

Republic of Yemen
Ministry of Public Works and Highways
Road Maintenance Fund
International Projects Implementation Unit

Technical Specifications

Maintenance Work for Taiz Street

(IUS-RMF-SAN-006)

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1 Foreword

This Specification, its method of measurement, Preamble and Schedule of Rates, has been prepared primarily for use in Road Maintenance contracts.. The requirement to do any work is instructed by means of a Works Order using procedures described in Yemen RMF Operations Manual.

These specifications is particularly suitable for routine road maintenance works. Conversely, most 'periodic maintenance' activities (e.g. resurfacing or resealing) are planned in advance. Here, the presentation to bidders of detailed site information ensures that competitive bids are encouraged.

.Day works are included to facilitate 'emergency' works and also those of unusual requirements.

1.1 Standards

In the specification, reference is made to Standards, Codes of Practice, and Specifications issued by International bodies and organizations. Whenever of material, completed or control on construction called for implied shall be carried out according to and the material shall comply with the requirements of the specifications of the following agencies as appropriate

- A) AASHTO: American Association of State Highway and Transportation Officials.
- B) ASTM : American Society for Testing Materials

Whenever standard is referred to, it shall be the latest edition of such standard issued prior to the issue of the Tender documents together with any amendments to such Editions as may have been issued.

Any material for which no standard is referred to, or has not been fully specified in The specification, shall be of first class quality, and the Engineer may require the Contractor to carry out the necessary tests based on international testing standards.

1.2 Workmanship and Quality Control

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

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

The Contractor's attention is drawn to the provisions of the various sections of the Specifications regarding the minimum frequency of testing that will be required for process

control. The Contractor shall, at his own discretion, increase this frequency where necessary to ensure adequate control.

On completion of every part of the work and submission thereof to the Engineer for examination, the Contractor shall submit to the Engineer the results of all relevant tests, measurements and levels indicating compliance with the Specifications.

2 Introduction

The Specification is no different in its approach to other Works specifications in that it defines standards of materials and workmanship that are required to be met or exceeded.

The approach taken differs in some areas from that of previous documentation and the following highlights certain key aspects:

Contractor to Inspect the Network

This element concerns the need to constantly watch and monitor the condition of the Network so that required maintenance works can be identified in a timely manner. The Contractor is well placed to observe the road needs. Firstly he will be mobile for the performance of other works in progress and secondly he is motivated to identify work so that Works Orders may be initiated. Of course the RMF Engineer will also be monitoring the Network, but will utilise reports from the Contractor as one key trigger for detailed inspections.

Traffic Control

This Specification recognises two main levels of requirement; that which merely needs to warn motorists to be cautious of an activity, and that which requires traffic to come to a complete halt in advance of work which temporarily closes a road lane. Whilst the former may require the setting of advance warning signs the latter requires a well-resourced operation including flagmen, barriers and traffic cones. This Specification provides a detailed layout for the latter and individual Item specifications make it clear which level of traffic control is to be provided.

Emergency Works

The full-time presence of a Contractor on a portion of the road Network is an excellent resource for dealing with unforeseen emergencies that may arise. The speed and efficiency with which problems can be dealt with is an important feature of Term Maintenance contracting. Because of the unpredictable and urgent nature of these works they are normally carried out on the basis of 'Dayworks'.

Appropriateness of Rates

One of the key objectives in designing a suitable set of distinct items and subcategories for payment has been to ensure that as far as practicably possible, work items are paid for at rates that do accurately reflect the differing resource requirements. The goal should be a pricing structure whereby the Contractor's payment reasonably parallels the work content. The target is to avoid such situations where a reluctance or over-eagerness to perform certain work categories arises as this inevitably results in administrative stresses or conflict.

This principle has been applied particularly to bitumen pavement repair items because of their relatively high value and constraints on methodology. Different unit prices apply depending on the quantity of work instructed in a single batch.

Typical Equipment

Each Item specification includes a listing of the typical equipment required for its performance. This information is for general guidance only and the Contractor is entirely responsible for selecting appropriate equipment and resources to comply with the Work Specification.

Choice of Measurement Units

Wherever possible, the choice of measurement units has been made to ease the administration burden and to facilitate subsequent verification.

Inclusiveness of Payment Items

It is a general principle throughout this Specification that the payment based on described units of measurement is entirely inclusive of all operations and inputs necessary to complete the work Item. Wherever there are important exceptions, these are specifically identified in the work Item Specification sheets.

3 Definitions

The following table provides guidance on the meaning of some of the main terms used throughout the Specification or which are otherwise in common use. The meaning of any terms not included in the list shall be taken as the normally understood definition within the civil engineering context or as otherwise explained by the Employer.

Term	Meaning
AASHTO	American Association of State Highway and Transportation Officials.
Asphalt	An all-encompassing description for a mixture to predetermined proportions of bituminous binder with mineral aggregate and filler.
Asphaltic Concrete	A high quality, densely graded hot-mix blend of penetration bitumen and aggregates. Normally, specially designed e.g. Marshall Method.
ASTM	American Society for Testing Materials.
Base	Otherwise referred to as 'road base'. The uppermost compacted layer of graded stone aggregate beneath a bituminous surfacing.
Binder	Viscous adhesive (normally bitumen based) used to bind aggregates together and provide waterproofing.
Bitumen	Petroleum based binder formed as residue following the distillation of crude oil. Comes in various grades depending on viscosity and volatility.
Blading	The activity of cutting the road surface using a motor grader.
Bleeding	Excess free binder on the surface of the pavement.
Block Cracking	Interconnected cracks in a bituminous road surface forming a series of large polygons usually with sharp corners or angles.
BS	British Standard.
(CBR)	California Bearing Ratio
Camber	The uniformly shaped slope of a road lane necessary to shed water off the road.
Camber board	'Homemade' apparatus for checking cross-fall of road or shoulder camber. Has a level upper surface used with a spirit level.
Cold-mix	A bitumen/aggregate asphalt, made with cutback bitumen to allow workability at ambient ('cold') temperatures. Used mainly for patch/pothole repair.

Term	Meaning
Compaction Fraction	A standard test for pipe bedding which compares uncompacted and compacted volumes of material using a specified procedure.
Contractor	A term defined in the contract, meaning the person or entity, contractually bound to carry out the work.
Cross-Fall	The gradient of pavement camber measured transversely across the road. Usually falls to either side of the centre line but may slope continuously across the road on bends ('super-elevation').
Crown	The highest point of the cross-section of the road, usually the centre line.
Cure	A term applied to the hardening of a bitumen cutback or emulsion resulting from the evaporation of volatile 'cutter' or water.
Cut-back (bitumen)	A blend of bitumen and volatile 'cutter' (normally a mixture of kerosene & diesel). Material is graded in terms of viscosity and curing rate (SC, MC & RC: 'slow', 'medium' and 'rapid' curing). Viscosity increases with size of number (e.g. MC 3000).
Dayworks	A form of payment for works based on pre-set schedules of prices for separate components of equipment, labour and materials. Based on a record of the actual resources consumed.
Dead weight	Refers to compaction equipment (usually rollers) where the compactive effort comes solely from the equipment's mass. There is no capability to apply vibration (which would multiply 'dead weight' effect).
Employer	The contractual term for the Employer – the Road Maintenance Fund.
Emulsion (bitumen)	A mixture of water and bitumen (held in fine suspension). Used mainly for surface dressing (treatment), patching material and as a tack coat. Can be used cold.
Fortnightly	At intervals of once every two weeks.
Kettle	Small mobile heater unit for raising the temperature of bitumen binders. Often fitted with hand lance and discharge pump/hose.
Liquid Limit	The moisture content at which the fine soil content of a graded aggregate (passing 0.425 mm sieve) passes from a plastic to liquid condition.

Term	Meaning
Macadam	A mix of bituminous binder with mineral aggregate. Similar to Asphaltic Concrete except the aggregate skeleton is usually less dense. Often made to a specified 'recipe' rather than a one-off design.
Main Contractor	The Contractor named in the Contract.
Maintenance	Routine, periodic and emergency works to keep a road pavement, shoulders, slopes, drainage facilities, furniture and structures in as near as possible their as-constructed or renewed condition to ensure its design life is attained.
Mandatory	A strict matter of absolute requirement. <u>Not</u> a matter of advice or best-practice target. Terms such as 'will', 'must' and 'shall', have similar force.
Mechanical compaction	Compaction using a purpose-built, engine driven 'dead weight' or vibratory roller, vibrating plate or power rammer. (Does <u>not</u> include compaction by vehicle tyre).
Nominal aggregate size	Normally the 2 nd largest sieve size in a quoted grading. Usually 100% must pass the largest, with a retained percentage required on the 2 nd largest.
Organic	A term referring to material from swamps, bogs, peat material and generally material that will support vegetation or is otherwise subject to rapid decay and decomposition.
Overlay	A uniform thickness layer of asphalt applied over an existing road, largely for strengthening the pavement.
Patching	The localised application of bituminous surfacing to an existing bituminous surface, to fill depressions or seal a defect.
Pedestrian roller	Small single or double drum vibratory roller. Operator walks behind and controls/guides roller by a height adjustable steering bar.
Periodic Maintenance	Maintenance works that are occasionally required at intervals of several years. Normally relatively costly, large scale works requiring specialist equipment and skilled resources. Often 'designed'.
Plastic Limit	A standard test on aggregate fines The moisture content at which a thread of material rolled to 3 mm diameter just crumbles.
Plasticity Index	Abbreviated 'PI'. The difference between Liquid and Plastic Limits of the 'fines' content of an aggregate material – serves as an indicator of the 'clay' content of the fines.

Term	Meaning
Pothole	A small void caused by a missing piece of bituminous surface. Often exposes, or passes through the underlying pavement layer. May also describe a localised hole in a gravel road surface.
Power Rammer	Engine driven impactor which applies compactive effort through a flat shoe plate by a series of dynamic impulses.
Prime coat	A penetrating, liquid application of heated bitumen (often a cutback) applied to an unbound aggregate pavement layer (usually road base) to seal the surface.
Proprietary	Made by a firm or company with exclusive rights of manufacture.
Pug-mill	A mixing machine featuring contra-rotating paddles/blades (each turns in an opposing direction) for efficient, thorough mixing of aggregate/binder blends.
Rehabilitation	A major intervention to an existing piece of infrastructure aimed at significantly extending its design life.
RMF Engineer	The person authorised to act on behalf of the Employer (as defined in the Contract). Reference to 'RMF Engineer' in the specification shall also mean any assistant appointed in accordance with the Contract.
Road base	See 'base'.
Roadbed	The natural insitu material on which fill, or in the absence of fill, any pavement layers, are to be constructed.
Routine Maintenance	Maintenance works required continuously or at intervals during the year.
Schedule of Rates	List of unit prices tendered by the Contractor for performing the Works.
Selected Fill	A naturally occurring fill material selected to have stated properties according to its specified use.
Slot	A sample cross-section of a drain or shoulder, formed at intervals. Constructed as a guide for bulk trimming/excavation works.
Spoil	Material originating from the maintenance/construction operations which is not re-utilised ('waste').
Sub-Contractor	A contractor not named in the Contract, appointed by the Main Contractor to perform certain Works.

Term	Meaning
Tack coat	A thin, highly viscous (when 'cured') film of bitumen used to adhere an asphalt overlay or regulating course to an existing asphalt surface. Tack coats may be cutback bitumen or emulsions.
Template	A 'homemade' board or fabricated timber shape used to check the shape of a trimmed excavation (side drain or shoulder).
Ten percent fines test	A standard test for evaluating the crushing strength of aggregates, BS 812 (1990). A similar test to the ACV but generally used for weaker stone. It is a measure of the compressive load that breaks down the aggregate, resulting in 10% of fines passing the 2.36 mm sieve.
Vibratory plate compactor	A small lightweight plate compactor without drum or wheels. An eccentric rotating vibrator provides downward force and forward motion. Typical weights are 50kg – 300 kg.
Weep hole	A hole in a wall/structure which allows the passage of water for the purpose of preventing the build-up of water pressure.
Windrow	A long, narrow mound or bund of material formed by a motor-grader.
Works Order	An instruction issued by the Employer or his Representative which directs the Contractor to carry out Works or perform some function or obligation under the Contract.

4 General requirements

4.1 Contractor's Inspections

The Contractor is required to inspect all road asset features on the Network and to report the occurrence of problems and other areas of deterioration to the Employer in an agreed format and intervals. Emergencies shall be reported immediately they become known. Inspection requirements are detailed in the table below:

All costs incurred by the Contractor in performing these obligations are deemed to be included elsewhere in the work Item rates.

4.2 Testing

The Contractor is responsible for conducting such testing as may be required in order to indicate to the Employer that proposed materials and mix designs comply fully with the requirements of the Specification. These tests shall be performed and submitted to the RMF Engineer for checking, in advance of carrying out Works. The Contractor shall also carry out such further monitoring tests as may be required by the Specification during the performance of the Works.

Except where otherwise provided for in the Contract, the cost of testing shall be borne by the Contractor and shall be deemed to be included in his tendered rates for the work item.

LIST OF MAIN TESTS ON MATERIALS AND WORK TO BE CARRIED OUT UNDER THE CONTRACT

SOILS	TEST METHOD AASHTO
Particle Size Analysis of Soils	T-88
Determining the Liquid Limit of Soils	T-89
Determining the Plastic Limit and Plasticity Index of Soils	T-90
Density of Soil In-Place by the Sand-Cone Method	T-191
Laboratory Determination of Moisture Content of Soils	T-265
Moisture Density Relations of Soils using a 4.54 kg Rammer and 457 mm drop	T-180
The California Bearing Ratio	T-193
AGGREGATES	
Sampling of Aggregates	T-2
Materials finer than 75 mm Sieve in Mineral Aggregates by washing	T-11
Unit Weight and Voids in Aggregate	T-19/T19M-5
Sieve Analysis of Fine and Coarse Aggregates	T-27
Sieve Analysis of Mineral Filler for Road and Paving Materials	T-37
Specific Gravity and Water Absorption of Fine Aggregate	T-84
Specific Gravity and Water Absorption of Coarse Aggregate	T-85
Resistance to Abrasion of Small-Size Coarse Aggregate by Abrasion and	
Impact in the Los Angeles Machine	T-96
Soundness of Aggregate by Use of Sodium Sulphate or Magnesium Sulphate	T-104
Clay Lumps and Friable Particles in Aggregate	T-112

BITUMINOUS MATERIAL	TEST METHOD
BITUMINOUS MATERIAL (Contd...)	AASHTO
Sampling Bituminous Materials	T-40
Solubility of Bituminous Materials**	T-44
Flash and Fire Points by Cleveland Open Cup**	T-48
Penetration of Bituminous Materials**	T-49
Ductility of Bituminous Materials**	T-51
Softening Point of Bitumen (Ring-and-Ball Apparatus)**	T-53
Residue of Specified Penetration	T-56
Saybolt Viscosity**	T-72
Distillation of Cut-Back Asphalt (Bituminous) Products**	T-78
Flash Point with Tag Open-Cup Apparatus for use with Materials Having a Flash less than 93.3°C**	T-79
Quantitative Extraction of Bitumen from Bituminous Paving Mixtures	T-164
Bulk Specific Gravity of Compacted Bituminous Mixtures using Saturated Surface-Dry Specimens	T-166
Sampling Bituminous Paving Mixtures	T-168
Bituminous Mixing Plant Inspection	T-172
Effect of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)**	T-179
Coating and Stripping of Bitumen-Aggregate Mixtures	T-182
Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus	T-245
Specific Gravity of Semi-Solid Bituminous Materials	T-228
Maximum Specific Gravity of Bituminous Paving Mixtures	T-209

CONCRETE

Compressive Strength of Cylindrical Concrete Specimens***	T-22
Making and Curing Concrete Test Specimens in the Field	T-23
Quality of Water to be used in Concrete***	T-26
Slump of Hydraulic Cement Concrete	T-119
Making and Curing Concrete Test Specimens in the Laboratory	T-126

Note : ** Manufacturer's Certificates of Test Results will be accepted for these items. However, in case of doubt, the Contractor shall have the test carried out at his own expense to the satisfaction of the Engineer.

*** In case the quantity of concrete to be used in the works is not significant, these tests will be permitted to be done in another laboratory to the approval of the Engineer.

4.2 Quarries, Borrow Areas and Dumps

The locations of all quarries, borrow areas and dumps (tips) must be approved by the Employer. Section 4.6 provides general requirements on the operation and restoration of such areas.

The Contractor is responsible for identifying all quarry and borrow areas that will yield materials in sufficient quantity and quality to meet all the requirements of the Specification. The Employer may provide reasonable assistance in securing consents and licenses, however the Contractor shall be responsible for any compensation, royalty and any other costs associated with acquiring rights and operating the site.

The Contractor is similarly responsible for identifying and acquiring rights to use all dump sites and for their subsequent restoration.

4.3 Safety

The Contractor shall engage only those people who have been adequately trained and instructed in their duties. All operators of equipment and vehicles shall be competent and hold all necessary licenses in accordance with current legislation. The Contractor shall employ sufficient numbers of helpers and watchmen who shall guide operators and provide warning of potential conflict with people and other vehicles.

All equipment and vehicles shall be in a good, safe condition. All intended guards and safety features originally provided by the manufacturer shall be in place and operational. Vehicles operating in the highway shall be roadworthy with working lights and braking system.

The Contractor shall pay due regard to the safety of his workers and the travelling public. Any obstructions unavoidably left within the highway shall be clearly marked and have advance warning markers and signs in accordance with the specification.

The Contractor shall pay particular attention to the safety of operators and all persons in the vicinity of heated bitumen works, and fuel transfer/storage operations. Fire extinguishers must be available and a prohibition of smoking must be actively enforced. The temperature of heated materials shall be measured and controlled to prevent overheating.

The Contractor shall have contingency arrangements in place to attend to personal injuries that may result from accidents occurring within the work Site.

PART I: GENERAL AND WORK SPECIFICATION

5 Work item specifications

The pages that follow provide the work specification for each of the term maintenance activity Items. A standard layout sheet is used for the specification of each Item. As well as stating the title, reference number and units for measurement, these provide information under the following headings:

- **Description** – provides an overview of the repair/work technique and the circumstances when it is normally used.
- **Typical Equipment** – provides advice on key items of equipment needed to perform the work. This is for guidance only and the Contractor may select his own fleet to the extent that the 'Work Specification' must be entirely complied with.
- **Materials** – describes and defines the type and quality of main materials which are to be incorporated into the maintenance work.
- **Work Specification** – describes the general methodology for performing the work, states any mandatory requirements (e.g. when mechanical compaction must be used), required standards of workmanship quality and any required testing.
- **Measurement for Payment** – describes in what units and how the accomplished work is to be measured for the application of unit payment rates.

The requirements stated under the headings of 'Work Specification' and 'Materials' shall take strict precedence over the advice provided under 'Description' and 'Typical Equipment'.

1 GENERAL

101 Temporary Lane Closure

G102 LABORATORY FACILITIES

G103 Project sign boards

ITEM NO. AND NAME	101 TEMPORARY LANE CLOSURE
UNIT OF MEASUREMENT:	NOT MEASURED (INCLUDED IN RATES)
DESCRIPTION:	The task involves setting up, operating and subsequently removing traffic safety measures for the duration of maintenance works within the highway which involve the closure of one or more traffic lanes. These measures are to safeguard both the road user and the workman. The activity includes the provision of two, full time traffic watchmen. Off-highway works that do not warrant the use of flagmen or barriers are not covered by this Item. These should generally be marked by a 'roadworks ahead' sign at each end of the work only, as stipulated within the individual work Item descriptions.
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> ❑ Barrier boards (2 No. minimum) ❑ Traffic cones (1 for every 10m of works, plus tapers) ❑ Traffic signs (as standard layout) ❑ Traffic hand-flags/Stop-Go boards ❑ High visibility safety vests
MATERIALS:	All signs and barrier boards shall have typefaces as shown on the Drawings and shall meet the standards adopted in the "European Rules concerning road traffic, sign and signals" agreed at the 1968 Vienna Convention and subsequent supplementary provision in the 1971 Geneva Agreement.
WORK SPECIFICATION: <ol style="list-style-type: none"> 1. It is mandatory that all work which intrudes on the highway (physical work, manoeuvring equipment, materials or labour) be protected. Where a single lane closure is necessary, signing shall be as indicated in Figure 101. 2. Single lane closures shall not be longer than 500 linear metres, providing always that the two flagmen are inter-visible. 3. Signs and cones shall be set out working in the same direction as the approaching traffic. 4. It is envisaged that signs, cones etc will be transported to the site as part of work mobilisation. A responsible individual must confirm the loading of these before departing for the work-site. 5. The RMF Engineer is authorised to instruct that all works within the highway shall cease where in his opinion traffic control is deficient. 6. Two 'flagmen' are to be nominated. Their sole duty must be traffic control. They must wear a high-visibility jacket/vest at all times. They must have received prior instructions on how to perform their duties. If they take a break for any reason they shall be replaced by another member of the work team. 	

7. The flagmen shall not be engaged in setting out signs, cones etc. They shall be established at each end of the work site at the edge of the highway on the side facing oncoming traffic and their duties are to warn, slow and direct traffic by waving red/green flags (or Stop-Go boards).

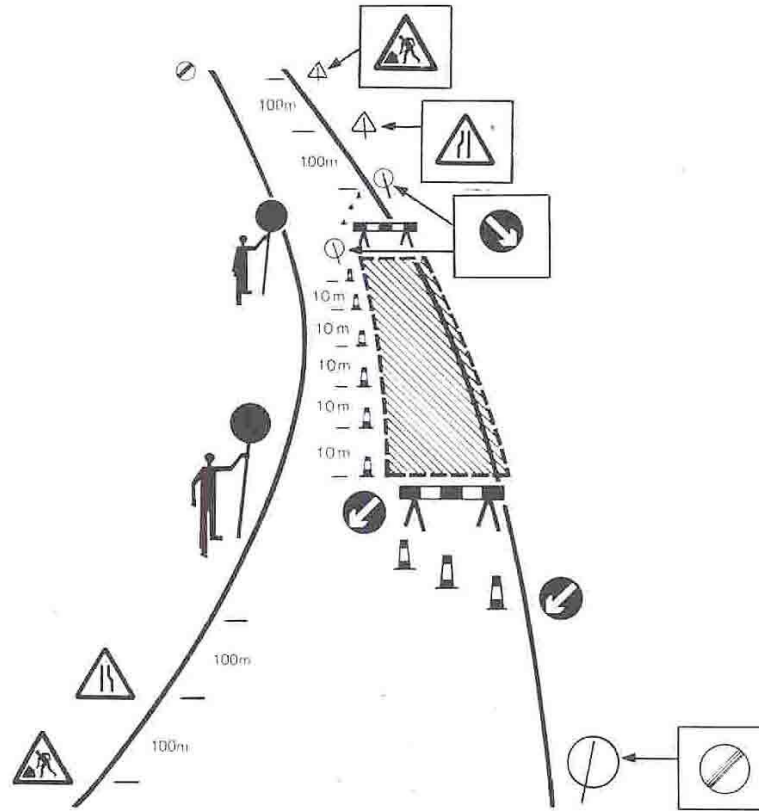


Figure 101 Sign layout for lane closure

8. The first duty of the flagmen is to direct traffic whilst other members of the work team set out the signs, cones and barriers.
9. The location of all signs shall be checked to ensure that they are correctly spaced and not hidden by bushes or other obstructions.
10. The two flagmen shall coordinate between themselves using hand signals so that no conflicting instructions are given to opposing traffic.
11. All members of the work team shall also wear high visibility vests. Wherever practical, the working area shall be marked by a tape or elevated string-line to prevent workers inadvertently entering live traffic lanes.
12. All sign faces, cones and barriers shall be maintained in a clean legible condition. Items that have become faded or otherwise damaged shall be removed from service and replaced.
13. Any sign, cone or barrier that falls over or is disturbed shall be re-sited at the earliest opportunity.
14. The flagmen shall warn workers of specific approaching dangers orally (e.g.

ITEM NO. AND NAME	101 TEMPORARY LANE CLOSURE
<p>wide loads, speeding traffic).</p> <p>15. Flagmen shall continue their duties throughout the subsequent removal of temporary traffic management.</p> <p>16. On no account shall rocks or stones be used to demark the work site.</p> <p>17. Signs which are to be left in the verge side unattended shall be staked or tied in position to prevent them being moved or blown over.</p> <p>18. On completion of the physical maintenance works, all traffic management shall be removed in the reverse order in which it was placed.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>This Item is not a separate pay item but forms a component of other work Items. The costs for performing these tasks must be included in the tendered rate for individual work Items.</p>	

ITEM NO. AND NAME	G 102 LABORATORY FACILITIES
DESCRIPTION:	<p>(A) Laboratory</p> <p>The Laboratory shall be at vicinity of the project site, on completion of the project, the facilities and contents, equipment and furniture will become the property of the Contractor.</p> <p>The Contractor shall provide sufficient water supply and power at all times for all lighting, other electrical appliances and apparatus. No construction work shall be permitted until the laboratories have been accepted by the Engineer.</p> <p>If the Contractor fails to provide the laboratories within the specified period, the Engineer shall make alternative arrangements as he considers necessary. These arrangements may include the use of rented accommodation, purchased caravans, port cabins and/or the contracting of laboratory services etc. The Contractor shall bear all the costs of such temporary arrangements made by the Engineer, including that of additional transport.</p> <p>(B) Laboratory Equipment and Testing</p> <p>The Contractor shall supply all necessary Constructional Plant required for the sufficient execution and completion of the Works. The Engineer may, if he considers it necessary for the execution of the Works in accordance with the Contract can instruct the Contractor to supply additional plant and equipment. The Contractor shall supply all plant and equipment complete with all spare parts and shall maintain sufficient stock of such spare parts to ensure the sufficient execution of the Works.</p> <p>The contractor shall provide in the site of the Contractor's Office and quarters a field laboratory with such testing equipment and apparatus as are needed for the performance of the tests specified in the Technical Specifications for the materials and construction of earth works.</p> <p>The Contractor shall within fourteen (14) days, from the date of the Engineer's Notice to Proceed submit a testing schedule for the Engineer's approval. Such testing schedule shall cover all tests for the embankment compaction and the embankment materials and also</p>

	<p>indicate testing methods, equipment and consumable.</p> <p>The laboratory provided by the Contractor shall be administrated and maintained by the Contractor. The supply of electric power and water to the laboratory shall be made by the Contractor. The Contractor shall provide testing equipment and apparatus and furnish all testing staff, labour and consumable necessary for carrying out his tests. Such costs incurred in operation of his testing as the electric power and water consumption shall also be borne by the Contractor. The Contractor shall also appoint a superintendent in charge of testing to work in the laboratory.</p> <p>The Contractor shall when requested by the Engineer or the Engineer's Representative carry out any test in the presence of the Engineer or the Engineer's Representative, or shall provide all necessary testing Engineers, laboratory assistance and labours required to the Engineer free of charge.</p> <p>The Contractor shall supply further jute, plastic or 4-ply brown paper sacks for sampling, paint, brushes, turpentine or any other laboratory equipment or materials required for use in the Site laboratory as may be instructed by the Engineer from time to time.</p>
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ITEM NO . AND NAME	G103 PROJECT SIGN BOARDS
	<ol style="list-style-type: none"> 1. provision erection and maintenance of project signboard(3.4*1.8m),5 slides every slide 0.4 m height material similar to specified large sign support. The following information will be written in Arabic and English Languages. 2. - Name and Flag of Republic of Yemen. 3. - Name and Logo of Employer (Ministry/Department). 4. - Name and Logo of Funding institutions (if any). 5. - Name of Project. 6. - Name of Consultant. 7. - Name of Contractor. <p>- Any other information instructed by the Employer/Engineer.</p>
PAYMENT:	The payment will be per number of installed project sign board and as indicated in the Bill of quantities .

200 CLEARING & TREE PLANTING

201 Cleaning of Pavement, Side-Walks and Median Island

202 CULVERT CLEANING

203 DRAIN CLEARING (LINED).....

204 CLEAR VEGETATION

205 SHOULDER TRIMMING

206 Removal of Material & Disposal

207 TREE PLANTIN

ITEM NO. AND NAME	201 Cleaning of Pavement, Side-Walks and Median Island
UNIT OF MEASUREMENT:	CUBIC METER
DESCRIPTION:	<p>The task involves the cleaning of the Pavement, Side-Walks, Median Island from debris, waste, gritting sand, garbage, silt and collecting of objectionable materials. The work also involves the proper loading, removal, disposal and hauling of waste spoil to the approved landfill areas. The Contractor should protect the road structures from any damage that comes across.</p> <p>Waste and debris shall be cleared and the road reserve shall be cleaned once in accordance with the Contractor's approved work schedule</p>
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> <input type="checkbox"/> Bobcat or Loader <input type="checkbox"/> Dump Trucks <input type="checkbox"/> Hand tools <input type="checkbox"/> Workers <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	Not Applicable
<p>1. WORK SPECIFICATION:</p> <ol style="list-style-type: none"> a. Traffic warning signs shall be established 100 m on either side of the culvert road crossing. 2. Care should be taken before clearing the pavement, sidewalks and median islands to check for any hazards. 3. The condition of road structures shall be visually checked before labourers commence working near the structure. Any obvious defects shall be reported to the RMF Engineer. 4. All cleared waste shall be disposed at approved dumps off site. 5. The completed work shall be checked visually by sighting. The view shall be clear of all removable obstructions. 6. Partially cleared culverts shall not be accepted for stage payment. 7. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition. 	

ITEM NO. AND NAME	201 Cleaning of Pavement, Side-Walks and Median Island
<p>MEASUREMENT FOR PAYMENT:</p> <p>The work shall be measured in CUBIC METER of waste and other debris, measured in trucks as loose material. The volume of debris to be cleared shall be computed and recorded from measurements or estimated dimensions when loaded to the trucks. Payment will only be certified, after the full waste volume been cleared. Unit rates shall be full compensation for all steps necessary to comply with the above, including all transport, handling, labour, materials, landfill fees and all incidentals to complete the work as specified.</p>	

ITEM NO. AND NAME	202 CULVERT CLEANING
UNIT OF MEASUREMENT:	CUBIC METER
DESCRIPTION:	The task involves the cleaning of silt and other debris from pipe, box culverts and other enclosed drainage facilities including inlet and outlet headwall aprons. The work also involves the proper disposal of waste spoil. The work should normally be scheduled in conjunction with ditch clearing works to ensure that the pipe invert has free-flowing discharge. The Contractor should advise the RMF Engineer of any serious scour, undermining or structural damage that he comes across.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Dump Truck <input type="checkbox"/> Hand tools <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	Not Applicable
<p>1. WORK SPECIFICATION:</p> <ol style="list-style-type: none"> Traffic warning signs shall be established 100 m on either side of the culvert road crossing. Care should be taken before entering culverts to check for snakes or other hazards. Whenever practical, cleaning works should start at the downstream end and proceed upstream. This is to enable any water seepage to discharge. The condition of culvert structure shall be visually checked before labourers commence working inside the structure. Any obvious defects shall be reported to the RMF Engineer. Where culverts are too small to allow entry, they shall be cleaned using long handled implements and/or drag-buckets on rope lines. All cleared waste shall be disposed of neatly by spreading on the downstream side of the structure (where practicable) and at a location where it cannot wash back into any drainage ditch or other drainage facility. Where this cannot be achieved it shall be disposed of at approved dumps off site. The operation shall include the careful removal of roots and other vegetation growth from cracks and joints in the culvert and headwall structures. The completed work shall be checked visually by sighting from one end of the culvert to the other. The view shall be clear of all removable obstructions. Culverts should not be cleaned in isolation. The downstream ditch outlet should be confirmed to be lower than the culvert floor and clear. Where this is not the case, the RMF Engineer must be informed so that necessary 	

ITEM NO. AND NAME	202 CULVERT CLEANING
<p>instructions may be issued as a separate work Item.</p> <p>11. Partially cleared culverts shall not be accepted for stage payment.</p> <p>12. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The work shall be measured in CUBIC METER of silt and other debris, measured in place before disturbing. The volume of debris to be cleared shall be computed and recorded from measurements or estimated dimensions before work commences. Payment will only be certified, after the full culvert length has been cleared. Unit rates shall be full compensation for all steps necessary to comply with the above, including all transport, handling, labour, materials and all incidentals to complete the work as specified. Any instructed work required to associated ditches, repairs to the structure, or backfill, shall be measured separately under an appropriate work Item.</p>	

ITEM NO. AND NAME	203 DRAIN CLEARING (LINED)
UNIT OF MEASUREMENT:	CUBIC METER
DESCRIPTION:	The task involves removing and disposal of silt, debris, vegetation and other waste or rubbish from drainage channels
TYPICAL EQUIPMENT:	<input type="checkbox"/> Dump Truck (occasional use) <input type="checkbox"/> Hand tools <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	Not Applicable
<p>1. WORK SPECIFICATION:</p> <p>2. Traffic warning signs shall be established at both ends of the work section.</p> <p>3. Clearing shall commence at the outfall end and proceed upstream.</p> <p>4. The Contractor shall take care not to damage or disturb the drain lining. Any avoidable damage shall be repaired at the Contractor's own cost to the satisfaction of the RMF Engineer.</p> <p>5. The excavated material shall be collected and transported to dump areas sufficiently remote that in the opinion of the RMF Engineer it is impossible for it to wash into any drain or other drainage facility. The material shall be spread in neat, shallow bunds. Dump areas shall be at locations selected by the Contractor and approved by the RMF Engineer and shall not be closer than 5m to any drain.</p> <p>6. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The unit of measurement shall be measured in CUBIC METER of lined drain cleared, measured in place before disturbing. The unit rate shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.</p>	

ITEM NO. AND NAME	204 CLEAR VEGETATION
UNIT OF MEASUREMENT:	NOT MEASURED (INCLUDED IN RATES)
DESCRIPTION:	This task consists of cutting, collecting, removing and disposing of roadside vegetation on shoulders, side slopes, and elsewhere in the road reserve. The purpose is to restore safe sight distance and visibility of signs, and to ensure that walkways are kept passable and that pedestrians are not forced to walk in the road.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Hand tools: slasher, machete, axe rakes etc. <input type="checkbox"/> (Mechanical mower – optional) <input type="checkbox"/> Roadworks traffic warning signs
MATERIALS:	Not Applicable
WORK SPECIFICATION: <ol style="list-style-type: none"> 1. Traffic warning signs shall be established at both ends of the work section. 2. The area to receive bush clearing shall normally extend at least to the outer edge of the side drains. The limits of the required work will be as directed in advance by the RMF Engineer. Additional clearing may be directed on the inside of bends for traffic visibility reasons. 3. Vegetation shall be removed by cutting. The finished cut height shall be between 50 – 75 mm above ground surface. Plants shall <u>not</u> be uprooted as the root structure contributes to erosion resistance. On no account may vegetation be removed by burning or by the application of herbicides. 4. The Item includes for cutting all undesirable vegetation up to a stem size that can be reasonable cut by blade (i.e. machete) and not requiring sawing. 5. The Contractor shall take great care not to remove or damage young trees that may be desirable or have been intentionally planted. The RMF Engineer may assist in identifying such instances. 6. Where mechanical mowers are used as an alternative to labour based methods, a walking gang must proceed in advance to remove large stones etc that could be thrown up by the cutter blades. Machines shall not be used where they may damage highway signs and other furniture and handwork will be required adjacent to these features. 7. All cuttings must be gathered and disposed of in unobtrusive and uncultivated areas at least 5 meters from the highway boundary (back of drain). The normal means of disposal is by composting through natural decay. The burning of cuttings will not be permitted for environmental reasons. 8. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition. 	

ITEM NO. AND NAME	205 SHOULDER TRIMMING
UNIT OF MEASUREMENT:	SQUARE METRE
DESCRIPTION:	The task comprises the manual trimming down of high or inadequately sloped shoulders adjacent to roads and the removal of that material to approved dump sites. The operation is intended to remove material that builds up gradually in shoulders and prevents the uniform discharge of water from the road surface into the drainage ditches.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Hand Tools <input type="checkbox"/> Tractor and Trailer <input type="checkbox"/> Roadworks traffic warning signs
MATERIALS:	Not Applicable
WORK SPECIFICATION: <ol style="list-style-type: none"> 1. Traffic warning signs shall be established at both ends of the work section. 2. Shoulders shall be trimmed to a fall of between 5 – 7% away from the road. The shoulder level at the joint with the road shall be flush with the road pavement (or marginally lower by not more than 10 mm) so that no water is trapped. 3. The finished profile must be uniform in shape and smooth. The procedure for attaining this standard will involve cutting narrow slots at frequent intervals using a camber board template and spirit level, then using these slot cuts to guide the accurate removal of the remaining enclosed material. 4. The fall of sloped shoulders must be checked using a camber board and spirit level. 5. No trimmed material shall be left in the carriageway, shoulders or side drains. 6. All trimmed materials shall be collected and removed from the work site to dumping areas approved by the RMF Engineer. 7. The carriageway shall be swept clean where debris has fallen onto it. The work shall not be accepted for payment until all trimmed material has been removed. 	
MEASUREMENT FOR PAYMENT: <p>The works shall be measured in square metres of road shoulder on which surface trimming has taken place. This shall include the complete removal and disposal of trimmed materials including haulage off-site. Physical measurements of length and average width shall be recorded. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.</p>	

Item No. and Name	206 Removal of Material & Disposal
1 Overhaul Scope	<p>This work shall consist of authorized hauling in excess of the haul distance (city land fill) of any material paid.</p> <p>Overhaul materials to which overhaul applies are those which are hauled in excess of the free haul distance and approved by the Engineer, and shall include only the following materials:</p> <p>a) Debris, waste or Soil, gravel or rock materials derived from highway excavation, found suitable for fill and transported to fill sites for Forming embankment/subgrade.</p> <p>b) Materials excavated From approved borrow areas transported to fill sites for forming embankment/subgrade</p> <p>Overhaul shall not be measured For all other materials such as those used in sub-base, base, surfacing, sand and concrete aggregates, or for disposal of unsuitable or surplus excavated materials.</p>
2 Measurement	<p>NOT MEASURED (INCLUDED IN RATES)</p>
3 Payment	<p>NOT MEASURED (INCLUDED IN OTHER ITEMS)</p>

ITEM NO. AND NAME	207 TREE PLANTING
UNIT OF MEASUREMENT:	Number
DESCRIPTION:	The task includes supply, plant and aftercare of Ficus Nitida Trees (2meter height) or other trees that comply with the current tree pattern of the median island agricultural blocks. Tree planting will normally comprise excavation a pit 60x60x60cm for each plant, fertilizer 50gm for each plant and a good soil. Rate includes irrigation during the whole period of the project.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Hand tools <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	Trees should be chosen dependent on agriculture blocks current pattern and be approved by the Engineer. In general, they should be well growing, long-living and have substantial root systems. Care should be taken not to plant species, which will cause traffic visibility problems where this might cause a traffic hazard.
<p>WORK SPECIFICATION:</p> <ol style="list-style-type: none"> 1- Traffic warning signs shall be established at both ends of the work section. 2- Trees seedlings shall be fresh rooted plants. They shall include sufficient root material and soil to ensure good growth. 3- Holes shall be dug to receive the seedlings which shall be not less than 600 mm in diameter and 600 mm in depth. The hole shall be filled with 50gm compound fertilizer (20 + 20 + 20 + TA) for each plant with fertile topsoil. 4- Trees shall be planted at the beginning of the project. 5- The trees seedlings shall be watered directly after planting and regularly thereafter to prevent undue drying out during the project period. 6- All planting works shall include associated aftercare necessary to ensure the survival of vegetation which shall continue until the plants become established and self-supporting. Measures may include, watering, shading from direct sunlight, staking for support and protection form grazing animals. 7- The Contractor shall tend to the planted trees for the project period following completion of planting and will replant any sections that die due to lack of care or watering at his own cost. 1. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition. 	

300 SOURCES OF MATERIALS AND EARTHWORK

- 301 SOURCE OF MATERIAL**
- 302 DEFINITIONS**
- 303 PROVISION OF LAND**
- 304 ENTRY UPON LAND**
- 305 SAFETY AND PUBLIC HEALTH REQUIREMENTS**
- 306 ACCESS TRACKS**
- 307 CLEARANCE AND REMOVAL OF OVERBURDEN**
- 308 MIXING, SELECTING AND STOCKPILING OF MATERIALS**
- 309 MATERIAL UTILISATION**
- 310 RECONSTRUCTION OF BASE COURSE**
- 311 PRECONSTRUCTION ACTIVITIES**
- 312 CLASSIFICATION OF EXCAVATION MATERIAL**
 - 312.2.1 Provide and construct Embankment**
- 313 RECONSTRUCTION OF SUB BASE AND SUB GRADE**
- 314 COMPACTION OF EARTHWORKS**
- 315 SPOIL MATERIAL**
- 316 BORROW AREAS AND REINSTATEMENT**
- 317 TRIMMING OF SLOPES**
- 318 SIDE DRAINS**
- 319 UNSTABLE MATERIAL IN CUT SLOPES**
- 320 Culvert Cleaning**
- 321 Drain Clearing (Lined)**
- 322 Drain Clearing (Unlined)**
- 323 Drain Blading (Mechanised)**
- 324 Repair Erosion Damage (Selected Fill)**
- 325 Repair Erosion Damage (Rock Fill)**
- 326 Routine Cleaning of Pavement**
- 327 Cleaning of Pavement from Screens and Slides**
- 328 Provide and construct Granular Material for Base Course layer**
- 329 Provide and construct SUB-BASE layer**
- 329 Natural Aggregate Sub-base (Granular Sub-base)**
- 330 Sub-grade Preparation**
- 331 Sub-grade layer construction**

ITEM NO. AND NAME	301 Source of Material
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The Contractor shall select the sources of aggregate for concrete works, bituminous pavement works, graded crushed stone base, stone masonry, riprap, rock fill to swamps etc. Such sources shall be designated as quarries and are defined in Clause 302 (a) of this Specification.</p> <p>The Contractor shall select the sources of natural materials for fill material in the construction of embankments and gravel for subbase, wearing course, haul roads and shoulders. Such sources shall be designated as borrow areas and are defined in Clause 302 (b) of this Specification. The environmental related issues are the sole responsibility of the contractor and they have to abide by the Yemen National environment requirement including of this specification The Employer shall not be held liable for the quality and suitability of any material in any of the quarries or borrow areas identified in the Engineer's report on materials.</p> <p>Although that document may have been made available to Bidders by the Employer during the Bid period, it does not constitute part of the Bid documents. The Contractor shall be held solely responsible for any conclusions that he may draw from the Engineer's report on materials including their lead in transportation from source to the site.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	-
MEASUREMENT FOR PAYMENT:	-

ITEM NO. AND NAME	302 Definitions
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>(a) A quarry is an open surface working from which stone is removed by drilling and blasting or excavated by any other means for use in the Works.</p> <p>(b) A borrow area is a site from which materials, other than stone, are removed for use in the Works.</p> <p>(c) A stockpile area is a site upon which material such as topsoil, fill material, gravel or aggregate is temporarily heaped prior to its incorporation in the Works.</p> <p>(d) A spoil area is a site upon which surplus or unsuitable materials arising out of the Works are spread and disposed of. Surplus or unsuitable material shall not be placed within the road reserve without the prior written approval of Engineer.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION: -	
MEASUREMENT FOR PAYMENT: -	

ITEM NO. AND NAME	303 Provision of Land
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The acquisition of all land required for:</p> <ul style="list-style-type: none"> · borrow, stockpile and spoil areas and quarries, · access roads thereto, · deviations outside the road reserve, · the Site laboratory, · the Engineer's residential and office accommodation, · the Contractor's camps, offices, stores, workshops, houses, etc., · Temporary Works, or, · any other purpose; <p>shall be the responsibility of the Contractor. The Contractor shall ensure that any national or local laws and regulations pertaining to locating and exploiting quarries and borrow areas are satisfied.</p> <p>The location and size of quarries, borrow areas, spoil areas and stockpile areas proposed by the Contractor shall be subject to the approval of the Engineer.</p> <p>If, in the opinion of the Engineer, the location of any proposed quarry, borrow area, spoil area or stockpile area, or access track to them, should:</p> <ul style="list-style-type: none"> · have a potentially detrimental effect on the environment, · be in or too near an urban centre, · require an access road that is excessively long, · cover too large an area, · constitute a risk to the safety of the public, · be more distant than another source of suitable material or area, · result in the obstruction or disruption of existing watercourses or water supplies, the Engineer's approval may be withheld. <p>The Contractor shall inform the Engineer in writing at least 28 days in advance of any work being undertaken in each particular quarry, borrow area, spoil area or stockpile area.</p> <p>Prospecting will be done prior to such notification and the Contractor shall inform landowners and get permission from the landowners at least 7 days before prospecting takes place. The Contractor shall complete all necessary negotiations with the owners of the land upon which any quarry, borrow area, spoil area or stockpile area is to be located and shall compensate the owners directly in respect of royalties, buildings to be demolished or loss of crops to which landowners may be entitled in accordance with current ordinances.</p> <p>The Contractor shall also be liable for any taxes, duties, levies and other statutory payments in respect of land use or the extraction of materials or water.</p> <p>Prior to the submission of written notice to the Engineer the Contractor shall set out each quarry, borrow area, spoil area</p>

ITEM NO. AND NAME	303 Provision of Land
	<p>and stockpile area with concrete beacons clearly identifying the areas required for working areas, stockpile areas, blasting safety zones and access routes. The Contractor's written notice shall include the following for each quarry, borrow area, stockpile area and spoil area:</p> <p>(a) details of the route of the access track proposed, (b) a plan at 1:500 scale in ink on a stable transparent material giving details of:</p> <ul style="list-style-type: none"> · plot boundaries, geometric dimensions, · owners' names and addresses, · local details such as buildings, fences, graves, types and areas of cultivation and, services, all agreed with the land owners, and, · areas to be used for working areas, stockpile areas, blasting safety zones, etc <p>(c) Authorization from the owner and competent national/local authorities indicating permission to occupy and use the land . Where a quarry, borrow area, spoil area or stockpile area has insufficient suitable material or area for the use for which it was intended, the Contractor shall propose in writing that either an existing quarry, borrow area, spoil area or stockpile area be extended or that a new quarry, borrow area, spoil area or stockpile area shall be opened.</p> <p>The approval and acquisition of such new or extended quarries, borrow areas, spoil areas or stockpile areas shall be in accordance with all the provisions of this Clause 303 of the Specification</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION: -	
MEASUREMENT FOR PAYMENT: -	

ITEM NO. AND NAME	304 Entry upon Land
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The Contractor shall, before entering upon any land provided by the Employer, satisfy himself that legal rights of entry have been obtained including environmental clearance.</p> <p>The Contractor shall not enter any area without the Engineer's written approval.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	-
MEASUREMENT FOR PAYMENT:	-

ITEM NO. AND NAME	305 SAFETY AND PUBLIC HEALTH REQUIREMENTS
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The Contractor shall comply with the bye-laws of the Local Authority regarding public health and safety in respect of the operation of quarries, borrow areas, stockpile areas and spoil areas, and in the absence of, or in addition to such bye-laws, shall comply with the following conditions:</p> <p>(a) All areas being worked shall be drained and kept dried. Where a quarry or borrow area has been excavated such that it will not drain naturally, it shall be continually pumped dry while being used. Where instructed by the Engineer, on completion such depressions may be left to form a reservoir for livestock drinking water. In which case slopes shall be graded back to a slope flatter than 1 in 6 to facilitate access by livestock.</p> <p>(b) Such areas shall not encompass or be located within or adjacent to watercourses, settlements or urban areas.</p> <p>(c) Such areas shall not be located within the boundaries of:</p> <ul style="list-style-type: none"> · Strictly Protected Areas, · National Conservation Parks, · Peripheral Zones, · Nature Reserves, · Monuments, · Strict Zone Forests, · Water Zones. <p>Spoil areas shall be located at least 500 m away from the forest areas and it shall not contaminate any water sources like rivers, streams, waterways, drains, watercourses, lakes etc.</p> <p>The Contractor shall confine his operations solely to the areas provided and shall demarcate the boundary of the area and erect temporary or permanent boundary fencing as instructed by the Engineer.</p> <p>(f) Where the height of any face exceeds 1 metre, the Contractor shall provide, erect and maintain at his own expense temporary livestock-proof fencing and gates to prevent unauthorized access to the top of the working face.</p> <p>(g) On completion of work all faces shall be battered back and neatly trimmed to a slope flatter than 1 in 6.</p> <p>(h) On completion of work temporary fences and all temporary structures shall be demolished and removed, all latrine pits shall be filled in and drained, topsoil shall be spread and watered and the Site shall be left neat and tidy.</p> <p>(i) The Contractor shall take all necessary steps to prevent the discharge of any operational pollutants, including, but not limited to, suspended sediments, solutes and oils, into ground water or surface drainage systems.</p> <p>(j) On completion of work all quarries, borrow areas, spoil and stockpile areas shall be reinstated such that they represent neither a visual intrusion upon the landscape nor a hazard to</p>

ITEM NO. AND NAME	305 SAFETY AND PUBLIC HEALTH REQUIREMENTS
	the public and livestock. Slopes shall be stable and provided with topsoil that shall be regularly watered to promote the growth of covering vegetation. Land drainage, as far as in the opinion of the Engineer is practicable, shall be restored to its original state.
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION: -	
MEASUREMENT FOR PAYMENT: -	

ITEM NO. AND NAME	306 Access Tracks
UNIT OF MEASUREMENT:	-
DESCRIPTION:	The Contractor shall provide at his own cost for the construction and maintenance of access tracks and existing roads to quarries, borrow areas, spoil areas and stockpile areas.
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	-
MEASUREMENT FOR PAYMENT:	-

ITEM NO. AND NAME	307 Clearance and removal of Overburden
UNIT OF MEASUREMENT:	
DESCRIPTION:	<p>Unless otherwise instructed by the Engineer, the Contractor shall clear the sites of all existing quarries, borrow areas, stockpile areas, spoil areas and access tracks thereto in accordance with the provisions of Section 200 of this Specification, no measurement and payment will be made for this work.</p> <p>All existing fences, trees, hedges and other features that the Engineer instructs shall not be removed or disturbed shall be protected in accordance with the requirements of Section 200 of this Specification.</p> <p>Unless otherwise directed by the Engineer the Contractor shall remove topsoil and/or overburden from quarries, borrow areas, spoil areas, stockpile areas and access tracks thereto. The Engineer shall direct whether topsoil shall be stripped and stockpiled separately or shall be excavated together with the overburden. The Engineer may direct that either topsoil or overburden, if it should prove suitable, be used in the Works.</p> <p>Topsoil shall be stockpiled in heaps not exceeding 1 m in height. The sides of topsoil heaps shall be fully terraced to prevent surface water run-off and to harvest rainfall.</p> <p>The Contractor shall regularly water topsoil heaps as required to promote the reestablishment of covering vegetation and prevent loss of topsoil by wind erosion.</p> <p>On completion of work in any quarry, borrow area, spoil area or stockpile area any overburden and/or topsoil that has not been used in the Works shall be pushed back, spread and landscaped over the area of the quarry, borrow area, spoil area, stockpile area or access track thereto. Where topsoil has been stockpiled separately it shall be held back in reserve for spreading over such areas after landscaping.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION: -	
MEASUREMENT FOR PAYMENT: -	

ITEM NO. AND NAME	308 Mixing, Selecting and Stock piling of Material
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The Engineer shall instruct the Contractor as to the type of material to be excavated and the areas and depths to be worked.</p> <p>For attaining the specified grading, the Contractor may be required to mix materials obtained from natural sources using appropriate mechanical equipment such as grader, loading shovel, rotavatoretc .</p> <p>Such materials shall be thoroughly mixed into a homogeneous composition and formed into stockpiles at least 21 days before intended use.</p> <p>The Contractor shall ensure that oversize materials and unacceptable material components such as , clay, humus or other inferior or deleterious material encountered in the workings is separated from the suitable materials proposed for use in the Works. Such undesirable material shall be removed to spoil. Within each borrow area separate stockpiles shall be used for each type and grading of material.</p> <p>When removing material from stockpiles, none of the underlying material shall be mixed with it, and generally at least the bottom 100 mm layer shall be left behind.</p> <p>Should any stockpiles prove surplus to requirements the Contractor shall spread the material over the area of the quarry or borrow area unless directed otherwise by the Engineer.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	-
MEASUREMENT FOR PAYMENT:	-

ITEM NO. AND NAME	309 Mixing, Selecting and Stock piling of Material
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The Engineer shall instruct the Contractor as to the type of material to be excavated and the areas and depths to be worked.</p> <p>For attaining the specified grading, the Contractor may be required to mix materials obtained from natural sources using appropriate mechanical equipment such as grader, loading shovel, rotavatoretc .</p> <p>Such materials shall be thoroughly mixed into a homogeneous composition and formed into stockpiles at least 21 days before intended use.</p> <p>The Contractor shall ensure that oversize materials and unacceptable material components such as , clay, humus or other inferior or deleterious material encountered in the workings is separated from the suitable materials proposed for use in the Works. Such undesirable material shall be removed to spoil. Within each borrow area separate stockpiles shall be used for each type and grading of material.</p> <p>When removing material from stockpiles, none of the underlying material shall be mixed with it, and generally at least the bottom 100 mm layer shall be left behind.</p> <p>Should any stockpiles prove surplus to requirements the Contractor shall spread the material over the area of the quarry or borrow area unless directed otherwise by the Engineer.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	-
MEASUREMENT FOR PAYMENT:	-

ITEM NO. AND NAME	310 Reconstruction of Base Course
UNIT OF MEASUREMENT:	CUBIC METER
DESCRIPTION:	<p>Reconstruction of base-course shall be carried out as directed by the Engineer where there are deep corrugations or other deformations over an extensive area or when the cross-fall (camber) is outside the specified limits.</p> <p>The seal shall be scarified over the affected area, the material collected, screened to obtain suitable material for reuse, and these shall be stockpiled separately.</p> <p>The base course shall be scarified lightly, and an approved base material complying with Section 301.3 of General Specification for Road and Bridge Works MoPWH added to obtain the required cross-fall and to fill any corrugations and depressions. Water shall then be sprayed to obtain the optimum moisture content and the base course mixed thoroughly and graded to the specified shape. The reshaped base course shall then be compacted commencing from the edges towards the centre of the road to achieve a Characteristic Value of 98% MDD (AASHTO T180)</p>
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> <input type="checkbox"/> Motor grader <input type="checkbox"/> Excavator (for larger tasks), <input type="checkbox"/> Hand tools <input type="checkbox"/> Dump truck (occasional use) <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)-
MATERIALS:	<p>Selected fill shall be naturally occurring cohesive material, or material of a nature similar to existing construction. The moisture content should be just sufficient to facilitate compaction. It shall not be organic, expansive, comprise topsoil or contain vegetable or other waste matter.</p>
WORK SPECIFICATION: <ol style="list-style-type: none"> Traffic warning signs shall be established at both ends of the work section. The volume of the repair shall first be estimated based on taped measurements and this shall be agreed with the RMF Engineer and recorded. Scarification of the sealed surface by handheld equipment or by excavator. Fill material reused from cutting shall be supplemented with borrow material cut from pits situated sufficiently far from the road so not to affect the drainage or stability of the highway features. The location of all borrow pits shall be subject to consent by the RMF Engineer. Water shall be sprinkled on fill that is too dry to facilitate compaction. The loose outer surface of the reinstatement shall be trimmed back to give a dense surface in line with the surrounding undisturbed construction. A degree 	

ITEM NO. AND NAME	310 Reconstruction of Base Course
<p>of initial over-filling may be necessary to achieve this.</p> <p>On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The reconstruction of base course, as measured above, shall be paid for at the tendered unit rates. The rates shall be compensation for removal and stockpiling of existing seal, the furnishing, mixing, placing compaction and trimming of all materials including all labour, equipment, tools, signs and incidentals necessary to complete the work including the rectification of any defective work and traffic control and the removal of debris from site.</p> <p>A suitable computer program utilizing yemeni's rule and the cross-sections taken in accordance with the provisions of Section 100 of this Specification at 20 m intervals shall be used for the computation of earthworks volumes. In irregular ground or tight curvature the Engineer may direct that cross-sections shall be taken at closer intervals. Cross section preparation is incidental to work at the contractor's own cost.</p>	

ITEM NO. AND NAME	311 Pre Construction activities
UNIT OF MEASUREMENT:	NOT MEASURED (INCLUDED IN RATES)
DESCRIPTION:	<p>Site clearance, grubbing and topsoil stripping, as instructed by the Engineer, shall be performed by the Contractor prior to commencing earthworks construction. All earthworks shall be constructed as shown on the Drawings or as directed by the Engineer to the specified slopes, levels, depths, widths, tolerances and heights. Any earthworks not so constructed shall be made good by the Contractor at his own expense.</p> <p>The Contractor shall excavate cuttings and place fill in embankments in accordance with the Drawings or as directed by the Engineer. Only suitable excavated materials shall be used to form embankments. Any material, that in the opinion of the Engineer is considered undesirable, shall be deemed to be unsuitable for the construction of embankment fills. Unsuitable material shall include but not be limited to:</p> <ul style="list-style-type: none"> • material containing more than 2% of organic matter such as topsoil, material • from swamps, peat, logs, stumps or any other perishable material, • flammable material, • material with a swell of more than 2.5%, • material containing clays with a Liquid Limit exceeding 30% or Plasticity Index exceeding 15%. • boulder, rock fragments and other lumpy material exceeding 75mm in size, weathered rock, volcanic material <p>Excess or unsuitable material shall be disposed of only in designated spoil areas which shall be provided in accordance with the provisions of Section 300 of this Specification.</p> <p>Where fill material can be obtained from cuttings, the Contractor shall use this material before taking material from a borrow pit, unless he is instructed by the Engineer to take suitable material to spoil. The Contractor shall dispose of unsuitable or excess suitable excavated material in designated tip areas.</p> <p>Where the quantity of material required for embankments exceeds that available from cuttings, the Contractor shall be instructed by the Engineer to widen cuttings and/or to open borrow areas.</p> <p>At all times the Contractor shall ensure that earthworks are not damaged by weather or traffic. If such damage should occur the Engineer may withdraw approval from the affected Works until the Contractor has carried out remedial works such that the requirements of this Specification are met., including protection to earth slopes by turfing or other means where so provided for. The expenses of all such remedial works and any consequential additional testing requirements</p>

ITEM NO. AND NAME	311 Pre Construction activities
	<p>shall be borne by the Contractor.</p> <p>The Contractor shall provide adequate supervision to ensure that only suitable materials are incorporated in embankment fills. If any unsuitable materials should be included it shall be removed and replaced with suitable material at the expense of the Contractor.</p> <p>All trimming of cuttings, embankments, side drains, and shoulders to the specified slopes and shapes shall be carried out concurrently with the earthworks that are being carried out at that particular location and level.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION: -	
MEASUREMENT FOR PAYMENT: -	

ITEM NO. AND NAME	312 ROAD EXCAVATIONS AND EMBANKMENT FORMATION
UNIT OF MEASUREMENT:	
	<p>Road Earthwork Excavation Classification, Measurement, and Payment</p> <p><u>Road Excavation Classification</u></p> <p>Road Excavation works are to be divided into two types:</p> <p>312.1 ROADWAY EXCAVATION (COMMON EXCAVATION), AND 312.2 BORROW EXCAVATION</p> <p>A <u>(Roadway and borrow Excavation)</u></p> <p>1. Scope This work shall consist of excavating and grading the roadway and borrow pits, including waterways, ditches, intersections, approaches, and slope rounding; excavating of unsuitable material from roadbed and beneath embankment areas; excavating selected material found in the roadway which is ordered for specific use in the improvement; excavation of slided material; and disposing of all excavated materials all accordance with these Specification and in conformity with the lines, grades, and dimensions shown on the drawings or as ordered by the Engineer.</p> <p>Where sufficient quantities of suitable materials are non available from roadway excavation, additional material shall be excavated form borrow pits approved by the Engineer. No material from borrow pits shall be placed in the embankment in any balance section until it has been determined that all roadway excavation within the balance section can be utilized in the embankment.</p> <p>2. Measurement and Payment: The quantities of the various classes of excavation and embankment to be measured for payment under the Contract will be limited to the lines shown on the drawings, and will be indicated on approved profiles and cross-sections by the Contractor. Input data for the electronic quantity calculation of earthworks, sub-base and base shall be recorded by the Contractor on forms approved by the Engineer.</p> <p>Excavation and filling beyond the lines on the approved profiles and cross-sections will not be paid for. The Engineer will decide the angle of the slope of cuts and fills as the work proceeds on the basis of his evaluation of the soil characteristics. The actual lines of the cuts and fills as made will be duly measured and recorded by the Contractor. The Engineer will check these records and will approve the measurements, if correct, as a basis of payment. Excess of excavation shall be backfilled, as directed by the Engineer, with approved material without extra payment to the Contractor; excess of fill may be either left in place or removed as required by the Engineer. Calculation for the earthworks, sub-base and base course material shall be carried out by the Engineer.</p> <p>A Roadway Excavation</p> <p>1. General</p> <p>A1.1 These Works shall consist of excavating material in the cut sections of the</p>

ITEM NO. AND NAME	312 ROAD EXCAVATIONS AND EMBANKMENT FORMATION
	<p>Road, including watercourses, ditches and wadi relocations (but excluding borrow pits and structural excavation) all as and where shown on the Drawings, and hauling the excavated material either to locations for Road embankments or to stockpiles or to waste.</p> <p>A1.2 These Works shall also include any necessary excavations outside the ROW ordered by the Engineer to safeguard and protect the Works. These may include diversion of existing wadi channels; excavation of materials obstructing or impairing the flow along stream channels; and excavation of unstable materials which may slide or encroach into ditches or onto the ROW. Disposal of all such excavated materials shall be as instructed by the Engineer.</p> <p>A1.3 The work shall also include all excavation work within the site limits to attain the final grading levels indicated on drawings.</p> <p>B Roadway Excavation shall be considered as:</p> <p>B.1 Either "Unclassified Excavation"</p> <p>B.2 Or , " Classified Excavation "</p> <p>B.1 Unclassified Excavation</p> <p>"Unclassified Excavation" which includes all materials encountered of any nature including silts, clays, sand gravel and granular materials and fractured, jointed and solid rock, concrete, bituminous pavement and unsuitable material.</p> <p>B.2 Classified Excavation (Common Excavation)</p> <p>.2.1 Common Excavation</p> <p>All material other than borrow worked economically and reasonably by standard equipment (scarifier, scrapers, excavators or lighter bulldozer than, for example caterpillar D8 with ripper attachment or equivalent) is designated as "Common Excavation".</p> <p>The quantity of common excavation placed to tip shall be the number of cubic meters of material acceptably excavated as hereinbefore prescribed. The material shall be measured in original position and the quantities computed by the average end-area method.</p> <p>Common Excavation work shall be graded and divided into excavation approved to build embankments or other or to be disposed of. It is understood that borrow excavation is made only for the construction of embankments or other.</p> <p>312.1 Roadway Common Excavation Works are to be divided into:</p> <p>312.1.1 Unsuitable Common Excavation in Earth</p> <p>312.1.2 Suitable Common Excavation in Earth</p> <p>312.1.3 Unsuitable Common Excavation in Rock</p> <p>312. 1.4 Suitable Common Excavation in Rock</p> <p>312.1.5 Common Excavation in Rock _Worked by Drills (Suitable /Unsuitable)</p> <p>312.1.6 Excavation of Unsuitable Material outside Right of Way (Clean, load, and dump , Away of Unsuitable Material outside Right of Way)</p> <p>312.1.1 Unsuitable Common Excavation Material in Earth</p> <p>Description</p> <p>Unsuitable Common Excavation Material in Earth (other than Rocks) is material arising from Roadway Excavation, which is declared in writing by the Engineer to be unsuitable for use.</p>

ITEM NO. AND NAME	312 ROAD EXCAVATIONS AND EMBANKMENT FORMATION																		
	<p>Construction Requirements Any material declared in writing by the Engineer to be unsuitable shall be disposed of and levelled in thin layers by the Contractor outside the right-of-way or as directed by the Engineer. When unsuitable material in earth is ordered to be removed and replaced the soil left in place shall be compacted as per the specifications requirements .Payment for such compaction shall be included in the contract price for the excavation of unsuitable material in earth If the unsuitable material in earth which is removed is below standing water level and the replacement material is gravel or a similar self-draining material of at least 30 cm in depth, the compaction may be dispensed with if approved by the Engineer.</p> <p>Measurement and Payment Only unsuitable common excavation material in earth, which is declared in writing by the Engineer to be unsuitable, will qualify for payments under Pay of the Project Bill of Quantities The under-mentioned Pay shall include the cost of obtaining the consent of the owner or tenant of the land where the disposal of unsuitable material is made. Suitable common excavation material in earth shall be measured in its original position and its volume shall be calculated in cubic meters in accordance with Section 2 The quantities determined as provided above shall be paid for at the contract unit price listed below and shown in the Bill of Quantities which price and payment shall constitute full compensation for all the costs involved in the proper completion of the work prescribed in this section.</p> <table><tr><th>Pay Item No.</th><th>Description</th><th>Unit of Measurement</th></tr><tr><td>312.1.1</td><td>Unsuitable Common Excavation in Earth</td><td>cubic meter</td></tr><tr><td>312.1.2</td><td colspan="2">Suitable Common Excavation Material in Earth</td></tr><tr><td></td><td colspan="2">Description The suitable common excavation material in Earth (other than Rocks) is material arising from Roadway Excavation, which is declared in writing by the Engineer to be suitable Material in Earth for use.</td></tr><tr><td></td><td colspan="2">Construction Requirements Any material declared in writing by the Engineer to be suitable common excavation material in Earth shall be used refilled and levelled in layers by the Contractor as per the specifications and as directed by the Engineer. When suitable material in earth is ordered to be used or replaced the bottom ground left in place shall be compacted as per the specifications requirements .Payment for such compaction shall be included in the contract price for the excavation of suitable common excavation material in earth The cost of excavation of material which is used anywhere in the Project shall deemed to be included in the pay items relating to the parts of the work where the material is used.</td></tr><tr><td></td><td colspan="2">Measurement and Payment Only suitable common excavation material in earth, which is declared in writing by the Engineer to be suitable, will qualify for payments under Payof the Project Bill of Quantities The under-mentioned Pay shall include the cost of obtaining the consent of the</td></tr></table>	Pay Item No.	Description	Unit of Measurement	312.1.1	Unsuitable Common Excavation in Earth	cubic meter	312.1.2	Suitable Common Excavation Material in Earth			Description The suitable common excavation material in Earth (other than Rocks) is material arising from Roadway Excavation, which is declared in writing by the Engineer to be suitable Material in Earth for use.			Construction Requirements Any material declared in writing by the Engineer to be suitable common excavation material in Earth shall be used refilled and levelled in layers by the Contractor as per the specifications and as directed by the Engineer. When suitable material in earth is ordered to be used or replaced the bottom ground left in place shall be compacted as per the specifications requirements .Payment for such compaction shall be included in the contract price for the excavation of suitable common excavation material in earth The cost of excavation of material which is used anywhere in the Project shall deemed to be included in the pay items relating to the parts of the work where the material is used.			Measurement and Payment Only suitable common excavation material in earth, which is declared in writing by the Engineer to be suitable, will qualify for payments under Payof the Project Bill of Quantities The under-mentioned Pay shall include the cost of obtaining the consent of the	
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ITEM NO. AND NAME	312 ROAD EXCAVATIONS AND EMBANKMENT FORMATION												
	<p>owner or tenant of the land where the disposal of unsuitable material is made. Unsuitable common excavation material in earth shall be measured in its original position and its volume shall be calculated in cubic meters in accordance.</p> <p>Measurement and Payment: The quantities determined as provided above shall be paid for at the contract unit price listed below and shown in the Bill of Quantities which price and payment shall constitute full compensation for all the costs involved in the proper completion of the work prescribed in this section.</p> <table><tr><th>Pay Item No.</th><th>Description</th><th>Unit of Measurement</th></tr><tr><td>312.1.2</td><td>Suitable Common Excavation in Earth</td><td></td></tr></table> <p>cubic meter</p> <p>Construction Requirements All suitable material excavated within the limits and scope of the Project shall unless provision is expressly made to the contrary in these Specifications be used in the most effective manner for the formation of the embankment, for backfill or for other included in the Contract.</p> <p>312. 1.4 Suitable Common Excavation in Rock Description The suitable common excavation material in Rock (other than Earth) is material arising from Roadway Excavation, which is declared in writing by the Engineer to be suitable common excavation material in Rocks for use.</p> <p>Construction Requirements Any material declared in writing by the Engineer to be suitable common excavation material in rock shall be used refilled and levelled in layers by the Contractor as per the specifications and as directed by the Engineer. When suitable material in rocks is ordered to used or replaced the bottom ground left in place shall be compacted as per the specifications requirements .Payment for such compaction shall be included in the contract price for the excavation of suitable common excavation material in rock The cost of suitable common excavation material in rock which is used anywhere in the Project shall deemed to be included in the pay items relating to the parts of the work where the material is used.</p> <p>Measurement and Payment Only suitable common excavation material in rock, which is declared in writing by the Engineer to be suitable, will qualify for payments under Pay Bill No.2 Item No. (2.1.3).of the Project Bill of Quantities The under-mentioned Pay Item No. (2.1.3) shall include the cost of obtaining the consent of the owner or tenant of the land where the disposal of unsuitable material is made. Unsuitable common excavation material in rock shall be measured in its original position and its volume shall be calculated in cubic meters in accordance with</p> <p>Measurement and Payment: The quantities determined as provided above shall be paid for at the contract unit price listed below and shown in the Bill of Quantities which price and payment shall constitute full compensation for all the costs involved in the proper completion of the work prescribed in this section.</p> <table><tr><th>Pay Item No.</th><th>Description</th><th>Unit of Measurement</th></tr><tr><td>312. 1.4</td><td>Suitable Common Excavation Material in Rock</td><td>cubic</td></tr></table> <p>meter</p>	Pay Item No.	Description	Unit of Measurement	312.1.2	Suitable Common Excavation in Earth		Pay Item No.	Description	Unit of Measurement	312. 1.4	Suitable Common Excavation Material in Rock	cubic
Pay Item No.	Description	Unit of Measurement											
312.1.2	Suitable Common Excavation in Earth												
Pay Item No.	Description	Unit of Measurement											
312. 1.4	Suitable Common Excavation Material in Rock	cubic											

ITEM NO. AND NAME	312 ROAD EXCAVATIONS AND EMBANKMENT FORMATION						
	<p>Construction Requirements All suitable material excavated within the limits and scope of the Project shall unless provision is expressly made to the contrary in these Specifications be used in the most effective manner for the formation of the embankment, for backfill or for other included in the Contract.</p> <p>312. 1.3 Unsuitable Common Excavation Material in Rock Description Unsuitable Common Excavation Material in Rock (other than Earth) is material arising from Roadway Excavation, which is declared in writing by the Engineer to be unsuitable for use.</p> <p>Construction Requirements Any material declared in writing by the Engineer to be Unsuitable Common Excavation Material in Rock shall be disposed of and leveled in thin layers by the Contractor outside the right-of-way or as directed by the Engineer. When Unsuitable Common Excavation Material in Rock is ordered to be removed and replaced the soil left in place shall be compacted as per the specifications requirements .Payment for such compaction shall be included in the contract price for the excavation of Unsuitable Common Excavation Material in Rock If the unsuitable Common Excavation Material in Rock which is removed is below standing water level and the replacement material is gravel or a similar self-draining material of at least 30 cm in depth, the compaction may be dispensed with if approved by the Engineer.</p> <p>Measurement and Payment Only unsuitable common excavation material in rock , which is declared in writing by the Engineer to be unsuitable, will qualify for payments under Pay of the Project Bill of Quantities The under-mentioned shall include the cost of obtaining the consent of the owner or tenant of the land where the disposal of unsuitable material is made. Suitable common excavation material in rock shall be measured in its original position and its volume shall be calculated in cubic meters in accordance with</p> <p>Measurement and Payment: The quantities determined as provided above shall be paid for at the contract unit price listed below and shown in the Bill of Quantities which price and payment shall constitute full compensation for all the costs involved in the proper completion of the work prescribed in this section.</p> <table><tr><th>Pay Item No.</th><th>Description</th><th>Unit of Measurement</th></tr><tr><td>312. 1.3</td><td>Unsuitable Common Excavation in Rock</td><td>cubic meter</td></tr></table> <p>312. 1.5 Common Excavation in Rock _Worked by Drills All rock material other than rocks that can not be worked economically and reasonably by standard equipment (scarifiers, scrapers, excavators or lighter bulldozer than, for example caterpillar D8 with ripper attachment or equivalent), but worked by Drills Equipments is designated as “Common Excavation in Rock _Worked by Drills”.</p> <p>Description Common Excavation Material in Rock Worked by Drills is material arising from Roadway Excavation, which is declared in writing by the Engineer to be</p>	Pay Item No.	Description	Unit of Measurement	312. 1.3	Unsuitable Common Excavation in Rock	cubic meter
Pay Item No.	Description	Unit of Measurement					
312. 1.3	Unsuitable Common Excavation in Rock	cubic meter					

ITEM NO. AND NAME	312 ROAD EXCAVATIONS AND EMBANKMENT FORMATION						
	<p>suitable or unsuitable for use.</p> <p>Construction Requirements</p> <p>Any material declared in writing by the Engineer to be Common Excavation Material in Rock Worked by Drills can be used (suitable or shall be disposed (unsuitable) by the Contractor outside the right-of-way or as directed by the Engineer or leveled (suitable)in layers.</p> <p>When Suitable /Unsuitable Common Excavation Material in Rock Worked by Drills is ordered to be removed or replaced the soil left in place shall be compacted as per the specifications requirements .Payment for such compaction shall be included in the contract price for the excavation of (Suitable /Unsuitable)Common Excavation Material in Rock Worked by Drills</p> <p>If the Common Excavation Material in Rock Worked by Drills which is removed or replaced is below standing water level and the replacement material is gravel or a similar self-draining material of at least 30 cm in depth, the compaction may be dispensed with if approved by the Engineer.</p> <p>Measurement and Payment</p> <p>Only material, which is declared in writing by the Engineer to be Suitable /Unsuitable Common Excavation Material in Rock Worked by Drills, will qualify for payments under Pay.of the Project Bill of Quantities</p> <p>The under-mentioned shall include the cost of obtaining the consent of the owner or tenant of the land where the disposal of unsuitable material is made.</p> <p>Suitable /Unsuitable Common Excavation Material in Rock Worked by Drills k shall be measured in its original position and its volume shall be calculated in cubic metres Measurement and Payment:</p> <p>The quantities determined as provided above shall be paid for at the contract unit price listed below and shown in the Bill of Quantities which price and payment shall constitute full compensation for all the costs involved in the proper completion of the work prescribed in this section.</p> <table><tr><th>Pay Item No.</th><th>Description</th><th>Unit of Measurement</th></tr><tr><td>312. 1.5</td><td>Common Excavation Material in Rock-by Drills</td><td>cubic meter</td></tr></table> <p>(Suitable /Unsuitable)</p> <p>312. 1.6 Excavation of Unsuitable Material Outside Right of Way (Clean, load, and dump away of Unsuitable Material Outside Right of Way)</p> <p>Description See Descriptions for the above Items (312. 1.1_ 312. 1.5)</p> <p>Construction Requirements See Construction Requirements for the above Items (312. 1.1_ 312. 1.5)</p> <p>3Measurement and Payment Only Clearance of unsuitable material that have to be removed. Cleared, load,</p>	Pay Item No.	Description	Unit of Measurement	312. 1.5	Common Excavation Material in Rock-by Drills	cubic meter
Pay Item No.	Description	Unit of Measurement					
312. 1.5	Common Excavation Material in Rock-by Drills	cubic meter					

ITEM NO. AND NAME	312 ROAD EXCAVATIONS AND EMBANKMENT FORMATION						
	<p>and dump away of unsuitable material outside Right of Way) (all types of materials-earth rock- asphalt, concrete,...,etc.) which are named and declared in writing by the Engineer to be unsuitable, will qualify for payments of the Project Bill of Quantities</p> <p>The under-mentioned shall include the cost of obtaining the consent of the owner or tenant of the land where the disposal of unsuitable material is made.</p> <p>Unsuitable material that have to be removed, Cleared, load, and dump away outside Right of Way) (all types of materials-earth rock- asphalt, concrete,...,etc.) shall be measured in its original position and its volume shall be calculated in cubic meters in accordance with Section Measurement and Payment</p> <p>The quantities determined as provided above shall be paid for at the contract unit price listed below and shown in the Bill of Quantities which price and payment shall constitute full compensation for all the costs involved in the proper completion of the work prescribed in this section.</p> <table><tr><th>Pay Item No.</th><th>Description</th><th>Unit of Measurement</th></tr><tr><td>312. 1.6</td><td>Unsuitable Common Excavation in Earth</td><td>cubic meter</td></tr></table> <p>Description</p> <p>Unsuitable Material that have to be removed, Cleared, load, and dump away outside Right of Way) (all types of materials-earth rock- asphalt, concrete,...,etc.) is material arising from Roadway Works, which is declared in writing by the Engineer to be unsuitable for use.</p> <p>Construction Requirements</p> <p>Any material declared in writing by the Engineer to be unsuitable shall be removed, Cleared, load, and dump away (all types of materials-earth rock- asphalt, concrete,...,etc.) by the Contractor outside the right-of-way or as directed by the Engineer.</p> <p>312.2 BORROW EXCAVATION</p> <p>Borrow excavation means the excavation of material from borrow pits selected by the Contractor and approved by the Engineer from which sources the Employer shall obtain the rights from the owners to produce material.</p> <p>Borrow material shall be the material approved by the Engineer meeting the requirements for the particular embankment, back-fill, or other use the material is intended.</p> <p>The location of borrow pits is indicated on the final design or will be designated by the Engineer.</p> <p>The necessary investigations have to be carried out by the Contractor under the supervision of the Engineer at no additional costs</p> <p><i>Borrow Excavation</i></p> <p>Borrow excavation can be resorted to for collection of materials for fill, if the Engineer is satisfied that sufficient suitable material from roadway and drainage excavation is not available. The work shall include excavation of the borrow area, hauling the material to fill sites and forming embankment/subgrade.</p> <p>It shall be the responsibility of the Contractor to choose the locations of all borrow pits and to demonstrate through tests that the material conforms to the specification requirements. For any borrow pit located on privately owned property, the Contractor shall secure the consent of the landowner, and where</p>	Pay Item No.	Description	Unit of Measurement	312. 1.6	Unsuitable Common Excavation in Earth	cubic meter
Pay Item No.	Description	Unit of Measurement					
312. 1.6	Unsuitable Common Excavation in Earth	cubic meter					

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	<p>called for, at his own cost compensate the landowner for the use of the material and/or land. No borrow pit shall be opened without the written approval of the Engineer.</p> <p>Borrow pits shall be located at the sites directed by the Engineer and shall not be located closer than 30 metres from the nearest toe of the roadway. The size, shapes, slopes and orientation of borrow pits shall be as directed by the Engineer for least environmental impact. Also, no borrow material shall be obtained from any area within 200 metres downstream of drainage structures.</p> <p>On completion of the work, the Contractor shall tidy up the borrow area, dress the side slopes to not steeper than 1 to 1 and as stated elsewhere, and provide for drainage of the pits to avoid water stagnation.</p> <p>Disposal of Surplus Materials</p> <p>The Contractor shall be responsible for the proper disposal of all surplus excavated materials. The materials shall be used to fill up the borrow pit excavated areas on priority basis to minimise negative environment impacts.</p> <p>Sediments/debris removed from wadi bed at Irish Crossings shall be deposited in low areas on the downstream side of the wadi to the approval of the Engineer.</p> <p>Surplus materials, if any, may be disposed off within the right-of-way in locations approved by the Engineer. The Engineer may also permit the materials to be used to widen embankments or flatten slopes. Such materials will not be included in the approved embankment cross sections for purposes of computing pay quantities. Materials disposed off within the right-of-way shall be leveled or shaped as directed or approved by the Engineer. The materials so disposed off shall not adversely affect natural drainage courses or threaten to cause damage to the highway or adjacent public or private property.</p> <p>When materials are to be deposited outside the right-of-way, the Contractor shall be responsible for obtaining the permission of the landowner and paying any compensation involved. Material deposited within view of the highway shall be leveled or shaped as directed or approved by the Engineer so as not to present an objectionable appearance.</p> <p>.Borrow Excavation Works composed of :: 312.2.1 Formation of Embankment 312.2.2 Sub-grade Improvement The quantity of borrow excavation to be paid for shall be the number of cubic metres of borrow excavation acceptably excavated as herein-before prescribed.</p>

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	<p>The material shall be measured in its final compacted position, placed in embankment, and the quantities will be computed by the average end-area method.</p> <p>Payment</p> <p>(a) The payment for excavation to tip shall be done according to the corresponding items of the Bill of Quantities.</p> <p>(b) Excavation of materials to fill inclusive borrow excavation shall be paid according to the items relevant to the construction of embankment or other.</p> <p>312.2.1 Embankment</p> <p>Earth embankments shall be constructed from satisfactory materials free of organic material and rocks with any dimension greater than 25mm. The material shall be placed in successive horizontal layers of loose material not more than 200 millimeters in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary and scarified or otherwise broken up in such a manner that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph 330 (Subgrade Preparation). Compaction shall be accomplished by sheepfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.</p> <p>Measurement and Payment CUBIC METER</p> <p>312.2.2 granuler backfill</p> <p>This Specification section addresses supplying, placing and compacting granular backfill adjacent to structures. The areas in which this material is to be placed shall be as indicated on the drawings or as required by the Employer's Representative.</p> <p>The material shall be well-graded crushed or uncrushed gravel, stone, rock-fill or natural sand or a well-mixed combination of any of these. Grading requirements for Granular Backfill are as follows:</p> <table data-bbox="756 1841 1445 2056"> <tr> <td>Maximum size</td><td>5 cm</td></tr> <tr> <td>Passing 4.75 mm sieve</td><td>(a) 25% to 90%</td></tr> <tr> <td>Passing 0.075 mm sieve</td><td>0% to 10%</td></tr> <tr> <td>Plasticity Index</td><td>6 max.</td></tr> </table>	Maximum size	5 cm	Passing 4.75 mm sieve	(a) 25% to 90%	Passing 0.075 mm sieve	0% to 10%	Plasticity Index	6 max.
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Plasticity Index	6 max.								

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	<p>Granular backfill shall be placed in layers not exceeding 15 cm and compacted to a density of 98% of the maximum dry density.</p> <p>Measurement and Payment The quantity of granular backfill to be measured of cubic meters (cubic meter) of suitable material supplied and compacted to the Employer's Representative satisfaction. Any existing material within areas to receive granular backfill which is removed because of the Contractor's method of working shall be replaced by granular backfill at the Contractor's expense. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labor, equipment, deposition, materials and all incidentals necessary to complete the work as specified</p> <p>The Contractor shall complete the final trimming as well as any repair or damage that may have occurred during construction after completing all other immediately adjacent or interfacing work</p> <p>The Contractor shall remove and dispose of all excavation material to at least 10 meters from the ditch area to prevent any surplus material from falling into the ditch.</p> <p>The Contractor shall rectify all ditch construction work that does not meet the tolerance criteria.</p> <p>The Contractor shall not disturb natural streams or channels as well as irrigation canals and drains adjacent to the works bordering on the site, without the approval of local authorities.</p> <p>Notwithstanding the Contractor's obligation to rectify unsatisfactory or failed work, the Contractor shall also be responsible for routine maintenance of all completed and accepted new waterways throughout the Contract Period. No separate measurement or payment shall be made for such routine maintenance.</p> <p>312.3 Structural Excavation</p> <p>1 Scope</p> <p>This work shall consist of the necessary excavating for the foundations of bridges, culverts, pipes, and other structures not otherwise provided in these Specification, the backfilling of completed structures, all in accordance with these Specifications and in conformity with the drawings.</p> <p>The work shall include necessary pumping, draining, watering, sheeting, bracing and the necessary construction of cofferdams, and furnishing the materials therefore, and the subsequent removal of cofferdams and the placing of all necessary back-fill.</p>

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	<p>This work shall also include the furnishing and placing of sand or gravel back fill material to replace unsuitable material encountered below the foundation elevation of structures.</p> <p>No allowance will be made for classification of material encountered.</p> <p>2 Construction</p> <p>A Clearing and Grubbing (Clean, load, and dump away of unsuitable material outside Right of Way) Prior to beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with above mentioned specifications Prior to starting excavation operations in any area all necessary clearing in that area shall have been performed, in accordance with these Specifications.</p> <p>B Excavation</p> <p>Excavation for foundation is to be made to a depth giving sufficiently good bearing strata, irrespective of that stratum being above or below the depth indicated on the drawings. The bottoms of all excavations shall be carefully levelled, stepped or benched horizontally as necessary, and left clean for pouring concrete.</p> <p>Should the structural excavation except rock excavation be carried out by machines moving on the excavation bed (bulldozer, etc.) then excavation may only be carried out up to 30 cm above the top of the prescribed excavation level shown on the drawings or as indicated by the Engineer.</p> <p>The remaining excavation work must be done by hand or with suitable equipment to avoid churning up of the soil, where the ground of excavated areas shows an insufficient density of soil, the ground shall be compacted by suitable equipment in order to achieve the required stability.</p> <p>The lean concrete bed specified under the footings is to be cast immediately after preparation of the subsoil. The excavation slopes are to be shaped such as to prevent any slides during construction.</p> <p>All extra works related to the excavation, such as vertical stiffening, cofferdams, etc., shall be included in the unit price for structural excavation.</p> <p>The Structural analysis and the drawings of these works have to be presented to the Engineer for approval. There is no extra payment for such works.</p> <p>Before commencement of excavation, ground levels shall be taken by the Contractor in the presence of a representative of the Engineer.</p> <p>The depth of foundation shall be subject to the approval of the Engineer.</p>

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	<p>After each excavation is completed, the Contractor shall notify the Engineer to that effect, and concrete or reinforcing steel shall be placed after the Engineer has approved the depth of excavation and the character of foundation material.</p> <p>For the full width of the footing area and replaced by lean concrete or suitable soil where a sufficient density of soil by compaction may be achieved.</p> <p>The suitable soil for replacing must be compacted, according to the requirements of the soil investigations.</p> <p>The Engineer shall determine the depth for displacement of soil. The costs of removing unstable soil material for refilling shall be covered, if necessary, by the relevant item of the Bill of Quantities.</p> <p>All excavated material so far as suitable, shall be utilized as back-fill or embankment. The surplus material, whether or not temporarily allowed to be placed within a stream area, shall finally be disposed of in such a manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure. No excavated material shall be deposited at any time so as not to endanger the partly finished structures.</p> <p>After completion of the structures the Contractor shall refill all construction pits up to the original level. This shall be done with suitable material in layers of max. 30cm thickness. Each layer shall be compacted carefully by means of vibrating plates or mechanical tampers.</p> <p>The maximum layer thickness specified above is subject to satisfactory compaction being achieved throughout the full depth of the layer.</p> <p>In case of executing foundation works below actual ground water level the costs for lowering ground water level are to be calculated in the unit prices for excavation. The Contractor has to take the necessary measurements by protecting the site area against storm-water during the rainy season. No additional payment will be made for these works.</p> <p>3 Measurement</p> <p>2.3 Excavation for Structures</p> <p>The quantity of any excavation to be paid for shall be the number of cubic meters, measured in original position, of material acceptably excavated in conformity with the drawings or as directed by the Engineer, but in no case shall any of the following volumes be included in the measurement for payment:</p> <p>(a) Water or other liquid, except that the volume of mud, muck, or similar semi-solid matter not resulting from the construction operations and which cannot be pumped or drained away shall be included;</p> <p>The volume of any excavation performed prior to the taking of elevations and</p>

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	<p>measurements of the undisturbed ground.</p> <p>4 Payment</p> <p>Excavation for Structures:</p> <p>The quantity, determined as provided above, shall be paid for at the Contract Unit Price per cubic meter, which price and payment will constitute full compensation for all labour, equipment, tools and incidentals necessary for completion of work, including any hauling of excavated material.</p> <table><thead><tr><th data-bbox="549 600 651 629">Pay Item</th><th data-bbox="1094 600 1197 629">Pay Unit</th></tr></thead><tbody><tr><td data-bbox="549 633 651 663">312.3.1</td><td data-bbox="730 633 1468 663">structural excavation in rock materials Cubic Meter</td></tr><tr><td data-bbox="549 667 651 696">312.3.2</td><td data-bbox="730 667 1468 696">structural excavation in common materials Cubic Meter</td></tr></tbody></table>	Pay Item	Pay Unit	312.3.1	structural excavation in rock materials Cubic Meter	312.3.2	structural excavation in common materials Cubic Meter
Pay Item	Pay Unit						
312.3.1	structural excavation in rock materials Cubic Meter						
312.3.2	structural excavation in common materials Cubic Meter						

ITEM NO. AND NAME	313 RECONSTRUCTION OF SUB BASE AND SUB GRADE
UNIT OF MEASUREMENT:	CUBIC METER
DESCRIPTION:	<p>Reconstruction of sub-base and sub-grade shall be carried out as directed by the Engineer where there have been significant pavement failures over an extensive area.</p> <p>The seal shall be scarified over the affected area, the material collected, screened to obtain suitable material for reuse, and stockpiled separately for re-use.</p> <p>The base course material shall be excavated, ensuring that the material is not contaminated and stockpiled separately for re-use.</p> <p>If directed by the Engineer the sub-base course material shall be excavated, ensuring that the material is not contaminated and stockpiled separately for reuse.</p> <p>The unit of measurement for the reconstruction of sub-base or sub-grade shall include: the area of the sealed surface to be scarified and stockpiled in square metres, the volume of base material removed and stockpiled in cubic metres, the volume of sub-base material removed and stockpiled in cubic metres, the volume of sub-grade material removed and replaced in cubic metres, and the volume of sub-base material including supply, place and compact in cubic metres.</p>
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> <input type="checkbox"/> Motor grader <input type="checkbox"/> Excavator (for larger tasks), <input type="checkbox"/> Hand tools <input type="checkbox"/> Dump truck (occasional use) <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)-
MATERIALS:	<p>If the sub-grade is to be replaced it shall be excavated to the depth directed by the Engineer and replaced with an approved, selected backfill material Such materials shall be compacted in layers not exceeding 200 mm to achieve 95% of the Maximum Dry Density as determined by AASHTO T 180</p> <p>If the sub-base course is to be replaced it shall be excavated to the depth directed by the Engineer and replaced with an approved sub-base material Such materials shall be compacted in layers not exceeding 200 mm to achieve 98% of the Maximum Dry Density as determined by AASHTO T 180</p>
WORK SPECIFICATION: <ol style="list-style-type: none"> 1. Traffic warning signs shall be established at both ends of the work section. 2. The volume of the repair shall first be estimated based on taped 	

ITEM NO. AND NAME	313 RECONSTRUCTION OF SUB BASE AND SUB GRADE
<p>measurements and this shall be agreed with the RMF Engineer and recorded.</p> <ol style="list-style-type: none"> 3. Scarification of the sealed surface by handheld equipment or by excavator. 4. Fill material reused from cutting shall be supplemented with borrow material cut from pits situated sufficiently far from the road so not to affect the drainage or stability of the highway features. The location of all borrow pits shall be subject to consent by the RMF Engineer. Water shall be sprinkled on fill that is too dry to facilitate compaction. 5. The loose outer surface of the reinstatement shall be trimmed back to give a dense surface in line with the surrounding undisturbed construction. A degree of initial over-filling may be necessary to achieve this. <p>On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The reconstruction of sub-base or sub-grade, as measured above shall be paid for at the tendered unit rates. The rates shall be compensation for removal and stockpiling of existing materials, the furnishing, mixing, placing compaction and trimming of all materials including all labour, equipment, tools, signs and incidentals necessary to complete the work including the rectification of any defective work and traffic control and the removal and disposal of debris.</p> <p>The reconstruction of base course, as measured above, shall be paid for at the tendered unit rates. The rates shall be compensation for removal and stockpiling of existing seal, the furnishing, mixing, placing compaction and trimming of all materials including all labour, equipment, tools, signs and incidentals necessary to complete the work including the rectification of any defective work and traffic control and the removal of debris from site.</p> <p>A suitable computer program and the cross- at 25 m intervals shall be used for the computation of earthworks volumes. In irregular ground or tight curvature the Engineer may direct that cross-sections shall be taken at closer intervals. Cross section preparation is incidental to work at the contractor's own cost</p>	

ITEM NO. AND NAME	314 COMPACTION OF EARTHWORKS
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The moisture content of the earthworks fill material shall be adjusted immediately prior to compaction by either uniformly mixing in water or drying out the material such that the range moisture content during compaction is between 1% above and 2% below the Optimum Moisture Content (AASHTO T180).</p> <p>The moisture content shall be kept within these limits till compaction is complete. Each layer of material shall be compacted at a moisture content within the above limits to a dry density equal to or exceeding those specified below:</p> <p>General</p> <ul style="list-style-type: none"> • all fill material in embankments, except the non-frost subgrade layer shall be • compacted to 95% MDD (AASHTO T180), • the 300 mm thick subgrade layer below the finished formation level in cuttings, if it is proved to be suitable by laboratory testing, shall be compacted to 98% MDD (AASHTO T180) a. <p>Compaction under and in embankments, and in cuttings, shall be performed utilizing the methods proposed by the Contractor based on site trials and approved by the Engineer in accordance with the provisions of Clause 1118 of this Specification.</p> <p>The Contractor shall compact each layer of hard fill material used in high embankments by pneumatic tyre roller weighing 18-20 tonnes dead weight, scraper or dump truck weighing not less than 5 tonnes dead weight.</p> <p>The Contractor shall submit to the Engineer his proposals for the compaction of each main type of material likely to be used in embankments in accordance with the provisions of Section 1100 of this Specification. Those proposals shall include the types of equipment, the range of passes and the loose depth of each layer. The Contractor, in consultation with the Engineer, shall carry out Site compaction trials, supplemented by any necessary laboratory investigations, using the methods he proposes to adopt for the construction of earthworks. The</p> <p>Contractor shall satisfy the Engineer that all the specified requirements in respect of compaction can be achieved utilizing his proposed methods. Site compaction trials of each main type of material likely to be encountered shall be completed before the commencement of the Permanent Works.</p> <p>Should any stockpiles prove surplus to requirements the Contractor shall spread the material over the area of the quarry or borrow area unless directed otherwise by the</p>

ITEM NO. AND NAME	314 COMPACTION OF EARTHWORKS
	<p>Engineer.</p> <p>The water to be used shall be clean and fresh, free from organic matter, impurities and deleterious substances. Water shall be obtained from a source approved by the Engineer. The Contractor shall, if the Engineer should so require, arrange for the analysis of water supplies to demonstrate compliance with this Specification.</p> <p>Water shall be evenly sprinkled on the surface of the fill material by machines of a type approved by the Engineer and capable of distributing water at a known, predetermined and constant rate.</p>
TYPICAL EQUIPMENT:	<input type="checkbox"/> Pneumatic Tyre roller <input type="checkbox"/> Grader
MATERIALS:	Not Applicable
WORK SPECIFICATION:	
MEASUREMENT FOR PAYMENT: -	

ITEM NO. AND NAME	315 SPOIL MATERIAL
UNIT OF MEASURE	
DESCRIPTION:	<p>Spoil material shall be defined as material which, having been obtained from roadway excavations (including from road subgrades and foundations), is unsuitable for use as fill in embankments, or otherwise determined by him as not required for use as fill material, which the Engineer has instructed to be carted to spoil. No excavated material should be carted to spoil except under the specific instructions of the Engineer.</p> <p>Excavated material initially classified as spoil material but latter on used by the Contractor as fill material, non-frost subgrade, subbase or in any other manner as part of road construction shall be declassified as spoil material and the measurement of spoil material shall be adjusted accordingly.</p> <p>Spoil material shall only be disposed of by deposition in</p>

	designated spoil areas located by the Contractor and subject to the prior approval of the Engineer. Land for spoil areas shall be provided in accordance with the provisions of Section 300 of this Specification. The Contractor shall give the Engineer at least 24 hours' notice of his intention to commence spoiling operations at a particular location.
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION: -	
MEASUREMENT FOR PAYMENT: INCLUDED IN OTHER ITEMS COST	
EM NO. AND NAME	316 BORROW AREAS AND REINSTATEMENT
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>Fill material that is required in addition to that provided by the excavation, or widening of existing cuttings shall be obtained from borrow areas. Land for borrow areas shall be provided in accordance with the provisions of Section 302 of this Specification.</p> <p>Borrow areas shall be located by the Contractor and shall be subject to the Engineer's approval.</p> <p>The Engineer may direct that particular materials in borrow areas shall be selected for use in a specific section of the Works. Where such selection is instructed, double handling, stockpiling or excavation in particular areas of a borrow area may be required.</p> <p>All borrow material shall be thoroughly mixed in or close to the borrow area and stockpiled for later use to ensure that material from a particular borrow area is homogeneous and uniform in nature throughout.</p> <p>The Contractor shall construct all accesses, to borrow area and clear and remove all vegetation, boulders and unsuitable, or oversize material from the borrow area.</p> <p>Overburden shall be removed and may be required to be stockpiled for use during the reinstatement of the borrow area in accordance with the provisions of Section 300 of this Specification.</p>

	<p>The Contractor shall ensure in every borrow area that suitable material is not contaminated with unsuitable material. Unsuitable material shall be spoiled in accordance with Clause 315 of this Specification or used to reinstate the excavation in accordance with Clause 313 of this Specification.</p> <p>Borrow areas shall be excavated to regular widths and shape and shall be cleaned up and reinstated on completion. Side slopes of reinstated borrow areas shall have a maximum slope of 6 horizontal to 1 vertical. Borrow area sides shall be neatly trimmed and their bottoms leveled and drained away from the Works all in accordance with applicable contractual, regulatory and legal requirements. The reinstatement is incidental to the item rate at the contractor's cost.</p>
TYPICAL EQUIPMENT:	<p>□ -</p>

ITEM NO. AND NAME	317 TRIMMING OF SLOPES
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The side slopes of cuttings and embankments shall be trimmed by hand or by approved mechanical means to uniform batters as shown on the Drawings or as instructed by the Engineer. The faces of embankments shall be of properly compacted material in accordance with the requirements of Clause 315 of this Specification and any loose improperly compacted or oversize material shall be trimmed back and removed from embankment faces. Such material shall either be carted to spoil or, if it should be deemed suitable by the Engineer, incorporated elsewhere in the Works. The trimming of cutting and embankment slopes shall be completed within 1 month of completion of earthwork up to formation level.</p> <p>Any rock, boulder or bitumen-bound/cement-bound pavement appearing in the face of a cutting or embankment shall be trimmed back to within the tolerance specified. If any exposed rock or boulder should be unstable, it shall be completely removed and the resulting void filled with suitable material compacted to the approval of the Engineer.</p> <p>Trimming the slopes of embankments and cuttings shall be deemed to be part and parcel of the excavation of cuttings and side drains and the construction of embankments and the Contractor shall not be entitled to any separate payment in respect thereof.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	-
MEASUREMENT FOR PAYMENT: THE PAYMENT WILL BE PER CUBIC METER	-

ITEM NO. AND NAME	318 SIDE DRAINS	
UNIT OF MEASUREMENT:	CUBIC METER	
DESCRIPTION:	<p>Side drains shall be considered as roadway excavation in accordance with Clauses 310, 311, 312 of this Specification and classified as earthworks. During the course of the Works, the Engineer may instruct amendments to the dimensions, slopes and depths of side drains which shall be constructed accordingly.</p> <p>Grouted stone pitching shall be provided for side drains where required in accordance with the Drawings or as instructed by the Engineer.</p>	
TYPICAL EQUIPMENT:	□ -	
MATERIALS:	Not Applicable	
WORK SPECIFICATION:		
-		
MEASUREMENT FOR PAYMENT:	The payment will be per CUBIC METER	

ITEM NO. AND NAME	319 UNSTABLE MATERIAL IN CUT SLOPES	
UNIT OF MEASUREMENT:	-	
DESCRIPTION:	<p>Where unstable material is encountered in cut slopes, the Contractor shall inform the Engineer and if so directed by the Engineer, shall excavate the unstable material, cart it to spoil in a designated spoil area and replace it with suitable material.</p> <p>Removal of unstable soil shall be treated as part of roadway excavation and its replacement as part of embankment construction.</p>	
TYPICAL EQUIPMENT:	□ -	
MATERIALS:	Not Applicable	
WORK SPECIFICATION:		
-		
MEASUREMENT FOR PAYMENT:	-	

ITEM NO. AND NAME	320 CULVERT CLEANING
UNIT OF MEASUREMENT:	Lump sum
DESCRIPTION:	The task involves the cleaning of silt and other debris from pipe, box culverts and other enclosed drainage facilities including inlet and outlet headwall aprons. The work also involves the proper disposal of waste spoil. The work should normally be scheduled in conjunction with ditch clearing works to ensure that the pipe invert has free-flowing discharge. The Contractor should advise the RMF Engineer of any serious scour, undermining or structural damage that he comes across.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Dump Truck <input type="checkbox"/> Hand tools <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	Not Applicable
WORK SPECIFICATION: <ol style="list-style-type: none"> 1. Traffic warning signs shall be established 100 m on either side of the culvert road crossing. 2. Care should be taken before entering culverts to check for snakes or other hazards. 3. Whenever practical, cleaning works should start at the downstream end and proceed upstream. This is to enable any water seepage to discharge. 4. The condition of culvert structure shall be visually checked before labourers commence working inside the structure. Any obvious defects shall be reported to the RMF Engineer. 5. Where culverts are too small to allow entry, they shall be cleaned using long handled implements and/or drag-buckets on rope lines. 6. All cleared waste shall be disposed of neatly by spreading on the downstream side of the structure (where practicable) and at a location where it cannot wash back into any drainage ditch or other drainage facility. Where this cannot be achieved it shall be disposed of at approved dumps off site. 7. The operation shall include the careful removal of roots and other vegetation growth from cracks and joints in the culvert and headwall structures. 8. The completed work shall be checked visually by sighting from one end of the culvert to the other. The view shall be clear of all removable obstructions. 9. Culverts should not be cleaned in isolation. The downstream ditch outlet should be confirmed to be lower than the culvert floor and clear. Where this is not the case, the RMF Engineer must be informed so that necessary instructions may be issued as a separate work item. 10. Partially cleared culverts shall not be accepted for stage payment. 11. On completion of the works, the site shall be cleaned of all surplus materials 	

ITEM NO. AND NAME	320 CULVERT CLEANING
and waste, and left in a clean, tidy condition.	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The work shall be measured in lump sum of silt and other debris, measured in place before disturbing. The volume of debris to be cleared shall be computed and recorded from measurements or estimated dimensions before work commences. Payment will only be certified, after the full culvert length has been cleared. Unit rates shall be full compensation for all steps necessary to comply with the above, including all transport, handling, labour, materials and all incidentals to complete the work as specified. Any instructed work required to associated ditches, repairs to the structure, or backfill, shall be measured separately under an appropriate work Item.</p>	

ITEM NO. AND NAME	321 DRAIN CLEARING (LINED)
UNIT OF MEASUREMENT:	Lump sum
DESCRIPTION:	The task involves removing and disposal of silt, debris, vegetation and other waste or rubbish from drainage channels
TYPICAL EQUIPMENT:	<input type="checkbox"/> Dump Truck (occasional use) <input type="checkbox"/> Hand tools <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	Not Applicable
WORK SPECIFICATION: 12. Traffic warning signs shall be established at both ends of the work section. 13. Clearing shall commence at the outfall end and proceed upstream. 14. The Contractor shall take care not to damage or disturb the drain lining. Any avoidable damage shall be repaired at the Contractor's own cost to the satisfaction of the RMF Engineer. 15. The excavated material shall be collected and transported to dump areas sufficiently remote that in the opinion of the RMF Engineer it is impossible for it to wash into any drain or other drainage facility. The material shall be spread in neat, shallow bunds. Dump areas shall be at locations selected by the Contractor and approved by the RMF Engineer and shall not be closer than 5m to any drain. 16. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.	
MEASUREMENT FOR PAYMENT: The unit of measurement shall be completed lump sum of lined drain cleared. The unit rate shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.	

ITEM NO. AND NAME	328 Granular Material for Base Course																				
	<p>i) Granular material for use in base course construction shall be a naturally occurring wadi gravel.</p> <p>ii) Granular base material shall consist of hard, durable particles or fragments free from dirt or other objectionable matter, and shall contain not more than 8% of flat, elongated, soft, or disintegrated pieces.</p> <p>iv) Granular material for base course delivered to road site shall meet the requirements of Class A or Class B gradations as shown in Table 328-a when tested in accordance with AASHTO T 27 after mixing with water and just before spreading and prior to compacting. The Class of aggregate to be used shall be as shown on the Drawings or otherwise as selected by the Engineer. The actual gradation shall, in all cases, be continuous and smooth within the specified limits for each Class. Gap graded aggregate will not be accepted. If gradation is tested after compaction a tolerance of 3% is allowed in upper limit for percentage of material passing sieve 200</p> <p>Table 328-a: Gradation of Granular Base Course by Class</p> <table data-bbox="486 987 1321 1375"> <tr> <th>Sieve size mm</th><th>Grading</th></tr> <tr> <td>50</td><td>100</td></tr> <tr> <td>37.5</td><td>65-90</td></tr> <tr> <td>25</td><td>45-75</td></tr> <tr> <td>19</td><td>35-70</td></tr> <tr> <td>12.5</td><td>25-60</td></tr> <tr> <td>4.75</td><td>15-40</td></tr> <tr> <td>2.36</td><td>10-26</td></tr> <tr> <td>0.300</td><td>5-15</td></tr> <tr> <td>0.075</td><td>2-10</td></tr> </table> <p>vii) The amount of the fraction of material passing the No 200 mesh sieve shall not exceed one half the fraction passing the No. 40 mesh sieve.</p> <p>viii) The loss in weight shall not exceed 45% after 500 revolutions, when tested in accordance with AASHTO T 96 (Los Angeles Abrasion Test).</p> <p>ix) The granular base course material shall have a 4-day soaked CBR of not less than 80 when compacted at 98% of modified proctor AASHTO (T180-D) and tested in accordance with AASHTO T 193.</p> <p>x) When tested for soundness in accordance with AASHTO T 104, the material shall not show signs of disintegration and the loss by weight shall not exceed 12% in the case of the sodium sulphate test and 18% in the case of the magnesium sulphate test.</p> <p>xi) The portion of granular material passing the 0.425 mm (No. 40) mesh sieve shall have a liquid limit (L.L.) of not more than 25 and plasticity index (P.I) of not</p>	Sieve size mm	Grading	50	100	37.5	65-90	25	45-75	19	35-70	12.5	25-60	4.75	15-40	2.36	10-26	0.300	5-15	0.075	2-10
Sieve size mm	Grading																				
50	100																				
37.5	65-90																				
25	45-75																				
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12.5	25-60																				
4.75	15-40																				
2.36	10-26																				
0.300	5-15																				
0.075	2-10																				

	<p>more than 6 when tested in accordance with AASHTO T 89 and T 90.</p> <p>xii) If additional fine material is required to correct the granular material gradation, or for adjusting the L.L. or P.I. of the fraction passing the 0.425 mm (No. 40) sieve, it shall be uniformly blended and mixed with the aggregate material plant at the crushing plant or by an approved plant. Reworking of the material in situ to obtain the specified gradation will not be permitted. Additional fine material for these purposes shall be obtained from the crushing of stone, gravel, or natural material</p>
<u>Payment</u>	The payment shall be made on CUBIC METER

ITEM NO AND NAME	330 Sub-grade Preparation
	<p>Subgrade Preparation in Earth Cut</p> <p>The objective of this operation is to ensure that the subgrade and its foundation comprise suitable material and specified density, that it is compacted to the specification limits and that it is leveled, shaped and made to a condition fit for receiving subsequent pavement layers.</p> <p>For this purpose, the material in earth cut to be used as subgrade shall be tested for conformity to Clause 301.3. If found suitable, the surface shall be loosened to a depth of 200 mm as directed by the Engineer, the moisture content adjusted, shaped to the specified levels and crossfall, and compacted to the density specified in Clause 303 considering top 200 mm as subgrade.</p> <p>If the material is found unsuitable, the same shall be sub-excavated to a depth of 200 mm or as ordered by the Engineer, replaced by suitable material to Clause 301.3 and compacted to the specified degree.</p> <p>Where a strata of boulder mixed with soil is met with, the same shall be sub-excavated to a depth of 200 mm and replaced by suitable subgrade material.</p> <p>Subgrade Preparation in Rock Cut</p> <p>Where the rock is met with over the full width of the formation, the same shall be sub-excavated to a depth of 100 mm below the subgrade level with a positive tolerance of 10 mm and negative tolerance of 30 mm.</p> <p>If any dish-shaped cavities result from the Contractor's operations that might accumulate water, the same shall be filled up with Class "C" concrete.</p> <p>After checking the levels and crossfall, a layer of selected subgrade material shall be applied to an average thickness of 100 mm, shaped and compacted to 95 percent MDD.</p> <p>Where rock occurs in part width of the formation, the whole width shall be sub-excavated to a depth of 100 mm and replaced with a layer of selected subgrade material.</p>
<u>Payment</u>	No payment (Included in Other Rates)

ITEM NO AND NAME	331 Construction Sub-grade
	<p>Subgrade shall be shaped to line, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed.</p> <p>Low areas resulting from removal of unsatisfactory material shall be brought up to required grade with satisfactory materials, and the entire surged shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 10 millimetre when tested with a 3.00 meter straightedge applied both parallel and at right angles to the centreline of the area. The elevation of the finish subgrade shall not vary more than 15 mm from the established grade and cross section.</p> <p>Compaction</p> <p>Compaction shall be accomplished by pneumatic – tired rollers, steel – wheeled rollers, vibratory compactors, or other approved equipment. Subgrade for pavements shall be compacted to at least 90-percentage laboratory maximum density for the depth below the surface of the pavement shown.</p> <p>Testing</p> <p>Testing shall be performed by an approved commercial testing laboratory or by the contractor facility subject to approval. If the contractor elects to establish testing facilities, no work requiring testing shall be permitted until the contractor's facilities have been inspected and approved by the Engineer. Cost incurred for any inspections required will be charged to the contractor. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2162. When test results indicate, as determined by the Engineer, that compaction is not as specified, the material shall be removed, replaced and compacted to meet specification requirements. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.</p> <p>Fill and backfill material gradation</p> <p>One test per 500 cubic meters stockpiled or in-place source material.</p> <p>Gradation of fill and backfill material shall be determined in accordance with ASTM C 136, ASTM D 422, or ASTM D 1140.</p> <p>In-Place Densities</p> <p>One test per 300 square meters, or fraction thereof, of each lift of fill or backfill areas compacted machines.</p> <p>One test per 50 linear meters, or fraction thereof, of each lift of embankment or backfill for roads.</p>

	<p>Moisture Contents In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Engineer.</p> <p>Optimum Moisture and laboratory maximum Density Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.</p> <p>Subgrade and Embankment Protection The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the traffic or other operation and shall be protected and maintained by the contractor in a satisfactory condition until ballast, subbase, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, or spongy, subgrade</p>
<u>Payment</u>	The payment shall be made on CUBIC METER

Materials Suitable for Fills

It is incumbent on the Contractor to make use in the construction of embankment and subgrade all the available suitable materials from highway excavation prior to resorting to borrow excavation. The following materials shall be considered suitable.

- i) Ordinary fill material complying with the following characteristics shall be used in embankment below subgrade level
 - Liquid limit shall not exceed 55 (AASHTO: T.90)
 - P.I. shall not exceed 25 (AASHTO - T.90)
 - Maximum laboratory dry density shall not be less than 1.60 gm/cm³ (AASHTO: T.180)
 - 4-day soaked CBR shall not be less than 8% (AASHTO: T193) at 90% MDD
- ii) Selected subgrade material for the top 20 cm of the embankment constituting the subgrade layer, or to depths as designated in the Drawings shall comply with the following characteristics:
 - Liquid limit shall not exceed 35 (AASHTO: T.90)
 - P.I. shall not exceed 12 (AASHTO: T.90)

- Maximum laboratory dry density shall not be less than 1.80 gm/cm³ (AASHTO: T.180)
- 4-day soaked CBR shall not be less than 12% (AASHTO: T.193) at 95% of MDD
- Maximum size of particles in soil shall not exceed 100 mm, and the large particles of over 50 mm size shall not constitute more than 25% of the total volume of the material.

Prior to start of earthwork operations, the Contractor shall, based on identification of the classification of the material met with at different locations, prepare a mass-haul diagram and submit the same to the Engineer for approval. This is intended for helping the Contractor in planning the earthwork activities, and the declaration of the Engineer whether the material from any location is suitable or not shall be based only on the results of the requisite tests.

Before commencing excavation work on any section of the road, the Contractor shall ensure that he has adequate instructions concerning the use of suitable excavated material.

Where excavation reveals a combination of suitable and unsuitable materials, the Contractor shall as far as possible and to the satisfaction of the Engineer carry out the excavation operations in such a manner that suitable material are excavated separately for use in the works without contamination by unsuitable materials.

Construction Requirements

General

All excavations shall be carried out to the widths, depths and side slopes shown on the Drawings or as directed by the Engineer. The work shall be so planned and executed that the suitable materials available from excavation are satisfactorily utilised in fills.

The Contractor shall not excavate outside the slopes or below the established grade line, or loosen any material outside the limits of excavation. Subject to the permitted tolerances, any excess depth excavated below the specified levels shall be made good by the contractor at his own expense, with suitable material as defined in these specifications and compacted to the density standard required at that level.

Dewatering

During construction of the roadway, the roadbed shall be maintained in such a condition that it will be well-drained at all times. In order that the embankment, subgrade, sub-base and/or base may not be subject to wetting, during or after construction, the Contractor shall at all times, and especially at an early stage of the work be required to provide adequate drainage by scheduling ditch work and outlet construction so as to prevent such wetting. The Contractor shall clean and trim all such drainage ditches from time to time during the work or when directed by the Engineer, so that there may be a free water flow throughout the whole time of work. Damage attributable to wetting through failure to provide such measures shall be immediately repaired by the Contractor at his own expense.

Blasting

Blasting shall be carried out in strict accordance with the latest Government Regulations. For handling explosives and blasting, the Contractor shall employ only men experienced in blasting and these men must be in possession of an approved current Blasting Certificate. The purchase, transport, storage and use of explosives shall be carried out in accordance with the Government Rules and Regulations and recognised good blasting practice. For use of explosives, the Contractor shall obtain the written permission of the Engineer for each location. If blasting is considered dangerous in any situation, the Engineer's decision in this regard shall be final. Notwithstanding any approval for blasting given by the Engineer, the Contractor shall be solely responsible for any damage resulting from the blasting operations and to any claims that may arise therefrom.

Where necessary and/or as directed by the Engineer, the Contractor shall provide heavy mesh blasting mats for protection of persons, properties and the Work. Blasting shall be restricted to the hours prescribed by the local authorities or the Engineer. If in the opinion of the authorities, and/or Engineer, blasting would be dangerous to persons or adjacent structures, or is being carried out in a reckless manner, the Engineer may prohibit it and order the rock to be excavated by other means.

If traffic on the road must be interrupted because of the blasting operation, the Contractor shall secure approval from the concerned authorities for his schedule for such interruption and his method for safeguarding the public and property, and shall satisfy the Engineer as to such approval.

Excessive blasting shall not be permitted. No payment for overbreak of any kind shall be made. The Contractor at his own expense shall remove any material outside the approved cross section limits that may be shattered or loosened because of blasting. All rock slopes shall be hand-scaled and the loose material removed.

Slips

During excavation, the Contractor shall limit vertical and other temporary faces to such heights as are suitable to the nature of the soil exposed. If slips, slides or subsidence occur during the process of construction and extend below the specified lines/levels, the excess excavation shall be at the Contractor's own expense and he shall make good in a manner satisfactory to the Engineer. If the slopes finished in accordance with the Drawings or as directed by the Engineer slide into the roadway subsequently, such slides shall be removed and paid for at the Contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

Tolerance for Excavation

- a) For excavation at the subgrade level, the permissible tolerance shall be (+) 10 mm and (-) 30 mm with respect to the levels shown on the Drawings or ordered by the Engineer.
- b) For cut slopes, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope except in the case of rock where the corresponding tolerance shall be 300 mm.

400 SUBBASE, BASE AND SHOULDER

- 401 GRANULAR SUBBASE AND CRUSHED STONE BASE**
- 402 CLASSIFICATION OF MATERIAL**
- 403 SETTING-OUT AND TOLERANCES**
- 404 DRAINAGE OF SUBBASE AND BASELAYERS**
- 405 GRAVEL WORK**
- 406 MATERIAL REQUIREMENTS**
- 407 CONSTRUCTION OF GRAVEL SHOULDER**
- 408 TOLERANCES**
- 409 Spot Repair Gravel Road**
- 410 Grade Gravel Road (Light)**
- 411 Grade Gravel Road (Heavy)**
- 412 Localised Regravelling**

ITEM NO. AND NAME	401 GRANULAR SUBBASE AND CRUSHED STONE BASE
UNIT OF MEASUREMENT:	CUBIC METER
DESCRIPTION:	<p>(a) Definition The term "natural material" shall include but not be limited to gravel, soft stone, sandy soils or a combination of any of these materials. A natural material is also referred to as "gravel" as a generalized term. Materials for subbase may be obtained directly from natural material sources or otherwise modified by crushing and/or screening, washing and recombining in appropriate proportions.</p> <p>"Graded crushed stone aggregates" means natural stone aggregates crushed from larger size stones with a smooth grading curve which is within a specified envelope. Materials for base shall be graded crushed stone aggregates.</p> <p>(b) Sources of materials Material for subbase and base may be obtained from the following sources: (i) quarries, (ii) borrow areas (iii) excavation in cuttings, widened if necessary,</p> <p>In all cases the Contractor shall locate the sources of material to be used, sources shall be subject to the Engineer's approval.</p> <p>(c) Inspection of Site The Contractor shall satisfy him self as to the adequacy of those sources of material available for inspection during the Tender Period in respect of but not limited to:</p> <ul style="list-style-type: none"> • the amount of overburden to be removed, • the ease with which the material can be removed, • the quality and hardness of the material, • the physical and chemical properties of the material, • the degree of selection necessary, • the proportion of oversize material, • the method of extraction, • the method of processing the material, • the access to the source. <p>(d) Quarries and borrow areas The Contractor shall comply with all national laws and regulations and the requirements of Section 300 of this Specification in respect of quarries, borrow areas and stockpile areas and access roads thereto.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable

ITEM NO. AND NAME	401 GRANULAR SUBBASE AND CRUSHED STONE BASE
WORK SPECIFICATION: -	
MEASUREMENT FOR PAYMENT: <p>The unit of measurement for subbase shall be the cubic metre placed and compacted upon the road as shown on the Drawings and as directed by the Engineer. The volume shall be calculated as the product of the compacted sectional area specified to be laid and the length instructed.</p> <p>No separate measurement or payment shall be made in respect of overhaul.</p> <p>The rate for subbase shall include for the costs of:</p> <ul style="list-style-type: none"> • site clearance of borrow areas, stockpile areas, processing areas and access tracks thereto, • removing and stockpiling separately as required topsoil and overburden from such areas and access tracks thereto, • drainage of such areas and access tracks and their landscaping, top soiling and reinstatement on completion, • borrow • area fencing, • constructing and maintaining access roads and complying with conditions of access, • traffic control, safety and public health requirements, • excavation and selection of material, • processing and modifying the natural gravel/aggregates for compliance with this Specification including any plasticity modifying agents • trial/test patch preparation • removal and disposal of oversize material, if any, • excavation of existing pavement layers and temporary stockpiling of material, • double handling and stockpiling material, • loading, transporting and dumping the stockpiled material, • all necessary hauls of cement, aggregate and water including their properties testing • providing and mixing water or drying out the material, • mixing and processing, including normal grid rolling, spreading and compacting the material, during initial stage and microcracking stage • providing and admixing of fines if necessary, • brooming, making good defective areas and maintenance of the surface, and, water curing including bituminous membrane laying for curing • complying with the requirements of Sections 100, and 1100 of this Specification, 	

ITEM NO. AND NAME	402 CLASSIFICATION OF MATERIAL
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>Natural material for subbase shall be material that can be extracted from a quarry, borrow area or a road cutting using excavating equipment without blasting.</p> <p>Graded crushed stone aggregate shall be extracted from a rock quarry and produced by crushing in at least two stages. The stone class shall be as specified or as instructed by the Engineer and the material to be crushed shall be naturally occurring rock or boulders of individual least dimension 100 mm or larger.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION: -	
MEASUREMENT FOR PAYMENT: -	

ITEM NO. AND NAME	403 SETTING-OUT AND TOLERANCES
UNIT OF MEASUREMENT:	-
DESCRIPTION:	Subbase and base layers shall be set out and constructed to the appropriate tolerances specified in Section 100 and 1100 of this Specification.
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	-
MEASUREMENT FOR PAYMENT:	-

ITEM NO. AND NAME	404 DRAINAGE OF SUBBASE AND BASE LAYERS
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The subbase and base shall be kept continuously drained and any damage caused by water accumulating on or running off the surface shall be made good at the Contractor's expense. In particular, the drainage requirements of Section 100 and this section shall apply.</p> <p>Should water accumulate on any part of the non-frost subgrade, subbase or base the Contractor shall remove and dispose of any material that becomes saturated or cannot then be compacted to the required density, and shall replace it with material complying with this Specification, all at his own expense.</p>
TYPICAL EQUIPMENT:	□ -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	
-	
MEASUREMENT FOR PAYMENT:	
-	

ITEM NO. AND NAME	405 GRAVEL WORK
UNIT OF MEASUREMENT:	-
DESCRIPTION:	<p>The term 'gravel' used means naturally occurring granular material and shall include natural gravel, crushed gravel and crushed rock.</p> <p>A "gravel shoulders" means a granular surfacing course constructed from one or a combination of these materials placed on a prepared and approved subbase for the purpose of protecting the edges of pavement.</p> <p>Gravel materials may be obtained directly from natural material sources or otherwise modified by crushing and/or screening, washing and and blenders in appropriate proportions.</p> <p>The Contractor shall comply with all national laws and regulations and the requirements of Section 300 of this Specification in respect of natural sources and stockpile areas and access roads thereto.</p>
TYPICAL EQUIPMENT:	<input type="checkbox"/> -
MATERIALS:	Not Applicable
WORK SPECIFICATION:	-
MEASUREMENT FOR PAYMENT:	-

ITEM NO. AND NAME	406 MATERIAL REQUIREMENTS																														
UNIT OF MEASUREMENT:	-																														
DESCRIPTION:	<p>The grading of gravel after placing and compaction shall be a smooth curve within and approximately parallel to the envelopes shown in Table 4-3. Grading B shall be used for forming the top 100 mm thick of the gravel shoulders or gravel surfacing and Grading A shall be used for forming the lower remaining thickness of the gravel shoulders or gravel surfacing. The exact designated thickness of the top and lower layer shall be indicated by the Engineer. Provided further that the Engineer at his discretion can omit the Grading A where the total gravel shoulders or gravel surfacing thickness in 200 mm or less. The Engineer can also omit the Grading B where the gravel shoulders is proposed to be laid with Grading A material and overlaid with base material. The grading shall be required to satisfy when the material after compaction is sieved and found to fall in the grading envelope.</p> <p>Table 4-3 Gradation Requirements for Gravel Shoulders and Gravel Surfacing</p> <table><tr><th rowspan="3">Sieve Size</th><th colspan="2">Mass Percent Passing</th></tr><tr><th colspan="2">Grading</th></tr><tr><th>A</th><th>B</th></tr><tr><td>37.5 mm</td><td>100</td><td>-</td></tr><tr><td>19.0 mm</td><td>95 – 100</td><td>100</td></tr><tr><td>9.5 mm</td><td>60 – 90</td><td>80 – 100</td></tr><tr><td>4.75 mm</td><td>40 – 70</td><td>60 – 75</td></tr><tr><td>2.36 mm</td><td>25 – 50</td><td>35 – 55</td></tr><tr><td>425 µm</td><td>15 – 35</td><td>18 – 27</td></tr><tr><td>75 µm</td><td>5 – 20</td><td>10 – 15</td></tr></table> <p>Material for gravel shoulders or surfacing shall have a minimum CBR of 60% at 98% MDD (AASHTO T180) and 4 days soaking. The Plasticity Index of the material shall lie within the range of 3 - 7%.</p>			Sieve Size	Mass Percent Passing		Grading		A	B	37.5 mm	100	-	19.0 mm	95 – 100	100	9.5 mm	60 – 90	80 – 100	4.75 mm	40 – 70	60 – 75	2.36 mm	25 – 50	35 – 55	425 µm	15 – 35	18 – 27	75 µm	5 – 20	10 – 15
Sieve Size	Mass Percent Passing																														
	Grading																														
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75 µm	5 – 20	10 – 15																													
TYPICAL EQUIPMENT:	□ -																														
MATERIALS:	Not Applicable																														
WORK SPECIFICATION:	-																														
MEASUREMENT FOR PAYMENT:	-																														

500 Bituminous Pavement Works

- 501 Pothole Reinstatement (Cold Mix)**
- 502 Pothole Repair – Plant Mix Asphalt**
- 503 Pothole Repair – Site Mixed Asphalt**
- 504 Pothole Repair – Stabilised Base Material**
- 505 Repair Edge Breaks – Asphalt**
- 506 Seal Coat**
- 507 Crack Sealing**
- 508 Base Failure Repair – Selected Material**
- 509 Base Failure Repair – Crushed Aggregate**
- 510 ASPHALT CONSTRUCTION**
 - 510.1 Rapid-Curing (RC) Cutback Bitumen**
 - 510.2 Medium-Curing (MC) Cutback Bitumen**
- 511 Removal OF Asphalt With Disposal,transportation and Bed Preparation**
- 512 Removal OF (Asphalt+ Base) With Disposal, transportation and Bed Prepration**
- 513 Repair existing granular base course by scarifying and adding Selected material**
- 514 Repair asphalt layer 50 mm thick At failure locations**
- 515 ASPHALT MILLING**

ITEM NO. AND NAME	501 POTHOLE REINSTATEMENT - COLD MIX
UNIT OF MEASUREMENT:	SQUARE METER FOR Potholes and Failure Repairs < 25 square meter Area CUBIC METER FOR Potholes and Failure Repairs > 25 square meter Area
DESCRIPTION:	<p>The task involves the temporary reinstatement of isolated potholes (up to 100 mm in depth) that have formed in the surface of an asphalt or surface dressed pavement. The intention is to facilitate a rapid efficient repair to return the road to a safe trafficable condition and to prevent the pothole from continuing to grow in size. The intention is that such temporary repairs may be programmed for subsequent permanent reinstatement. In conjunction with other works. However, in certain situations or where traffic is light, the reinstatement may perform adequately as a permanent repair.</p> <p>The repair involves the removal of failed material, preparation of the hole, application of tack/prime coat and cut back bitumen to the cut faces. Backfill is made using cold premix asphalt manufactured to recipe using a pug-mill or concrete mixer and mechanically compacted to achieve a smooth, even road surface.</p>
TYPICAL EQUIPMENT:	<p>Off-Site Premix Production:</p> <ul style="list-style-type: none"> ❑ Bitumen kettle; ❑ Concrete mixer (small works) or; ❑ 'Spot-mixer'/'Pug-mill' (larger works). <p>On-Site Works Performance:</p> <ul style="list-style-type: none"> ❑ Dump truck + trailer; ❑ Hand breakers; ❑ Hand Rammers and vibrating plate compactor; ❑ Small tools inc: brushes, shovels, rakes, wheelbarrows, etc.; ❑ Road signage in accordance with Item 101.

ITEM NO. AND NAME	501 POTHOLE REINSTATEMENT - COLD MIX
MATERIALS:	<p>Bituminous binder for the premix shall be MC3000 cut-back bitumen.</p> <p>Coarse aggregate shall be crushed and consist of clean, hard durable rock fragments of which not less than 75% by mass shall have two or more crushed faces.</p> <p>Sand shall consist of clean, hard natural or crushed rock sand free from lumps, clay, mica and foreign matter.</p> <p>Filler (when required to achieve the specified grading) shall be crushed rock fines, Ordinary Portland Cement or hydrated lime.</p> <p>Tack coat for painting the joints shall be quick breaking spray grade bitumen emulsion (containing not less than 60% bitumen).</p>

ITEM NO. AND NAME	501 POTHOLE REINSTATEMENT - COLD MIX																
<p>WORK SPECIFICATION:</p> <p>Part A – Materials Production</p> <ol style="list-style-type: none"> 1. Cold premix is manufactured off-site in advance and stocked ready for use. 2. The Contractor shall supply an aggregate recipe based on laboratory sieve analysis of the constituent materials and of the blend, for consent by the RMF Engineer. The recipe shall state relative volumetric mix proportions for each mineral ingredient used. 3. All constituent materials shall be stored in separate stockpiles on a dry base and shall be protected from rain. Materials that have become wet shall be allowed to become entirely dry before mixing (unless a heater/drier is to be used). 4. Mixing must normally be performed using a mechanical mixer. A pug-mill mixer such as an 'asphalt spot-mix' unit is preferred. For small quantity work, mixing may be performed in a concrete mixer, providing the Contractor can demonstrate total coverage of aggregate using the specified quantity of bitumen, without segregation, or 'balling' of fine aggregates. 5. The required gradation of blended aggregates shall be as follows: <table data-bbox="451 1025 1283 1523"> <tr> <th colspan="2">14 mm nominal size</th></tr> <tr> <th>BS sieve (mm)</th><th>% passing</th></tr> <tr> <td>20</td><td>100</td></tr> <tr> <td>14</td><td>90-100</td></tr> <tr> <td>10</td><td>55-75</td></tr> <tr> <td>6.3</td><td>25-45</td></tr> <tr> <td>3.35</td><td>15-25</td></tr> <tr> <td>.075</td><td>2-6</td></tr> </table> <p>Source: TRL Overseas Road Note 2 (2nd Edition)</p> 6. Volume gauge boxes shall be used to ensure the correct proportions of constituent aggregates are mixed. 7. Bitumen content shall be in the 4-5% (by weight) of the total mix. The exact quantity shall be determined by trials. 8. MC3000 shall be preheated and applied to the aggregate at a temperature of 80 – 110 deg. C. Where an aggregate heater is used in conjunction with a 'pug-mill' mixer, aggregates shall normally be preheated to approximately 65 °C. 9. Heated MC3000 shall normally be fed to the mixing unit by means of a pump and spray lance. The quantity shall be controlled by timing the duration of application. The RMF Engineer may permit addition using a calibrated 		14 mm nominal size		BS sieve (mm)	% passing	20	100	14	90-100	10	55-75	6.3	25-45	3.35	15-25	.075	2-6
14 mm nominal size																	
BS sieve (mm)	% passing																
20	100																
14	90-100																
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6.3	25-45																
3.35	15-25																
.075	2-6																

ITEM NO. AND NAME	501 POTHOLE REINSTATEMENT - COLD MIX
<p>measuring vessel provided that the quality of the resulting mix is not compromised.</p> <p>10. Mixing shall be continued until a mixture is produced in which the bitumen is evenly distributed and all the aggregate is surface coated.</p> <p>11. If difficulties are encountered in achieving a homogeneous, workable mix, the RMF Engineer may authorise the addition of small quantities of kerosene to the MC3000 to decrease its viscosity. In such instances, the amount shall be carefully controlled and shall be in addition to the required quantity of MC3000 and not as a substitute. Additional fire precautions shall also be employed which shall include the mandatory presence of fire extinguishers and a ban on smoking.</p> <p>12. The mixed material shall be stockpiled in the shade under a rainproof cover on a dust free solid surface (e.g. concrete floor). It should be produced only in such quantities that will be used within 1 month of mixing. Alternatively, for small quantities, the material may be bagged in polythene fertiliser bags with the necks sealed by tying for longer storage.</p> <p>13. Cold-mix should normally be used within 1 month of production unless the performance of older material has been satisfactorily demonstrated to the RMF Engineer.</p> <p>14. The Contractor is expected to maintain a reasonable stock of ready cold-mix in all cases where an anticipated need has been agreed with the RMF Engineer.</p>	
<p>Part B – Work Performance</p> <p>15. Traffic management shall be established, maintained and subsequently removed in accordance with Item 101.</p> <p>16. The repair shall be marked out in a rectangular shape. This shall extend beyond the edge of the damaged surface by 100 mm minimum at all points.</p> <p>17. The edge of the repair shall be cut with a uniform face sloping inward at 60 degrees to the horizontal, using a mechanical breaker and/or hand chisel.</p> <p>18. Pavement material shall be broken up with the aid of a breaker/hand-chisel and removed from site. Care shall be taken not to disturb the edges or underlying material.</p> <p>19. The hole shall be brought to a clean, dry, dust-free condition before proceeding.</p> <p>20. The sides of the hole and base shall be painted with bitumen emulsion.</p> <p>21. The asphalt shall be placed and levelled in lifts of 30 – 70 mm (compacted thickness) and compacted using hand rammer. Compaction shall continue until there is no discernable settlement between successive blows. The top surface of the repair shall be compacted by plate compactor or small roller.</p> <p>22. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p>	

ITEM NO. AND NAME	501 POTHOLE REINSTATEMENT - COLD MIX
<p>MEASUREMENT FOR PAYMENT:</p> <p>The work for payment shall be measured in:</p> <p>SQUARE METER FOR Potholes and Failure Repairs < 25 square meter Area</p> <p>CUBIC METER FOR Potholes and Failure Repairs > 25 square meter Area</p> <p>of compacted cold mix material accepted in the repair. The quantity shall be computed based on the surface area and the specified thickness. Physical measurements of average length, breadth and depth shall be recorded. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified. There shall be no adjustment to the rates paid on account of any necessary adjustments in the cold-mix recipe proportions. No payment for materials on site will normally be made in respect of mixed material held in stockpile.</p> <p>The Schedule of Rates may include separate pay items depending on the quantity of work instructed by a single Works Order.</p>	

ITEM NO. AND NAME	502 POTHOLE REPAIR – PLANT MIX ASPHALT
UNIT OF MEASUREMENT:	SQUARE METER FOR Potholes and Failure Repairs < 25 square meter Area CUBIC METER FOR Potholes and Failure Repairs > 25 square meter Area
DESCRIPTION:	<p>The works comprise the permanent repair of existing potholes in paved roads, or reinstatement of previous temporary repairs, using hot-mix asphalt produced at a central batching plant to an approved recipe. To ensure the proper performance of the completed repair, the asphalt is required to be placed and compacted under strict limits of material temperature. Where distance from production plants make the attainment of these requirements impracticable, consideration should be given to other repair options</p>
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> ❑ Dump Truck (Small); ❑ Pedestrian roller (0.75 to 1.25 tonnes) or vibrating plate; ❑ Small tools inc: brushes, shovels, rakes, wheelbarrows, watering cans etc.; ❑ Road signage in accordance with Item 101.
MATERIALS:	<p>Hot-mix Asphalt shall be a continuously Graded (Medium) asphalt surfacing using 60/70 penetration grade bitumen and designed in accordance with the requirements of Technical Specification for Rehabilitation and Maintenance. In certain situations the Employer may permit the use of standard recipe mix designs or alternative approved specifications, but only where sufficient test data and records of field performance confirm suitability.</p> <p>Prime coat to unbound bases shall be MC- 70</p> <p>Tack coat for joints shall be RC-250 or heated penetration grade bitumen.</p>
WORK SPECIFICATION: Part A – Materials Production 1. Production of hot-mix asphalt shall be in accordance with the relevant articles of the above specification. Part B – Work Performance 2. Traffic management shall be established, maintained and subsequently removed in accordance with Item 101. 3. Only those potholes that will be completely repaired on the same day shall be opened for reinstatement. On no account shall partially completed work be left	

ITEM NO. AND NAME	502 POTHOLE REPAIR – PLANT MIX ASPHALT
<p>overnight.</p> <ol style="list-style-type: none"> 4. The repair shall be marked out in a rectangular shape. This shall extend beyond the edge of the damaged surface by 100 mm minimum at all points. The dimensions shall also be sufficient to accommodate the choice of compaction equipment (assuming more than one layer of reinstatement). 5. The existing surfacing shall be cut using appropriate hand or mechanical cutters to produce a neat, straight cut around the repair with a uniform face sloping inward at 60 degrees to the horizontal. Cut lines shall meet but not cross. 6. All unsound pavement material shall be broken up to at least the minimum depth specified in the Works Order and removed from site. Care shall be taken not to disturb the edges or underlying material. 7. In the case of deep potholes affecting more than one layer of bituminous material, a horizontal step of at least 50 mm shall be formed between layers. 8. If the base of the hole is unbound material it shall be lightly watered and re-compacted by mechanical plate or power rammer. Only in the case of very small repairs which cannot accommodate the size of such equipment will hand ramming be permitted. 9. The hole shall be brought to a clean, dry, dust-free condition before proceeding. 10. Prime or tack coat (unbound/asphaltic bases respectively) shall be brush/spray applied at a uniform rate to give even coverage without pools forming. It shall be allowed to soak in or cure until surface-dry. The grade and dilution shall be selected to enable rapid work progression. 11. The prepared sides of the hole shall be painted with undiluted emulsion or heated penetration grade bitumen. 12. On no account shall the hole be marked or protected by rocks or other hazardous object. 13. Hot-mix asphalt shall be delivered to the site in covered trucks at such times and in quantities such that at all times prior to placing, the material is maintained in the temperature range 125 to 155 °C. The Contractor must provide operational thermometers on site at all times which shall be available for use by the RMF Engineer if so requested. The RMF Engineer shall have full authority to reject material outside this temperature range. 14. Hot-mix asphalt shall be shovelled directly into the hole working from the edges toward the centre. Material shall not be heaped. The layer shall be levelled by hand raking taking precautions to avoid segregation. 15. Compaction shall commence as soon as practicable and always before the mix temperature falls below 95 °C. 16. The asphalt shall be compacted in lifts not exceeding 50 mm (compacted thickness) using mechanical equipment (roller, plate or power rammer depending on hole size). Compaction must be fully achieved along all edges and into corners. Compaction shall continue until there is no discernable 	

ITEM NO. AND NAME	502 POTHOLE REPAIR – PLANT MIX ASPHALT
	<p>settlement between successive passes (typically 6 passes required). The compactor's surface may be lightly watered as necessary to prevent asphalt from sticking to it.</p> <p>17. The number and thickness of lifts shall be adjusted such that a final layer of 20 – 50 mm is required. The patch area must be surcharged with loose asphalt material so that after compaction the surface is flush (or marginally proud) with the surrounding pavement. Any loose asphalt spilt onto the surrounding pavement shall be removed prior to compaction works starting.</p> <p>18. For the final layer, compaction will start along one edge with the roller or plate on the existing pavement with not more than 150 mm extending into the reinstatement. The same shall follow on the opposite joint. Remaining compaction shall be carried out at right angles to the compacted edges with each pass gradually moving further into the patch. On a grade or camber, compaction should proceed from the low end.</p> <p>19. The finished patch shall be checked for level and smoothness with a straight edge or string-line. If the surface of the patch (at any point) is lower than the surrounding pavement it will be rejected and the repair removed and discarded whilst it is still warm. On no account shall the level of the patch be made up by the addition of fine material. A patch between 0 – 5 mm high is acceptable. Above this, an attempt may be made to compact it further, failing which the repair shall be rejected.</p> <p>20. The patch shall be allowed to cool before opening to traffic. It may be warm to touch but not uncomfortably hot.</p> <p>21. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p> <p>22. The repaired area shall be rectangular. The edges of the completed surfacing shall not be above the existing surface by more than 3 mm. The edges or any part of the repaired area shall not be below the surrounding road surface. The thickness of the asphalt surfacing at any point shall be 50 mm \pm 10 mm. The cross fall of the completed area shall be equal to that of the adjacent surface to within a tolerance of $\pm 0.5\%$ cross fall. When tested with a 3 m straight edge laid parallel to or at right angles to the road centreline, the surface of the area shall not deviate from the bottom of the straight edge by more than 5 mm.</p>

ITEM NO. AND NAME	502 POTHOLE REPAIR – PLANT MIX ASPHALT
<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in :</p> <p>SQUARE METER FOR Potholes and Failure Repairs < 25 square meter Area</p> <p>Unit of measurement as indicate in bill of quantity FOR Potholes and Failure Repairs > 25 square meter Area</p> <p>of asphalt surfacing material, accepted in place, after compaction. Physical measurements of average length, breadth and average thickness shall be recorded. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified. There shall be no adjustment to the rates paid on account of any necessary adjustment in the recipe mix proportions. Where the job requires the prior reinstatement of lower unbound layers with unbound aggregate base, this shall be performed and measured separately under Item 608 or 609.</p> <p>The Schedule of Rates may include separate pay items depending on the quantity of work instructed by a single Works Order.</p> <p>There shall be two subcategories of this Item for payment purposes:</p> <p>502a Pothole Repair – Plant Mix Asphalt: 20 mm to 50 mm thick</p> <p>502b Pothole repair – Plant Mix Asphalt: 50 mm to 100 mm thick</p> <p>Only one category shall apply to a single pothole which shall be determined based on averaged thickness.</p>	

ITEM NO. AND NAME	504 POTHOLE REPAIR – STABILISED BASE MATERIAL
UNIT OF MEASUREMENT:	SQUARE METER FOR Potholes and Failure Repairs < 25 square meter Area CUBIC METER FOR Potholes and Failure Repairs > 25 square meter Area
DESCRIPTION:	<p>The works comprise the permanent repair of existing potholes in paved roads, or reinstatement of temporary repairs, using stabilised aggregate base materials. The minimum thickness of stabilised base repair is 85 mm. This method is particularly suitable where a low number of repairs or site location make the use of hot mix asphalt inappropriate.</p> <p>Due to the relatively open texture of the repair it should normally be finished with a slurry seal performed separately under Item 606.</p>
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> ❑ Dump Truck (Small); ❑ Concrete Mixer; ❑ Pedestrian roller (0.75 to 1.25 tonnes) or vibrating plate; ❑ Small tools inc: brushes, shovels, rakes, wheelbarrows, watering cans etc.; ❑ Road signage in accordance with Item 101.

ITEM NO. AND NAME	504 POTHOLE REPAIR – STABILISED BASE MATERIAL																													
MATERIALS:	<p>60% stable grade anionic bitumen emulsion (suitably diluted).</p> <p>Ordinary Portland Cement.</p> <p>Crushed stone base material complying with the following specification. The source of base material must be approved by the Employer prior to the works proceeding.</p> <p>Aggregate road-base shall satisfy one of the following gradings:</p> <table><tr><th rowspan="2">BS test sieve (mm)</th><th colspan="2">Percentage Passing (by mass)</th></tr><tr><th>37.5 mm</th><th>26.5 mm</th></tr><tr><td>37.5</td><td>100</td><td>100</td></tr><tr><td>26.5</td><td>84 – 94</td><td>100</td></tr><tr><td>19</td><td>71 – 84</td><td>85 – 95</td></tr><tr><td>13.2</td><td>59 – 75</td><td>71 – 84</td></tr><tr><td>4.75</td><td>36 – 53</td><td>42 – 60</td></tr><tr><td>2</td><td>23 – 40</td><td>27 – 45</td></tr><tr><td>0.425</td><td>11 – 24</td><td>13 – 27</td></tr><tr><td>0.075</td><td>4 – 12</td><td>5 – 12</td></tr></table> <p>Aggregate road base material shall also comply with the following:</p> <ul style="list-style-type: none">❑ The maximum Flakiness Index for any size of coarse aggregate shall be 35.❑ The minimum ‘Ten Per Cent Fines Test’ result shall be 110KN (dry test).❑ The material shall have a soaked CBR (Modified AASHTO, 4-day soaked value at 98% MDD) of not be less than 80%.❑ At least 50% by mass of material on each standard sieve of 5 mm or larger shall have at least one fractured face.❑ The fines (passing 0.425 mm) of these materials shall have a Liquid Limit not exceeding 25% and a Plasticity Index not exceeding 6%.	BS test sieve (mm)	Percentage Passing (by mass)		37.5 mm	26.5 mm	37.5	100	100	26.5	84 – 94	100	19	71 – 84	85 – 95	13.2	59 – 75	71 – 84	4.75	36 – 53	42 – 60	2	23 – 40	27 – 45	0.425	11 – 24	13 – 27	0.075	4 – 12	5 – 12
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0.075	4 – 12	5 – 12																												

ITEM NO. AND NAME	504 POTHOLE REPAIR – STABILISED BASE MATERIAL
<p>WORK SPECIFICATION:</p> <p>Part A – Materials Production</p> <ol style="list-style-type: none"> 1. The preparation of stabilised base material shall be carried out only after the pothole has been prepared and is ready for reinstatement. It shall be mixed only in quantities that can be immediately used. A density of approximately 2.1 Kg/litre for compacted material may be assumed for quantity estimation purposes. 2. Prior to commencing any work the Contractor shall calculate appropriate batch sizes. Volumetric boxes and containers shall be identified and marked for accurately batching the correct proportions (aggregates, bitumen and cement). 3. The measured aggregate shall be placed in the mixer drum to which Ordinary Portland Cement shall be added at the rate of 1% by mass (of the dry aggregate) and mixed. It shall then be gradually moistened with the mixer running until slightly damp in appearance without any excess surface water. 4. Emulsion (60% anionic stable grade) shall then be added at the rate of 2% by mass. 5. Further water shall then be gradually added until a suitable consistency is obtained. This may be judged as when a cohesive ball can be formed in the hand. 6. Small adjustments to the mix proportions may be made with approval of the RMF Engineer where it is necessary to adjust the consistency of the mix. <p>Part B – Work Performance</p> <ol style="list-style-type: none"> 7. Traffic management shall be established, maintained and subsequently removed in accordance with Item 101. 8. Only those potholes that will be completely repaired on the same day shall be opened for reinstatement. On no account shall partially completed work be left overnight. 9. The repair shall be marked out in a rectangular shape. This shall extend beyond the edge of the damaged surface by 100 mm minimum at all points. The dimensions shall also be sufficient to accommodate the choice of compaction equipment (assuming more than one layer of reinstatement). 10. The existing surfacing shall be cut using appropriate hand or mechanical cutters to produce a neat, straight cut made around the repair. Cut lines shall meet but not cross. 11. All unsound pavement material shall be broken up to at least the minimum depth specified in the Works Order and removed from site. Generally this shall be sufficient to accommodate at least 85 mm thickness of stabilised base. Care shall be taken not to disturb the edges or underlying material. 12. If the base of the hole is unbound material it shall be lightly watered and re-compacted by mechanical plate or power rammer. Only in the case of very small repairs which cannot accommodate the size of such equipment will hand ramming be permitted. 13. On no account shall the hole be marked or protected by rocks or other 	

ITEM NO. AND NAME	504 POTHOLE REPAIR – STABILISED BASE MATERIAL
<p>hazardous object.</p> <p>14. Freshly mixed, stabilised base material shall be delivered to the prepared pothole by wheelbarrow and spread in uniform layers not exceeding 50 mm (compacted thickness).</p> <p>15. The repair shall be compacted using mechanical equipment (roller, plate or power rammer depending on hole size). Compaction must be fully achieved along all edges and into corners. Compaction shall continue until there is no discernable settlement between successive passes (typically 6 passes required).</p> <p>16. The finished patch shall be checked for level and smoothness with a straight edge or string-line. It shall be lower than the surrounding pavement surface by the thickness of the final specified surface (i.e. generally the thickness of slurry application).</p> <p>17. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in :</p> <p>SQUARE METER FOR Potholes and Failure Repairs < 25 square meter Area</p> <p>CUBIC METER FOR Potholes and Failure Repairs > 25 square meter Area</p> <p>completed repair of any thickness. Physical measurements of average length, breadth and depth shall be recorded. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified. There shall be no adjustment to the rates paid on account of any necessary adjustment in the recipe mix proportions.</p> <p>Where normally directed that the repair shall be covered with a slurry seal, this shall be carried out and measured as a separate pay item.</p> <p>The Schedule of Rates may include separate pay items depending on the quantity of work instructed by a single Works Order.</p>	

ITEM NO . AND NAME	506 SEAL COAT
	The task covers the application of hot mix sand asphalt, with max agg. Size of 8mm, to existing pavement to cover the surface where ravelling occurs and shall be ordered and approval by the engineer. Materials and grading specifications refer to 510 Bitumen 60/70
<u>PAYMENT</u>	this item shall be measured and paid in square meters

ITEM NO. AND NAME	507 CRACK SEALING
UNIT OF MEASUREMENT:	LINEAR METRE
DESCRIPTION:	The works comprise the sealing (filling) of individual, wide cracks (>3 mm) using hot penetration grade bitumen containing rubber additive. The purpose is to seal the crack against the ingress of water. Thinner cracks (<3 mm) should not be sealed in this way as the bitumen will not penetrate. In these cases a slurry seal (undertaken as a separate Item) would be more appropriate. The cleanliness of the prepared crack is crucial to the success of the repair.
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> ❑ Small dump truck (or tractor & trailer); ❑ Air compressor (for bulk work); ❑ Bitumen kettle/lance; ❑ Small tools inc: brushes, wire-brushes, shovels, rakes, wheel barrows, watering cans etc.; ❑ Road signage in accordance with Item 101.
MATERIALS:	<p>Bitumen shall be heated 80/100 penetration grade bitumen.</p> <p>Rubber crumbs for additive (25%) shall pass a 2.00 mm sieve.</p> <p>Sand or Quarry fines (for blinding).</p> <p>Asphaltic Emulsion</p>
WORK SPECIFICATION: <ol style="list-style-type: none"> 1. Traffic management shall be established, maintained and subsequently removed in accordance with Item 101. 2. The repair area shall be thoroughly brushed and the cracks marked out and agreed with the RMF Engineer. 3. Each crack shall be individually cleaned using a stiff broom followed by wire brushes. The crack shall be cleaned until it is visually open to a depth of at least 5 mm. Where this cannot be achieved by hand, air compressors must be used. Operators must be equipped with protective eye goggles. 4. The repair area must be completely dry, bearing in mind that the inside of the crack may remain damp long after the road surface has dried. For this reason the cracks should <u>not</u> normally be cleaned with water unless strictly necessary. Cracks should not be repaired within 72 hrs of the last rain or washing. 5. The heated bitumen rubber (75% bitumen: 25% rubber) shall be applied using a fine nozzled hand lance. Watering cans fitted with a fine nozzle may be used where adequate crack penetration can be demonstrated. The spray nozzle or watering can spout, must be held close to the road surface to minimise the width of spread. 	

ITEM NO. AND NAME	507 CRACK SEALING
<p>6. A 50 mm wide paint-scraper shall be used to force the sealant into the crack. After the applied sealant has cooled a second application shall be made to top-up the crack surface. Once the applied sealant has ceased penetrating, the surface band width shall be spread (blinded) with sand or quarry fines to the extent that no bitumen remains visible.</p> <p>7. After all cracks have been blinded as above, the repair area may be opened to traffic.</p> <p>8. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p> <p>9. The sealed cracks shall be watertight, look neat and the sealant shall not project above the road surface by more than 3 mm.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in linear metres (m) of individual crack sealing. Physical measurements of the length of each individual crack shall be recorded. Unit rates shall include full compensation for all steps necessary to comply with the above including the multiple application of sealant, all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.</p>	

ITEM NO . AND NAME	507a CRACK SEALING
UNIT OF MEASUREMENT	SQUARE METER
DESCRIPTION:	<p>The works comprise the sealing (filling) of MULTI CRACKS, wide cracks (>3 mm) using hot penetration grade bitumen containing rubber additive. The purpose is to seal the crack against the ingress of water. Thinner cracks (<3 mm) should not be sealed in this way as the bitumen will not penetrate. In these cases a slurry seal (undertaken as a separate Item) would be more appropriate. The cleanliness of the prepared crack is crucial to the success of the repair.</p>
MATERIALS:	<p>Bitumen shall be heated 80/100 penetration grade bitumen.</p> <p>Rubber crumbs for additive (25%) shall pass a 2.00 mm sieve.</p> <p>Sand or Quarry fines (for blinding).</p>

<p>WORK SPECIFICATION:</p>	<p>10. Traffic management shall be established, maintained and subsequently removed in accordance with Item 101.</p> <p>11. The repair area shall be thoroughly brushed and the cracks marked out and agreed with the RMF Engineer.</p> <p>12. Each crack shall be individually cleaned using a stiff broom followed by wire brushes. The crack shall be cleaned until it is visually open to a depth of at least 5 mm. Where this cannot be achieved by hand, air compressors must be used. Operators must be equipped with protective eye goggles.</p> <p>13. The repair area must be completely dry, bearing in mind that the inside of the crack may remain damp long after the road surface has dried. For this reason the cracks should <u>not</u> normally be cleaned with water unless strictly necessary. Cracks should not be repaired within 72 hrs of the last rain or washing.</p> <p>14. The heated bitumen rubber (75% bitumen: 25% rubber) shall be applied using a fine nozzled hand lance. Watering cans fitted with a fine nozzle may be used where adequate crack penetration can be demonstrated. The spray nozzle or watering can spout, must be held close to the road surface to minimise the width of spread.</p> <p>15. A 50 mm wide paint-scraper shall be used to force the sealant into the crack. After the applied sealant has cooled a second application shall be made to top-up the crack surface. Once the applied sealant has ceased penetrating, the surface band width shall be spread (blinded) with sand or quarry fines to the extent that no bitumen remains visible.</p> <p>16. After all cracks have been blinded as above, the repair area may be opened to traffic.</p> <p>On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p>
<p><u>PAYMENT</u></p>	<p>this item shall be measured and paid in square meters</p>

ITEM NO. AND NAME	508 BASE FAILURE REPAIR – SELECTED MATERIAL																
UNIT OF MEASUREMENT:	SQUARE METRE																
DESCRIPTION:	<p>This task is normally performed in conjunction with bitumen surfacing repairs where the depth of potholes or other failure areas, extend significantly within lower unbound pavement layers and where the extent of works is extensive such as localised reconstructions. It is also used where the cause of surfacing failure has been traced to weakness and deformation of the unbound layers or road foundation. Reconstruction of the unbound layers under this item is made using selected natural gravel base material compacted mechanically.</p>																
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> <input type="checkbox"/> Dump truck <input type="checkbox"/> Hand and/or mechanical breakers <input type="checkbox"/> Plate compactor, or power rammer <input type="checkbox"/> Vibrating roller <input type="checkbox"/> Small tools including watering cans and water containers <input type="checkbox"/> Road signage in accordance with Item 101 																
MATERIALS:	<p>Gravel base material shall be obtained only from approved sources and borrow areas.</p> <p>Gravel base material shall unless otherwise authorised, comply with the gradation and properties below:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Grading for Natural Gravel Base</th></tr> <tr> <th>BS sieve (mm)</th><th>% passing</th></tr> </thead> <tbody> <tr> <td>37.5</td><td>80 – 100</td></tr> <tr> <td>19.0</td><td>60 – 90</td></tr> <tr> <td>4.75</td><td>30 – 65</td></tr> <tr> <td>2.00</td><td>20 – 50</td></tr> <tr> <td>0.425</td><td>10 – 30</td></tr> <tr> <td>0.075</td><td>5 – 15</td></tr> </tbody> </table> <p>Plasticity Index: 6% maximum</p> <p>California Bearing Ratio: 80% minimum at 98% Mod AASHTO density (soaked)</p>	Grading for Natural Gravel Base		BS sieve (mm)	% passing	37.5	80 – 100	19.0	60 – 90	4.75	30 – 65	2.00	20 – 50	0.425	10 – 30	0.075	5 – 15
Grading for Natural Gravel Base																	
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19.0	60 – 90																
4.75	30 – 65																
2.00	20 – 50																
0.425	10 – 30																
0.075	5 – 15																

ITEM NO. AND NAME	508 BASE FAILURE REPAIR – SELECTED MATERIAL
<p>WORK SPECIFICATION:</p> <ol style="list-style-type: none"> 1. Traffic management shall be established, maintained and subsequently removed in accordance with Item 101. 2. The repair shall be marked out with chalk or other clearly visible means. 3. Failed pavement layers shall be excavated from the repair area down to sound material, loaded onto transport and removed to approved dump sites. The base of the excavation shall be levelled. All loose material and any visible water shall be removed. 4. The base of the excavation shall be lightly watered if dry and compacted using mechanical compaction equipment. 5. Backfill shall be made using natural gravel base as specified above. Any stockpiled material shall be kept clear of the road carriageway except that material to be used the same day may be kept within the boundary of the temporary traffic control providing any excess is removed at the end of the day. 6. The base material shall be placed into the hole with shovels and levelled. The thickness shall be no more than will produce a compacted layer thickness of 100 mm (approx 120 – 135 mm, loose). 7. Base material shall be used at a moisture content that facilitates compaction. In general this will be just sufficient moisture to yield a darkened (damp) appearance but with no visible free water. Moistening shall not be performed to the stockpile but by lightly sprinkling water on to the loosely prepared layer. 8. Compaction shall be by mechanical equipment (either power rammer, vibrating plate or vibrating roller depending on the size of the repair). Compaction shall proceed until there is no discernable settlement between successive passes (approximately 6 passes). 9. The finished surface of the repair shall be at the level below the existing road surface, to accommodate the asphalt reinstatement. The surface shall be checked for uniformity and level with a straight edge or string line. On no account shall this finished surface be above the top of the highest unbound layer in the existing pavement. 10. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition. 	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in cubic metres (cubic meter) of selected natural gravel base material, accepted in place, after compaction. Physical measurements of length, breadth and average thickness shall be recorded. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.</p>	

ITEM NO. AND NAME	509 BASE FAILURE REPAIR – CRUSHED AGGREGATE																														
UNIT OF MEASUREMENT:	CUBIC METRE																														
DESCRIPTION:	<p>This task is normally performed in conjunction with bitumen surfacing repairs where the depth of potholes or other failure areas, extend significantly within lower unbound pavement layers and where the extent of works is extensive such as localised reconstructions. It is also used where the cause of surfacing failure has been traced to weakness and deformation of the unbound layers or road foundation. Reconstruction of the unbound layers under this item is made using selected crushed aggregate base material compacted mechanically.</p>																														
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> <input type="checkbox"/> Dump truck; <input type="checkbox"/> Hand and/or mechanical breakers; <input type="checkbox"/> Plate compactor, or power rammer; <input type="checkbox"/> Vibrating roller; <input type="checkbox"/> Small tools including watering cans and water containers; <input type="checkbox"/> Road signage in accordance with Item 101. 																														
MATERIALS:	<p>Aggregates used for this Item shall comprise a crushed stone base derived from hard, sound, durable and unweathered parent rock. It shall contain no deleterious material such as decomposed rock, clay or shale. The source of base material must be approved by the Employer prior to the works proceeding.</p> <p>Crushed stone base shall satisfy one of the following gradings:</p> <table border="1" data-bbox="686 1429 1217 2018"> <thead> <tr> <th rowspan="2">BS test sieve (mm)</th><th colspan="2">Percentage Passing (by mass)</th></tr> <tr> <th>37.5 mm</th><th>26.5 mm</th></tr> </thead> <tbody> <tr> <td>37.5</td><td>100</td><td>100</td></tr> <tr> <td>26.5</td><td>84 – 94</td><td>100</td></tr> <tr> <td>19</td><td>71 – 84</td><td>85 – 95</td></tr> <tr> <td>13.2</td><td>59 – 75</td><td>71 – 84</td></tr> <tr> <td>4.75</td><td>36 – 53</td><td>42 – 60</td></tr> <tr> <td>2</td><td>23 – 40</td><td>27 – 45</td></tr> <tr> <td>0.425</td><td>11 – 24</td><td>13 – 27</td></tr> <tr> <td>0.075</td><td>4 – 12</td><td>5 – 12</td></tr> </tbody> </table>		BS test sieve (mm)	Percentage Passing (by mass)		37.5 mm	26.5 mm	37.5	100	100	26.5	84 – 94	100	19	71 – 84	85 – 95	13.2	59 – 75	71 – 84	4.75	36 – 53	42 – 60	2	23 – 40	27 – 45	0.425	11 – 24	13 – 27	0.075	4 – 12	5 – 12
BS test sieve (mm)	Percentage Passing (by mass)																														
	37.5 mm	26.5 mm																													
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2	23 – 40	27 – 45																													
0.425	11 – 24	13 – 27																													
0.075	4 – 12	5 – 12																													

ITEM NO. AND NAME	508 BASE FAILURE REPAIR – SELECTED MATERIAL
	<p>Properties of aggregate road base shall also comply with the following:</p> <ul style="list-style-type: none"> ❑ The maximum Flakiness Index for any size of coarse aggregate shall be 35. ❑ The minimum 'Ten Per Cent Fines Test' result, shall be 110KN (dry test). ❑ The material shall have a soaked CBR (Modified AASHTO, 4-day soaked value at 95% MDD) of not be less than 80%. ❑ At least 50% by mass of material on each standard sieve of 5 mm or larger, shall have at least one fractured face. <p>The fines (passing 0.425 mm) of these materials shall have a Liquid Limit not exceeding 25% and a Plasticity Index not exceeding 6%.</p>
<p>WORK SPECIFICATION:</p> <ol style="list-style-type: none"> 1. Traffic management shall be established, maintained and subsequently removed in accordance with Item 101. 2. The repair shall be marked out with chalk or other clearly visible means. 3. Failed pavement layers shall be excavated from the repair area down to sound material, loaded onto transport and removed to approved dump sites. The base of the excavation shall be levelled. All loose material and any visible water shall be removed. 4. The base of the excavation shall be lightly watered if dry and compacted using mechanical compaction equipment. 5. Backfill shall be made using crushed stone base material as specified above. Any stockpiled material shall be kept clear of the road carriageway except that material to be used the same day may be kept within the boundary of the temporary traffic control providing any excess is removed at the end of the day. 6. The base material shall be placed into the hole with shovels and levelled. The thickness shall be no more than will produce a compacted layer thickness of 100 mm (approx 120 – 135 mm, loose). 7. Base material shall be used at a moisture content that facilitates compaction. In general this will be just sufficient moisture to yield a darkened (damp) appearance but with no visible free water. Moistening shall not be performed to the stockpile but by lightly sprinkling water on to the loosely prepared layer. 8. Compaction shall be by mechanical equipment (either power rammer, vibrating plate or vibrating roller depending on the size of the repair). Compaction shall proceed until there is no discernable settlement between successive passes (approximately 6 passes). 9. The finished surface of the repair shall be at the level below the existing road surface, to accommodate the asphalt reinstatement. The surface shall be checked for uniformity and level with a straight edge or string line. On no 	

ITEM NO. AND NAME	508 BASE FAILURE REPAIR – SELECTED MATERIAL
<p>account shall this finished surface be above the top of the highest unbound layer in the existing pavement.</p> <p>10. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in cubic metres (cubic meter) of crushed aggregate base material, accepted in place, after compaction. Physical measurements of length, breadth and average thickness shall be recorded. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.</p>	

ITEM NO. AND NAME	510 ASPHALT CONSTRUCTION
<p>The bituminous binder</p> <p>Following the completion of the base course, the Contractor shall perform all maintenance work necessary to keep the base course in a condition satisfactory for priming. After priming, the surface shall be kept clean and free from foreign material. The base course shall be properly drained at all times. If cleaning is necessary, or if the prime coat becomes disturbed, any work or restitution necessary shall be performed at the expense of the Contractor.</p> <p>The bituminous binder for asphalt concrete shall be penetration grade asphalt cement of 60-70 grade conforming to AASHTO M20. The requirements of the material are provided in <i>Table 503-1</i>. It shall be homogenous, free from water and shall not foam when heated to 176°C. The Contractor shall obtain from supplying refinery a certificate of analysis For each shipment made to the project. The certificate of analysis shall show the test results for all specified requirements, and in addition the net weight of each shipment. The certificate shall be submitted to the Engineer for his approval of the sources. Mixing of bitumen originating from different refineries shall not be permitted</p> <p>The Contractor shall inform the Engineer in advance of the supplying refinery from which the Contractor proposes to procure bitumen along with test data for bitumen and obtain the Engineer's approval of his selection of refinery. The Contractor shall not change the supplying refinery without the Engineer's approval.</p>	

The temperature for storage and at mixing of the asphaltic binder shall be as follows::

Asphalt Grade	Max. Storage Temperature °C		Temperature Range for Mixing
	Upto 24 hrs	Over 24 hrs	
60/70	177	135	160-177

Table 503-1 Specification of Asphalt Cement

Sl. No.	TEST	Test Method	Requirement for 60/70 penetration asphalt cement
1	Penetration at 25°C (100g, 5 sec.) 1/10 mm	AASHTO T-49	60-70
2	Flash point, Cleveland Open cup, °C	AASHTO T-48	232 Min.
3	Ductility at 25°C 5 cm/min, cm	AASHTO T-51	100 Min.
4	Solubility in trichloroethylene, percent	AASHTO T-44	99 Min.
5	Softening point, ring and ball, °C	AASHTO T-53	49 - 54
6	Thin film oven test, penetration after test, percent of original	AASHTO T-179/ T-49	54 Min.
7	Loss on heating (5 hrs, at 163°C), percent	AASHTO T-179	0.8 Max.
8	Ductility of residue at 25°C, 5 cm/min, cm	AASHTO T-179/ T-51	50 Min.

Bituminous Tack Coat

The work covered by this section consists of furnishing all plant labour, equipment and materials and performing all operations to complete the bituminous tack coat.

The work shall include supplying and applying bituminous material to a previously prepared, bonded and/or bituminized surface leveling of base course or existing pavement in accordance with the Specification and to the width shown on the Drawings or indicated by the Engineer.

The approximate amount of bituminous material including water per square metre for the tack coat shall be up to 0.8 litres. The exact amount shall be as ordered by the Engineer.

Bituminous Surface Course

The work consists of furnishing all plant, labour, equipment and materials and performing all operations to complete the bituminous surface course.

The surface course shall be composed of mineral aggregate and bituminous material mixed in a central mixing plant and placed on a prepared course in accordance with the Specification and shall conform to the dimensions and typical cross-section shown on the Drawings and/or established by the Engineer.

The surface course shall be constructed in two courses. Each course shall be constructed to the depth, typical section or elevation shown on the Drawings or established by the Engineer and shall be rolled, finished and approved before the placement of the next course.

The aggregate shall consist of crushed stone or crushed gravel with or without sand or other inert finely divided mineral aggregate. The aggregate shall be composed of sound, tough, durable particles, free from clay balls, organic matter and other deleterious substances. The aggregate shall not contain more than 8 % by weight of flat or elongated pieces.

The coarse aggregate shall show no more than 40 % wear and no signs of disintegration nor shall the sodium sulphate soundness loss exceed 9 %.

The bituminous plant mix shall be composed of a mixture of aggregate, filler if required and bituminous materials. The several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula.

A closer control appropriate to the job materials will be required in gradations which shall produce a relatively smooth curve when plotted in a semi logarithmic gradation chart.

Work shall not begin nor shall any mixture be accepted until the Contractor has submitted samples of the materials intended for use and the Engineer has established a satisfactory job mix formula for each mixture to be used.

The crushing of the aggregate shall result in a product in which 75% (retained on No. 8 sieve) by weight of particles with one or more fractured faces.

Filler

When filler in addition to that naturally present in the aggregate is necessary, it shall consist of stone dust, Portland cement, or other approved mineral matter.

The asphalt cement will be 60 - 70 grades.

The job mix formula for each mixture shall be in effect until modified in writing by the Engineer. This job mix formula will establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate and a single temperature at which the mixture is to be delivered at the point of discharge.

The gradations in the table below represent the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradations decided on within the limits designated in the table shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieves or vice versa.

The selection of any of the gradations shown in the table shall be such that the maximum size aggregate used shall be not more than one half the thickness of the layer of the surface course being constructed.

Aggregate

The aggregate shall consist of coarse and fine aggregates and mineral filler in such proportions that when combined; it conforms to the specified gradation.

Coarse aggregate, that is the material retained on 2 mm sieve, shall be of uniform quality and shall be produced by crushing solid rock or gravel from sources approved by the Engineer. It shall be free from clay balls, vegetable matter or other deleterious substances and an excess of flat or elongated pieces. The aggregate shall have at least one mechanically fractured face on 80 percent of the particles retained on 4.75 mm sieve. The aggregate shall also conform to the following quality requirements:

Los Angeles Abrasion (AASHTO T-96)

- for wearing course 30% Max.
- for lower courses 35% Max.

Aggregate Impact Value 25% Max.

Soundness, Sodium Sulphate

(AASHTO T-104) 12% Max.

Liquid Limit (AASHTO T-89) 25% Max.

Plasticity Index (AASHTO T-90) Non Plastic

Stripping Test (ASTM D: 1664) 5% Max. Uncoated aggregate

Flakiness Index (BS: 812) 30% Max.

Water Absorption 2% Max.

Note: The aggregate may be tested either for Los Angeles abrasion or for Aggregate impact value.

In case the coarse aggregate does not pass the stripping test, an approved anti-

stripping agent shall be added for which no additional compensation shall be made to the Contractor. The aggregate shall be produced and separately stored in three sizes suitable for combining with the fine aggregate and filler to provide the grading specified in Table 510-a. Grading of 25 mm and 19 mm nominal sizes are to be adopted for binder course and wearing course respectively. Grading of 25 mm, 19 mm or 12.5 mm nominal size may be used for levelling course depending on the minimum thickness of the layer as directed by the Engineer.

The mineral aggregate and asphalt (and if needed, mineral filler) shall be combined to meet the following gradations:

TABLE 510-a Grading requirement for asphalt concrete layer

Sieve size Layer Thickness	Layer 50mm	Layer 40mm	Layer 30mm	Seal coat 20-25mm	Levelling course
20 mm	100				
16 mm	-	100			
12.5 mm	80-100	80-100	100		100
10 mm	-	70-90	90-100	100	90-100
4.75 mm	45-65	50-72	55-85	80-100	55-85
2.36 mm	30-54	34-56	32-67	65-100	32-67
1.18 mm	-	-		50-80	
0.300 mm	6-24	7-23	8-24	7-40	8-24
0.075 mm	2-10	2-10	2-10	2-10	2-10

Before approving the job mix formula, the Engineer may require the contractor to furnish additional data and to carry out additional tests. The Engineer and his representative shall have full access to the contractor's testing operations related to preparation and finalisation of the job mix formula.

Once the job mix formula is approved it shall be the responsibility of the contractor to produce the asphaltic concrete mix accordingly and within the tolerances indicate in table 510-b.

Table 510-b Design criteria for asphalt concrete

Property	Layer			Levelling course
	50mm	40mm	30mm	
Compaction, Noof blows	75	75	75	75
Marshall stability (min)	9	9	8	6.0 min
Flow (mm)	2-4	2-4	2-4	2-4
Air void (%)	3-5	3-6	3-6	3-6
Voids filled with bitumen (%)	63-75	65-75	65-75	65-75
Loss of Marshall stability(%) max	25	25	25	
VMA (%) min	13	14	14	15

Loss of Marshall Stability on Immersion
(24 hrs in water at 60°), percent 25.0 Max

Construction Methods

The surface course shall be constructed only when the surface is dry, the atmospheric temperature is above 4 degrees C, and the weather is neither foggy nor rainy. The temperature requirements may be waived only when so directed by the Engineer.

Sufficient storage space shall be provided for each size of aggregate. The different aggregate sizes shall be kept separated until they have been delivered to the cold elevator feeding the drier. The storage yard shall be neat, orderly and the separate stockpiles readily accessible for sampling.

Preparation of Mineral Aggregate

The aggregate for the mixture shall be dried and heated at the paving plant before entering the mixer. When introduced into the mixer the combined aggregate shall not contain more than 0.5 percent moisture in the asphalt mixture. Water in the aggregate shall be removed by heating to the extent that there is no subsequent forming in the mixture prior to the placing of the material.

The aggregate shall be heated. The maximum temperature and rate of heating shall be such that no permanent damage occurs to the aggregates. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by heating. The aggregate shall be screened to specified sizes and conveyed into separate bins ready for mixing with bituminous material.

Preparation of Bituminous Mixture

Before delivery, the aggregate shall be mixed with the bituminous material at a central mixing plant. The mixture shall be prepared at the temperature specified.

The dry aggregates, prepared as specified shall be combined in the plant in the proportionate amounts of each fraction of aggregate to meet the specified gradation. The quantity of aggregate for each batch shall be determined, measured and conveyed into the mixer. In case of volumetric proportioning the size of the gate openings shall be determined and the gates locked in position.

Transportation and Delivery of the Mixture

The mixture shall be transported from the mixing plant to the point of use in approved vehicles.

The mixture shall be placed at a temperature between 121°C and 149° C when asphalt cement is used. When the mixture is being placed during warm weather and the Engineer has determined that satisfactory results can be obtained at lower temperatures he may direct that the mixture be mixed and delivered at the lower temperatures.

Loads shall not be sent out so late as to interfere with spreading and compacting the mixture during daylight unless artificial light, approved by the Engineer, is provided. The mixture shall be delivered at a temperature within the tolerance specified in the approved job formula and maintained throughout the spreading operation.

Spreading and Laying

Immediately before placing the bituminous mixture the existing underlying course shall be cleaned of loose or deleterious material.

The mixture shall be laid only upon an approved underlying course which is dry and only when weather conditions are suitable. No mixture shall be placed when the air temperature in the shade and away from artificial heat is 4 degrees C or lower unless so directed by the Engineer. The Engineer may permit work to continue when overtaken by sudden rains up to the amount, which may be in transit from the plant at the time and provided the mixture is within the temperature limits specified.

Fine Spreading

After arrival, the mixture shall be dumped and immediately spread to the full width required. It shall be struck off in a uniform layer such that when the work is completed it will have the required thickness.

Compaction of Mixture

After spreading, the mixture shall be thoroughly and uniformly compacted with power rollers as directed by the Engineer.

The speed of the roller shall at all times be slow to avoid displacement of the hot mixture. Any displacement occurring as a result of reversing the direction of the roller or from any other cause shall be corrected at once by rakes and fresh mixture.

Equipment

General

The hot mix plant and other equipment used by the Contractor shall conform to and according to the type and number indicated in the Contractor's detailed works programme as approved by the Engineer. Particular requirement of the individual plants are indicated in the following paragraphs.

Hot Mix Plant

The plant shall be so designed and operated to produce mixtures within the specified job mix tolerances. All plants used for preparation of asphalt concrete shall have automatic controls linked to micro processor in the control room, and shall consist of the following components:

- 1) A cold feed system, either a single reciprocating feeder, or a multiple feeder that is capable of feeding various sizes into the dryer to obtain uniform production and temperature.
- 2) A conveyor or elevator to move the cold aggregate into the dryer.
- 3) A rotary dryer that continuously agitate the aggregate during the heating and drying process.
- 4) A dust collector with a means for returning the collected mineral dust back into the hot stone elevator all or any part of the material collected.
- 5) A hot stone elevator.
- 6) A set of screens to make the separation of the aggregate to the sizes as required by the specifications and having normal capacities in excess of the full capacity of the mixer.

- 7) A set of hot storage bins for the supply of the various components of the aggregate and having sufficient capacity to supply the mixer operating at full capacity. Bins shall be provided with adequate telltale devices that indicate the position of the aggregates in the bins at the lower quarter points.
- 8) An approved proportioning system, either by volume or weight
- 9) Adequate and approved scales or volumetric devices for the control of the proportioning with an accuracy of 0.5 percent of the required load.
- 10) An approved mixture pugmill.
- 11) A discharge hopper for loading trucks
- 12) Adequate and approved asphalt and fuel storage tanks
- 13) Thermometer equipment of adequate range at suitable location to measure the temperature of bitumen, aggregate and the mix.

Tanks for the storage of asphalt shall be equipped with heating coils under effective and positive control for the heating of the material to the temperature requirements as instructed. Heating shall be accomplished by an approved means but in no case shall open flame be allowed to contact the heating tank. A circulating system for the continuous circulation between the storage tank and the mixer shall function during the entire operational period. All pipelines, tanks and units carrying hot asphalt shall be insulated or jacketed. The asphalt storage tank shall have a capacity for at least one day's full operation.

A satisfactory means shall be provided either by weighing or by volume or by metering to obtain the proper amount of asphalt in the mix. The accuracy shall be to one percent of the amount required; if the metering system is used there shall be means to check the delivery by weight. Suitable means shall be provided for maintaining the specified temperatures of the asphalt in the pipelines, meters, weight buckets, spray bars, tanks and other containers.

The plant shall be equipped with a positive means to govern the time of mixing and to keep it constant. The plant shall be equipped with ladders and stairs for inspection, and all open gears or exposed moving parts shall be guarded. Ample and unobstructed passage shall be maintained at all times in and around the truck loading area.

Approved truck scales shall be provided for weighing the asphalt concrete mix discharged from the mixer. Scales shall be inspected by the Engineer for accuracy and scaled as often as the Engineer deems necessary.

ASPHALT CONCRETE

Description

The work shall consist of the construction of one or more courses of hot-mixed, hot-laid asphalt concrete mixture over a primed and approved base course, an existing bituminous pavement or bridge deck in accordance with

the requirements of these specifications and in conformity with the lines, levels and thickness shown on the Drawings or as directed by the Engineer.

The work shall include the procuring and furnishing of mineral aggregates and bituminous binder, mixing in a central mixing plant, hauling, spreading and compacting the mixture, all as specified hereunder for the construction of asphalt concrete binder course, leveling course or wearing course.

The asphalt concrete binder or wearing course for new roads shall be of uniform thickness as designated in the contract. For rehabilitation of existing roads thickness of the leveling course will vary depending on the unevenness of the existing pavement, and its thickness at the various locations shall be determined as provided for in the Contract or as directed by the Engineer.

For overlaying existing pavements with the overlay course laid in combination with the leveling course, the combined course will be designated by the nominal or range of thickness. As in the case of the leveling course, the thickness at the various locations for this case shall be determined as provided in the Contract or as directed by the Engineer. **Levelling Course**

The work shall consist of application of differential thickness layer of asphaltic concrete over the existing asphalt surface to bring the latter to design grade and crossfall. The leveling course shall be applied after the existing surface has been repaired of all potholes and patching, has been thoroughly cleaned of all dust and extraneous matter, and has been provided with tack coat

At least 21 days prior to start on leveling course work at Site, the Contractor shall provide the Engineer with cross-sectional data of the existing pavement for seven (7) points across each cross-sections (at either edges, 1 at the centreline and 2 equi-distant points on each lane), with the cross sections taken by a Total Station survey equipment at the interval of 10 m for flat terrain and 5 m for hilly terrain. The data shall provide X, Y and Z coordinates or equivalent of each point, and data for a continuous section to a length of not less than 3 km and not more than 4 km shall be submitted to the Engineer in a batch on a computer diskette in Excel format. On receipt of the survey data, the Engineer will work out the finished centre line levels of the leveling course as also the thickness of leveling course to be applied at each cross-section. The Contractor shall then proceed to construct the leveling course accordingly.

The asphalt concrete mix to be used for the leveling course shall be of the aggregate nominal size directed by the Engineer depending on the thickness of the layer.

510.1 Rapid-Curing (RC) Cut-back Bitumen

- i) RC cutback shall conform with the requirements of AASHTO M 81, which covers Grades RC-70, RC-250, RC-800, and RC-3000 and are listed in Table 4.13.3.
- ii) Sampling and testing shall be in accordance with the AASHTO standard methods listed in AASHTO M 81.
- iii) RC cut-back bitumen spraying temperature ranges shall be as follows:

RC Cutback Grade	Spraying Temp °C
RC - 70	40 -75
RC – 250	65 -105
RC – 800	90 - 115
RC - 3000	105-135

510.2 Medium-Curing (MC) Cutback Bitumen

- i) MC cutback shall conform with the requirements of AASHTO ,M 82, which covers Grades MC-30, MC-70, MC-250, MC-800 and MC-3000 and are listed in table 4.13.4.
- ii) Sampling and testing shall be in accordance with the AA.SHTO standard methods listed in AASHTO M 82.
- iii) MC cutback bitumen spraying temperature ranges shall be as follows:

MC Cut-back Grade	Spraying Temp °C
MC - 30	21-63
MC – 70	90
MC – 250	70-110
MC – 800	95-125
MC - 3000	110-145

510.3 Slow-Curing (SC) Cut-back Bitumen

- i) SC cutback shall conform with the requirements of ASTM 02026 which covers Grades SC-70, SC-250, SC-800, and SC-3000, and are shown in Table 4.13.5.
- ii) Sampling and testing shall be in accordance with the appropriate ASTM standard methods.
- iii) SC cutback bitumen spraying temperature ranges shall be as follows:

SC Cut-back Grade	Spraying Temp °C
SC - 70	45 – 80
SC – 250	70 – 110
SC – 800	95 – 125
SC - 3000	110 - 145

510.4 Cut-back Bitumen Generally

- i) Selection and use of Cut-back bitumen shall generally be in accordance with the recommendations in AASHTO R 5.

- ii) Emulsified bitumen which have been subjected to freezing temperature while in storage shall be retested and acceptance or rejection of the material shall be based on the results of the retest.
- iii) The manufacturer shall furnish samples of the base bitumen used in the emulsion.
- iv) When samples of undiluted emulsion are not readily available for test purposes, tests may be made on the diluted emulsion and the respective specifications modified to reflect the changes in properties resulting from dilution of the bitumen.
- v) All emulsified bitumen shall adhere firmly to the surface of the mineral aggregate or the highway surface as appropriate. Failure of the emulsified bitumen to perform satisfactorily on the job- shall be deemed cause for its rejection regardless of satisfactory laboratory test results.

510.5 Anionic Emulsified Bitumen

- i) Anionic emulsified bitumen shall, prior to dilution, conform with the requirements of AASHTO M 140, for Types SS-1 and SS-1h and as listed in Table 510.5.a

Table 510.5.a : Properties of R.C Cutback Bitumen

	RC-		RC-250		RC-		RC-30	
	Min.	Max.	Min.	Max.	Min.	Max.	Min	Max.
Kinematic Viscosity at 60° C	70	140	250	500	800	1600	3000	6000
centistokes								
Flash Point (Tag, open-cup)	-	-	27	-	27	-	27	-
Water, percent	-	0.2	-	0.2	-	0.2	-	0.2
Distillation test:								
Distillate, percentage by volume	10	-	-	-	-	-	-	-
of total distillate to 360° C	50	-	35	-	15	-	-	-
to 190° C	70	-	60	-	45	-	25	-
to 225° C	85	-	80	-	75	-	70	-
to 260° C								
Residue from distillation to volume percentage of sample by difference	55	-	65	-	75	-	80	-
Tests on residue from distillation:	600	2400	600	2400	600	2400	600	2400
Absolute viscosity at 60° C	100	-	100	-	100	-	100	-
Solubility in Percent	99	-	99	-	99	-	99	-
Spot test with:								
Standard naphtha	Negative for all							
Naphtha-xylene solvent - percent xylene	Negative for all							
Heptane-xylene solvent - percent xylene	Negative for all							

Table 510.5b: Properties of M.C. Cutback Bitumen

	MC- 30	MC-70	MC-250	MC-800	MC- 3000
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	Min.	Max	Min.	Max	Min.	Max.	Min	Max.	Min	Max.
Kinematic Viscosity 60° C centistokes	30	60	70	140	250	500	800	1600	3000	6000
Flash Point open-cup) degrees	38	-	38	-	66	-	66	-	66	-
Water, percent	-	0.2	-	0.2	-	0.2	-	0.2	-	0.2
Distillation test:										
Distillate,										
by volume of distillate to 360° C										
to 225° C	-	25	0	20	0	10	-	-	-	-
to 260° C	40	70	20	60	15	55	0	35	0	15
to 3 15 ° C	75	93	65	90	60	87	45	80	15	75
Residue distillation to 360° C										
volume percentage sample by difference	50	-	55	-	67	-	75	-	80	-
Tests on residue distillation:										
Absolute viscosity at 60° C poises	300	1200	300	1200	300	1200	300	1200	300	1200
Ductility, 5 cm/min. 25° C cm	100	-	100	-	100	-	100	-	100	-
Solubility in										
Trichloroethylene, percent	99	-	99	-	99	-	99	-	99	-
Spot test with:										
Standard naphtha		Negative for all								
Naphtha-xylene solvent										
- percent xylene		Negative for all								
Heptane-xylene solvent										
- percent xylene		Negative for all								

ITEM NO. AND NAME	511 Removal OF Asphalt With Disposal, transportation and Bed Preparation												
	<p>The Contractor will demarcate any failed areas to be repaired, and shall instruct his employees with regard to the repair work to be done. The Contractor shall provide assistance and temporary traffic control facilities for marking out failed sections of the road.</p> <p>The repaired area shall have a neat rectangular shape, at right angles to the direction of traffic. The existing material shall be excavated and removed to the specified depth.</p> <p>Excavation for pavement failures shall be cut or trimmed with side slopes perpendicular to the horizontal; for each excavated layer, a step shall be created with the horizontal distance equal to the vertical distance to a maximum of 150 mm. The existing pavement material shall be broken down to the specified depth and removed, or reprocessed inside, whichever may be required. The underlying layers may not be damaged, and material from one layer may not be mixed with that of another layer.</p> <p>Asphalt and cemented layers shall be cut or sawn through to the specified depth along the measured limit.</p> <p>The floor of the excavation shall be compacted to the specified density for the layer concerned.</p> <p>Backfilling of excavation for pavement failures</p> <p>Prior to backfilling, the base and sides of the excavation shall be cleaned of all loose material. The excavation shall be backfilled with approved gravel, crushed stone or asphalt and compacted to a density as specified below:</p> <table><tr><td>Base</td><td>(0-150 mm below final base level)</td><td>98% of modified AASHTO density</td></tr><tr><td>Selected Subgrade with CBR > 30%</td><td>(150 mm - 300 mm below final base level)</td><td>95% of modified AASHTO density</td></tr><tr><td>Selected material with CBR (20-30)%</td><td>(300 mm - 600 mm below final base level)</td><td>93% of modified AASHTO density</td></tr><tr><td>Fill material with CBR > 15%</td><td>(Below 600 mm of final base level)</td><td>90% of modified AASHTO density</td></tr></table> <p>Backfilling of the excavation shall be done as follows:</p> <p>Backfilling for the base layer shall be done with imported crushed stone material. The density of the backfilling of the base layer shall be at least 98% of modified AASHTO density. The backfilling of the base layer can also be done with continuously graded asphalt.</p>	Base	(0-150 mm below final base level)	98% of modified AASHTO density	Selected Subgrade with CBR > 30%	(150 mm - 300 mm below final base level)	95% of modified AASHTO density	Selected material with CBR (20-30)%	(300 mm - 600 mm below final base level)	93% of modified AASHTO density	Fill material with CBR > 15%	(Below 600 mm of final base level)	90% of modified AASHTO density
Base	(0-150 mm below final base level)	98% of modified AASHTO density											
Selected Subgrade with CBR > 30%	(150 mm - 300 mm below final base level)	95% of modified AASHTO density											
Selected material with CBR (20-30)%	(300 mm - 600 mm below final base level)	93% of modified AASHTO density											
Fill material with CBR > 15%	(Below 600 mm of final base level)	90% of modified AASHTO density											
Payment	The payment will be per SQUARE METER												

ITEM NO. AND NAME	512 Removal OF (Asphalt +Base) With Disposal, transportation and Bed Preparation
	<p>Potholes: The existing material shall be removed in a neat rectangle to sound base, with a minimum dimension of 200 mm x 200 mm. All sides shall be perpendicular or parallel to the direction of traffic.</p> <p>Edge breaks: Loose and cracked edges shall be trimmed back to a neat rectangular shape, parallel and perpendicular to the centre line of the road to sound surrounding surfacing or base layer. All edges shall be saw cut to a minimum depth of 30 mm below the road surface and the maximum thickness of each layer shall be 50 mm.</p> <p>Surfacing failures: The surface repair shall have a neat rectangular shape, at right angles to the direction of traffic.</p> <p>The floor of the excavation shall be cleaned of all undulations to ensure a firm flat base and sides and shall be tacked with 60% cationic stable-grade bitumen emulsion at a rate of 0,6 liter per square meter Continuously graded medium asphalt shall be placed and compacted to the level of the existing adjacent surfacing.</p>
Payment	The payment will be per SQUARE METER rate shall be include the serves and compact the blower layer

ITEM NO. AND NAME	513 Repair existing granular base course by scarifying and adding selected material thickness up to 15cm
Description	<p>This item include:</p> <p>1-Removal OF (Asphalt +Base) With Disposal, transportation and Bed Preparation indicated as indicated Item No.512.</p> <p>2- Provided Base Failure repair –selected material up to 10-15cm as indicated Item No. 508.</p> <p>3- Repair of existing potholes or surface failure in paved roads, or reinstatement of previous temporary repairs, using hot-mix asphalt produced at a central batching plant to an approved recipe as indicated Item No.502</p>
Payment	The payment will be per SQUARE METER

ITEM NO. AND NAME	514 Repair asphalt layer 50 mm thick At failure locations by removing existing asphalt to spoil, water and compact existing base course, prime coat and 50mm asphalt layer.
Description	<p>This item include:</p> <p>1- Removal OF Asphalt With Disposal, transportation and Bed Preparation indicated as indicated Item No.511</p> <p>2- removing existing asphalt to spoil, water and compact existing base course</p> <p>3- Repair of existing potholes or surface failure in paved roads, or reinstatement of previous temporary repairs, using hot-mix asphalt produced at a central batching plant to an approved recipe prime coat and 50mm asphalt layer. as indicated Item No 502</p>
Payment	The payment will be per SQUARE METER

ITEM NO. AND NAME	515 ASPHALT MILLING
UNIT OF MEASUREMENT	SQUARE METER
DESCRIPTION:	<p>This work shall consist of milling of asphaltic pavement surface layer by Milling Machine to improve the readability in accordance with these specifications and in reasonably close conformity with the lines, grades and cross sections shown on the plans or as instructed by the Engineer. The sequence of the locations to be milled will be determined by the Engineer.</p>
EQUIPMENT	<p>The equipment for milling and scarifying the pavement surface shall be a cold planning machine specifically designed for automatically controlled profiling.</p> <ul style="list-style-type: none"> - The automatic controls shall provide for accurately establishing profile grades at each edge of the machine by referencing from the existing pavement or an independent grade reference, where required, or be capable of automatically maintaining a designated cross slope from a single reference. - The machine shall be self-propelled and shall have sufficient power, traction and stability to maintain an accurate depth of cut. - The machine will be equipped with means to effectively control dust generated by the cutting operation. - Hauling equipment shall be available to receive milled material directly from the milling machine or loaded from a windrow of milled material when approved by the Engineer, and haul it directly to the approved waste junk-yards. - Equipment for removing any loose material during the sweeping operation shall have the capability to pick the material up off the milled and/or adjacent roadway and be able to be unload onto the hauling equipment

<p>WORK CONSTRUCTION</p>	<p>. The pavement surface shall be scarified by milling machine to the specified depth, width, grade, and cross section shown on the plans or as directed and instructed by the Engineer</p> <ul style="list-style-type: none"> - The number of passes required to achieve the specified width and depth shall be determined by the Contractor. - If the milled surface is to be used as the final wearing surface, the texture produced by the planning operation should be characterized by uniform, discontinuous longitudinal striations or other patterns which will, in the opinion of the Engineer, provide a satisfactory riding surface and skid resistance. - The surface deviation should not exceed 10 mm in 10 m for a final wearing surface. - The milling is to expose frames of all manholes, water valves, survey monuments, power and telephone poles and water valves to the required depth of milling. - Dust produced shall be controlled to a level acceptable to the Engineer. - When pavement Milling is to be completed across the entire roadway width, it shall be completed to a uniform termination point in any given working day. For divided roadways, the interpretation of "entire roadway width" shall be that portion of the roadway facility associated with the movement of traffic in one direction. At the point of daily termination of removal operations, abrupt changes in the roadway surface profile shall be avoided. The longitudinal transition shall be a maximum of 25 mm vertically per meter. - In the event the entire roadway of pavement along a section has not been milled by the end of the working period, resulting in a vertical longitudinal face, the maximum deviation between the two surfaces should not exceed 20 mm. - Suitable signing and/or warning devices shall be provided by the Contractor. - Asphaltic concrete that cannot be removed by the milling equipment because of physical or geometrical restraints should be removed by other methods suitable to the Engineer. - All milled material shall be loaded directly to trucks from the milling machine or from the windrow if approved by the Engineer, and hauled to the approved waste site. - The milling equipment shall be operated and maintained in such a manner that tearing and breaking out of the underlying and adjacent material is minimized. - The resultant milled roadway surface shall be swept clean immediately after the removal of the milled material, and in no case should the sweeping operation be more than 100 meters behind the milling operation. - Any distress of the newly milled surface caused by the milling which may constitute a driving hazard, shall be promptly repaired to the satisfaction of the Engineer - The Contractor shall at all times minimize contamination of the milled material with granular or deleterious material.
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MEASUREMENT FOR PAYMENT	<p>Work shall be measured by the square meter of surface area milled to a specified depth.</p> <p>Asphalt milling shall be paid for at the tendered unit price which shall be full compensation for all labour, tools, materials and equipment necessary to complete the work, including all other work necessary or incidental thereto for which separate payment is not provided elsewhere.</p> <p>Price and payment will be full compensation for all work, including hauling off and disposing of the milled material.</p>
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600 CONCRETE CONSTRUCTION

600 CONCRETE CONSTRUCTION

601 PRECAST CONCRETE UNITS

602 STEEL REINFORCEMENT

ITEM NO. AND NAME	600 Concrete construction
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600.1 Description

This work consists of the furnishing and placing in structures inclusive of transport, of cement concrete made from approved Portland cement, water, fine and coarse aggregates, all in accordance with the requirements in these Specifications, and in a manner shown on the drawings and to the approval of the Engineer.

600.2 Classes of Concrete:

The classes of concrete recognized in these Specifications shall be designed A, B and Lean Concrete. Each class of concrete shall be used where it is called for on the drawings, or where directed by the Engineer. The following requirements shall govern unless otherwise shown on the drawings or approved by the Engineer.

Class A (Grade 25): concrete shall be used everywhere, for non-reinforced and reinforced concrete structures, except as noted below or directed by the Engineer. Concrete Class A shall have a minimum cement content of 350 kg per cubic metre of concrete and a slump between 5 and 10 cm.

Class B (Grade 15): concrete shall be used for surrounding and bed for pipe culverts.

Lean Concrete: Shall be used in thin layers underneath footings and when called for on the drawings or directed by the Engineer.

The concrete of the various classes shall satisfy the requirements shown in Table 4A.

Table (4A) Concrete Classes

Class	Max. Size of Coarse Aggregate (inches)	28 day compressive strength		Recommended consistency (range in slump) (cm)
		(kg/square meter)	(psi)	
A	1 ½	300	(4000)	5-10
B	2	150	(2200)	5-10
Lean Concrete(c)	-	53	(750)	-

600.3 Material Requirements

Portland Cement

Portland cement shall conform to be requirements for Cement Type I of the Standard Technical Specifications

Specifications for Portland cement of the AASHTO Designation M85. Samples of cement shall be obtained in accordance with AASHTO Designation T127 or any other standard approved by the Engineer. Approval of a cement quality shall not waive the responsibility of the Contractor to fabricate concrete of the strength specified.

The Contractor shall provide suitable means for storing cement and protecting it from dampness.

Fine Aggregate:

The fine aggregate shall consist of sand, stone screening or other approved inert materials with similar characteristics, or a combination thereof, having clean, hard, strong, sound, durable, uncoated grains, free from injurious amount of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam or other deleterious substances, and shall not contain more than three percent of material passing the No. 200 sieve by washing nor more than one percent of clay lumps or one percent of shale.

For exposed work, the fine aggregate shall be free from any substance that will discolour the concrete surface.

The fine aggregate shall be tested for sodium sulphate soundness in accordance with AASHTO T104 five cycles and shall show a maximum loss of not more than ten percent.

The fine aggregate shall be uniformly graded and when tested in accordance with AASHTO Designations T11 and T27 shall meet the following graded requirements:

<u>U.S. Standard Sieve</u>	<u>Percentage Passing by Weight</u>
9.5mm	100
No. 4	95-100
No. 16	45-80
No. 50	10-30
No. 100	2-10

Coarse Aggregate:

The Coarse aggregate shall consist of crushed or uncrushed stones, gravel or other approved inert materials with similar characteristics, or a combination thereof, having clean, hard, strong, sound, durable uncoated particles, free from injurious amount of soft, friable, thin elongated, or laminated pieces, alkali, organic or other deleterious matter and conforming to the requirements of these Specifications.

The coarse aggregate shall not contain deleterious substances in excess of the following percentages:

AASHTO Test Percentage by Wt. Clay lumps T112 0.25

Materials passing 75mm sieve ,Thin or elongated pieces (length greater than 5 times maximum thickness) -10

The coarse aggregate shall be of uniform grading with maximum sizes as required for the various classes of concrete and shown in Table 5A. It shall conform to the requirements of the following table for size or sizes designated (AASHTO M43):

Table (4B)

Sieve size	Class A Concrete
37.5 mm	100
25 mm	95-100
19 mm	-
12.5 mm	25-60
9.5 mm	-
4.75 mm	0-10
2.36 mm	0-5

Not more than five percent shall pass a No. 8 sieve.

Coarse aggregate shall have an abrasion loss of not more than 40% at 500 revolutions; in accordance with AASHTO test T96.

In accordance with AASHTO test T104 five cycles, the sodium sulphate soundness shall be not more than 12% maximum loss.

Natural aggregates shall be thoroughly washed before use.

Combined Aggregate:

The aggregate shall unless otherwise directed by the Engineer be combined in proportions to product mixture within the grading limits for combined aggregates as shown in Table 5C.

Table 4C
Grading of Combined Aggregate

U.S. Standard Sieve	Percentage Passing Maximum Size of Aggregate	
	37.5 mm	12.5 mm

37.5 mm	100	
25 mm	80-100	
19 mm	55-100	
12.5 mm	-	100
9.5 mm	45-75	80-100
No. 4	35-60	55-80
No. 8	27-45	42-60
No. 16	20-35	35-48
No. 30	12-25	20-33
No. 50	5-15	9-20
No. 100	1-5	1-6
No. 200	0-2	0-2

Storage of Cement and Aggregates:

(a) All cement shall be stored, immediately upon arrival on the site of the Work, weatherproof buildings, which will protect the cement from dampness. The floor shall be raised from the ground. Provisions for storage shall be ample, and the shipments of cement as received be separately stored in such a manner as to provide easy access for identification and inspections of each shipment. Storage buildings shall have capacity for storage of a sufficient quantity of cement to allow sampling at least 12 days before the cement is to be used. Bulk cement, if used, shall be transferred to elevated airtight and weatherproof bins.

Stored cement shall meet the test requirements at any time after storage when retest is ordered by the Engineer. At the time of use all cement shall be free-flowing and free of lumps.

(b) The handling and storing of concrete aggregates shall be such as to prevent segregation or the inclusion of foreign materials. The Engineer may require that aggregates be stored on separate platforms at satisfactory locations.

In order to ensure greater uniformity of the concrete mix, the Engineer may require that the coarse aggregate be separated into two or more sizes. Different sizes of aggregate shall be stored in separate bins or in separate stock piles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed.

Water:

The water for curing, for washing aggregates and for mixing shall be subject to the approval of the Engineer. It shall be free from oil and shall not contain more than 1000 parts per million of chlorides as CL₄, nor more than 1300 parts per million of sulphates SO₄. In no case shall the water contain an amount of impurities that will cause a change in the setting time of the Portland cement of more than 25%.

Water for curing concrete shall not contain any impurities in a sufficient amount to cause discolouration of the concrete or produce etching of the surface.

If required by the Engineer, the quality of the mixing water shall be determined by the Standard Method of Test for Quality of Water to be used in Concrete, AASHTO Methods of Sampling and Testing, Designation T26.

Admixtures:

No admixtures shall be used without written permission from the Engineer. If air-entraining agents, water-reducing agents, set retarders or strength accelerators are permitted to be used, they shall not be used in greater dosages than those recommended by the manufacturer, or permitted by the Engineer. The material should conform to the requirements of AASHTO M154 (ASTM C260) for 7 and 28 day compressive and flexural strengths.

600.4 Construction Requirements:

The manufacturing, transport handling and placing of concrete shall conform to the requirements given hereinafter.

Proportioning of Concrete:

All concrete shall be proportioned by weighing, except as specified herein. The proportions by weight of cement, fine aggregates, coarse aggregates and water necessary to produce concrete of the required strength and consistency shall be approved by the Engineer. Such approval may be withdrawn at any time, and changes in the proportions may be required.

Based on the approved mix proportions, the Contractor shall prepare lists showing the number of kilograms of the various materials to be used in the batch size adopted. The required consistency shall also be shown. Such lists are subject to approval by the Engineer, and shall be posted at the mixer. The amount of water in the mix is the total amount of free water, including the free water held by the aggregates.

No concrete shall be placed in the Works until the results of the 10-day test indicate that the design proportions are satisfactory as per requirements under the below "Testing of Compressive Strength". Adjustment of the proportions shall be subject to the following provisions:

(a) Adjustment for variation in workability - if it is found impossible to obtain concrete of the desired place ability and workability with the proportions originally approved, the Engineer may agree to such changes as are necessary.

(b) Adjustment for new materials - No change in the sources or character of the materials shall be made without due notice to the Engineer and no new materials shall be used until the Engineer has accepted such materials and has approved new proportions based on trial mixes.

The Contractor's attention is directed to the time required to prepare test trial batches and the Contractor shall be responsible for production of trial batches at a sufficiently early date

so that progress of the Work is not delayed.

Consistency:

Concrete shall have a consistency such that it will be workable in the required position. It shall be of such a consistency that it will flow around reinforcement steel but individual particles of the coarse aggregate when isolated shall show a coating of mortar containing its proportionate amount of sand. The consistency of concrete shall be determined to be as dry as is practicable to satisfy the requirements for transportation and placing of the concrete as described hereinafter.

Mixing Concrete:

(a) Mixing General:

Concrete shall be thoroughly mixed in a mixer of an approved size and type that will ensure a uniform distribution of the materials throughout the mass.

All concrete shall be mixed in mechanically operated mixers. Mixing plant and equipment for transporting and placing concrete should be arranged with an ample auxiliary installation to provide a minimum supply of concrete in case of breakdown of machinery or in case the normal supply of concrete shall be sufficient to complete the casting of a section up to a construction joint that will meet the approval of the Engineer.

Equipment having components made of aluminium or magnesium alloys, which would have contact with plastic concrete during mixing, transporting or pumping of Portland cement concrete, shall not be used.

Concrete mixers shall be equipped with adequate water storage and a device for accurately measuring and automatically controlling the amount of water used.

Materials shall be measured by weighing, except as otherwise specified or where other methods are specifically authorized by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. The accuracy of all weighing devices except that for water shall be such that successive quantities can be measured to within one percent of desired amount. Cement in standard packages (bags) need not to be weighed. The water-measuring device shall be accurate to plus or minus 0.5 percent. All measuring devices shall be subject to the approval of the Engineer. Scales and measuring devices shall be tested at the expense of the Contractor as frequently as the Engineer may deem necessary to ensure their accuracy.

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cut-off shall not vary from the weight designated by the Engineer more than one percent for cement, 1½ percent for any size of aggregate, or one percent for the total aggregate in any batch.

Where volumetric measurements are authorized by the Engineer, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowances shall be made for variations in the moisture content of the aggregates, including the bulking effect in the fine aggregates. Boxes of similar containers of the exact volume require shall be filled and struck off. Measurement by wheel barrow volumes will not be.

(b) Mixing at Site

Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. The pick-up and throw-over blades of mixers shall be restored or replaced when any part or section is worn one inch or more below the original height of the manufacturer's design. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used.

When bulk cement is used and volume of the batch is one cubic yard or more, the scale and weigh hopper for Portland cement shall be separate and distinct from the aggregate hopper or hoppers. The discharge mechanism of the bulk cement weigh hopper shall be interlocked against opening before the full amount of cement is in the hopper. The discharging mechanism shall also be interlocked against opening before the full amount of cement is in the hopper. The discharging mechanism shall also be interlocked against opening when the amount of cement in the hopper is underweight by more than one percent or overweight by more than three percent of the amount specified.

When the aggregates contain more water than the quantity necessary to produce a saturated surface dry condition, representative samples shall be taken and the moisture content determined for each kind of aggregate.

The temperature of mixed concrete immediately before placing shall be not more than 35° C or not less the 5° C or as approved by the Engineer. Aggregates and water shall be cooled as necessary to produce concrete within this temperature limit. Neither aggregates nor mixing water shall be heated to exceed 65° C. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.

The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregates. All water shall be in the drum by the end of the first ¼ of the specified mixing time.

Cement shall be batched and charged into the mixer by means that will not result in loss of cement due to the effect of wind, or in accumulation of cement on surfaces of conveyors or hoppers, or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

The entire contents of a batch mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch except water shall be deposited simultaneously into the mixer.

All concrete shall be mixed for a period of not less than 1½ minutes after all materials, including water, are in the mixer. During the period of making, the mixer shall operate at the speed for which it has been designed.

Mixers shall be operated with an automatic timing device. The time device and discharge mechanism shall be so interlocked that during normal operation no part of the batch will be discharged until the specified mixing time has elapsed.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand and water to coat the inside of the drum without reducing the required mortar content of the mix. When mixing is to cease for a period of one hour or more, the mixer shall be thoroughly washed and cleaned.

(c) Plant Mixing:

Mixing at a central plant shall conform to the requirements for mixing at the site.

(d) Truck Mixing

Truck mixers, unless otherwise authorized by the Engineer, shall be of revolving drum type, watertight, and so constructed that the concrete can be mixed to ensure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch; in which case a tank is not required. Truck mixers may be required to be provided with a means by which the mixing time can be readily verified by the Engineer.

The maximum size of batch in truck mixers shall not exceed the minimum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing shall be continued for not less than 50 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.

Mixing shall begin within 30 minutes after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water or surface-wet aggregate and when the temperature is above 32° C, this limit shall be reduced to 15 minutes. The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the judgment of the Engineer, there will be not harmful effects on the cement.

(e) Partial Mixing at the Central Plant

When a truck mixer, or an agitator provided with adequate mixing blades, is used for transportation, the mixing time at the stationery machine mixer may be reduced to 30 seconds and the mixing completed in a truck mixer/agitator. The mixing time in the truck mixer or agitator equipped with adequate mixing blades shall be as specified for truck mixing.

(f) Hand Mixing

In case where the Engineer may authorize hand mixing, the latter shall be done on a watertight platform and in such a manner as to ensure a uniform distribution of the materials throughout the mass. Mixing shall be continued until a homogeneous mixture of the required consistency has been obtained.

Hauling and Delivery of Mixed Concrete

(a) Hauling

Mixed concrete may be transported to the delivery point is truck agitator or truck mixers operating at the speed designated by the manufacturer of the equipment, as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place.

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

Bodies of non-agitating hauling equipment shall be so constructed that leakage of the concrete mix, or any part thereof, will not occur at any time, and they shall be self-cleaning during discharge.

Concrete hauled in open-top vehicle shall be protected during hauling against access of rain or exposure to the sun for more than 20 minutes when the ambient temperature exceeds 25° C.

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point, unless ordered by the Engineer. If the Engineer orders additional water to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed after the water has been added and before discharge is commenced.

The rate of discharge of mixed concrete from truck mixer agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1½ hours, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of cement to the aggregates. Under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 30° C or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.

(b) Delivery

The organization supplying concrete shall have sufficient plant capacity and transportation apparatus to ensure continuous delivery at the rate required. The rate of the delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The methods of delivering and handling the concrete shall be such as will facilitate placing with the minimum handling.

(c) Retempering

The concrete shall be mixed only in such quantities as are required for immediate use and any concrete that has developed initial set shall not be used. Concrete that has partially hardened shall not be retempered or remixed.

Handling and Placing Concrete

(a) General

In preparation of the placing of concrete all saw-dust, chips and other construction debris and extraneous matter shall be removed from inside the form-work, and struts, stays and braces serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

No concrete shall be used that does not reach its final position in the forms within the time stipulated above under Section "Hauling and Delivery of Mixed Concrete.". Concrete shall be placed so as to avoid segregation of materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying concrete to the

forms shall be permitted only on written authorization of the Engineer. In any case the Engineer will reject the use of equipment for concrete transportation that will allow segregation, loss of fines, or in any other way will have a deteriorating effect on the concrete quality.

Open troughs and chutes shall be of metal or metal lined, where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reserve the direction of movement.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run; water used for flushing shall be discharged clear of the structure.

When placing operations would involve dropping the concrete more than 1½ metres, it shall be conveyed through sheet metal or other approved pipes. As far as practicable, the pipes shall be kept buried in the newly placed concrete. After initial set of the concrete the forms shall not be jarred and no loading of any kind shall be placed on the ends of projecting reinforcement bars.

The concrete shall be placed as near as possible to its final position and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

(b) Pumping

The placing of concrete by pumping will be permitted only if authorized by the Engineer. The equipment shall be so arranged that no vibration will occur that might damage freshly placed concrete.

Where concrete is conveyed and placed by mechanically applied pressure the equipment shall be suitable in kind and adequate in capacity for the Work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is obtained. When pumping has been completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be thoroughly cleaned.

(c) Placing Concrete Under Water

Concrete shall not be placed under water except where inevitable in which case approval must be sought from the Engineer and the work carried out under his immediate supervision. In this case the method of placing shall be as hereinafter specified.

Concrete deposited under water shall be Class A concrete with a minimum cement content of 400 kg per cubic metre of concrete. The slump of the concrete shall be maintained between 18 and 22 cm. To prevent segregation it shall be carefully placed in compact mass, in its final position, by means of tremie, a bottom-dump bucket, or other approved means, and it shall not be disturbed after being placed. Water must not be allowed to flow past the fresh concrete surface.

A tremie shall consist of a tube constructed in sections having flanged couplings fitted with

gaskets with a hopper at the top. The tremie shall be supported so as to permit free movement of the discharge and over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of work so as to prevent water from entering the tube and shall be completely submerged in concrete at all times; the tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, but always keeping it in the placed concrete. The flow shall be continuous until the work has been completed.

When the concrete is placed with a bottom-dump bucket, the top of the bucket shall be open. The bottom doors open freely downward and outward when stripped. 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 discharged shall be withdrawn slowly until well above the concrete.

(d) Compaction

Concrete, during and immediately after placing, shall be thoroughly compacted, except lean concrete under footings and concrete deposited under water.

Concrete in walls, beams, columns, etc., shall be placed in horizontal layers not more than 30 cm thick, except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding layer has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the layers. Each layer shall be compacted so as to avoid the formation of a construction joint with a preceding layer.

The compaction shall be done by mechanical vibration. The concrete shall be vibrated internally unless special authorization of other methods is given by the Engineer or is provided herein. Vibrators shall be of a type, design and frequency approved by the Engineer. The intensity of vibration shall be such as visibly to affect a mass of concrete with a 3 cm slump over a radius of at least half a metre. The contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it has been placed in the forms. Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms and shall be applied at the point of placing and in the area of freshly placed concrete. The vibrations shall be inserted into and withdrawn from the concrete slowly. The vibration shall be of sufficient duration and intensity to compact the concrete thoroughly but shall not be continued at any one point to the extent that localized areas of grout are formed. Application of vibrations shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. Vibration shall not be applied directly to the reinforcement or to sections of layers of concrete that have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to transport concrete neither in the forms nor in troughs or chutes.

Sufficient vibrators in a serviceable condition shall be on the site so that spare equipment is always available in the event of breakdowns.

Vibration shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

The provisions for vibration of this paragraph shall apply to precast girders, and other precast members except that, if approved by the Engineer, the manufacturer's method of

vibration may be used.

Casting Sections and Construction Joints:

(a) General:

The concrete in each integral part of a structure shall be placed continuously, and the Contractor will not be allowed to commence work on any such part unless sufficiently inspected and approved material for the concrete is at hand, and his forces and equipment are sufficient to complete the part without interruption in the placing of the concrete.

Joints in the concrete due to stopping work shall be avoided as far as possible. Such joints, when necessary, shall be constructed to meet the approval of the Engineer.

When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its shape, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. Where a "feather edge" might be produced at a construction joint, as in the sloped top surface of a wing wall, an inset form-work shall be used to produce an edge thickness of not less than 15 cm in the succeeding layer. Work shall not be discontinued within 50 cm of the top of any face, unless provision has been made for a coping less than 50 cm thick, in which case, if permitted by the Engineer, the construction joint may be made at the underside of the coping.

Immediately following the discontinuance of placing concrete all accumulations of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. Care shall be exercised during the cleaning of the reinforcing steel, not to injure or break the concrete steel bond at and near the surface of the concrete.

(b) Box Culverts

In general, the base slab of box culverts shall be placed and allowed to set before the remainder of the culvert is constructed. In the construction of box culverts the side walls and top slab may be constructed as a monolith.

If the concrete in the walls and top slab is placed in two separate operations special care shall be exercised in order to secure bonding in the construction joint and appropriate keys shall be left in the side walls for anchoring the cover slab. Each wing wall shall be constructed, if possible, as a monolith. Construction joints in walls, where unavoidable, shall be horizontal and wing so located that no joints will be visible in the exposed face of the wing wall above the ground line. Vertical Construction joints shall be at right angles to the axis of the culvert.

(c) Columns, Slabs and Girders:

Concrete in columns shall be placed in one continuous operation, unless otherwise directed. The concrete shall be allowed to set for at least 12 hours before the caps are placed.

Unless otherwise permitted by the Engineer, no concrete shall be placed in the superstructure until the column forms have been stripped sufficiently to determine the condition of the concrete in the columns. The load of the superstructure shall not be allowed to come upon the bents until they have been in place at least 14 days, unless otherwise permitted by the Engineer.

Concrete in slab spans shall be placed in one continuous operation for each span unless otherwise provided.

Concrete in T-beam or deck girder spans shall be placed in one continuous operation unless otherwise directed. If it is permitted to place the concrete in two separate operations, each of the operations shall be continuous; first, to the top of the girder stems, and second, to completion. In latter case, the bond between stem and slab shall be secured by means of suitable shear keys in top of the girder stem, designed in accordance with AASHTO's Standard Specifications for Highway Bridges, article 1.5.1(C). In general, suitable keys may be formed by the use of timber blocks approximately 5 cm by 10 cm in cross-section having a length of 10 cm less than the width of the girder stem. These key blocks shall be placed along the girder stems as required, but the spacing shall not be greater than 30 cm centre to centre. The blocks shall be levelled and oiled in such a manner as to ensure their ready removal, and they shall be removed as soon as the concrete has set sufficiently to retain its shape. If the Contractor wishes to place the concrete in two separate operations he shall, with his request for permission to do so, submit plans of the required changes to the reinforcement. Attention is drawn to the AASHTO Standard Specifications for Highway Bridges, article 1.5.6(g).

In box girders, the concrete in the bottom slab shall be poured first, as a separate operation.

The concrete in the webs and the top slab shall be placed in one continuous operation unless otherwise specified. If it is permitted to place the concrete in more than one operation, the requirements for T-beams shall apply.

(d) Construction Joints:

Construction joints shall be made only where shown on the drawings, unless otherwise approved by the Engineer. If not detailed on the drawings, construction joints, also in cases of emergency, shall be placed to meet the approval of the Engineer. Shear keys or reinforcement shall be used, unless otherwise specified, to transmit shear or to bond the two sections together.

Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened. The surface of the hardened concrete shall be roughened as required by the Engineer, in a manner that will not leave loose particles of aggregate or damaged concrete at surface. It shall be thoroughly cleaned of foreign matter and laitance. When directed by the Engineer the surface of the hardened concrete which will be in contact with new concrete shall be washed with water to his satisfaction, and to ensure an excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and watered surface, including vertical and inclined surface, shall first be thoroughly covered with a coating of mortar of the same proportion of sand and cement as the class of concrete used against which the new concrete shall be placed before the grout or mortar has attained its final set.

The placing of concrete shall be carried out continuously from joint to joint. The face edges of all joints, which are exposed to view, shall be carefully finished true to line and elevation.

Concrete Surface Finishing:

(a) General:

Concrete surface finished shall be classified as follows:

- Bridge Deck Surface Finish
- Sidewalk Surface Finish
- Ordinary Surface Form Finish
- Class I Surface Form Finish.

The requirements for sidewalk surface finish apply to the surfaces of the bottom slabs in box culverts, except that the acceptable variation from a three-metre straight edge shall be 12 mm, and brooming shall be omitted.

The ordinary surface form finish shall be the final finish applied to all surfaces after removal of forms, unless otherwise specified or called for on the drawings.

The Class 1 surface form finish shall be applied only where specified, or as required by the Engineer when the ordinary surface finish did not produce the required smooth, even surface of uniform texture and appearance.

(b) Bridge Deck Surface Finish:

A smooth riding surface of uniform texture, true to the required grade and cross-section, shall be obtained on all bridge roadway decks. The Contractor may use hand tools, or finishing machines or a combination of both, conforming to the requirements specified herein for finishing bridge roadway deck concrete.

Finishing of concrete placed in bridge decks shall consist essentially of compacting and striking off the surface of the concrete as placed and floating with longitudinal floats.

The placing of concrete in bridge roadway decks will not be permitted until the Engineer is satisfied that the rate of producing concrete will be sufficient to complete the proposed placing and finishing operations within the scheduled time, that experienced finishing machine operators and concrete finishers are employed to finish the deck, that fogging equipment and all necessary finishing tools and equipment are on hand at the site of the Work and in satisfactory condition for use. Finishing machines shall be set up sufficiently in advance of use to permit inspection by the Engineer during the daylight hour before each pour.

The adjustment and operation of deck finishing machines shall be verified by moving the machine over the full length of the deck section to be placed and traversing the float completely across all end bulkheads before replacement of concrete is begun.

Unless adequate lighting facilities are provided by the Contractor, the placing of concrete in bridge decks shall cease at such time that finishing operations can be completed during daylight hours.

Rails for the support and operation of finishing machines and headers for hand-operated strike-off devices shall be completely in place and firmly secured for the scheduled length for concrete placement before placing of concrete will be permitted. Rails for finishing machines shall extend beyond both ends of the scheduled length for concrete replacement a sufficient distance that will permit the float of the finishing machine to fully clear the concrete to be placed. Rails or headers shall be adjustable for elevation and shall be set to elevations, with allowance for anticipated settlement, camber and deflection of falsework, as required to obtain a bridge roadway deck true to the required grade and cross-section. Rails or headers shall be of a type and shall be so installed that no springing or deflection will occur under the weight of the finishing equipment and shall be so located that finishing equipment may operate without interruption over the entire bridge roadway deck being

finished. Rails or headers shall be adjusted as necessary to correct for unanticipated settlement or deflection, which may occur during finishing operations.

Should settlement or other unanticipated events occur, which in the opinion of the Engineer would prevent obtaining a bridge deck conforming to the requirements of these Specifications, placing of deck concrete shall be discontinued until corrective measures satisfactory to the Engineer are provided. In the event satisfactory measures are not provided prior to initial set of the concrete in the affected area, the placing of concrete shall be discontinued and a bulkhead installed at a location determined by the Engineer. All concrete in place beyond the bulkhead shall be removed.

Unless otherwise permitted by the Engineer, bridge deck concrete shall be placed in a uniform heading approximately parallel to the bridge pier or bent caps. The rate of placing concrete shall be limited to that which can be finished before the beginning of initial set except that concrete for the deck surface shall not be placed more than 3 m a head of strike-off.

After the concrete has been placed, compacted and consolidated the surface of the concrete shall be carefully struck off by means of a hand-operated strike board operating on headers, or by a finishing machine operating on rails. A uniform deck surface true to the required grade and cross-section shall be obtained.

Following strike-off, the surface of the concrete shall be floated longitudinally. In the event strike-off is performed by means of a hand-operated strike board, 2 separate hand-operated float boards for longitudinal floating shall be provided. The first float shall be placed in operation as soon as the condition of the concrete will permit and the second float shall be operated as far back of the first float as the workability of the concrete will permit.

In the event the strike-off is performed with a finishing machine, longitudinal floating of the concrete shall be performed by means of a hand-operated float board or a finishing machine equipped with a longitudinal wooden float. The longitudinal wooden float on the finishing machine shall have a length of not less than 2.5 m nor more than 3.5m. When both strike-off and a second machine, with a second operator, shall be used for longitudinal floating, longitudinal floating may be performed with the same finishing machine that is used for strike-off provided that the length of deck unit placed is not more than 10m and the strike-off operation is completed for said deck before the condition of the concrete requires that longitudinal floating be started.

Finishing machines used for strike-off having a wheel base 1.8m less shall be followed by 2 separated hand-operated float boards for longitudinal floating. All the provisions in this section pertaining to hand-operated float boards shall apply to the 2 separate float boards for longitudinal floating.

Longitudinal floats, either hand-operated or machine-operated, shall be used with the long axis of the float parallel to the centre line of the bridge roadway. The float shall be operated with a combined longitudinal and transverse motion planning off the high sides and floating the material removed into the low areas. Each pass of the float shall lap the previous pass by one-half the length of the float. Floating shall be continued until a smooth riding surface is obtained.

In advance of curing operations, the surface of the concrete shall be textured by brooming with a stiff bristled broom or by other suitable devices which will result in uniform scoring. The operation shall be performed at a time and in a manner to produce a hardened surface having a uniform texture.

Hand-operated float boards shall be from 3.5 to 5.0 m long, ribbed and trussed as necessary to provide a rigid float and shall be equipped with adjustable handle at each end. The float shall be wood, not less than 2.5cm thick and from 10 cm to 20 cm wide. Adjusting screws spaced, as not to exceed 60 cm on centres shall be provided between the float and the rib. The float board shall be maintained free of twist and true at all times.

Hand-operated float boards shall be operated from transverse finishing bridges. The finishing bridges shall span completely the roadway area being floated and a sufficient number of finishing bridges shall be provided to permit operation of the floats without undue delay. Not less than 2 transverse finishing bridges shall be provided when hand-operated float boards are used. When a finishing machine is used for longitudinal floating, one finishing bridge equivalent to the transverse finishing bridge specified herein shall be furnished for use by the Engineer.

All finishing bridges shall be of rigid construction and shall be free of excessive wobble and springing when used by the operators of longitudinal floats and shall be easily moved.

Immediately following completion of the deck finishing operations the concrete in the deck shall be cured as specified in "Curing Concrete" hereinafter.

The finishing surface of the concrete shall be tested by means of a straightedge 3.0 m long. The surface shall not vary more than 8 mm from the lower edge of the straightedge. All high areas in the hardened surface in excess of 8 mm as indicated by testing shall be removed by abrasive means. After grinding by abrasive means has been performed, the surface of the concrete shall not be smooth or polished. Ground areas shall be of uniform texture and shall present neat and approximately rectangular patterns.

Where the concrete of the bridge deck is to be covered by bituminous surfacing, earth, or other cover, 2.5 cm or more in thickness, the surface of the concrete shall not vary more than 12 mm from the lower edge of the 3m straightedges.

Bridge deck surface under the curves, railings and sidewalks shall be struck off to the same plane as roadway and left undisturbed when future widening is shown on the plans.

(c) Sidewalk Surface Finish

After the concrete has been placed it shall be compacted and the concrete shall be struck off by means of a strike board, floated with a wooden or cork float and finished with a broom. An approved edging tool shall be used on all edges and at all expansion joints. Brooming shall be transverse to the line of traffic and if water is necessary, it shall be applied to the surface immediately in advance of brooming. The surface shall not vary more than 6 mm under a 3 m straightedge, and the finished surface shall be free from blemishes.

(d) Ordinary Surface Form Finish

Ordinary surface finish shall consist of filling holes or depressions in the surface of the concrete, repairing rock pockets, removing stains and discolourations visible from travelled ways. Ordinary surface finish shall be applied to all concrete surfaces either as a final finish or preparatory to the Class 1 finish. On surfaces which are to be buried underground or surfaces which are enclosed, such as the cells of box girders, the removal off fins will not be required.

Except as provided herein, all form bolts and metal placed for the convenience of the

Contractor shall be removed to a depth of at least 2.5 cm below the surface of the concrete. All rock pockets and other unsound concrete shall be removed. The resulting holes or depressions shall be cleaned and filled with mortar. Form bolts projecting into the cells of box girders need not to be removed unless permanent access is provided into the cells, in which case such bolts shall be removed flush with the surface of the concrete.

Mortar used to fill bolt holes shall consist of one part cement and two parts sand. Other depressions and pockets shall be filled with either packed mortar or air-blown mortar as directed by the Engineer. Mortar shall be cured in conformance with the requirements below "Curing Structures".

If rock pockets or holes, in the opinion of the Engineer, are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

(e) Class 1 Surface From Finish

Class 1 surface finish shall consist of finishing the surfaces of the structure as necessary to produce even surfaces of uniform texture and appearance, free of unsightly bulges, depressions and other imperfections. The degree of care in building forms and character of materials used in form-work will be a contributing factor in the amount of additional finishing required to produce even surfaces of uniform texture and appearance, free of unsightly bulges, depressions and other imperfections, and the Engineer shall be the sole judge in this respect.

After completion of the ordinary finish, areas which do not exhibit the required smooth, even surface of uniform texture and appearance shall be sanded with power sanders or other approved abrasive means until smooth, even surfaces of uniform texture and appearance are obtained. The use of power Carborundum stones or disks will be required to remove bulges and other imperfections.

Class 1 surface finish shall not be applied until a uniform appearance can be obtained.

Class 1 surface finish may be required to be applied as the final finish for the following surfaces, unless otherwise directed by the Engineer:

- All form finish surfaces of bridge superstructures, except the under-surfaces between girders and the inside vertical surfaces of T girders.
- All surfaces of bridge piers, columns and abutments, and retaining walls above finished ground and to at least 30 cm below finished ground.
- All surfaces of open spandrel arch rings, spandrel columns and abutment towers.
- Surfaces above finished ground of culvert headwalls, endwalls and retaining walls.

Curing Concrete:

(a) General:

All newly placed concrete shall be cured in accordance with these Specifications, unless otherwise directed by the Engineer.

(b) Methods of Curing:

The curing method shall be one or more of the following to be described hereinafter:

- Water Method
- Curing Compound Method
- Water proof Membrane Method if required by the Engineer.
- Forms-in-place Method

Water Method:

The concrete shall be kept continuously wet by the application of water for a minimum period of 5 days after the concrete has been placed.

Cotton mats, rugs, carpets, or earth or sand blankets may be used as a curing medium to retain the moisture, the entire surface of the concrete shall be kept damp of applying water with a nozzle that atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period the concrete surfaces shall be cleared of all curing media.

When concrete bridge decks and flat slabs are to be cured without the use of a moisture retaining medium, the entire surface of the bridge deck or slab shall be kept damp by the application of water with an atomizing nozzle as specified in the preceding paragraph until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than 7 days.

Curing Compound Method:

Surfaces exposed to the air may be cured by the application of an impervious membrane if approved by the Engineer.

The membrane-forming compound used shall consist of a practically colour-less liquid. The use of any membrane-forming compound that will alter the natural colour of the concrete or impart a slippery surface to any wearing surface shall be prohibited. The compound shall be applied with a pressure spray in such a manner as to cover the entire concrete surface with a uniform film, and shall be of such character that it will harden within 30 minutes after application. The amount of compound applied shall be ample to seal the surface of concrete thoroughly. Power-operated spraying equipment shall be equipped with an operational pressure gauge and means controlling the pressure.

The curing compound shall be applied to the concrete following the surface finishing operation immediately after the moisture sheen begins to disappear from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any delay in the application of curing compound which results in any drying or cracking of the surface, application of water with an atomizing nozzle as specified under "Water Method" shall be started immediately and shall be continued until application of the compound is resumed or started; however, the compound shall not be applied over any resulting free-standing water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures, the damaged portion shall be repaired immediately with additional compound.

Curing compounds shall not hard settle in storage. They shall not be diluted or altered in any manner after manufacture. At the time of use, the compound shall be in a thoroughly mixed condition. If the compound has not been used within 120 days after the date of manufacture, the Engineer may require additional testing before use to determine compliance with requirements.

An anti-settling agent or combination of anti-settling agents shall be incorporated in the curing compound to prevent caking.

The curing compound shall be packed in clean barrels or steel containers or shall be supplied from a suitable storage tank located at the job site. Site storage tanks shall have a permanent system designed to completely redisperse any settled material without introducing air or any other foreign substance.

Containers shall be well sealed with ring seals and lug type crimp lids. The linings of the containers shall be of a character that will resist the solvent of the curing compound. Each container shall be labelled with the manufacturer's name, specification number, batch number, number of litres and date of manufacture, and shall have label warning concerning flammability. The label shall also warn that the curing compound shall be well stirred before use. When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.

Curing compound may be sampled by the Engineer at the source supply and at the job site.

Waterproof Membrane Method:

The exposed finishing surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the curing membrane shall remain in place for a period of not less than 72 hours.

Waterproof paper shall conform to the specifications of AASHTO Designation M139. Plastic type sheeting shall conform the specifications of AASHTO Designation M171.

The waterproof paper or white plastic membrane shall be formed into sheets of such width as to provide a complete cover of the entire concrete surface.

All joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 10 cm.

The sheets shall be securely weighted down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the Engineer.

Should any portion of the sheets be broken or damaged within 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

Sections of membrane which have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used.

Forms-in-place Method:

Formed surfaces of concrete may be cured by retaining the forms-in-place. The forms shall

remain in place for a minimum period of 7 days after the concrete has been placed, except that for members over 50 cm in least dimension, the forms shall remain in place for a minimum period of 5 days. Wooden forms shall be kept wet by watering during the curing period.

(c) Curing Structures:

All newly placed concrete for cast-in-place structures, other than highway bridge decks, shall be cured by the water method, the forms-in-place method, or, as permitted herein, by the curing compound method, all in accordance with the requirements as above "Methods of Curing".

The curing compound method may be used on concrete surfaces which are to be buried underground, and surfaces where only Ordinary Surface Finish is to be applied and on which a uniform colour is not required and which will not be visible from any public travelled way.

The top surface highway bridge decks shall be cured by both the curing compound method, and by the water method. The curing compound shall be applied progressively during the deck-finishing operations immediately after finishing operations have been completed on each individual portion of the deck. The water cure shall be applied not later than 4 hours after completion of the deck finishing or, for portions of the decks on which finishing is completed after normal working hours, the water cure shall be applied not later than 8.00 a.m. the following morning.

When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surfaces being cured by the curing compound method or by the forms-in-place method, until the Engineer determines that a cooling effect is no longer required.

(d) Curing Precast Concrete Members:

Precast concrete members shall be cured for not less than 7 days by the water method or by steam curing, at the option of the Contractor. Steam curing for precast members shall conform to the following provisions:

- After placement of the concrete, members shall be held for a minimum 4-hours presteaming period.
- To prevent moisture loss on exposed surfaces during the presteaming period, members shall be covered immediately after casting or the exposed surfaces shall be kept wet by fog spray or wet blankets.
- Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good repair and secured in such a manner to prevent the loss of steam and moisture.
- Steam at jets shall be low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 20° C per hour. The curing temperature throughout the enclosure shall not exceed 65° C and shall be maintained at a constant level for a sufficient time necessary to develop the required compressive strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a

location where temperature is representative of the average temperature of the enclosure.

- Temperature recording devices that will provide an accurate continuous permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per 60m of continuous bed length will be required for checking temperature.

- Curing of precast concrete will be considered completed after a termination of the steam curing cycle.

Testing of Aggregates:

Samples of fine and coarse aggregates to be used shall be selected by the Engineer. It shall be the responsibility of the Contractor to designate the source or sources of aggregate and to obtain the necessary samples and submit them for testing at least 60 days before actual concreting are to begin.

Samples of aggregates shall be obtained and tested in accordance with the following standard AASHTO methods:

Sampling aggregate	T - 2
Sieve analysis	T - 27
Amount of material Passing the No. 200 sieve	T - 11
Organic impurities	T - 21
Sodium sulphate soundness	T - 104
Friable particles	T - 112
Abrasion loss	T - 96

No aggregate for testing during the production of concrete shall be sampled at the discharge gates of the bins feeding the weight hopper. The Contractor, at his expense, shall provide safe and suitable facilities for obtaining the samples. No concreting work on the project will be permitted to be done until the Engineer signifies in writing that he gives his approval, following the performance of the necessary tests, to the use of all the materials involved in making the concrete.

Testing of Compressive Strength:

Concrete compressive strength requirements consist of a minimum strength at the age of 28 days and the minimum strength which must be attained before various loads or stresses are applied to the concrete. The various strengths required are specified in Table (5A).

The compressive strength of concrete will be determined from test cylinders which have been fabricated from concrete sampled and tested in accordance with AASHTO T23 and AASHTO T22.

Trial Batches for Mix Proportions:

The placing of concrete shall not begin until trial batches of the mix design to be used have been produced by the Contractor and tested. The trial mix proportions shall be such that the average strength of 5 consecutive test cylinders shall be 20% higher than the specified 28 day strength and no individual test cylinder shall be below the specified strength.

When concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member test cylinders will be cured under conditions similar to those at the casting site. The compressive strength of concrete determined for such purposes will be evaluated on the basis of individual tests.

Measurement and Payment:

The quantity of concrete to be paid for shall be the number of cubic metres of concrete of

the various classes complete in place and accepted, if payment is not provided for under other items shown in the Bill of Quantities.

In measuring the volume of concrete to be paid for, the dimensions to be applied shall be those shown on the drawings except where otherwise ordered by the Engineer in writing.

Deductions from the theoretical volume of concrete shall be made for the volume of draining holes, weep holes, pipes and conduits, etc., in cases where their cross-sectional areas exceed 500 square centimetres.

The measurement shall not include any concrete used in the construction of cofferdams or falsework.

The volume involved in fillets, scorings or chamfers less than 50x50mm shall be measured as if these features were not present.

Lean concrete shall be measured by a number of square metres of a net area of the foundations. The Contractor's rate for the lean concrete shall include for the 10 cm sand drain bedding in addition to the concrete.

The accepted quantity measured as provided above shall be paid for at the contract unit price respectively for the pay items listed below that is shown in the Bill of Quantities which prices and payment shall be full compensation for all equipment, tools, materials, form-work, bracing and also for such works as curing, surface finishing as required, formation of construction joints and any such work and incidentals necessary to complete the item except works that are paid for under other pay item.

CONCRETE CURBS

PART 1 - GENERAL

Drawings and General Provisions of the Contract, including Conditions of Contract and Division 1 Specifications Sections, apply to this Section.

SUMMARY

A.This Section includes the following:

Precast concrete curbs and units.

B.Related sections include the following:

Division 3: Section 03300 "Cast-in-place Concrete".

SUBMITTALS

The Contractor shall submit for approval, samples of each of the proposed units together with the manufacturer's certificates and details of the method of manufacture and materials to be used. The Engineer's approval of the samples will not be considered final and the Engineer may reject any precast units delivered to the Site, which do not, in his opinion, meet the required standards.

QUALITY ASSURANCE

Quality System: Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Engineer and the Employer.

Fabricator Qualifications: Shall comply with the following requirements:

1. Has sufficient production capacity to produce required units without delaying the work.
2. Is experienced in manufacturing precast concrete curbs units and tiles similar to those indicated for this project and can demonstrate a record of successful in-service performance.

DELIVERY, STORAGE, AND HANDLING

Deliver precast units to Project Site in such quantities and at such times to ensure continuity of installation. Store units at Project-site in such a way as to prevent cracking or other physical damage.

PART 2 - PRODUCTS

CONCRETE

A.All concrete shall conform with the relevant requirements of Section 03300 - "Cast-in-place Concrete" and shall be produced by an approved commercial ready-mix plant. All In-situ and precast concrete shall have 28 days compressive strength on cylinder equal to 21 MPa, except base course and backing concrete which shall be 17 MPa with a maximum aggregate size equal to 60 mm.

B.Mortar shall conform with all relevant requirements of Section 03300 - " Cast-in-place Concrete ", and shall consist of cement and fine aggregate having the same proportions as that used in the concrete construction.

601 PRECAST CONCRETE UNITS

All precast units shall be manufactured to the dimensions shown on the Drawings. Manufacturing tolerances shall be 3 mm in any one dimension. End and edge faces shall be perpendicular to the base.

Each precast curb unit shall normally be 500 mm in length and this length shall be reduced to 250 mm or as directed, where units are to be installed along curves of less than 10 m radius.

For horizontal curves of radius less than 10 m, curb and gutter units shall be manufactured to the radius shown and in such circumstances straight elements or portions of straight elements shall not be used. Bullnoses and curved faces shall be of constant radius with a smooth change from radius to plain face.

Precast units shall be cast upside down in approved steel molds under conditions of controlled temperature and humidity. The units shall be steam cured, or cured by another method approved by the Engineer, until the concrete attains the full specified 28-day

strength.

BEDDING

Bedding material shall conform with the relevant requirements of Section 02721 - "Aggregate Sub-base Course" for Class A or Class B granular material.

PART 3 - CONSTRUCTION AND INSTALLATION

PRECAST CONCRETE CURBS

A. Base course concrete shall be placed, compacted and shaped to the sections shown on the Drawings. Concrete shall be compacted with an approved internal type vibrator or if approved, by hand spudding and tamping. Edges shall be rounded if necessary by the use of wood molding or by the use of an edger as applicable. The concrete base shall be finished to a true and even surface with a wood float. Concrete shall be membrane or water cured for at least 7 days before precast units are placed thereon.

B. Precast units shall be soaked in water immediately before installation. Units shall be set accurately in position in mortar on the concrete base. Joints between precast units shall not be mortared unless otherwise shown on the Drawings. Units shall be closely spaced and every 10 m run shall be provided with an expansion joint.

ERECTION TOLERANCE

Tolerances on tangent sections of curb and gutter shall be tested using a 4 m straightedge. The finished surface of concrete shall not deviate from the straightedge between any 2 contact points by more than 5 mm. Curved sections shall be true to the specified radius plus or minus 5 mm and all joints shall be flush and neat in appearance.

The area adjacent to completed and accepted curbs and gutters shall be backfilled with approved material to the top edges of the curbs or gutters or the elevations shown on the Drawings. Backfill shall be placed and compacted to 95% AASHTO T 180 maximum density.

FIELD QUALITY CONTROL

Remove and replace work that does not comply with specified requirements.

Additional testing and inspecting, at the Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

REPAIRS

Repair precast concrete curbs to match color, texture, and uniformity of surrounding precast concrete curbs and tiles if permitted by the Architect.

Remove and replace damaged precast concrete curb units if repairs do not comply with requirements

Joints and Bearing Devices for Concrete Structures:

Description:

The work shall consist of furnishing and installing in the concrete structure joint and bearing devices and handrails in accordance with the drawings or as required by the Engineer and the requirement of these Specifications.

Material Requirements:

Joints:

a) Premoulded Expansion Joint Fillet

Premoulded Joint filler shall conform to the requirement of AASHTO SQUARE METER13 or equivalent.

b) Elastic Joint Sealing:

Joint sealing material shall be Expandite two-part polysulphide sealant Thioflex 600 or other equivalent approved compound.

Elastomeric Bearing Pads:

Elastomeric bearing pads shall conform to the dimensions as given in the drawings and AASHTO SQUARE METER51 or equivalent approved.

The Contractor shall furnish to the Engineer a certification by the manufacturer that the elastomer, and fabric (if used), in the elastomeric bearing pads to be furnished conforms to all of the above requirements. The certification shall be supported by a certified copy of the results of tests performed by the manufacturer upon samples of the elastomer and fabric to be used in the pads.

Bridge Handrail:

Material for the steel railing shall conform to ASTM A501 Grade B or equivalent approved by the Engineer.

Construction Requirements

Open Joints:

Open joints shall be constructed at the locations shown on the drawings or required by the Engineer using a suitable material which is subsequently removed. When removing the material, care shall be exercised to avoid chipping or breaking the concrete. Reinforcement shall not extend across an open joint unless shown on the drawings.

Filled Joints:

When joints of the preformed type are required on the drawings or by the Engineer, the filler shall be placed in correct position before concrete is placed against the filler. Holes and joints in the fill shall be cause for their being rejected.

Bridge Handrail:

The bridge railing shall be constructed to the line and grade shown on the plans and shall not reflect any unevenness in the structure. Railing shall not be placed on a span until centering or flasework has been removed, rendering the span self-supporting.

(a) Material 12 mm thick or less may be cut by shearing, sawing, or milling. Material over 12 mm thick shall be sawed or milled. Galvanizing will not be required. All welding shall conform to the American Welding Society Standards for Bridges, current edition. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be filleted by drilling prior to cutting. Flame cutting will not be permitted.

(b) Bending: Material may be heated to a temperature not exceeding 200° C for period not exceeding 30 minutes to facilitate bending, unless cold bending is required to retain the original mechanical properties of the material furnished.

(c) Bolt Holes: Bolt holes shall be drilled to finished size or sub-punched smaller than the nominal diameter of the fastener and reamed to size. The amount by which the diameter of a sub-punched holes is smaller than that of the finished hole shall be at least one-quarter the thickness of the piece. The finished diameter of holes shall be not more than 7 percent greater than the nominal diameter of the fastener except:

(1) Slotted bolt hole to take care of expansion shall be provided as called for on the plans.

(2) Anchor bolt holes may be up to 25 percent greater than the nominal bolt diameter with a maximum of 12 mm greater than the nominal bolt diameter.

The general welding programme for shop welding including particulars of the preparation of fusion faces, the method of preheating where required, the methods of making the welds, and the types of electrodes shall be submitted to the Engineer for his approval before the work is put in hand. No departure from the agreed welding programme from the details shown in the drawings shall be made without the agreement of the Engineer. Electrodes and fluxes shall be so chosen that the properties of the deposited metal are not inferior to those of the parent metal. All butt welds shall be complete penetration welds made between prepared fusion faces. In the fabrication of built-up assemblies, all butt welds in each component part shall be completed, whenever possible, before the final assembly.

When directed by the Engineer and before fabrication is commenced, welding procedure trials shall be carried out using representative samples of materials to be used in the work.

Welding arcs shall be of the proper lengths to produce good welds. After being deposited, welds shall be brushed with wire brushes, shall be ground smooth, and shall show uniform section, smoothness of weld metal, feather edges without envelopes and freedom from porosity and clinkers. Visual inspection at edges and ends of fillets and butt joint welds shall indicate good fusion with and penetration into the base metals. All welds shall be sound and precaution shall be taken to minimize locked-up stresses and distortion due to heat.

All rails and posts shall be straightened before they are set up; posts shall be set plumb. Longitudinal members shall follow the grade. In setting up the railings, care shall be taken to ensure proper level and alignment in order to prevent springing or bending of the railing in erection.

All metal members except those to be embedded in concrete shall receive one shop primer coat and two field coats of approved paint.

The paint shall be approved by the Engineer and shall be of a good commercial grade and carefully applied after the steel has been thoroughly brushed and cleaned. Colour will be selected.

Measurement and Payment:

Premoulded joint fillers and elastic joint seals shall not be measured, their cost shall be deemed to be included in the unit price for other items.

The quantity of rubber bearing pads shall be the number of pads completed in place and accepted. The payment shall be full compensation for supply and placing.

The bridge railing shall be measured as the actual number of linear metres of completed and accepted railing of the type specified on the drawing.

The unit price shall constitute the full compensation for supply, erection and surface treatment

Safety Barriers

Safety barriers shall be provided to the perimeter of work areas and to trench and other types of excavations and to existing openings such as manholes, drawpits and the like. When exposed to the public, safety barriers shall be provided to both sides of trenches and around all sides of openings.

The Contractor shall provide details of the type or types of safety barriers for each excavation for the approval of the Engineer prior to commencing work. No work shall commence until the safety barriers are in place.

The type of safety barrier used shall be appropriate to the particular location and the potential risks to the public. Examples of different types of safety barriers are given below:

Type 1 - excavated material;

Type 2 - non-rigid barrier of rope or florescent tape strung between metal rods driven into the ground;

Type 3 - rigid barrier of timber, steel or concrete. Such barriers could be in the form of horizontal rail(s) or sheet material secured to posts driven or concreted into the ground.

The following are guidelines on the type of safety barriers that could be used in

Differing situations. They apply particularly to trenches but also apply to other types of excavations, existing openings and to the perimeter of work areas:

Areas not subject to vehicular traffic - Types 1 or 2;

Roadways (low traffic speed) - Types 1 or 2; Roadways (high traffic speed) - Types 1 or 3.

The above examples of the types of barriers and the guidelines on situations in which they could be used shall not relieve the Contractor of his obligations and responsibilities.

Measurement and Payment

Hand railings will be measured in linear meters for the delivery and complete installation in place. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.

ITEM NO. AND NAME	602STEEL REINFORCEMENT
UNIT OF MEASUREMENT:	Ton
DESCRIPTION:	The task comprises the provision, cutting, bending, fixing and securing of steel reinforcement and is intended primarily for use with Class 1 concrete. This Specification is not suitable for main load bearing elements of bridge decks or heavily loaded structures. In these cases a construction specification and formal design will be required.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Hand-tools including wire pliers, hacksaws, bending-bars etc. <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	<p>Steel reinforcement shall be deformed high-yield steel bar, unless otherwise called for in the Schedule of Rates. Normal diameters shall be between 12 mm – 20 mm or to match those in the existing structure or as detailed on drawings provided with the Works Order. All reinforcement shall be new (not salvaged) and shall be free from rust, dirt, paint, oil or other contaminants.</p> <p>Tying wire shall be 1.6 or 1.25 mm diameter annealed wire.</p>

ITEM NO. AND NAME	602STEEL REINFORCEMENT
<p>WORK SPECIFICATION:</p> <ol style="list-style-type: none"> 1.The configuration of reinforcement (bar diameter, spacing etc.) shall take account of the arrangement exposed in the existing structure and will be confirmed by the RMF Engineer. 2.The quantity of steel reinforcement shall not normally be less than 275 Kg per cubic metre of concrete (excluding laps) unless otherwise approved by the Employer. 3.Cover to all steel shall be 40 mm (min.). Cover shall be assured by the use of spacer blocks held rigidly in position so that displacement will not occur during placing and compaction of the concrete. Spacer blocks shall be made with 6 mm maximum size aggregate concrete with cast-in ties. 4.Reinforcement bent to 'chairs' or 'stools' shall be used where necessary to prevent horizontal bars from sagging. On no account shall partially set concrete be used to support steel reinforcement. 5.Reinforcement that requires shaping shall be bent cold by slowly applying steady pressure without jerking or impact. Previously bent bars shall not be re-bent or straightened. 6.Reinforcement shall be evenly spaced and held in position with tying wire. Sufficient ties shall be used so that the cage is rigid and individual bars cannot slide. All wire ends shall be turned into the body of the concrete and not allowed to contact the formwork. The welding of reinforcement will not be permitted. 7.Laps between connecting bars shall normally be 40 times the bar diameter unless directed otherwise by the Employer. On no account will laps less than 20 times the bar diameter be permitted. (Preparation of the existing structure should be such that a sufficient length of bar is exposed). 8.Care shall be taken when fixing reinforcement and spacer blocks to ensure that formwork is not displaced or damaged. 9.On completion, all excess reinforcement, off-cuts and tying wire, shall be gathered and removed from the site. 	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in (Ton)of reinforcement, accepted in place as directed. The weight shall normally be ascertained by theoretical calculation based on linear metre of each bar size using standard published unit weights. The measurement shall include material used in laps and 'stools' but excluding any discarded off-cuts and tying wire. The provision and fixing of cover blocks is deemed as included. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.</p>	

700 DRAINAGE, structure and protection works

701 Boulder Mortared Masonry

702 Apply Cement Mortar

703 Mortared Masonry

704 Renew Bridge Timbers

705 Subsoil Filter Drains

706 Demolition and Removal of Existing Structures and Obstructions

707 Repair of Existing Riprap

708 Provide and construct New Grouted Riprap 25cm thick.

709 Cast Iron storm Water Cover

710 Provide and construct Shibami stones.

711 Removing damaged concrete curb stone and tiles

712 Cement Tiles

713 Reinstallation of Broken or loosed (RCC) Hand Rail Panels

714 Bonding New RCC Slab over Existing Concrete Pavement

715 Manhole rise and fall

ITEM NO. AND NAME	701 Boulder Mortared Masonry
Description:	Boulder masonry shall be used for walls of different types below ground level. The construction is similar to stone masonry except that the stones may not be laid in regular course and that the surface tolerance may be up to 50 mm.
PAYMENT	The quantity to be paid for will be the number of cubic metres of Boulder Masonry complete in place and accepted. The quantities of excavation below ground level and backfilling will be measured as structural excavation.

ITEM NO. AND NAME	702 Apply Cement Mortar:
Description:	Apply cement mortar for the joints and between stone buildings opening in roadside ditches /culvert walls/retaining walls and dry retaining walls or such other places as may be indicated on the drawings or as directed by the Engineer.
Material Requirement	<p>General: apply cement mortar work shall be to fill the joints and openings between stones with cement mortar consisting of (one part Portland cement and three parts of fine sand) with sufficient water to produce a plastic mix as approved by the Engineer.</p> <p>Sand for mortar shall be hard, natural sand or crushed stone sand. It shall be clean and free from organic impurities. Sand that is visually dirty or creates dust when worked, shall be washed. The grading shall be that 100% of material is finer than 2.36 mm with not more than 5% finer than 0.075 mm.</p> <p>Cement for mortar shall be Ordinary Portland Cement.</p> <p>Water for mixing mortar must be clean and clear.</p> <p>The stones opening shall be filled with mortar about 3-10 cm depth using appropriate tools. After placement of the filling mortar by hand, all the joints shall be completely filled with cement mortar 2 cm thick. The finished work shall present a uniform surface with no point deviating from the general line by more than 10 mm in the case of shoulder paving, and hard strips, and not more than 25 mm in other cases. The finished work shall be protected against the adverse effects of weather and cured for at least 4 days.</p> <p>Construction Requirements: Wherever soft spots of unstable stone joints or heavily decomposed rock are encountered such unsuitable material shall be removed to an extent, as the Engineer considers necessary. Backfilling shall be done with approved material.</p>
PAYMENT	The payment will be per SQUARE METER

ITEM NO. AND NAME	703 MORTARED MASONRY
UNIT OF MEASUREMENT:	CUBIC METRE
DESCRIPTION:	The task involves the construction of coursed random rubble masonry in bridge, culverts, check-dams and retaining walls structures to neat lines. The work will often include the taking down of damaged masonry, salvage of materials where appropriate and preparation of surfaces to receive new masonry including the excavation of foundations where required. Backfill of the completed repair is included, necessary to complete the work.
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> <input type="checkbox"/> Dump truck (part-time) <input type="checkbox"/> Mortar mixer (for larger tasks) <input type="checkbox"/> Hand tools <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	<p>Selected and shaped masonry stone which is hard, durable and free from weathering.</p> <p>Sand for mortar shall be hard, natural sand or crushed stone sand. It shall be clean and free from organic impurities. Sand that is visually dirty or creates dust when worked, shall be washed. The grading shall be that 100% of material is finer than 2.36 mm with not more than 5% finer than 0.075 mm.</p> <p>Cement for mortar shall be Ordinary Portland Cement.</p> <p>Water for mixing mortar must be clean and clear.</p>

ITEM NO. AND NAME	703 MORTARED MASONRY
<p>Stone Masonry</p> <p>Stone masonry shall be used for walls of different types above the ground level. The stones shall be of regular shape with length of any stone not exceeding 3 times its height, with the breadth on the bed not less than 150 mm nor greater than three quarters of the thickness of the wall. Unless otherwise directed, stones shall have thickness not less than 15 cm.</p> <p>All stone possessing bedding planes shall be laid with its natural bed as nearly as possible at right angles to the direction of load, and in case of arch rings, the natural bed shall be radial.</p> <p>Each course shall present a uniform horizontal line of more or less equal height. Vertical joints shall be broken by the adjoining courses. All joints shall be sufficiently thick to prevent stone to stone contact and shall be completely filled with mortar. On the exposed face no part of the masonry shall deviate from the general line of the wall by more than 20 mm.</p> <p>Walls of stone masonry shall be provided with weep holes as shown on the Drawings or directed by the Engineer. In continuous long structures, expansion joints shall be formed as shown on the Drawings subject to a minimum spacing of 10 m.</p> <p>All face joints shall be finished almost flush with the surface of the work without covering the stones. The top surface of all walls shall be provided with 2 cm thick cement mortar coping with a crossfall for shedding rainwater.</p> <p>Newly laid masonry shall be protected against the harmful effects of weather and cured for a minimum period of 4 days. All visible surfaces of the masonry shall be clean and free from mortar stains and other blemishes.</p> <p>Backfill behind the stone masonry walls shall be placed only after the masonry work has been in place for at least 14 days, or as directed by the Engineer.</p>	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in cubic metres (cubic meter) of new walling and foundations constructed and accepted. Payment shall include for the complete removal and disposal of trimmed materials including haulage off-site. Physical measurements of length, depth and width shall be recorded at sufficient intervals to accurately quantify the work. Unit rates shall include for the taking down, reusing or disposal of existing materials, selection and provision of new stone and all necessary preparation of the failed structure. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials, backfill and all incidentals necessary to complete the work as specified.</p>	

ITEM NO. AND NAME	704 RENEW BRIDGE TIMBERS
UNIT OF MEASUREMENT:	LINEAR METRE
DESCRIPTION:	The works comprise the inspection, removal of deteriorated wooden bridge deck members, cleaning of the receiving structure and replacing with new members as required and fixing securely in place. In terms of payment, a differentiation is made between timber superstructure bridges and Bailey Bridges due to the difference in fixings.
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> <input type="checkbox"/> Truck for delivery of timber, <input type="checkbox"/> Drill and drill bits, <input type="checkbox"/> Hand tools (saws, hammers, etc.), <input type="checkbox"/> Road signs, barrier boards and diversion notices.
MATERIALS:	<p>Timber chassis cross-member (225 - 250 x 75 mm) and running board planks (225 - 250 x 25 mm): pine or equivalent soft wood,</p> <p>Timber bearer beams (300 – 450 mm dia. to match existing): approved soft wood,</p> <p>Timber packing pieces (hardwood),</p> <p>Galvanised coach screws,</p> <p>Preservative paint.</p>

WORK SPECIFICATION:

1. The Contractor shall close the road by placing barrier boards in advance of both approaches. Signs indicating that traffic is diverted shall also be provided and fixed at the preceding junctions.
2. The bridge shall be stripped of rotten or otherwise faulty timbers as directed by the RMF Engineer. The exact extent of the work will be confirmed on site depending on the agreed condition of the exposed timber.
3. Faulty timbers shall be replaced with new timbers that generally have the same dimensions as the original, except as otherwise directed by the Employer.
4. Discarded timbers shall be disposed of by the Contractor in dumps approved by the RMF Engineer. On no account shall these be burned other than indirectly by logging and donation to local dwellers for cooking fuel, etc.
5. All deck timbers shall be square sawn, well seasoned, without warps or twists and free of jagged edges.
6. Main bearer beams shall be straight and without splits or cracks and be of uniform size.
7. All softwood shall first be given two coats of proprietary preservative paint applied strictly in accordance with the manufacturer's instructions. Any cuts that are subsequently made to the timber shall be similarly treated.
8. Chassis timbers (cross-members) shall be fitted with an air gap of 20 mm between adjacent planks to allow drainage and prevent dirt from becoming trapped. Where for reason of uneven beams the planks do not sit uniformly, they shall be packed using hardwood packing pieces cut to size. Packing pieces shall be a minimum of 300 mm in length. High points on bearers may be locally removed by trimming.
9. All timbers shall be fixed using galvanised coach screws or nuts and bolts. Nails shall not be used due to their tendency to work loose.
10. In the case of Bailey Bridge redecking only proprietary galvanised steel fixings shall be permitted.
11. After renewing the deck chassis timbers, new running boards shall be fitted. These shall comprise two or three strips of longitudinal boards to match the previous configuration (each running surface to have a minimum width of 1.1m). All running boards shall be longer than 1.5m in length. Joints between parallel boards shall be staggered.
12. All road signs for the temporary diversion of traffic shall be removed.
13. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition.

MEASUREMENT FOR PAYMENT:

The works shall be measured in linear metres of each timber size installed and accepted on the bridge structure excluding all off-cuts and wasted pieces which shall not be measured. Payment shall include for the provision and application of the preservative and all metal fixings etc. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.

There shall be four subcategories of this Item for payment purposes:

704a Renew Bridge Timbers (225 – 250 mm x 75 mm Standard Chassis)

704b Renew Bridge Timbers (225 – 250 mm x 75 mm Bailey Bridge Chassis)

704c Renew Bridge Timbers (225 – 250 mm x 25 mm Running Boards)

704d Renew Bridge Timbers (300 – 450 mm diameter Bearers)

ITEM NO. AND NAME	705 SUBSOIL FILTER DRAINS
UNIT OF MEASUREMENT:	CUBIC METRE
DESCRIPTION:	The task involves the installation of subsoil filter drains in order to lower the water table in areas prone to subsurface saturation. The drains comprise a trench lined with filter fabric and filled with free-draining filter media.
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"><input type="checkbox"/> Dump truck,<input type="checkbox"/> Excavator (for larger tasks),<input type="checkbox"/> Hand tools,<input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum).

ITEM NO. AND NAME	705 SUBSOIL FILTER DRAINS												
MATERIALS:	<p>Filter fabric shall be tough and durable engineering grade filter, with a minimum thickness of 1 mm and minimum weight of 0.24kg per square metre.</p> <p>Graded filter media shall be clean durable crushed rock or natural permeable material complying with the following grading limits:</p> <table data-bbox="587 533 1262 902"> <tr> <th>BS sieve (mm)</th><th>% passing</th></tr> <tr> <td>37.5</td><td>80-100</td></tr> <tr> <td>10</td><td>45-65</td></tr> <tr> <td>2.36</td><td>25-45</td></tr> <tr> <td>0.425</td><td>15-25</td></tr> <tr> <td>0.075</td><td>0-5</td></tr> </table>	BS sieve (mm)	% passing	37.5	80-100	10	45-65	2.36	25-45	0.425	15-25	0.075	0-5
BS sieve (mm)	% passing												
37.5	80-100												
10	45-65												
2.36	25-45												
0.425	15-25												
0.075	0-5												
WORK SPECIFICATION: <ol style="list-style-type: none"> 14. Traffic warning signs shall be established at both ends of the work section. 15. The width, depth, gradient and alignment of the filter drain shall be set out according to the Works Order. Unless stated otherwise the width of the trench shall be 300 mm. 16. The trench shall be excavated commencing at the downstream end working uphill. The excavated material shall be disposed of in dumps approved by the RMF Engineer. 17. Prior to backfilling, the trench floor shall be trimmed to a uniform surface and compacted with hand rammers. 18. Where directed, a short section of 150 – 400 mm diameter pipe shall be installed from the downstream end invert to facilitate discharge of water to outfall. 19. All soil faces to the trench shall be lined with filter fabric having minimum laps of 300 mm at all joints. Sufficient height of fabric shall be included so that the top surface of the filter may be covered by folding-over, after filling to give a 300 mm lap. 20. Graded filter media shall be placed in layers not exceeding 300 mm and lightly compacted using hand tools. The top surface shall be levelled at 150 mm below the surrounding ground surface level. 21. After sealing the top surface of the filter by folding over the remaining fabric, the final 150 mm shall be reinstated with selected material or topsoil. In certain circumstances where directed, the stone filter media will be brought up to the ground surface and not covered. 22. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition. 													

ITEM NO. AND NAME	705 SUBSOIL FILTER DRAINS
<p>MEASUREMENT FOR PAYMENT:</p> <p>The work shall be measured in cubic metres of completed subsoil drain filled with filter media. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified. The cost of providing filter fabric and for providing discharge pipe section shall be included in the rate.</p>	

ITEM NO. AND NAME	706 Demolition and Removal of Existing Structures and Obstructions
	<p>Demolition and removal of existing structures consist of the removal, wholly or in part, and satisfactory disposal of all structures, pavements, and any other obstructions, which are not designated or permitted to remain. Demolition includes the salvaging of designated materials and proper backfilling (in accordance with specification requirements) of any and all trenches, holes and pits resulting from demolition and removal work.</p> <p>Demolition and removal of existing structures is carried out by Contractor within and adjacent to roadways and on the ROW territory.</p> <p>All designated for utilization suitable material shall be removed, without unnecessary damage, in sections or pieces that may be readily transported, and shall be stored by the Contractor at specified places on the project.</p> <p>Culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic under a different scheme.</p> <p>Dismantling of existing culverts within embankment areas is permissible only as necessary for the installation of new structures. Abandoned culverts shall be broken down, crushed and sealed or plugged.</p> <p>All culvert sections removed which are not designated for stockpiling or relaying shall be removed from the site area.</p> <p>Wherever only a section of the existing structure is to be demolished the Contractor shall execute this work in such a way as to avoid damage to the section designated to remain.</p>
Measurement and Payment	<p>Demolition and removal of existing structures and obstructions shall be measured as the volume in cubic meter (cubic meter) of precast or cast in situ concrete or other material required to be removed. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labor, equipment, deposition, materials, and all incidentals necessary to complete the work as specified.</p>

ITEM NO. AND NAME	707 Repair of Existing Riprap
Description:	Rip-rap repair shall consist of fixing and repair the old riprap either by new riprap stones or by applying cement mortar for the disturbed riprap, which should be placed on places that may be indicated on the drawings or as directed by the Engineer. The material specifications as indicate in item No 708
PAYMENT	The payment will be per SQUARE METER

ITEM NO. AND NAME	708 Provide and construct New Grouted Riprap 25cm thick
Description:	Rip-rap erosion protection shall consist of broken stones placed on slopes, in inlet and outlet, or such other places as may be indicated on the drawings or as directed by the Engineer.
Material Requirement	<p>General: The stones for this work shall be durable, angular field or quarry stones of approved quantity, sound, hard, free from seams and other structural defects, and shall have a specific gravity of not less than 24 kn/cubic meter in air-dry condition.</p> <p>Stones: The weight of the stones shall be 15-25 kg or as directed by the Engineer. Grouting: The rip-rap shall be grouted. The grout shall be prepared in accordance with the requirements below, unless otherwise provided. It shall be of stiff but workable consistency.</p> <p>This type of masonry that is constructed in a single layer over a bed of mortar shall be used for shoulder paving, hard strips, aprons, drainage chutes, lined ditches and slope protection. The stones shall be of regular shape and uniform thickness. Prior to laying of the stones, the base shall be brought to regular shape and levels, watered and well compacted. Where this type of masonry is to be used for paving shoulders or for carriageway widening of existing roads, the base shall be slightly loosened, watered and compacted to 95% MDD prior application of the riprap. The stones shall be placed over a bed of mortar about 2 cm thick (one part of Portland cement and three parts of sand). After placement of the stones by hand, all the joints shall be completely filled with cement mortar. The finished work shall present a uniform surface with no point deviating from the general line by more than 10 mm in the case of shoulder paving, and hard strips, and not more than 25 mm in other cases. The finished work shall be protected against the adverse effects of weather and cured for at least 4 days.</p> <p>Construction Requirements: Rip-rap: The sub-grade upon which rip-rap is to be placed shall be shaped to the required lines and grades. The prepared sub-grade shall be slightly tamped. Wherever soft spots of unstable soil or heavily decomposed rock are encountered such unsuitable material shall be removed to an extent, as the Engineer considers necessary. Backfilling shall be done with approved material.</p>
PAYMENT	<p>The payment will be per SQUARE METER</p> <p>The works shall be measured in square metres . Payment shall include for the complete removal and disposal of trimmed materials including haulage off-site. Physical measurements of length and width shall be recorded at sufficient intervals to accurately quantify the work. Unit rates shall include for the taking down, reusing or disposal of existing materials, selection and provision of new stone and all necessary preparation of the failed structure. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials, backfill and all incidentals necessary to complete the work as specified.</p>

ITEM NO. AND NAME	709 Cast Grate Iron storm Water Cover
	<p>Provide and install cast grate iron heavy duty for storm water catch basin cover.</p> <p>The work consists of the performance of all work required for the construction of storm catch basin iron grate complete with frames and covers. The requirement for tensile strength of the gray cast iron shall conform to the requirements of AASHTO M-306. Manhole frames, covers, and grates shall be furnished with machined horizontal bearing surfaces and shall conform to the Standard Details. The cover or grate shall not rock when rotated to any position in the frame. Catch basin cover castings shall conform to the Standard Details. Gray iron castings shall have appropriate certifications and be individually marked in accordance with the requirements of AASHTO M-306. Castings which do not possess appropriate AASHTO M-306 certifications and markings shall be replaced by the Contractor at no expense to the Owner.</p> <p>The frames and covers shall be brought to grades shown on the Drawings unless otherwise approved by the Engineer.</p> <p>Frames shall be set centered on the opening with a maximum lateral offset of one-half inch (1/2") permitted.</p> <p>Contractor shall construct storm drain manholes in accordance with the Drawings and Standard Details.</p>
Measurement and Payment	<p>Provide and install cast grate iron heavy duty for storm water catch basin cover shall be measured as numbers of units, complete in place. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labor, equipment, deposition, materials, and all incidentals necessary to complete the work as specified.</p>

ITEM NO. AND NAME	710 Provide and construct Shibami stone.
Description:	<p>The contractor should provide shaped, saw Shibami stone with the required strength mentioned in general specification and with thickness not less than 150 mm. the stone must be constructed with right way to make sure that cement mortar will inter to all gaps between stones. All stone surface must be levelled and finished without any appearance to small corrugation or unlevelled surface Concrete.</p> <p>Concrete layer type A with 100mm thickness should be done below stone pavement</p> <p>All needed steps and tests for this type of concrete mentioned in general specification must be followed</p> <ul style="list-style-type: none"> - Base Coarse Layer <p>Constructing base coarse layer with 100 mm thick below concrete layer with the same quality material of base coarse in General specification following all needed steps for preparing, finishing and testing base coarse layer.</p> <p>The Rate includes but not limited to the following works:</p> <ul style="list-style-type: none"> _ Removal of (Asphalt+Base+lower layers) to depth of 500 mm _ Sub Grade Preparation _ Base course 150mm thick _ Cast and place plain concrete class (C) 100mm thick _ Lay Sand 50mm thick for leveling _ Shibami stone paving 150mm thick with cement mortar 50mm thick _ Disposal and hauling of waste material to the approved location <p>.The space between stones of grouted riprap shall be filled with grout consisting of one part Portland cement and 1 parts of fine aggregate, lime with sufficient water to produce a plastic mix as approved by the Engineer. Immediately after pouring, the grout shall be spaded and rodded into place with suitable spades trowels or other approved method, and boomed into the spaces until the voids are completely filled.</p> <p>Joints will be provided at a maximum interval of 12 m, to be filled with joint ribbon as approved by the Engineer.</p> <p>Stones used shall be hard and durable without weak seams or cracks and of rectangular shape. The Los Angeles Abrasion Value shall not exceed 50. The apparent specific gravity shall not be less than 3.5 and water absorption when tested in accordance with AASHTO T85 shall not exceed 5 percent</p>
PAYMENT	The payment will be per SQUARE METER

ITEM NO. AND NAME	711: Removing damaged concrete curb stone and tiles
Description:	Removing damaged concrete curb stone or tiles with proper method to prevent any damage and disturbance to the surrounded area , loading hauling all waste material to the places of garage material approved by RMF engineer
PAYMENT	The payment will be per liner meter or as indicated in Bill of quantities

ITEM NO. AND NAME	712: Cement Tiles
Description:	<ul style="list-style-type: none"> • The contractor should deliver good cement tiles with the colour as directed by the engineer • Remove any surplus material hauling to the garbage location (city land fill) • Level the surface back to the tile by sand plain concrete • ,preparing, clearing, moisture , finishing and compacting layer below the tiles to the density of not less than subgrade density • The cement mortar used below tiles should be with thickness not less than 50 mm and with proportion of sand cement of mortar mentioned in general specification
PAYMENT	The payment will be per square meter

713 Reinstallation of Broken or loosed (RCC) Hand Rail Panels

The work shall consist of precasting and fixing in position RCC hand railing panels of bridges where the existing panels are broken/damaged and designated to be removed. The railing panels shall be of the same type, design and dimensions as the existing panels as detailed in the drawings. Notwithstanding the details provided in the Drawings, it shall be the responsibility of the Contractor to ascertain the exact dimensions of the unaffected panels, and propose his methodology of casting and fixing the new railing panels at the broken spaces.

714 :Bonding New RCC Slab Over Existing Concrete Pavement

The work shall consist of bonding a new RCC overlay slab to an existing concrete pavement with necessary bonding between the two.

Bonding shall be effected through any or all of the following methods as shown on the drawings or as directed by the Engineer.

- Holes, 20 mm diameter shall be drilled into the existing pavement upto a depth at 200 mm. The holes shall be at 1.0 m staggered intervals in both directions. The drilled holes shall be thoroughly cleaned, and 18 mm dia, 500 mm long deformed dowel bars hooked at the top to tie with the reinforcement of the overlay slab shall be fixed to the holes with epoxy resin grout.

- ii) The existing pavement surface shall be thoroughly cleared of oil, grease, mud and other extraneous matter and given a detergent wash.
 - iii) On the cleared surface, epoxy bonding agent (Nitobond or FOSROC or equivalent) shall be applied prior to application of the overlay.
- The overlay shall be of Class AA concrete to Clause 601. Steel reinforcement and dowel bars shall conform to Clause 602. Construction joints of the overlay slab shall match with those of the existing pavement.

ITEM NO. AND NAME	715:Manhole rise and fall (ADJUSTING MANHOLE FRAMES AND COVERS)
UNIT OF MEASUREMENT	Nr- Each
DESCRIPTION:	<p>This item shall consist of reconstructing and/or adjusting manholes, covers or frames and furnishing all materials, all other miscellaneous related work and labor necessary to bring them to the locations and grades as required, adjusting final grade of manhole top, repair of voids and restoration of the structural integrity of the manhole, or as instructed by the Engineer. , The Contractor shall be responsible for raising to grade indicated manholes, whether or not visible to the naked eye.</p> <p>The Contractor shall take all the required measures to carry out the work including the Perform traffic site control in accordance with the approved traffic control submittal plan.</p>
RESETTING & ADJUSTING	<p>All manholes, covers where required , shall be reset in accordance with these Specifications when the existing manholes, are more than one quarter inch (1/4") over or under the street grade level for the finished pavement or construction. They shall be accurately set to line and grade by removing the frame and cover, and raising or lowering the masonry top of the structure and resetting on a cushion of cement mortar;</p>
EXCAVATION	<p>Excavation shall be performed wherever necessary to bring the manholes cover or frame to the required streets finished level and as instructed by the Engineer.</p>

MATERIALS	<ul style="list-style-type: none"> • Mortar shall be composed of the following mixture: one part Portland cement, two parts sand, hydrated lime not to exceed ten percent of the cement used. Water shall be added to the mixture in such quantity as to form a stiff paste. • The mortar shall be hand-mixed or machine-mixed. In the preparation of hand-mixed mortar, the sand, cement and hydrated lime shall be thoroughly mixed together in a clean, tight, mortar mix until the mixture is of uniform color, after which water shall be added. Mortar shall be prepared in an approved mixer, and shall be mixed not less than 1 1/2 minutes. <p>3. Mortar shall be used within thirty minutes after mixing. Re-tempering of mortar will not be permitted.</p> <p>Materials used shall conform to the following Specifications:</p> <ol style="list-style-type: none"> a. Portland Cement, Type I AASHTO M 85 b. Hydrated Lime ASTM C 6 c. Sand <ul style="list-style-type: none"> • Backfill material shall conform to the existing material in the subgrade and base course, and thoroughly tamped in place until no further displacement occurs. • Adjustable manhole frames shall consist of not less than four circular segments connected by diameter adjustment screws with locking apparatus. • The cover seat portion of the frame shall be covered with a plastic gasket. The frame shall be capable of being adjusted to fit the existing manhole frame in such a manner that no vibration or movement of the manhole cover will occur. • Adjustable frames shall be approved by the Engineer prior to placement.
CLEANING	<p>All manholes, shall be thoroughly cleaned of all excess mortar and accumulations of silt, clay, debris, or foreign matter of any kind and shall be free from such at the time pavement is to be laid.</p>
MEASUREMENT FOR PAYMEN	<p>The number of manholes will be the actual number of each reset, completed .accepted and approved by the Engineer, Payment shall be payment in full for</p> <p>Furnishing all materials, excavation, form work when necessary, backfilling, disposal of surplus materials, and for all labor, equipment, tools, and incidentals necessary to complete the work herein specified. This specification consists of all work, materials, labor and equipment required for manhole rehabilitation for the purpose of eliminating infiltration and exfiltration, providing corrosion protection</p>

800 ANCILLARY WORKS

801 Paint Road Markings

802 Paint Metal Surfaces

803 Grass Planting

804 Provide Road Signs

804.1 INFORMATORY and DIRECTION ROAD SIGNS

805 Markers and kilometre Posts

806a Roads Cats Eyes (One Face)

806b Roads Cats Eyes (Two Faces)

807 GUARD RAILS

807.1 Galvanized Steel Fence

808 SINGLE CHEVRONS

809 Crosswalk & Speed bump Marking

ITEM NO. AND NAME	801 PAINT ROAD MARKINGS
UNIT OF MEASUREMENT:	linear METRE
DESCRIPTION:	<p>This work shall consist of making traffic markings on the finished pavement surface in accordance with these specifications and to the details shown on the Drawings or established by the Engineer. The markings shall be of reflective thermoplastic striping material conforming to AASHTO M249.</p> <p>Paint shall always be applied in two coats.</p>
TYPICAL EQUIPMENT:	<ul style="list-style-type: none"> ❑ String lines for marking-out; ❑ Straight edges and forms; ❑ Mechanical painting equipment ❑ Brushes and cleaning apparatus; ❑ Traffic signs and resources as described below 10°C.
MATERIALS:	Road-marking paint shall comply with the requirements of Technical Specifications for Rehabilitation and Maintenance of Road Project.
<p>Work Specifications: This work shall consist of making traffic markings on the finished pavement surface in accordance with these specifications and to the details shown on the Drawings or established by the Engineer. The markings shall be of reflective thermoplastic striping material conforming to AASHTO M249.</p> <p>The material shall be reflectorised (white for centreline and yellow for edge line markings) abrasion-proof road marking paint made by an approved manufacturer who has been making the paint for at least 5 years. It shall be a homogeneously composed mixture of pigment, filler, resins and glass reflectorised spheres. It shall be suitable for application by mechanical means to give a chemically stable film of uniform thickness. The paint shall be supplied fresh and in solid form in sealed containers, which shall be stored in accordance with the manufacturer's instructions.</p> <p>The Contractor shall furnish to the Engineer the manufacturer's certificate giving the test properties for his approval. The Engineer may require further tests to be carried out on the material brought to site in accordance with the related AASHTO test procedures, and these shall be carried out at the Contractor's expense.</p> <p>Traffic markings shall be applied with approved equipment capable of applying the striping material to the specified width and film thickness, and at the specified rate of application. In no case shall the Contractor proceed with the work until the equipment, method of application and rate of application as established by a test section have been approved by the Engineer. The test section shall be to a length of about 100 m on which the Contractor has to use the method, materials and equipment, which he intends to use for the work proper. If approved, the test section will be incorporated in the Works.</p> <p>The paint material in solid form shall be added to the pre-heated kettle in the application machine and the temperature of the melted paint shall be maintained for about one hour at 200oC before starting to spray. The spraying temperature shall be 211 + 7oC,</p>	

ITEM NO. AND NAME	801 PAINT ROAD MARKINGS
	<p>and in no case the temperature shall be allowed to go beyond 220oC.</p> <p>Side by side with the spraying, glass beads conforming to AASHTO M247 - Type 2 shall be applied to the surface by drop-on method at the rate at 450 gm/m2.</p> <p>For the white centreline and yellow edge line markings, the minimum average thickness of application of the paint shall be 2.5 mm. A wet mill paint gauge shall be furnished to the Engineer by the Contractor for checking purposes.</p> <p>Immediately prior to the application of the paint the roadway surface shall be cleaned of all dirt, loose stones, and other objectionable matter. The surface shall be clean and dry at the time the paint is applied. Painting shall not be carried out until the shoulders are completed. Warning signs shall be erected when painting is in progress and traffic shall be prevented from passing over we paint. Any painting disfigured by traffic, or any painting not to the satisfaction of the Engineer shall be effaced and repainted at the Contractor's expense.</p> <p>The edge strips shall be solid yellow line of the width shown on the Drawings. The dashed white centreline stripes of the width shown on the Drawings shall be a painted line of three metre length, with a six metre gap or as otherwise indicated on the Drawings or directed by the Engineer. No-passing stripes shall be solid white paint line of the width shown on the Drawings and located as directed by the Engineer. Intersection markings, special pavement markings and obstruction hazard zone markings, shall be as shown on the Drawings or as directed by the Engineer.</p>
	<p>MEASUREMENT FOR PAYMENT:</p> <p>Road markings shall be measured for the painted area in square metre for white and yellow colour. Gaps in lines shall not be measured. Special markings shall be converted in terms of area and added to the measured quantities.</p> <p>The rate entered in the Bill of Quantities shall include for providing and application of the paint and all other items involved in the satisfactory completion of the work in accordance with the specifications. Glass beads applied on the paint shall not be measured separately.</p>

M NO. AND NAME	802PAINT METAL SURFACES
UNIT OF MEASUREMENT:	SQUARE METRE
DESCRIPTION:	The works comprise the repainting of existing metal components such as hand railings to bridges including all preparatory cleaning and the removal of loose paint and rust.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Hand tools including: <input type="checkbox"/> Paint brushes, wire brushes, scrapers etc. <input type="checkbox"/> Traffic signs and resources as described below
MATERIALS:	Primer, undercoat and finishing coat shall be in accordance with Technical Specifications for Rehabilitation and Maintenance of Road Project.
WORK SPECIFICATION: <ol style="list-style-type: none"> 1. Traffic warning signs shall be established at both ends of the work section. In addition the Contractor shall provide DRIVE SLOWLY signs adjacent to the work. Where there is any pedestrian traffic WET PAINT signs shall also be posted. 2. The limits of the area to receive new finishing coat shall be as directed by the RMF Engineer the marking out of which shall be agreed on Site. 3. All surfaces to be painted shall first be prepared. All dirt, grease or other contaminants shall be washed off using solvent if necessary. Loose paint shall be removed by chipping and wire brushing. Rusted areas shall be brushed and chipped to remove all affected material and the surface shall be sanded down to expose a bare metal surface. 4. The entire surface to be painted shall be wire brushed or lightly sanded to ensure that there is a good bond. 5. All paint shall be applied strictly in accordance with the manufacturer's instructions. 6. All surfaces must be completely dry and no painting is to be performed during rain, drizzle or mist or when such conditions appear likely. 7. The Contractor shall erect suitable protection to shield all surfaces not being painted from splatters, splashes or drips. The Contractor shall be responsible for any paint contamination of vehicles or property as a result of his operations. 8. Prepared loose or rusted areas shall first receive two coats of primer. The dry film thickness shall not be less than 30 µm per coat. The area to be painted shall extend by an overlap of 50 mm on all edges onto sound painted surfaces. 9. Once the prime coat has dried sufficiently, a single coat of universal undercoat shall be applied to achieve a dry-film thickness of not less than 25 µm. 10. After the undercoat has fully dried it shall be lightly sanded and the surface washed and allowed to completely dry. Two finishing coats, each of dry-film thickness of not less than 25 µm shall then be applied. 11. Any unsightly paint stains or spills shall be removed by the Contractor at his own cost. 12. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition. 	

MEASUREMENT FOR PAYMENT:

The works shall be measured in square metres of structure surface painted regardless of the number of paint coats applied. Only the surface covered by the final finishing coat shall be measured for payment. Physical measurements for the computation of area shall be recorded. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified. Providing and maintaining safe temporary access platforms and the performance of all repairs is included in the payment rates.

ITEM NO. AND NAME	803 GRASS PLANTING
UNIT OF MEASUREMENT:	SQUARE METRE
DESCRIPTION:	The task includes the planting and aftercare of grasses and other approved vegetation suitable for binding the surface of drain slopes and other soil surfaces against the forces of erosion. Grass planting will normally comprise sprigging. Treatments should be based on accepted local good practice.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Hand tools <input type="checkbox"/> Roadworks traffic warning signs (2 No. minimum)
MATERIALS:	Species should be chosen dependent on local site conditions (climatic and physical) and be approved by the Employer. In general they should be rapid growing, long-living, have substantial root systems and be easy to propagate. However, they should not be invasive or poisonous to livestock. Care should be taken not to plant species, which will cause traffic visibility problems or encourage grazing of livestock where this might cause a traffic hazard.
WORK SPECIFICATION: <ol style="list-style-type: none"> 1. Traffic warning signs shall be established at both ends of the work section. 2. Grass runners or sprigs shall be fresh rooted plants harvested on the day of planting. They shall be of an approved variety and include sufficient root material and soil to ensure good growth. 3. Holes shall be dug to receive the sprigs which shall be not less than 50 mm in diameter and 50 mm in depth. The hole shall be filled with fertile topsoil into which the sprig shall be planted. 4. The grass shall be planted at 250 mm centres in both directions. 5. The grass shall be watered directly after planting and regularly thereafter to prevent undue drying out. 6. All planting works shall include associated aftercare necessary to ensure the survival of vegetation which shall continue until the plants become established and self-supporting. Measures may include, watering, shading from direct sunlight, staking for support and protection from grazing animals. 7. The Contractor shall tend to the planted grass for a 3 month period following completion of planting and will replant any sections that die due to lack of care or watering at his own cost. 8. On completion of the works, the site shall be cleaned of all surplus materials and waste, and left in a clean, tidy condition. 	

ITEM NO. AND NAME	803 GRASS PLANTING
<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in square metres of area grassed. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified for establishing an acceptable cover and maintaining the grass, except for any subsequent cutting.</p>	

ITEM NO. AND NAME	804 PROVIDE ROAD SIGNS
UNIT OF MEASUREMENT:	NUMBER
DESCRIPTION:	The task involves the provision and installation of new permanent road traffic safety signs. Signs shall meet the design and fabrication requirements specified and are required to be manufactured by competent suppliers approved by the Employer. Sign faces shall be reflectorised and either 600 mm or 900 mm nominal size and triangular, round or octagonal in shape. The work consists of complete installation of a new sign and post structure.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Drill and drill bits <input type="checkbox"/> Miscellaneous hand tools
<p>The work shall consist of furnishing and installing road signs and post assemblies as shown on the Drawings and in accordance with these specifications or as directed by the Engineer. Lettering on Place Name Signs and Distance Signs should conform to the layout in the drawings and special specifications or as directed by the Engineer. Prior to manufacture and fabrication of the signs the Contractor shall submit to the Engineer for approval, detailed drawings showing letter sizes, traffic symbols and sign layout. Unless otherwise shown on the Drawing, all signs shall be lettered in both Arabic and English.</p> <p>The signs shall be fabricated by an experienced specialist manufacturer or by the sign shop of the General Corporation for Roads and Bridges, Sana'a.</p> <p>The signs shall consist of 3 mm thick aluminium alloy conforming to ASTM B209, 6061-T6 aluminium, covered with reflective sheeting. Reflective sheeting shall consist of synthetic sheet resin or other approved non-cellulostic materials, transparent plastic of each of the colours specified and glass spheres. The glass spheres shall adhere to the synthetic sheet resin and be embedded beneath a flexible transparent plastic film forming a smooth flat surface. The reflective sheeting shall have a precoated pressure sensitive adhesive backing, or a precoated pressure sensitive adhesive backing. The sheeting shall adhere tightly to the prescribed surfaces when applied in accordance with the manufacturer's recommendations. The precoated adhesive shall form a durable bond to clean corrosion-proof metals and shall adhere securely under normal service. After forty-eight hours of aging at 240C from time of application, the precoated adhesive shall be capable of withstanding eight hours of soaking in water at 240C without appreciable decrease.</p> <p>The Contractor shall submit samples of each required colour of the reflective sheeting to the Engineer for approval prior to ordering the materials.</p> <p>The signs shall be mounted on tubular steel posts of specified diameter and galvanised in accordance with AASHTO M111. All bolts, nuts and washers shall be galvanised in accordance with ASTM A153. The sign posts shall be fixed to the ground in Class C concrete to Clause 601 to the details shown on the Drawings. The post and back of the signs shall be painted gray.</p> <p>The sign shall be of the colour, shape and sizes as shown on the Drawings. Prior to fabrication, the Contractor shall submit to the Engineer for approval, three copies of shop drawings for all sign faces bearing messages, showing the arrangement and spacing of both the Arabic and English sign messages. Official town names and their English and Arabic spellings shall be as provided by the Engineer. Signs delivered for use on a project shall be stored on a raised platform under cover in a manner approved by the Engineer. Any sign damaged, discoloured or defaced during transportation, storage or erection shall be rejected.</p>	

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	<p>The signs shall be erected at locations shown on the Drawings or established by the Engineer, at a distance from the edge of the carriageway and to the specified levels. All signs shall be erected so that their edge and face are truly vertical and the face is at an angle of 92 degrees to the centreline; that is, facing slightly away from the centreline of the lane, which the sign serves to avoid reflection and glare.</p> <p>Pits excavated for fixing sign posts shall be backfilled and compacted in a neat manner to adjoining levels. All signs shall be maintained in a clear and legible condition and shall be washed if necessary for the duration of the Contract.</p>
	<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in the number of new signs provided and erected in position. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.</p>

ITEM NO. AND NAME	804.1 INFORMATORY and DIRECTION ROAD SIGNS
UNIT OF MEASUREMENT:	SQUARE METRE
DESCRIPTION:	The task involves the provision and installation of new permanent road traffic information and direction signs with two posts . Signs shall meet the design and fabrication requirements specified and are required to be manufactured by competent suppliers approved by the Employer. Sign faces shall be reflectorized and either 600 mm or 900 mm nominal size or more and triangular, round or octagonal in shape. The work consist s of complete installation of a new sign and two post sstructure.
TYPICAL EQUIPMENT:	<input type="checkbox"/> Drill and drill bits <input type="checkbox"/> Miscellaneous hand tools
<p>The work shall consist of furnishing and installing road signs and posts assemblies as shown on the Drawings and in accordance with these specifications or as directed by the Engineer. Lettering on Place Name Signs and Distance Signs should conform to the layout in the drawings and special specifications or as directed by the Engineer. Prior to manufacture and fabrication of the signs the Contractor shall submit to the Engineer for approval, detailed drawings showing letter sizes, traffic symbols and sign layout. Unless otherwise shown on the Drawing, all signs shall be lettered in both Arabic and English.</p> <p>The signs shall be fabricated by an experienced specialist manufacturer or by the sign shop of the General Corporation for Roads and Bridges, Sana'a.</p> <p>The signs shall consist of 3 mm thick aluminium alloy conforming to ASTM B209, 6061-T6 aluminium, covered with reflective sheeting. Reflective sheeting shall consist of synthetic sheet resin or other approved non-cellulostic materials, transparent plastic of each of the colours specified and glass spheres. The glass spheres shall adhere to the synthetic sheet resin and be embedded beneath a flexible transparent plastic film forming a smooth flat surface. The reflective sheeting shall have a precoated pressure sensitive adhesive backing, or a precoated pressure sensitive adhesive backing. The sheeting shall adhere tightly to the prescribed surfaces when applied in accordance with the manufacturer's recommendations. The precoated adhesive shall form a durable bond to clean corrosion-proof metals and shall adhere securely under normal service. After forty-eight hours of aging at 240C from time of application, the precoated adhesive shall be capable of withstanding eight hours of soaking in water at 240C without appreciable decrease.</p> <p>The Contractor shall submit samples of each required colour of the reflective sheeting to the Engineer for approval prior to ordering the materials.</p> <p>The signs shall be mounted on tubular steel posts of specified diameter and galvanised in accordance with AASHTO M111. All bolts, nuts and washers shall be galvanised in accordance with ASTM A153. The sign posts shall be fixed to the ground in Class C concrete to Clause 601 to the details shown on the Drawings. The post and back of the signs shall be painted gray.</p> <p>The sign shall be of the colour, shape and sizes as shown on the Drawings. Prior to fabrication, the Contractor shall submit to the Engineer for approval, three copies of shop drawings for all sign faces bearing messages, showing the arrangement and spacing of both the Arabic and English sign messages. Official town names and their English and Arabic spellings shall be as provided by the Engineer. Signs delivered for use on a project shall be</p>	

ITEM NO. AND NAME	804.1 INFORMATORY and DIRECTION ROAD SIGNS
	<p>stored on a raised platform under cover in a manner approved by the Engineer. Any sign damaged, discoloured or defaced during transportation, storage or erection shall be rejected.</p> <p>The signs shall be erected at locations shown on the Drawings or established by the Engineer, at a distance from the edge of the carriageway and to the specified levels. All signs shall be erected so that their edge and face are truly vertical and the face is at an angle of 92 degrees to the centreline; that is, facing slightly away from the centreline of the lane, which the sign serves to avoid reflection and glare.</p> <p>Pits excavated for fixing sign posts shall be backfilled and compacted in a neat manner to adjoining levels. All signs shall be maintained in a clear and legible condition and shall be washed if necessary for the duration of the Contract.</p>
	<p>MEASUREMENT FOR PAYMENT:</p> <p>The works shall be measured in SQUARE METRE of new signs provided and erected in position. Unit rates shall include full compensation for all steps necessary to comply with the above including all transport, handling, labour, materials and all incidentals necessary to complete the work as specified.</p>

ITEM NO. AND NAME	806a Roads Cats Eyes (One Face) 806b Roads Cats Eyes (Two Faces)
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Cats eye Type Reflective Pavement Studs

Cats eye type pavement (road) studs shall consist of mountable aluminium casting. The stud anchor shall be of aluminium approximately 60 mm long and 30 mm in diameter. The anchor shall be suitably deformed or slotted to resist pullout and rotational displacement. Each stud shall have 1 or 2 reflecting surfaces as appropriate.

Resist compression ability more than 20 tones, weight between 200 gm to 700 gm, reflector material: glass beads, Body material: cast aluminium, working temperature:-10 to + 60

Cats eye type pavement studs shall be approximately 150 mm square by 25 mm high. Each reflecting surface shall have 5 circular clusters of 7 bi-convex lenses and shall meet the minimum reflectance requirements given as follows:

Reflectance Requirements for Cats eye Type

*		** Minimum Specific Intensity (Millicandle as per lux)		
Observation Angle (degrees)	Entrance Angle (degrees)	Clear or White	Red	Amber
0.2	14.0 L & R	5	1	2.5
1.0	10.0 L & R	10	2	5.0
0.5	10.0 L & R	15	3	7.5
0.3	5.0 L & R	20	4	10.0

reflector between the observer's line of sight and the axis of the incident light beam.

**Entrance angle means the angle at the reflector between the direction of light incident on it and the direction of the reflector axis.

Epoxy Adhesive for Pavement Markers (include in cat eyes rate)

Adhesive used to install all types of raised pavement markers shall be a 2-component epoxy of high viscosity and rapid setting characteristics, conforming to AASHTO M 237, Class II.

Measurement for Payment Roads Cats Eyes	The works shall be measured in number as indicated in bill of quantities (one face or two face)
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ITEM NO. AND NAME	807 GUARD RAILS
	<p>The work shall consist of furnishing and installing beam-type guard rail in accordance with these specifications and in conformity with the lines and grades shown on the Drawings or as directed by the Engineer</p> <p>Posts shall be of structural steel, meeting the requirements of AASHTO M1S3. These flshall be to the dimensions and weights shown on the Drawings and shall be galvanized by the hot-dip process in accordance with the requirements of AASHTO M111. Bolts and nuts shall conform to or exceed the requirements of ASTM A 307, and shall be hot-dip zinc coated in accordance with the requirements of AASHTO SQUARE METER32, Class C or mechanically zinc coated in accordance with AASHTO SQUARE METER9S, Class 50, and Type 1. Washers shall be hot-dip zinc coated in accordance with the requirements of AASHTO SQUARE METER32. Beam elements shall be fabricated from sheets of open hearth, electric furnace or basic oxygen steel. The beam shall have a projected width of not less than 300 mm and a depth of not less than 75 mm, and shaped as shown on the Drawings. The beam shall be of 12 gauge galvanized steel sheet (2.74 mm thick) and meet the requirements of AASHTO M1S0, Class A, Type II. The beams shall be completely formed, punched with holes for mounting and splicing and ready for assembly when delivered. Beams shall be of uniform section and straight or curved as required. Beams to be ejected on a radius of 45 m or less shall be shop-curved as indicated on the Drawing* directed by the Engineer.</p> <p>The Contractor shall furnish to the Engineer the manufacturer's certificate slating that the material supplied conforms to the requirements of the specifications.</p> <p>Beam, posts and appurtenances for guard rail shall not be field punched, or drilled except as may be approved in location ofsplices necessitated by field clearances. The beams for terminal sections may be either shop or field twisted and bent. Deformation shall be such that the*beam will retain the required shape in a relaxed condition. Glavanised material on which the smelter coating has been bruised or broken will be rejected or may, with approval of the Engineer be repaired by an approved method.</p> <p>Guard rail shall be erected at the location shown on the Drawings or designated by the Engineer. Holes for guard rail posts shall be of the depth and size shown on the Drawings. Posts shall be spaced as shown on the Drawings and shall be set plumb and to the established lines and grades. End sections shall be anchored to the ground by means of RCC post as indicated on the Drawings. The shoulder area around the posts shall be neatly compacted to adjoining levels.</p> <p>The guard rail as installed and finished shall not deviate in the horizontal direction and in levels from the specified lines and grades by more than 5 mm.</p>
Payment	The payment shall be made on liner metre for the executed works

ITEM NO. AND NAME	807.1 Galvanized Steel Fence
	The work shall consist of furnishing and installing steel fence fenders accordance with these specifications and in conformity with the lines and grades shown on the Drawings or as directed by the Engineer, the steel fence shall be of the type Metal beam guardrail to Clause 807 fixed rigidly to steel posts. The posts shall be rigidly anchored to the concrete footpaths of the bridge/culvert.
Payment	The payment shall be made on liner metre for the executed works

ITEM NO. AND NAME	808 SINGLE CHEVRONS
PAYMENT	The works shall be measured in number

810-1 Single Chevrons, Signs W 061, are available to indicate sharp changes of direction. These are rectangular signs consisting of a single yellow chevron on a black background.

810-2 Unlike other warning signs, chevrons are 'sight boards', which are intended to be placed at the hazard so that drivers can see the change of direction clearly. They should be placed directly in the sight line of approaching drivers.

810-3 Signs W 061, Single Chevrons, should be used instead of Signs W 062 or W 063 on bends or corners where there is restricted room on the verge or where their use will provide a clearer indication than a Multiple Chevron sign.

810-4 Signs W 061 shall not be used to indicate a narrowing of the road.

Sign Size

**W 061L: Single Chevron
(to Left)**



**W 061R: Single Chevron
(to Right)**



810-5 Single Chevron signs are available in heights of 400mm, 600mm and 800mm and in corresponding widths, as shown in Table 6.4. The larger sizes should generally be used for higher speed approaches, as indicated in the table.

Table 6.4: Single Chevron Sign Sizes

Speed (km/h)	Height of Sign (mm)	Width of Sign (mm)
≤ 70	400	500
80 to 100	600	750
120	800	1000

Location

810-6 Chevron signs shall be oriented so that the chevron points in the direction in which drivers need to turn.

810-7 At least three Signs W 061 shall be provided at any one curve in any one direction. A minimum of two such signs should be visible from a point on the approach to the curve from a distance equivalent to 3 seconds travel time, at the 85%-percentile approach speed of private cars, in advance of the start of the curve.

810-8 Single Chevrons, W 061, should be located in such a way that drivers are able to see at least three chevrons at all times as they travel through the curve. Where there is no vegetation behind the chevrons, the minimum number should be increased to five.

810-9 The normal mounting height for chevrons is 1000mm to the lower edge of the sign. However, this may be varied to suit sight lines and particular layout.

810-10 Signs W 061 shall be placed close to the carriageway on the outside of the curve, preferably with a clearance of 600mm to 1200mm.

They should be angled towards oncoming traffic such that they are at right angles to an approaching vehicle at the limit of visibility of the sign.

ITEM NO. AND NAME	809 Provide and install SPEED BUMP
DESCRIPTION	<p>The works consists of :</p> <ol style="list-style-type: none">1. Lay out and mark area for placement of speed bump.2. Clean area of all dirt and debris.3. Notch existing asphalt surface to alleviate speed bump displacement.4. Tack coat area of installation using Liquid asphalt.5. Install hot mix surface asphalt to a maximum height of 20 cm at the apex and a width of 2m.6. Apply a seal of liquid asphalt to the adjoining edge of the installation to Help prevent moisture penetration.7. Apply heavy-duty reflective traffic paint Sufficient to identify the speed bump.
PAYMENT	The works shall be measured in number or as indicate in the Bill of quantities

ITEM NO. AND NAME	810 Crosswalk & Speed bump Marking
Description	<p>When a standard or ladder-type crosswalk is located on a residential or local street, the width of the crosswalk (distance between transverse lines) shall be 8 feet(2.44m) on center. When the crosswalk is located on a collector or arterial street, the width of the crosswalk shall be 10feet (3m)on center. In accordance with the MUTCD, all transverse lines, regardless of their marking material, shall be solid white in color with a width of 12 inches(30.5cm).</p> <p>When a ladder-type crosswalk is installed, thx longitudinal lines or bars shall be solid white incolor, have a width of 12 inches(30.5cm), and be spaced 3 feet(0.9m) apart on center.</p> <p>The marking location of the longitudinal lines should avoid the wheel paths whenever possible as directed by the Engineer.</p>
Material Requirements:	<p>It is important that crosswalk makings be visible to motorists (especially at night), not be Slippery or create tripping hazards, and not be difficult to traverse by those with diminished mobility or visual capabilities. All crosswalk markings shall therefore be installed using either: (a) a chlorinated paint suitable for application on asphalt surfaces, (b) a thermoplastic Paving marking material, or (c) an inlay polymer marking tape. All crosswalk markings shall also consist of high reflexivity materials.</p> <p>because it is highly reflective, durable, slip-resistant, and does not require a high level of maintenance, it shall be the policy of the Town to install marked crosswalks using inlay tape whenever possible. To the maximum extent practicable, inlay tape shall be used as the preferred marking material whenever crosswalks are installed on new or resurfaced pavements.</p>
Construction Requirements	Road-marking paint shall comply with the requirements of Technical Specifications .
Payment	The works shall be measured in square metres

900 DAYWORKS

ITEM NO. AND NAME	901 DAYWORKS
UNIT OF MEASUREMENT:	RESOURCES
DESCRIPTION:	<p>This Item covers the listing of daywork items for use in determining payment for work for which no other applicable rate exists in the Schedule of Rates or for which the mode of operation required by the Employer differs significantly from that specified in the individual items.</p> <p>The scope of possible works is not limited but may be particularly appropriate in the following examples:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Attending to emergencies, <input type="checkbox"/> Cleaning or clearing the road surface, <input type="checkbox"/> Removing wrecks, stripped tyres and other waste or otherwise assisting the traffic police at accident sites, <input type="checkbox"/> All other items of small repair works, river training works etc.
TYPICAL EQUIPMENT:	<p>The required equipment will vary depending on the scope of the instructed work. It will be as directed by individual Works Orders or as is agreed in writing between the Contractor and RMF Engineer in advance, as being reasonable to perform the work satisfactorily.</p>
MATERIALS:	<p>Materials will be to the standards and specifications referred to in the Works Order or elsewhere in this Specification.</p>
<p>WORK SPECIFICATION:</p> <p>No daywork shall be undertaken unless written authorisation has been obtained from the RMF Engineer in the form of a Works Order. In the case of emergency work, the Contractor shall act upon the verbal instructions of duly authorised representatives of the RMF Engineer, provided that the RMF Engineer will confirm such instruction in writing and by formal Works Order at the earliest, reasonable opportunity.</p> <p>In respect of ordered dayworks, the Contractor shall deliver each day (or such longer reasonable period as the RMF Engineer may permit) accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Name, designation and hours of Contractor's personnel, <input type="checkbox"/> Identification, type and hours worked of Contractor's plant and equipment, <input type="checkbox"/> Type and quantities of all materials used. 	
<p>MEASUREMENT FOR PAYMENT:</p> <p>The records described above for personnel, plant/equipment, and materials, shall form the basis for determining payments due for works instructed to be performed under dayworks.</p> <p>The amounts payable will be subject to the following provisions:</p>	

ITEM NO. AND NAME	901 DAYWORKS
<p>(i) Plant and equipment</p> <p>The unit of measurement shall be the unit specified for the item of plant or equipment in the Schedule of Rates. Non-working hours for transport, breakdown, lack of operator or any other reason shall <u>not</u> be measured.</p> <p>Rates entered by the Contractor in the Dayworks Schedule for each category and type of plant shall be deemed to include for: all operation, maintenance, repairs, fuel, oil, grease, hydraulic fluids, taxes, duties, drivers wages, overtime and profit. Where plant or equipment has to be brought to the Site specifically and solely for an item of dayworks, the resources used in transporting the equipment to and from its normal base to the work Site may be payable but not the item of transported equipment itself.</p> <p>(ii) Personnel</p> <p>The unit of measurement shall be the unit specified for the personnel in the Schedule of Rates. The workforce eligible for payments shall be restricted to workers and direct site supervisors such as foreman only. Site office and head office management and support workers shall be excluded. The rates entered by the Contractor in the Dayworks Schedule for each category of worker shall be deemed to include for: wages, overtime, all statutory payments required to be made by the Employer, travel time and transport to place of normal reporting, hand tools, accommodation, fringe benefits, supervision and profit.</p> <p>Time spent and resources used in travelling from the place of normal reporting to the Site is normally payable when resources are specifically mobilised for the dayworks task. Otherwise, only the actual time spent working shall be paid for.</p> <p>(iii) Materials</p> <p>The basic unit of measurement shall be the amounts actually paid for the procurement of materials which are used in the ordered works as evidenced by official invoices and receipts. The RMF Engineer may require that the Contractor seeks his prior consent before purchasing Materials, in which case this will be stated in the Works Order. The tendered additional percentage applied to procurement charges shall be in full and final compensation in respect of the Contractor's handling costs, profit and all other charges in connection with the procurement and supply of the materials.</p>	

6 PREAMBLE TO SCHEDULE OF RATES

1. In the Schedule of Rates the Item numbers, headings and item descriptions identify the work covered by the respective items. The exact nature and extent of the work is to be ascertained by reference to the Works description, Specification and Conditions of Contract. The rates and prices entered in the Schedule of Rates shall be deemed to be the full inclusive value of the work including the following, unless expressly stated otherwise:
 - (a) The provision, storage, transport, handling, use, distribution, and maintenance of all materials, plant, equipment, machinery and tools including all costs, charges, dues, demurrage or other outlays involved in carriage and importation, including waste and delivery to Site and the Network,
 - (b) The provision, storage, transport, use, handling, distribution and maintenance of all consumable stores, fuel, water and electricity,
 - (c) Temporary Works,
 - (d) Establishment charges including temporary accommodation at individual sites, overheads and profit,
 - (e) All risks, liabilities, contingencies, insurance and obligations imposed or implied by the Contract,
 - (f) Attendance and transport for sampling and testing carried out by the RMF Engineer, supplying results of tests carried out by the Contractor and providing test certificates,
 - (g) Awaiting approvals and or consents,
 - (h) Travelling to, between and from different locations within the Network,
 - (i) The provision and care of all staff and labour and their payment, accommodation, transport, fares and other requirements including First Aid, welfare and safety requirements,
 - (j) Setting out, including the location and preservation of survey markers, measurement and supervision,
 - (k) The opening operation and reinstatement upon completion of all quarries and borrow pits,
 - (l) The construction and maintenance of the temporary diversion routes as required, the control of traffic, and the provision of temporary road signs as described or otherwise necessary for the safe performance of the Works,
 - (m) Injury caused to the works under construction, plant, materials and consumable stores by weather,
 - (n) Co-ordination with other Contractors or Authorities carrying out work either in connection with or adjacent to the works,
 - (o) The protection of mains, ducts and services,
 - (p) Pumping, de-watering and for working in water.
2. Each individual item shall have a rate or price entered against it.
3. Unless expressly stated otherwise the Contractor shall allow in his rates and prices for carrying out the works at any location within the Network, for setting up at each Site and for movement between Sites.
4. The Contractor shall allow for the items in the Schedule of Rates being used only once, a number of times or not at all and in any quantity during the currency of the Contract.

5. Where the Schedule of Rates includes separate pay items depending on work quantity, this shall be on the basis of the quantity of each work Item instructed by a single Works Order.
6. The final measurement of quantity against each item on a Works Order shall be computed net to two decimal places from the dimensions stated in the Contract unless stated otherwise in the Specification or stated on the Works Order.
7. The measured quantity for each item of work executed by the Contractor in accordance with the Contract shall be measured net and no allowance will be made for waste, bulking, shrinkage, increase or decrease of volume due to compacting or to the provision of working space.
8. Where in the Contract a choice of alternatives is permitted, the scheduled description and the rates and prices inserted shall be deemed to cover any of the permitted alternative materials or designs the Contractor may elect to use.
9. The Schedule of Rates does not include or infer any pre-estimate of the required work quantities. The Contractor should make his own predictions regarding the amounts, frequencies and distribution of the Works based on the information contained in the Contract, his own experience of patterns of road deterioration, and his pre-tender inspection of the Network. The Contractor is entirely responsible for any inaccuracies in his predictions.
10. Except in circumstances as provided for in the Contract, the Contractor will not be entitled to any monthly interim payment or any other payment on account until all the work required by a Works Order is complete. Payment will then normally be claimed in the next monthly statement following certified completion by the Employer. However, payment for continuous Length-Person activities may be claimed on a regular monthly basis in arrears.

MINIMUM TESTS REQUIERMENTS

The basis of taking samples and their repetitions for various construction and maintenance items for Road/street projects are shown in tables below:

1. Earthworks (Cont'd)

<i>Work Item</i>	<i>A Tests at Source of Material</i>	<i>Frequency for all tests mentioned under (A)</i>	<i>(B) Tests at Road site</i>	<i>Frequency for all tests mentioned under (B)</i>
1-5 Subgrade and shoulders	1-Granular Gradation 2-Plasticity Index 3-C.B.R. 4-Any other tests or required in specs and drawings.	- Test for each borrow pit - Test for each cut area having suitable material - Test for each 4000 m ³ - When materials quality Change	1-Modified proctor 2-Granular gradation 3-Plasticity Index 4-Soil Classification (AA SHTO) 5-C.B.R	- Test for each 1 000 L.m and for each layer. - When materials quality Changes
			6-Field Design 7-Any other tests as required by technical specs and drawings	- Test for each 1 500 m ² or 100 L.m for each layer
1-6 Selected subgrade	1-Granular Gradation 2-Plasticity Index 3-C.B.R. 4-Any other tests or required in specs and drawings.	- Test for each source - When materials quality Change	1-Modified proctor 2-Granular gradation 3-Plasticity Index 4-C.B.R	- Test for each 500 L.m and for each layer. - When materials quality Changes
			5-Field Density 6-Layer thickness 7-Any other tests as required by technical specs and drawings	- Test for each 1 500 m ² or 100 L.m for each layer.

MINIMUM TESTS REQUIRED

2. BASE & SUBBASE

<i>Work Item</i>	<i>A Tests at Source of Material</i>	<i>Frequency for all tests mentioned under (A)</i>	<i>(B) Tests at Road site</i>	<i>Frequency for all tests mentioned under (B)</i>
2-1 Base & Subbase	1- Granular Gradation 2- Plasticity Index 3- Abrasion 4- C.B.R. 5- Sand equivalent 6- Fractured faces (for bases) 7- Any other tests or required in technical specs and drawings	- Test for each source - Test for each 2000 m ³ - When materials quality Change	1- Modified proctor 2- Granular gradation 3- Plasticity Index 4- C.B.R. 5- Abrasion 6- Sand equivalent 7- Field Density 8- Layer thickness 9- Any other tests as required by technical specs and drawings 10 - Clay lumps & friable particles	- Test for each 500 L .m and for each layer. - When materials quality Change - Test for each 750 m ² and for each layer

MINIMUM TESTS REQUIRED

3. CONCRETE

<i>Work Item</i>	<i>A Tests at Source of Material</i>	<i>Frequency for all tests mentioned under (A)</i>	<i>(B) Tests at Road site</i>	<i>Frequency for all tests mentioned under (B)</i>
3-1 Fine aggregate for concrete	1- Gradation and fineness modulus 2- Specific gravity and water absorption. 3- sand equivalent 4- Organic and harmful material. 5- As requested in the special specs. And drawings 6- Sulfates & chlorides	- Test for each source - Test for each 2000 m3 - When materials quality Change	1- Gradation and fineness modulus 2-Specific gravity and water absorption. 3-sand equivalent 4- Organic and harmful material. 5- Any other tests and requested in the specs. And drawings 6- Sulfates & chlorides 7- Soundness test	- Test for each source - Test for each 300 m3 - When materials quality Changes.
3-2 Coarse aggregate for concrete	1- Gradation 2- Specific gravity and water absorption. 3- Abrasion 4- Organic and harmful materials 5- Clay lumps and friable materials. Elongated and flaky particles Index. 6- Any other tests as required in specs and drawings	- Test for each source - Test for each 2000 m3 - When materials quality Changes	(Same tests mentioned under A) in addition to: 1- Abrasion test 2- Percentage of clay lumps and friable particles 3- Flakiness index & Elongation index.	- Test for each source - Test for each 300 m3 - When materials quality Changes.

3. Concrete (Cont'd)

<i>Work Item</i>	<i>A Tests at Source of Material</i>	<i>Frequency for all tests mentioned under (A)</i>	<i>(B) Tests at Road site</i>	<i>Frequency for all tests mentioned under (B)</i>
3-3 Combined aggregates for concrete	1-Must satisfy fine and coarse aggregate requirements. 2-Gradation.	- Test for each source - Test for each 4000 m3 - Test at change of material	- Must satisfy fine and coarse aggregate requirements - Gradation	- Test for each source - Test for each 500 m3 - Test at change of material.
3-4 Water for concrete	1-PH. 2-Sulfates & chlorides 3-Water effect in concrete strength and properties 4-Grease and oil.	- Test for each source - When source changes	Same tests mentioned under (A)	- Test for each source - When source change.
3-5 Concrete admixtures	1- Manufacturer's Certificate	- One for each type or manufacturer	- Trial mixes to check suitability and percentages to be used based on site conditions, materials and manufacturer's recommendations. - Any other tests as requested in the spec and drawing.	- One for each type or manufacture.

3. Concrete (Cont'd)

Work Item	A Tests at Source of Material	Frequency for all tests mentioned under (A)	(B) Tests at Road site	Frequency for all tests mentioned under (B)								
3-6 Concrete (fresh) 3-6-1 Trail Mix Design			1-Slump test 2-Cubes or cylinders for crushing strength as specified. 3-Workability	- Test for each class of concrete. - Test for change in any material.								
3-6-2 Ready Mix	1-The concrete and all its constituents shall satisfy all concrete and materials00 requirements as specified. 2-Workability 3-Any other tests as required in technical specs and drawings	- For each source - When any material changes	1- Slump test	- For each transit mixer.								
			2-Compression Tests (Take cubes) 3-Any other tests as required in specs and drawings	<table><tr><td>No. of Transit Mixers</td><td>No. of sample</td></tr><tr><td>1</td><td>6</td></tr><tr><td>2-5</td><td>12</td></tr><tr><td>6-10</td><td>18</td></tr><tr><td>11-20</td><td>24</td></tr></table> - For each 10 additional transit mixes take 6 additional samples (Test half the samples after week and the next half after 2 8 days).	No. of Transit Mixers	No. of sample	1	6	2-5	12	6-10	18
No. of Transit Mixers	No. of sample											
1	6											
2-5	12											
6-10	18											
11-20	24											

3. Concrete (Cont'd)

<i>Work Item</i>	<i>A Tests at Source of Material</i>	<i>Frequency for all tests mentioned under (A)</i>	<i>(B) Tests at Road site</i>	<i>Frequency for all tests mentioned under (B)</i>
3-6-3 Concrete Tests			1- Compression tests	- 6 specimens for every less or equal 8 0 m3.
			2-Workability 3-Slump	- 6 specimens for each casting day. - Test for each transit mixer at casting location
3-7 Hardened Concrete			1-Core samples 2-any other tests as required in the technical specs and drawing	- 3 cores for each part of a structure that did not satisfy the compression test after 28 days. - If samples are not taken during casting. - 3 cores for each part of a structure.

4. ASPHALT MIXES

<i>Work Item</i>	<i>A Tests at Source of Material</i>	<i>Frequency for all tests mentioned under (A)</i>	<i>(B) Tests at Road site</i>	<i>Frequency for all tests mentioned under (B)</i>
4-1 Materials in Asphalt mix. (At Batching Plant)	1-Specific gravity and water absorption. 2-Abrasion test 3-Chert content 4-Clay lumps and friable particles. 5-Flaky and elongated particles 6-Soundness	- Test for each source - When material quality changes - As required		
4-2 Materials used in Asphalt mix (from hot pins)	1-Gradation 2-Specific gravity and water absorption. 3-Plasticity index 4-Sand Equivalent 5-Stripping with asphalt	- Test for each source - When materials quality change - As required.		

4. Asphalt Mixes

<i>Work Item</i>	<i>A Tests at Source of Material</i>	<i>Frequency for all tests mentioned under (A)</i>	<i>(B) Tests at Road site</i>	<i>Frequency for all tests mentioned under (B)</i>
4-3 Asphalt mix design each layer (At Batching Plant)	1-Complete mix design in accordance with the American Asphalt Institute (MS2) 2-Loss of stability	- For each project - When materials quality changes. - When results are not consistent with the mix design results. - As required.		
4-4 Asphalt mix for each layer	At Batching Plant		Behind spreader	- Test each working days - Test for each batching - As requested
	1- Stability 2- Flow 3- Extraction (binder content and gradation) 4- Air voids 5- Voids in mineral aggregates. 6- Daily Marshall Density		1-Stability 2-Flow 3-Extraction (binder content and gradation) 4-Air voids 5-Voids in mineral aggregates. 6-Daily Marshall Density 7-Loss of Stability	
	7- Loss of Stability	- As requested - Once per week	8- Road density and thickness (after final compaction)	- Test each 200 L. m. per lane and for each layer. - As requested.

MINIMUM TESTS REQUIRED
5. MISCELLANEOUS

<i>Work Item</i>	<i>A Tests at Source of Material</i>	<i>Frequency for all tests mentioned under (A)</i>	<i>(B) Tests at Road site</i>	<i>Frequency for all tests mentioned under (B)</i>																
5-1 Concrete pipes (Plain! reinforced plant)	1- Abrasion 2- Proof & Ultimate loads 3- Materials used in pipes shall satisfy each individual material requirements as specified 4-Any other tests as required in the specs and drawings.	- Specimen for each pipe diameter	1- Absorption 2-Proof & Ultimate loads 3-Any other tests as required in the specs and drawings.	<table><tr><td>Pipes</td><td>No . of</td></tr><tr><td>Diameter</td><td>specimens</td></tr><tr><td>In (mm)</td><td></td></tr><tr><td>100 – 500</td><td>2-3</td></tr><tr><td>501 – 1000</td><td>3-6</td></tr><tr><td>1001 – 1</td><td>500 6-9</td></tr></table>	Pipes	No . of	Diameter	specimens	In (mm)		100 – 500	2-3	501 – 1000	3-6	1001 – 1	500 6-9				
Pipes	No . of																			
Diameter	specimens																			
In (mm)																				
100 – 500	2-3																			
501 – 1000	3-6																			
1001 – 1	500 6-9																			
5-2 Reinforcing steel	1- Tensile strength 2- Yield point 3-Elongation 4- Bending 5- Dimensions 6- Any other tests as required in the specs and drawings	- For each source 3 specimens for each diameter (Specimens to be taken from different bars)	1- Tensile strength 2-Yield point 3- Elongation 4- Bending 5- Dimensions 6- Any other tests as required in the specs and drawings	<table><tr><td>Shipment</td><td>No. of</td></tr><tr><td>Load</td><td>(Tons) Specimens</td></tr><tr><td>< 10</td><td>1</td></tr><tr><td>10-50</td><td>2</td></tr><tr><td>51-100</td><td>3</td></tr><tr><td>101-500</td><td>4</td></tr><tr><td>501-100 0</td><td>6</td></tr><tr><td colspan="2">Over 1000 tons – divide shipment into the above mentioned ranges in accordance with the AASHTO standards.</td></tr></table>	Shipment	No. of	Load	(Tons) Specimens	< 10	1	10-50	2	51-100	3	101-500	4	501-100 0	6	Over 1000 tons – divide shipment into the above mentioned ranges in accordance with the AASHTO standards.	
Shipment	No. of																			
Load	(Tons) Specimens																			
< 10	1																			
10-50	2																			
51-100	3																			
101-500	4																			
501-100 0	6																			
Over 1000 tons – divide shipment into the above mentioned ranges in accordance with the AASHTO standards.																				