bulk density measure – 7 litre capacity	1
E. Soil Testing Equipment	
Mechanical loading press, suitable for the determination of the laboratory CBR, with all fittings necessary, including proving rings (0 to 10 KN and 0 to 50 KN).	1
CBR Moulds fitted with collars and base plates, for compaction and soaking and tripods fitted with dial gauges (25 mm travel, 0.01 mm division),	24
Solid Base plate for above	6
Surcharge weight (2kg) ring type.	24
Surcharge weight (2 kg) split type	24
Sets slotted surcharge weight (2kg).	24
Surcharge weight (1kg) ring type	24
Soaking tank for at least 20 CBR moulds	1
Complete field density kits, sand displacement type, 6.5 inches (165.1 mm ASTM method for fine and coarse grained soils.	3
Standard compaction hammer.	3
Modified compaction hammer.	5
Standard compaction moulds.	3
Modified compaction moulds.	5
Compaction mould extruder	3
Aluminium moisture content cans – 75 x 25 mm with lids.	75
Wash sieves – 75 microns.	3
Desiccators (300 mm dia, vacuum)	2
Atterberg Limit Machine (Caliberated) with a grooving device.	2
Liquid Limit Cone Penetrometer to measure L>L	1
Hydrometer	3
Sand Replacement test set, complete with graduated plastic cylinder, manual and mechanical shaker and stock solution.	2
Set Hand Auger for sampling of depths of 3 m supplied with 100 mm diameter heads suitable for boring in cohesionless and cohesive soils.	3
Drying pans – 400 x 400 x 75 mm deep.	10
Set – Mackintosh test equipment	2
Set – Dynamic cone penetrometer equipment.	2
Set equipment for S.G. determination of both coarse and fine graded soils, including ancillary glassware.	3
Set organic test apparatus for soils.	2
Speedy moisture \tester with Calcium \carbide	2
F. Concrete Testing Equipment	
Standard steel cube moulds for concrete testing (15 cm sides).	30
Concrete compression testing machine 200 T and with 3 scales i.e 0 - 0.5 T, 0 -100 T and 0 – 200 T.	1

Curing tank for test cubes – (3 m x 1.5 m x 1 m)	1
Slump cones and associated equipment (Slump cone, base plate, tamping rod).	5
Flakiness index gauge.	3
G. Bitumen Testing Equipment	
Bottle carbon disulphide 500 ml	1
Standard Penetrometer for Penetration.	2
Ring & Ball apparatus for softening ppoint	2
Ductility apparatus	1
Rotating oven – temp 10^{0} - 200^{0}C, (30 x 30 x 30 cm^{3})	1
Specific gravity glass bottle with glass stopper, 100 ml.	3
H. Asphalt Testing	
Marshall hammer and set of moulds.	1
Proving ring and dial gauge	1
Marshall apparatus to read the stability and flow.	1
Set of jaws to hold the specimen	1
Compaction and mould extruder	1
Hot water tank (60cm x 30 cm x 30 cm) temperature range 0^{0} - 150^{0}C	1
Core cutter machine with apparatus	1
Centrifugal extractor as per ASTM – D2172 of capacity 3000 g complete with 500 filter disks. Carbon tetrachloride	1
A Water bath thermostatically controlled to maintain a temperature of 60°C±0.05C° fitted with trays to support Marshall specimens in such a manner that a good circulation of water around them is assured. The bath is to be deep enough to allow at least 25 cm depth of water to cover the trays and a pump stirrer is to be fitted to ensure continuous circulation of water.	1
I. Aggregate	
Electrical sieve shaker for 200 mm sieves	1
Electrical sieve shaker for 300 mm sieves	1
Sets 200 mm B.S. sieves 20, 14, 10, 9.5, 6.3, 5.0, 4.75, 3.35, 2.36, 2.0, 1.7, 1.18, 0.6, 0.425, 0.3, 0.15, 0.075.	2
Sets 450 mm B.S. sieves – 75, 50, 37.5, 28, 25, 20, 19, 16, 14, 12.5, 10.5 with lid and pan	2
Lid pan for 200 mm B.S. sieves	2
Field scale capacity 20 kg, graduation 1 gramme	2
Aggregate impact value test apparatus.	2
Flakiness Index gauge	2
Specific gravity and absorption of coarse aggregate.	1
Field density kit – for 200 m.m diameter	2
10% \fine Value apparatus	1
Aggregate crushing value test apparatus inclusive of measuring mould and tamping rod.	1
Elongation Index – length gauge	2

Secondary Laboratory

B. Secondary laboratory	
Laboratory of gross floor area 80 sq. m. located adjacent to the Secondary Office (Resident Engineer's Office)	
Bathroom	1
Kitchen	1
Store room	1
B. Furnishings and Equipment	
Office desks 120x70cm and each having at least 3 drawers, one of which is lockable.	2
Computer desks.	1
Typist chairs, gas lift height adjustment, arm rests.	6
Bench Stools	6
Steel filing cabinets with four drawers.	2
Book shelves, 1m.x 2m. with 3 shelves and lockable cupboard at base.	1
Storage cabinets 1mx2m, two door, lockable.	1
Laboratory benches sufficient for all testing equipment	As reqd.
Laboratory sinks with cold tap (minimum)	2
Bulletin board 0.9x0.6m.	1
White marker board 1.2mx0.8m.	1
IBM Compatible PC, 2.4Ghz processor, 256 Mb DDR RAM, 40Gb Hard Drive, DVD-CD /RW, Modem, 101 Key English Key Board, 2 x USB ports, VGA card, 17" flat screen monitor, Microsoft Mouse, with licensed MS Windows XP and MS Office Professional	1
Uninterrupted Power Supply, On line unit 1 kVA with sealed maintenance free battery and 60 minutes backup time.	1
A4 laser jet printer	1
C. Safety Equipment	
Safety helmets.	6
Water/ windproof jacket and over trousers.	6
Motorcycle crash helmets.	4
Fire extinguishers - one per room	7
First aid box – stocked.	1
E. General Laboratory Equipment	
Rubber mallet	5
Steel scoops	8
Flasks 2 Nos. 100 ml, 2 Nos. 250 ml, 2 Nos. 500 ml, and 2 Nos. 1000 ml	8
Measuring Cylinders - 3 Nos. 500 ml, 3 Nos. 1000 ml., 3 Nos 250 ml	9
Vernier Calipers – 150 mm	1
Steel ruler – 300 mm	3
Sample splitter – 50 mm	1
Sample splitter – 12 mm	1
Aluminium trays 24 x 40 cm	12
Electric forced draught oven – capacity 0.15 cu.m.	2
Solution balance capacity 20 kg, graduation 1 gramme	2
Filed scale balance capacity – 35 kg	2
Triple beam balance capacity 10 kg accuracy 0.1 gramme	2
Triple beam balance capacity 3 kg accuracy 0.01 gramme	2
Triple beam balance capacity 2610 grams	2
Triple beam balance capacity 311 grams	2
Electronic balance 1000 gm capacity accurate to 0.01 grams	1
Electronic balance of 1000 gm capacity, accurate to 0.1 gram with a tare correction of not less than 100 gramme.	3
Glass plates – 400 x 600 x 6 mm	4
Linear shrinkage moulds – 250 mm	4
Spatulas – 150 mm	10
Sets Crowbar, pick and spade	2
175 mm diameter porcelain bowl together with a rubber head – pestle.	2

Hot plates as approved by Engineer	2
Sets accessories for all apparatus, trays, hand gloves, consumables, chemicals, sampling tools all complete.	2
Suitable set of tools.	2
Thermometer (mercury in glass) – 0 – 110°C	3
Thermometer (mercury in glass) – 0 – 250°C	3
Metal thermometer – 0 – 250° (in metal casing) 60 cms in length	3
Thermometer glass – 0.50°C	3
Sand absorption cone and tamping road	1
Bulk density measure – 30 litre capacity	1
Bulk density measure – 7 litre capacity	1
F. Soil Testing Equipment	
Mechanical loading press, suitable for the determination of the laboratory CBR, with all fittings necessary, including proving rings (0 to 10 KN and 0 to 50 KN).	1
CBR Moulds fitted with collars and base plates, for compaction and soaking and tripods fitted with dial gauges (25 mm travel, 0.01 mm division),	15
Solid Base plate for above	3
Surcharge weight (2kg) ring type.	15
Surcharge weight (2 kg) split type	15
Sets slotted surcharge weight (2kg).	15
Surcharge weight (1kg) ring type	15
Soaking tank for at least 20 CBR moulds	1
Complete field density kits, sand displacement type, 6.5 inches (165.1 mm ASTM method for fine and coarse grained soils.	2
Standard compaction hammer.	2
Modified compaction hammer.	3
Standard compaction moulds.	2
Modified compaction moulds.	3
Compaction mould extruder	3
Aluminium moisture content cans – 75 x 25 mm with lids.	75
Wash sieves – 75 microns.	2
Desiccators (300 mm dia, vacuum)	1
Atterberg Limit Machine (Caliberated) with a grooving device.	1
Liquid Limit Cone Penetrometer to measure L>L	1
Hydrometer	2
Sand Replacement test set, complete with graduated plastic cylinder, manual and mechanical shaker and stock solution.	1
Set Hand Auger for sampling of depths of 3 m supplied with 100 mm diameter heads suitable for boring in cohesionless and cohesive soils.	2
Drying pans – 400 x 400 x 75 mm deep.	10
Set - Mackintosh test equipment	1
Set – Dynamic cone penetrometer equipment.	2
Set equipment for S.G. determination of both coarse and fine graded soils, including ancillary glassware.	2
Set organic test apparatus for soils.	1
Speedy moisture \tester with Calcium \carbide	2
G. Concrete Testing Equipment	
Standard steel cube moulds for concrete testing (15 cm sides).	30
Concrete compression testing machine 200 T and with 3 scales i.e 0 - 0.5 T, 0 -100 T and 0 – 200 T.	1
Curing tank for test cubes – (3 m x 1.5 m x 1 m)	1
Slump cones and associated equipment (Slump cone, base plate, tamping rod).	5
Flakiness index gauge.	3
H. Aggregate	
Electrical sieve shaker for 200 mm sieves	1
Electrical sieve shaker for 300 mm sieves	1
Sets 200 mm B.S. sieves 20, 14, 10, 9.5, 6.3, 5.0, 4.75, 3.35, 2.36, 2.0, 1.7, 1.18, 0.6, 0.425, 0.3, 0.15, 0.075.	2
Sets 450 mm B.S. sieves – 75, 50, 37.5, 28, 25, 20, 19, 16, 14, 12.5, 10.5 with lid and pan	2
Lid pan for 200 mm B.S. sieves	2

Field scale capacity 20 kg, graduation 1 gramme	2
Aggregate impact value test apparatus.	1
Flakiness Index gauge	2
Specific gravity and absorption of coarse aggregate.	1
Field density kit – for 200 m.m diameter	2
10% \fine Value apparatus	1
Aggregate crushing value test apparatus inclusive of measuring mould and tamping rod.	1
Elongation Index – length gauge	2

APPENDIX 6

SURVEY EQUIPMENT FOR THE ENGINEER

Survey Equipment

DESCRIPTION	No.
Total Station with the following accuracy:- Measuring range (using one AP01 prism) 1m to 2000m. Display resolution (selectable) 1"/0.2mgon/0.005mil, 5"/1 mgon/0.02 mil Accuracy (ISO/DIS 12857-2:1995) H&V 3"/1 mgon Magnification 30x	1
Accessories for total station	
Rechargeable batteries for above	2
Charger for above	1
Single or double prism – tilt type with carrying case	2
Targets with carrying case	2
Interchangeable tribrachs with optical plummet telescope	2
Tripods telescopic type	3
Pole adapter for targets and prisms	2
Telescopic ranging rods	12
Theodolite 20" with tripod and accessories	2
Automatic level with accessories	2
Levelling staff – 5m aluminium telescopic	4
Circular bubble, clip on type for pole	4
Circular bubble, angular type for staff	4
100m x 10mm steel rustless measuring band divided throughout and numbered at 1 m intervals	2
50m steel tapes, white faced, same as abo	4
50m fibre glass box tape	4
30m fibre glass box tape	4
Brass plumb bobs	8
Surveyors road wheel	2
Hammer 7kg	2
Hammer 2kg	2
Surveyors umbrella	4
3m aluminium straight edges with handles and with spirit level and 2 measuring wedges	4
Set of axes, shovels, mammoties etc	2
Pegs and stakes	As reqd
Boxes of Yellow marking crayon and white chalk	As reqd

THE STANDARD SPECIFICATION

SPECIFICATION

Part I: Standard Specification

The Standard Specifications comprise *Standard Specifications for Construction and Maintenance of Road and Bridges* issued under the authority of General Manager, Road Development Authority, in 1989.