

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study
on
The Rural Road Network Development Project

FINAL REPORT (Volume 27)

SPECIFICATION
FOR
EXPERIMENTAL PAVEMENT CONSTRUCTION

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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SPECIFICATION FOR EXPERIMENTAL PAVEMENT CONSTRUCTION

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SPECIFICATIONS FOR EXPERIMENTAL
PAVEMENT CONSTRUCTION

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PART A - GENERAL

DPWH STANDARD SPECIFICATIONS 1988 shall be applied to any matter not stipulated in this specifications.

PART B - EARTHWORK

ITEM 102 - EXCAVATION

102.1 Description

This Item shall consist of roadway and borrow excavation, and the disposal of material in accordance with this Specification and in conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer.

102.1.1 Roadway Excavation

Roadway excavation will include excavation and grading for roadways, parking areas, intersections, approaches, slope rounding, benching, waterways and ditches; removal of unsuitable material from the roadbed and beneath embankment areas; and excavating selected material found in the roadway as ordered by the Engineer for specific use in the improvement. Roadway excavation will be classified as "unclassified excavation", "rock excavation", "common excavation", or "muck excavation" as indicated in the Bill of Quantities and hereinafter described.

(1) Unclassified Excavation. Unclassified excavation shall consist of the excavation and disposal of all materials regardless of its nature, or not classified and included in the Bill of Quantities under other pay items.

(2) Rock Excavation. Rock excavation shall consist of igneous, sedimentary and metamorphic rock which cannot be excavated without blasting or the use of rippers, and all boulders or other detached stones each having a volume of 1 cubic or more as determined by physical measurements or visually by the Engineer.

(3) Common Excavation. Common excavations are those not included in the Bill of Quantities under "rock excavation" or other pay items.

(4) Muck Excavation. Muck excavation shall consist of the removal and disposal of saturated mixtures of soils and organic matter not suitable for foundation materials regardless of moisture content.

(5) Excavation of Existing Pavement. Excavation of existing pavement shall consist of the excavation of bituminous surface treatment in Section No. 3 and No. 4, bituminous concrete surface course in Section No. 5 and aggregate base and subbase courses in Section No. 3, 4 and 5.

102.1.2 Borrow Excavation

Borrow excavation shall consist of the excavation and utilization of approved material required for the construction of embankments, shoulder or for other portions of the work, and shall be obtained from approved sources, in accordance with the following:

(1) Borrow, Case 1. Borrow Case 1 will consist of material obtained from sources designated on the Plans or in the Special Provisions.

(2) Borrow, Case 2. Borrow, Case 2 will consist of material obtained from sources provided by the Contractor.

The material shall meet the quality requirements determined by the Engineer unless otherwise provided in the Contract.

102.2 Construction Requirements

102.2.1 General

When there is evidence of discrepancies on the actual elevations and that shown on the Plans, a pre-construction survey referred to the datum plane used in the approved Plan shall be undertaken by the Contractor under the control of the Engineer to serve as basis for the computation of the actual volume of the excavated materials.

All excavations shall be finished to reasonably smooth and uniform surfaces. No materials shall be wasted without authority of the Engineer. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed. Prior to excavation, all necessary clearing and grubbing in the area shall have been performed in accordingly with Item 100, Clearing and Grubbing.

102.2.2 Conservation of Topsoil

Where provided for on the Plans or in the Special Provisions, suitable topsoil encountered in excavation and on areas where embankment is to be placed shall be removed to such extent and to such depth as the Engineer direct. The removed topsoil shall be transported and deposited in storage piles at locations approved by the Engineer. The topsoil shall be completely removed to the required depth from any designated area prior to the beginning of regular excavation or embankment work in the area and shall be kept separate from other excavated materials for later use.

102.2.3 Utilization of Excavated Materials

All suitable material removed from the excavation shall be used the formation of the embankment, subgrade, shoulders, slopes, bedding, and backfill for structures, and for other purposes shown on the Plans or as directed.

The Engineer will designate as unsuitable those soils that cannot be properly compacted in embankments. All unsuitable material shall be disposed off as shown on the Plans or as directed without delay to the Contractor.

Only approved materials shall be used in the construction of embankments and backfills. All suitable materials shall be disposed off as shown on the Plans or as directed.

All excess material, including rock and boulders that cannot be used in embankments shall be disposed off as directed.

Material encountered in the excavation and determined by the Engineer as suitable for topping, road finishing, slope protection, or other purposes shall be conserved and utilized as directed by the Engineer.

Borrow material shall not be placed until after the readily accessible roadway excavation has been placed in the fill, unless otherwise permitted or directed by the Engineer. If the Contractor places more borrow than is required and thereby causes a waste of excavation, the amount of such waste will be deducted from the borrow volume.

102.2.4 Pre-watering

Excavation areas and borrow pits may be pre-watered before excavating the material. When pre-watering is used, the areas to be excavated shall be moistened to the full depth, from the surface to the bottom of the excavation. The water shall be controlled so that the excavated material will contain the proper moisture to permit compaction to the specified density with the use of standard compacting equipment. Pre-watering shall be supplemented where necessary, by truck watering units, to assure that the embankment material contains the proper moisture at the time of compaction.

The Contractor shall provide drilling equipment capable of suitably checking the moisture penetration to the full depth of the excavation

102.2.5 Pre-splitting

Unless otherwise provided in the Contract, rock excavation which requires drilling and shooting shall be pre-split.

Pre-splitting to obtain faces in the rock and shale formations shall be performed by : (1) drilling holes at uniform intervals along the slope lines, (2) loading and stemming the holes with appropriate explosives and stemming material, and (3) detonating the holes simultaneously.

Prior to starting drilling operations for pre-splitting, the Contractor shall furnish the Engineer a plan outlining the position of all drill holes, depth of drilling, type and explosives to be used, loading pattern and sequence of firing. The drilling and blasting plan is for record purposes only and will not absolve the Contractor of his responsibility for using proper drilling and blasting procedures. Controlled blasting shall begin with a short test section of length approved by the Engineer. The test section shall be pre-split, production drilled and blasted and sufficient material excavated whereby the Engineer can determine if the Contractor's methods are satisfactory. The Engineer may order discontinuance of the pre-splitting when he determines that the materials encountered have become unsuitable for being pre-split.

The holes shall be charged with explosives of the size, kind strength, and at the spacing suitable for the formations being pre-split and with stemming material which passes a 9.5 mm (3/8 inch) standard sieve and which has the qualities for the proper confinement of the explosives.

The finished pre-split slope shall be reasonably uniform and free of loose rock. Variance from the true plane of the excavated back-slope shall not exceed 300 mm (12 inches); however, localized irregularities or surface variations that do constitute a safety hazard or an impairment to drainage courses or facilities will be permitted.

A maximum offset of 600 mm (24 inches) will be permitted for a construction working bench at the bottom of each lift for use in drilling the next lower pre-splitting pattern.

102.2.6 Excavation of Ditches, Gutters, etc.

All material excavated from side ditches and gutters, channel changes, irrigation ditches, inlet and outlet ditches, toe ditches, furrow ditches, and such other ditches as may be designated on the Plans or staked by the Engineer, shall be utilized as provided in Subsection 102.2.3.

Ditches shall conform to the slope, grade, and shape of the required cross-section, with no projections of roots, stumps, rock, or similar matter. The Contractor shall maintain and keep open and free from leaves, sticks and other debris all ditches dug by him until final acceptance of the work.

Furrow ditches shall be formed by plowing a continuous furrow along the line staked by the Engineer. Methods other shall be cleaned out by hand shovel work, by ditcher, or by some other suitable method, throwing all loose materials on the downhill side so that the bottom of the finished ditch shall be approximately 450 mm (18 inches) below the crest of the loose material piled on the downhill side. Hand finish will not be required, but the flow lines shall be in satisfactory shape to provide drainage with overflow.

102.2.7 Excavation of Roadbed Level

Rock shall excavated to a depth of 150 mm (6 inches) below subgrade within the limits of the road bed, and the excavation backfilled with material designated on the Plans or approved by the Engineer and compacted to the required density.

When excavation methods employed by the Contractor leave undrained pockets in the rock surface, the Contractor shall, at his own expense, properly drain such depressions or when permitted by the Engineer fill the depressions with approved impermeable material.

Material below subgrade, other than rock shall be thoroughly scarified to a depth of 150 mm (6 inches) and the moisture content increased or reduced, as necessary, to bring the material throughout this 150 mm layer to the moisture content suitable for maximum compaction. This layer shall then be compacted in accordance with Subsection 104.3.3.

102.2.8. Borrow Areas

The Contractor shall notify the Engineer sufficiently in advance opening any borrow areas so that cross-section elevations and measurements of the ground after stripping may be taken, and the borrow material can be tested before being used. Sufficient time for testing the borrow material shall be allowed.

All borrow areas be bladed and left in such shape as to permit accurate measurements after excavation has been completed. The Contractor shall not excavate beyond the dimension and elevations established, and no material shall be removed prior to the staking out and cross-sectioning of the site. The finished borrow areas shall be approximately true to line and grade established and shall finished, as

prescribed in Clause 61. When necessary to remove fencing, the fencing shall be replaced in at least as good condition as it was originally. The Contractor shall be responsible for the confinement of livestock when a portion of the fence is removed.

102.2.9 Removal of Unsuitable Material

Where the Plans show the top portion of the roadbed to be selected toppings, all unsuitable materials shall be excavated to the depth necessary for replacement of the selected toppings to the required compacted thickness.

Where excavation to the finished graded section results in a subgrade or slopes of unsuitable soil, the Engineer may require the Contractor to remove the unsuitable material and backfill to the finished graded section with approved material. The Contractor shall conduct his operations in such a way that the Engineer can take the necessary crosssectional measurements before the backfill is placed.

The excavation of musk shall be handled in manner that will not permit the entrapment of muck within the backfill. The material used for backfill up to the ground line or water level, whichever is higher, shall be rock or other suitable granular material selected from the roadway excavation, if available. If not available, suitable material shall be obtained from other approved sources. Unsuitable material removed shall be disposed off in designated area shown on the Plans or approved by the Engineer.

102.3 Method of Measurement

The cost of excavation of material which is incorporated in the Works or in other areas of fill shall be deemed to be included in the Items of Works where the material is used.

Measurement of Unsuitable or Surplus Material shall be the net volume in its original position.

For measurement purposes, surplus suitable material shall be calculated as the different between the net volume of suitable material required to be used in embankment and the net volume of suitable material from excavation. Separate pay items shall be provided for surplus common, unclassified and rock material.

The Contractor shall be deemed to have included in the contract unit prices all cost of obtaining land for the disposal of unsuitable or surplus material.

102.4 Basis of Payment

The accepted quantities, measured as prescribed in Section 102.3, shall be paid for at the contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities which price and payment shall be full compensation for the removal and disposal of excavated materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item:

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
102 (1)	Unsuitable Excavation	Cubic meter
102 (2)	Surplus Common Excavation	Cubic meter
102 (3)	Surplus Rock Excavation	Cubic meter
102 (4)	Surplus Unclassified Excavation	Cubic meter
102 (5)	Surplus Excavation of Existing Pavement for Section No. 3 and 4	Cubic meter
102 (6)	Surplus Excavation of Existing Pavement for Section No. 5	Cubic meter

Item 104 - EMBANKMENT

104.1 Description

This Item shall consist of the construction of embankment in accordance with this Specification and in conformity with the lines, grades, and dimension shown on the Plans or established by the Engineer.

104.2 Material Requirements

Embankment shall be constructed of suitable materials, in consonance with the following definitions:

(1) Suitable Material - Material which is acceptable in accordance with the Contract and which can be compacted in the manner specified in this Item. It can be common material or rock.

Selected borrow, for topping - soil of such gradation that all particles will pass a sieve with 75 mm (3 inches) square opening and not more than 15 mass percent will pass percent will pass 0.075 mm (No.200) sieve, as determined by AASHTO 11. The material shall have a plasticity index of not more than 6 as determined by AASHTO T 90 and liquid limit of not more than 30 as determined by AASHTO T 89.

(2) Unsuitable Material- Material other than suitable such as:

- (a) Materials containing detrimental quantities of organic material, such as grass, roots and sewage.
- (b) Highly organic soils such as peat and muck
- (c) Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.
- (d) Soils with a natural water content exceeding 100%
- (e) Soils with very low natural density, 800 kg/m³ or lower.
- (f) Soils that can not be properly compacted as determined by the Engineer.

104.3 Construction Requirements

104.3.1 General

Prior to construction of embankment, all necessary clearing and grubbing in the area shall have been performed in conformity with Item 100, Clearing and Grubbing.

Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or adjacent to the roadway; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits, and other depressions within the roadway area.

Embankment and backfills shall contain no muck, peat, sod, roots or other deleterious matter. Rocks, broken concrete or other solid, bulky materials shall not be placed in embankment areas where piling is to be placed or driven.

Where shown on the Plans or directed by the Engineer, the surface of the existing ground shall be compacted to a depth of 150 mm (6 inches) and to the specified requirements of this Item.

Where provided on the Plans and Bill of Quantities the top portions of the roadbed in both cuts and embankments, as indicated, shall consist of selected borrow for topping from excavations.

104.3.2 Methods of Construction

When there is evidence of discrepancies on the actual elevations and that shown on the Plans, a pre-construction survey referred to the datum plane in the approved Plan shall be undertaken by the Contractor under the control of the Engineer to serve as basis for the computation of the actual volume of the embankment materials.

When embankment is to be placed and compacted on hillsides, or when new embankment is to be constructed against existing embankment, or when embankment is to be constructed against existing embankment, or when embankment is built one-half width at a time, the existing slopes that are steeper than 3:1 when measured at right angles to the roadway shall be continuously benched over those as the work is brought up in layers. Benching will be subject to the Engineer's approval and shall be of sufficient width to permit operation of placement and compaction equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus excavated shall be placed and compacted along with the embankment material in accordance with the procedure described in this Section.

Unless shown otherwise on the Plans Provisions, where an embankment of less than 1.2 m (4 feet) below subgrade is to be made, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up plowing, scarifying, or stepping to a minimum depth of 150 mm except as provided in Subsection 102.2.2. This area shall then be compacted as provided in Subsection 104.3.3. Sod not required to be removed shall be thoroughly disc harrowed or scarified before construction of embankment. Wherever a compacted road surface containing granular materials lies within 900 mm (36 inches) of the subgrade, such old road surface shall be scarified to a depth of at least 150 mm (6 inches) whenever directed by the Engineer. This scarified material shall then be compacted as provided in Subsection 104.3.3.

When shoulder excavation is specified, the road shoulders shall be excavated to the depth and width shown on the Plans. The shoulder material shall be removed without disturbing the adjacent existing base course material, and all excess excavated materials shall be disposed of as provided in Subsection 102.2.3. If necessary, the areas shall be compacted before being backfilled.

Roadway embankment in earth material shall be placed in horizontal layers not exceeding 200 mm (8 inches), loose measurement, and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to

compacting. As the compaction of each layer progresses, continues leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Removal or water shall be accomplished through aeration by plowing, blading, discing, or other methods satisfactory to the Engineer.

Where embankment is to be constructed across low swampy ground that will not support the mass of trucks or other hauling equipment, the lower part of the fill may be constructed by dumping successive loads in uniformly disturbed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers.

When excavated material contains more than 25 mass percent of rock larger than 150 mm in greatest diameter and cannot be placed in layers of the thickness prescribed without crushing, pulverizing or further breaking down the pieces resulting from excavation methods, such breaking down the pieces resulting from excavation methods, such materials may be placed on the embankment in layers not exceeding in thickness the approximate average size of the larger not exceeding in thickness the approximate average size of the larger rocks, but not greater than 600 mm (24 inches).

Even though the thickness of layers is limited as provided above, the placing of individual rocks and boulders greater than 600 mm in diameter will be permitted provided that when placed, they do not exceed 12000 mm (48 inches) in height and provided they are carefully distributed, with the interstices filled with finer material to form a dense and compact mass.

Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of earth. Lifts of material containing more than 25 mass percent of rock larger than 150 mm in greatest dimension shall not be constructed above an elevation 300 mm (12 inches) below the finished subgrade. The balance of the embankment shall be composed of suitable material smoothed and placed in layers not exceeding 200 mm (8 inches) in loose thickness and compacted as specified for embankments.

Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until compaction complies with the requirements of Subsection 104.3.3.

Hauling and leveling equipment shall be so routed and distributed over each layer of the fill in such a manner as to make use of compaction effort afforded thereby and to minimize rutting and uneven compaction.

104.3.3 Compaction

Compaction Trials

Before commencing the formation of embankments, the Contractor shall submit in writing to the Engineer for approval his proposal for the compaction of each type of fill material to be used in the Works. The Proposal shall include the relationship between the types of compaction equipment, and the number of passes required and the method of adjusting moisture content. The Contractor shall carry out full scale compaction trials on areas not less than 10 m wide and 50 m long as required by the Engineer and using his proposed procedures or such amendment hereto as may be found necessary to satisfy the Engineer that all the specified requirements regarding compaction can be consistently achieved. Compaction trials with the main types of fill material to be used in the Works shall be completed before work with the corresponding materials will be allowed to commence.

Throughout the periods when compaction of earthwork is in progress, the Contractor shall adhere to the compaction procedures found from compaction trials for each type of material being compacted, each type of compaction equipment employed and each degree of compaction specified.

Earth

The Contractor shall compact the material placed in all embankment layers and the material scarified to the designated depth below subgrade of the maximum determined by AASHTO T 99 Method C, is attained, at a moisture content determined by the Engineer to the suitable for such density. Acceptance of compaction may be based on adherence to an approved roller pattern developed as set forth in Item 106, Compaction Equipment and Density Control Strips.

The Engineer shall during progress of the Work, make density tests of compacted material in accordance with AASHTO T 191, T 205, or other approved field approved density tests, including the use of properly calibrated nuclear testing devices. A correction for coarse particles may be made in accordance with AASHTO T 224. If, by such tests, the Engineer determines that the specified density and moisture conditions have not been attained, the Contractor shall perform additional work as may be necessary to attain the specified conditions.

At least one group of the three in-situ density test shall be carried out for each 500 m of each layer of compacted fill.

Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with approved methods.

Embankment materials classified as rock shall be deposited, spread and leveled the full width of the fill with sufficient earth or other fine material so deposited to fill the interstices to produce a dense compact embankment. In addition, one of the requirements set forth in Subsection 106.2.1, Compaction Equipment, shall compact the embankment full width with a minimum.

104.3.4 Protection of Roadbed During Construction

During the construction of the roadway, the roadbed shall be maintained in such condition that it will be well drained at all times. Side ditches or gutters emptying from cuts to embankments by erosion.

104.3.5 Protection of Structures

If embankments can be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of, or excessive pressure against the structure. When noted on the Plans, the fill adjacent to the end bent of a bridge shall not be placed higher than bottom to the backwall of the bent until the superstructure is in place. When embankment is to be placed on both sides of a concrete wall or box type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure.

104.3.6 Rounding and Warping Slopes

Rounding - except on solid rock, the tops and bottoms of all slopes, including the slopes of drainage ditches, shall rounded as indicated on the Plans. A layer of earth overlaying rock shall be rounded above the rock as done in earth slopes.

Warping - Adjustments in slopes shall be made to avoid injury in standing trees or marring of weathered rock, or to harmonize with existing landscape features, and the transition to such adjusted slopes shall be gradual. At intersection of cuts and fills, slopes shall be adjusted and warped to flow into each other or into the natural ground surfaces without noticeable break.

104.3.7. Finishing Roadbed and Slopes

After the roadbed has been substantially completed, the full width shall be conditioned by removing any soft or other unstable material that will not compact properly or serve the intended purpose. The resulting areas and all other low sections, holes or depressions shall be brought to grade with suitable selected material. Scarifying, blading, dragging, rolling, or other methods of work shall be performed or used as necessary to provide a thoroughly compacted roadbed shaped to the grades and cross-sections shown on the Plans or as staked by the Engineer.

All earth slopes shall be left with roughened surfaces but shall be reasonably uniform, without any noticeable break, and in reasonably close conformity with the Plans or other surfaces indicated on the Plans, or as staked by the Engineer, with no variations therefrom readily discernible as viewed from the road.

104.3.8 Serrated Slopes

Cut slopes in rippable material (soft rock) having slope ratios between 0.75:1 and 2:1 shall be constructed so that final slope line shall consist of a series of small horizontal steps. No scaling shall be performed on the stepped slopes except for removal of large rocks which will obviously be safety hazard if they fall into the ditchline or roadway.

104.3.9 Earth Berms

When called for the Contract, permanent earth berms shall be constructed of well graded materials with no rocks having a diameter greater than 0.25 the height of the berm. When local material is not acceptable material shall be imported, as directed by the Engineer.

Compacted Berm

Compacted berm construction shall consist of moistening or drying and placing material as necessary in locations shown on the drawings or as established by the Engineer. Material shall contain no frozen material, roots, sod, or other deleterious materials. Contractor shall take precautions to prevent material from escaping over the embankment slope. Shoulder surface beneath berm will be roughened to provide a bond between the berm will be roughened to provide a bond between the berm and shoulder when completed. The Contractor shall compact the material placed until at least 90 mass percent of the maximum density is obtained as determined by AASHTO T 99, Method C. The cross section of the as shown on the Plans.

Uncompacted Berm

Uncompacted berm construction shall consist of drying, if necessary, and placing material in locations shown on the Plans or as established by the Engineer. Material shall contain no frozen material, roots, sod or other deleterious materials. Contractor shall take precautions to prevent material from escaping over the embankment slope.

104.3 Method of Measurement

The quantity of embankment to be paid for shall be the volume of material compacted in place, accepted by the Engineer and formed with material obtained from any source.

Material from excavation per Item 102 which is used in embankment and accepted by the Engineer will be paid under embankment and such payment will be deemed to include the cost of excavating, hauling, stockpiling and all other costs incidental to the work.

Material for Selected Borrow topping will be measured and paid for under the same conditions specified in the preceding paragraph.

104.5 Basis of Payment

The accepted quantities, measure as prescribed in Section 104.4, shall be paid for the contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities. The payment shall constitute full compensation for placing and compacting all materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
104 (1)	Embankment	Cubic meter
104 (2)	Selected Borrow for topping, Case 1	Cubic meter
104 (3)	Selected Borrow for topping, Case 2	Cubic meter
104 (4)	Earth Berm	Meter
104 (5)	Embankment for Shoulder with Materials obtained from Excavation of Existing Pavement	Cubic meter

ITEM 105 - SUBGRADE PREPARATION

105.1 Description

This item shall consist of the preparation of the subgrade for the support of overlaying structural layers. It shall extend to full width of the roadway. Unless authorized by the Engineer, subgrade preparation shall not be done unless the construction of the pavement structure.

105.2 Material Requirements

Unless otherwise stated in the Contract and except when the subgrade is in rock cut, all materials below subgrade level to depth 150 mm or to such greater depth as may be specified shall meet the requirements of Section 104.2, Selected Borrow for Toppings.

105.3 Construction Requirements

105.3.1 Prior Works

Prior commencing preparation of the subgrade, all culverts, cross drains, ducts and the like (including their fully compacted backfill), ditches, drains and drainage outlets shall be completed. Any work on the preparation of the subgrade shall not be started unless prior work herein described shall have been by the Engineer.

105.3.2 Subgrade Level Tolerances

The finished compacted surface of the subgrade shall conform to the allowable tolerances as specified hereunder:

Permitted variation from	+ 20 mm
design LEVEL OF SURFACE	- 30 mm
Permitted SURFACE IRREGULARITY	
MEASURED BY 3 - m STRAIGHT EDGE	30 mm
Permitted variation from	
design CROSSFALL OR CAMBER	± 0.5 %
Permitted variation from	
Design LONGITUDINAL GRADE	
over 25 m length	± 0.1 %

105.3.3 Subgrade in Common Excavation and Excavation of Existing Pavement

Unless otherwise specified, all materials below subgrade level in earth cuts to a depth 150 mm or other depth shown on the Plans or as directed by the Engineer shall be excavated. The material, if suitable, shall be set aside for future use or, if unsuitable, shall be disposed off in accordance with the requirements of Subsection 102.2.9.

Where material has been removed from below subgrade level, the resulting surface shall be compacted to a depth of 150 mm and in accordance with the other requirements of Subsection 104.3.3.

All materials immediately below subgrade level in the earth cuts to a depth of 150 mm, or to such greater depth as may be specified, shall be compacted in accordance with the requirements of Subsection 104.3.3.

105.3.4 Subgrade in Rock Excavation

Surface irregularities under the subgrade level remaining after trimming of the rock excavation shall be leveled by placing specified material and compacted to the requirements of Subsections 104.3.3.

105.3.3 Subgrade of Embankment

After the embankment has been completed, the full width shall be conditioned by removing any soft or other unstable material that will not compact properly. The resulting areas and all other sections, holes, or depressions shall be brought to grade with suitable material. The entire roadbed shall then be shaped and compacted to the requirements of Subsections 104.3.3. Scarifying, blading, dragging, rolling, or other methods of work shall be performed or used as necessary to provide a thoroughly compacted roadbed shaped to the cross-section shown on the Plans.

105.3.6 Subgrade on Existing Pavement

Where the new pavement is to be constructed immediately over an existing Portland Cement concrete pavement and if so specified in the Contract the slab shall be broken into pieces with greatest dimension of not more than 500 mm and the existing pavement material compacted as specified in Subsection 104.3.3, as directed by the Engineer. The resulting subgrade level shall, as part of pavement construction be shaped to conform to the allowable tolerances of Subsection 105.3.2 by placing comprising the material of the pavement course to be placed immediately above.

Where the new pavement is to be constructed immediately over an existing asphalt concrete pavement or gravel surfaced pavement and if so specified in the Contract the pavement shall be scarified, thoroughly loosened, reshaped and recompactd in accordance with Subsection 104.3.3. The resulting subgrade level shall conform to the allowable tolerances of Subsection 105.3.2.

105.3.7 Protection of Completed Work

The Contractor shall be required to protect and maintain at his own expense the entire work within the limits of his Contract in good condition satisfactory to the Engineer from the time he first started work until all work shall have been completed. Maintenance shall include repairing and recompactd ruts, ridges, soft spots and deteriorated sections of the subgrade caused by the traffic of the Contractor's vehicle/equipment of that public.

105.3.8 Templates and Straight-edges

The Contractor shall provide for use of the Engineer, approved templates and straight-edges in sufficient number to check the accuracy of the work, as provided in this Specification.

105.4 Method of Measurement

105.4.1 Measurement of Items for payment shall be provided only for:

1. The compaction of existing ground below subgrade level in cuts of common material as specified in Subsection 105.3.3

2. The breaking up or scarifying up or, loosening, reshaping and recompactd of existing pavement as specified in Subsection 105.3.6. The quantity to be paid for shall be the area of the work specified to be carried out and accepted by the Engineer.

105.4.2 Payment for all work for the preparation of the subgrade including shaping to the required levels and tolerances, other than as specified above shall be deemed to be included in the Pay Item for Embankment.

105.5 Basis of Payment

The accepted quantities, measured as described in Section 105.4, shall be paid for the appropriate contract unit price for Pay item listed below that is included in the Bill of Quantities which price and payment shall be full compensation for the placing or removal and disposal of all materials including all labor, equipment, tools and

incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

Payment Item Number	Description	Unit of Measurement
105 (1)	Subgrade Preparation (Common Material)	Square meter
105 (2)	Subgrade Preparation (Existing Pavement)	Square meter
105 (3)	Subgrade Preparation (Unsuitable Material)	Square meter

ITEM 106 - COMPACTION EQUIPMENT AND DENSITY CONTROL STRIPS

106.1 Description

When specified, this procedure will be used to determine density requirements of selected embankments, subgrade, bases, and bituminous concrete. The procedure will consist of control strip construction to establish target for the specified course plus use of sand-cone method of density testing equipment to determine in-place densities obtained during the construction process.

106.2 Construction Requirements

106.2.1 Compaction Equipment

Compaction equipment shall be capable of obtaining compaction requirements without detrimentally affecting the compacted material. The equipment shall be modern, efficient compacting units approved by the Engineer. The compacting units may be of any type, provided they are capable of compacting each of material as specified and meet the minimum requirements as contained herein. Minimum requirements for rollers are as follows:

1. Sheepfoot, tamping or grid rollers shall be capable of exerting a force of 45 Newton per millimeter (250 pounds per inch) of length of roller drum.
2. Steel - wheel rollers other than vibratory shall be capable of exerting a force of not less than 45 Newton per millimeter of width of the compression roll or rolls.
3. Vibratory steel-wheel rollers shall have a minimum mass of 6 exerting a force of not less than 45 Newton per millimeter of width of the compression roll or rolls.

4. Pneumatic-tire rollers shall have smooth tread of equal tires of equal size that will provide a uniform compacting pressure for the full width of the roller and capable of exerting a ground pressure of at least 550 kpa(80 pounds per square inch)

5. Heavier compacting units may be required to achieve the specified density of the embankment.

106.2.2 Construction of Control Strips and Determination of Target Density.

To determine target density, a control strip shall be constructed at the beginning of work on each course of material to be compacted. Each control strip, constructed to acceptable density and surface tolerances shall remain in place and become a section of the completed roadway. Unacceptable control strip shall be corrected or removed and replaced at the Contractor's expense. A control strip shall have an area of approximately 335 square meters and shall be of the same depth specified for the construction of the course which it represents.

The materials used in the construction of control strip shall conform to the specification requirements. They shall be furnished from the same source and shall be of the same type to be used in the remainder of the course represented by the control strip. The underlying grade or pavement the prior approval of the Engineer.

The Equipment used in the construction of the control strip be approved by the Engineer and shall be of the same type and mass to be used of the remainder of the course represented by the control strip.

Compaction of control strips shall commence immediately after the course has been placed to the specified thickness, and shall be continuous and uniform over the entire surface. Compaction of the control strip shall be continued until no discernible increase in density can be obtained by additional compactive effort.

Upon completion of the compaction, the mean density of the control strip will be determined by averaging the results of the in-place density taken at randomly selected sites within the control strip. The mean density of the control strip shall be target density for the remainder of the course which it represents.

If the mean density of the control strip is less than 98 percent of the density of laboratory compacted specimens as determined by testing procedures appropriate for the material being placed, the engineering may order the construction of another strip.

A new control strip may also be ordered by the Engineer or requested by the Contractor when:

1. A change in the material of job-mix formula, is made
2. Ten days of production have been accepted without construction of a new control strip.
3. There is reason to believe that a control strip density is not representative of the material being placed.

106.3 Method of Measurement

No measurement for payment will be made for this item.

106.4 Basis of Payment

Unless otherwise provided, the cost of constructing the control strip will be considered incidental to the cost of the work item for which a control strip is required. Payment for the work item shall be deemed to include compensation for performing the work herein specified and the furnishing of all materials, labor, tools, equipment and incidentals necessary to construct the density control strip. No payment will be made for any material used in the construction of unacceptable control strip.

ITEM 107 - OVERHAUL

The cost of overhaul will not be directly paid for, but will be considered as a subsidiary obligation of the Contractor under other Contract Item.

ITEM 108 - Re-shaping of Existing Shoulder

108.1 Description

This Item shall consist of re-shaping and/or grading of existing shoulder in Section No. 3 and 4 in conformity with the lines, grades, and dimensions shown on the Plans or established by the Engineer.

108.2 Method of Measurement

Measurement of this Item for payment shall be provided only for the portion where no material is filled on existing shoulder. The quantity of re-shaping of existing shoulder to be paid for shall be the area of the work specified to be carried out and accepted by the Engineer.

108.3 Basis of Payment

The accepted quantities, measured as prescribed in Section 108.2, shall be paid for at the contract unit price for re-shaping of existing shoulder which price and payment shall be full compensation for the placing or removal and disposal of all materials including all labor, equipment, tools and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No.	Description	Unit of Measurement
108	Re-shaping of Existing Shoulder	Square meter

PART C - SUBBASE AND BASE COURSE

ITEM 200 - AGGREGATE SUBBASE COURSE

200.1 Description

This Item shall consist of furnishing, placing and compacting an aggregate sub-base course on a prepared subgrade in accordance with this Specification and the lines, grades and cross sections shown on the Plans, or as directed by the Engineer.

200.2 Material Requirements

Aggregate for sub-base shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable sub-base. It shall conform to the grading requirements shown in Table 200.1.

Table 200.1 - Grading Requirements

Sieve Designation		Mass Percent Passing
Standard mm	Alternate US Standard	
50	2"	100
25	1"	55-85
9.5	3/8"	40-75
0.075	No. 200	0-12

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No. 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and plasticity index not greater than 12 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve, shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion Tests as determined by AASHTO T 96.

The material shall have a soaked CBR value of not less than 25% as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density as determined by AASHTO T 180, Method D.

200.3 Construction Requirements

200.3.1 Preparation of Existing Surface

The existing surface shall be graded and finished as provided under Item 105, Subgrade Preparation, before placing the sub-base material.

200.3.2 Placing

The aggregate sub-base material shall be placed as a uniform mixture on a prepared subgrade in a quantity which will provide the required compacted thickness. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow. The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans.

When hauling is done over previously placed material, hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer, to minimize rutting or uneven compaction.

200.3.3 Spreading and Compacting

When uniformly mixed, the mixture shall be spread to the plan thickness, for compaction.

Where the required thickness is 150 mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate sub-base shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of sub-base material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothing, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road, and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until the surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the sub-base material shall be compacted thoroughly with approved tampers or compactors.

If the layer of sub-base material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a field density of at least 100 percent of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191.

200.3.4 Trial Sections

Before sub-base construction is started, the Contractor shall spread and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and construction method which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m² shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.

If a trial section shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable for sub-base, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.

If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

200.3.5 Tolerance

Aggregate sub-base shall be spread with equipment that will provide a uniform layer which when compacted will conform to the designed level and transverse slopes as shown on the Plans. The allowable tolerance shall be as specified hereunder:

Permitted variation from design THICKNESS OF LAYER	±20mm
Permitted variation from design LEVEL OF SURFACE	+10mm -20mm
Permitted SURFACE IRREGULARITY MEASURED by 3-m straight-edge	20mm
Permitted variation from design CROSSFALL or CAMBER	+0.3%
Permitted variation from design LONGITUDINAL GRADE over 25 m length	±0.1%

200.4 Method of Measurement

Aggregate Sub-base Course will be measured by the cubic meter (m³). the quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed course. No allowance will be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of sub-base herein measured.

200.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 204, shall be paid for at the contract unit price for Aggregate Sub-base Course which price and payment shall be full compensation for furnishings and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
200	Aggregate Sub-base Course	Cubic meter

ITEM 201 - AGGREGATE BASE COURSE

201.1 Description

This Item shall consist of furnishing, placing and compacting an aggregate base course on a prepared subgrade/sub-base in accordance with this Specification and the lines, grades, thickness and typical cross-sections shown on the Plans, or as established by the Engineer.

201.2 Material Requirements

Aggregate for base course shall consist of hard, durable particles or fragments of crushed slag or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable base.

The base course material shall conform to Table 201.1 whichever is called for in the Bill of Quantities.

Table 201.1 - Grading Requirements

Sieve Designation		Mass Percent Passing	
Standard mm	Alternate US	Grading A	Grading B
50	2"	100	
37.5	1 1/2"	-	100
25.0	1"	60-85	-
19.0	3/4"	-	60-85

Table 201.1 - Grading Requirements (cont'd)

Sieve Designation		Mass Percent Passing	
Standard mm	Alternate US	Grading A	Grading B
12.5	1/2"	35-65	-
4.75	No. 4	20-50	30-55
0.425	No. 40	5-20	8-25
0.075	No. 200	0.12	2-14

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No. 40) sieve).

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 25 and plasticity index not greater than 6 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion test determined by AASHTO T 96.

The material passing the 19 mm (3/4 inch) sieve shall have a soaked CBR value of not less than 80% as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density (MDD) as determined by AASHTO T 180, Method D.

If filler, in addition to that naturally present, is necessary for meeting the grading requirements or for satisfactory bonding, it shall be uniformly blended with the base course material on the road or in a pugmill unless otherwise specified or approved. Filler shall be taken from sources approved by the Engineer, shall be free from hard lumps and shall not contain more than 15 percent of material retained on the 4.75 mm (No. 4) sieve.

201.3 Construction Requirements

201.3.1 Preparation of Existing Surface

The existing surface shall be graded and finished as provided under Item 105, Subgrade Preparation, before placing the base material.

201.3.2 Placing

It shall be in accordance with all the requirements of Sub-section 200.3.2, Placing.

201.3.3 Spreading and Compacting

It shall be in accordance with all the requirements of Sub-section 200.3.3, except that the field density required of each layer is not less than 100 percent of the maximum dry density determined in accordance with AASHTO T 180 Method D. The field density is determined in accordance with AASHTO T 191.

201.3.4 Trial Sections

Trial sections shall conform in all respects to the requirements specified in Sub-section 200.3.4

201.3.5 Tolerances

The aggregate base course shall be laid to the designed level and transverse slopes shown on the Plans. The allowable tolerances shall be in accordance with the following:

Permitted variation from design THICKNESS OF LAYER	±10mm
Permitted variation from design LEVEL OF SURFACE	+ 5mm +10mm
Permitted SURFACE IRREGULARITY MEASURED by 3-m straight-edge	5mm
Permitted variation from design CROSSFALL or CAMBER	±0.2%
Permitted variation from design LONGITUDINAL GRADE over 25 m length	±0.1%

201.4 Method of Measurement

Aggregate Base Course will be measured by the cubic meter (m³). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed base course. No allowance shall be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of aggregate base course.

201.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 201.4, shall be paid for at the contract unit price for Aggregate Base Course which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
201	Aggregate Base Course	Cubic meter

ITEM 202 - CRUSHED AGGREGATE BASE COURSE

202.1 Description

This Item shall consist of furnishing, placing and compacting crushed gravel, crushed stone or crushed rock on a prepared subgrade/sub-base in one or more layers in accordance with this Specification and the lines, grades, thickness and typical cross-sections shown on the Plans or as established by the Engineer.

202.2 Material Requirements

202.2.1 Crushed Aggregate

It shall consist of hard, durable particles or fragments of stone or gravel crushed to the size and of the quality requirements of this Item. It shall be clean and free from vegetable matters, lumps or balls of clay and other deleterious substances. The material shall be of such nature that it can be compacted readily to form a firm, stable base. It shall conform to the grading requirements shown in Table 202.1.

Table 202.1 - Grading Requirements

Sieve Designation		Mass Percent Passing	
Standard mm	Alternate US	Grading A	Grading B
37.5	1 1/2"	100	
25	1"	-	100
19	3/4"	60-85	-
12.5	1/2"	-	60-90
4.75	No. 4	30-55	35-65
0.425	No. 40	8-25	10-30
0.075	No. 200	2-14	5-15

The portion of the material passing the 0.075 mm (No. 200) sieve shall not greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No. 40) sieve.

The portion of the material passing the 0.425 mm (No. 40) sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 6 as determined by AASHTO T 89 and 90, respectively.

The coarse aggregate retained on a 2.00 mm (No. 10) sieve shall have a mass percent of wear not exceeding 45 by the Los Angeles abrasion Test as determined by AASHTO T 96,

and not less than 50 mass percent shall have at least one (1) fractured face.

The material passing the 19 mm (3/4 inch) sieve shall have a minimum soaked CBR - value of 80% tested according to AASHTO T 193. The CBR - value shall be obtained at the maximum dry density determined according to AASHTO T 180, Method D.

If filler, in addition to that naturally present, is necessary for meeting the grading requirements or for satisfactory bonding, it shall be uniformly blended with the crushed base course material on the road or in a pugmill unless otherwise specified or approved. Filler shall be obtained from sources approved by the Engineer, free from hard lumps and not contain more than 15 percent of material retained on the 4.75 mm (No. 4) sieve.

202.3 Construction Requirements

Same as Sub-sections 201.3.1 through 201.3.5.

202.4 Method of Measurement

Crushed Aggregate Base Course will be measured by the cubic meter (m^3). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed course. No allowance shall be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of crushed aggregate base course.

202.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 202.4, shall be paid for at the contract unit price for Crushed Aggregate Base Course which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
202	Crushed Aggregate Base Course	Cubic meter

PART D - SURFACE COURSES

ITEM 300 - AGGREGATE SURFACE COURSE

300.1 Description

This Item shall consist of a wearing or top course composed of gravel or crushed aggregate and filler material, whichever is called for in the Bill of Quantities, constructed on a prepared base in accordance with this Specification and in conformity with the lines, grades and typical cross-sections shown on the Plans.

300.2 Material Requirements

The aggregate shall consist of hard, durable particles or fragments of stone or gravel and sand or other fine mineral particles free from vegetable matter and lumps or balls of clay and of such nature that it can be compacted readily to form a firm, stable layer. It shall conform to the grading requirements shown in Table 300.1 when tested by AASHTO T 11 and T 27.

Table 300.1 - Grading Requirements

Sieve Designation		Mass Percent Passing			
Standard mm	Alternate U.S. Standard	Grading A	Grading B	Grading C	Grading D
25	1"	100	100	100	100
9.5	3/8"	50-85	60-100	-	-
4.75	No. 4	35-65	50-85	55-100	70-100
2.00	No. 10	25-50	40-70	40-100	55-100
0.425	No. 40	15-30	25-45	20-50	30-70
0.075	No. 200	5-20	5-20	6-20	8-25

The coarse aggregate material retained on the 2.00 mm (No. 10 sieve shall have a mass percent of wear by the Los Angeles Abrasion Test (AASHTO T 96) of not more than 45.

When crushed aggregate is called for in the Bill of Quantities, not less than fifty (50) mass percent of the particles retained on the 4.75 mm (No. 4) sieve shall have at least one (1) fractured face.

The fraction passing the 0.75 mm (No. 200) sieve shall not be greater than two-thirds of the fraction passing the 0.425 mm (No. 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and a plasticity index range of 4 to 9, when tested by AASHTO T 89 and T 90, respectively.

300.3 Construction Requirements

300.3.1 Placing

Aggregate surface course shall be placed in accordance with the requirements of Item 201, Aggregate Base Course.

300.3.2 Compacting Requirements

Aggregate surface course shall be compacted in accordance with the requirements of Item 201, Aggregate Base Course.

300.3.3 Trial Sections

Trial sections shall be carried out for aggregate surface course in accordance with the requirements of Item 201, Aggregate Base Course.

300.3.4 Surface Course Thickness and Tolerances

The aggregate surface course shall be laid to the designed level and transverse slopes shown on the Plans. The allowable tolerances shall be as specified hereunder:

Permitted variation from design THICKNESS OF LAYER	+15 mm - 5 mm
Permitted variation from design LEVEL OF SURFACE	+15 mm - 5 mm
Permitted SURFACE IRREGULARITY measured by 3-m straight-edge	5 mm
Permitted variation from design CROSSFALL OR CAMBER	+0.2%
Permitted variation from design LONGITUDINAL GRADE over 25 m in length	+0.1%

300.4 Method of Measurement

Aggregate surface course shall be measured by the cubic meter (m^3). The quantity to be paid for shall be the number of cubic meters of aggregate including all filler, placed, compacted and accepted in the completed course. No allowance will be given for material placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantities as measured above.

300.5 Basis of Payment

The accepted quantity, measured as prescribed in Section 300.4 shall be paid for at the contract unit price for Aggregate Surface Course which price and payment shall constitute full compensation for furnishing, handling, placing, watering and rolling all materials, including all labor and equipment, tools and incidentals necessary to complete this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
300	Aggregate Surface Course	
300 (1)	Gravel Surface Course	Cubic meter
300 (2)	Crushed Aggregate Surface Course	Cubic meter

ITEM 301 - BITUMINOUS PRIME COAT

301.1 Description

This Item shall consist of preparing and treating an aggregate base course with material in accordance with the Plans and Specifications, preparatory to the construction of a bituminous surface course.

301.2 Material Requirements

Bituminous material shall be Medium Curing Cut-back Asphalt, MC-70 whichever is called for in the Bill of Quantities. It shall conform to the requirements of Item 401, Bituminous Materials.

301.3 Construction Requirements

301.3.1 Surface Condition

Prime coat shall be applied only to surfaces which are dry or slightly moist. No prime coat shall be applied when the weather is foggy or rainy.

301.3.2 Equipment

The liquid bituminous material shall be sprayed by means of a pressure distributor of not less than 1000 liters capacity, mounted on pneumatic tires of such width and number that the load produced on the road surface will not exceed 1 KN (100 kgf) per cm width of tire.

The tank shall have a heating device able to heat a complete charge of bituminous liquid to 180 C. The heating device shall be such that overheating will not occur. Consequently, the flames must not directly touch the casing of the tank containing the bituminous liquid. The liquid shall be insulated in such a way that the drop in temperature when the tank is filled with bituminous liquid at 180 C and not heated will be less than 2 C per hour. A thermometer shall be fixed to the tank in order to be able to measure continuously the temperature of the liquid. The thermometer shall be placed in such a way that the highest temperature in tank is measured. The tank shall be furnished with a calibrated dip-stick to indicate the contents. The pipes for filling the tank shall be furnished with an easily changeable filter.

The distributor shall be able to vary the spray width of the bituminous liquid in maximum steps of 100 mm to a total width of 4 m. The spraying bar shall have nozzles from which the liquid is sprayed fan-shaped on the road surface equally distributed over the total spraying width.

For adding the liquid bituminous material, the distributor shall have a pump either driven by a separate motor, or with a device to synchronize its speed with the speed of the distributor. The pump shall be furnished with an indicator showing the rate of flow. The suction side of the pump shall have an easily changeable filter. A thermometer shall be fixed, such that it indicates the temperature of the liquid immediately before it leaves the spraying bar.

The distributor shall be furnished with a tachometer, indicating its forward speed, which shall be visible from the driver's seat. The distributor shall be designed so that the deviation from the prescribed rate of application does not exceed 10% and shall be equipped with a device for hand spraying of the bituminous liquid.

301.3.3 Application of Bituminous Material

Immediately before applying the prime coat, the full width of surface to be treated shall be swept with a power broom and if necessary, scraped to remove all dirt and other objectionable materials. Where required by the Engineer, immediately prior to the application of the prime coat, the surface shall slightly sprayed with water but not saturated. Bituminous material shall be applied by means of a pressure distributor at the temperature given in Item 401, Bituminous Materials. The rate of application of the bituminous material shall be within the range of 1 to 2 liters/m², the exact rate to be ordered by the Engineer.

The prime coat shall be left undisturbed for a period of at least 24 hours and shall not be opened to traffic until it has penetrated and cured sufficiently so that it will not be picked up by the wheels of passing vehicles. The Contractor shall maintain the prime coat until the next course is applied. Care shall be taken that the application of bituminous material is not in excess of the specified amount, any excess shall be blotted with sand or removed as directed by the Engineer. All areas inaccessible to the distributor shall be sprayed manually using the device for hand spraying. The surface of structures and trees adjacent to the areas being treated shall be protected in such a manner as to prevent their being splattered or marred.

301.4 Method of Measurement

Bituminous Prime Coat shall be measured by the tonne (t). The quantity to be paid for shall be the number of tonnes of bituminous material applied and accepted in the completed work.

301.5 Basis of Payment

The accepted quantity, measured as prescribed in Section 301.4, shall be paid for at the contract unit price for Bituminous Prime Coat which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
301	Bituminous Prime Coat	
301 (1)	MC-70 Cut-back Asphalt	Tonne

ITEM 303 - BITUMINOUS SEAL COAT

303.1 Description

This Item shall consist of an application of bituminous material with or without an application of aggregate in accordance with the Plans and Specifications.

303.2 Material Requirements

303.2.1 Quantities of Materials

The approximate amounts of materials per square meter for seal coats of the several types shall be as provided in Table 303.1. The exact amounts to be used shall be set by the Engineer.

Table 303.1 - Quantities of Materials for Seal Coats

	Type 1	Type 2	Type 3
Bituminous material L/m ²	0.20-0.50	0.50-1.00	0.85- 1.50
Cover aggregate, kg/m ²	none	5.00-10.00	8.00-14.00

303.2.2 Bituminous Materials

Bituminous material shall be Medium Curing Cut-back Asphalt MC-800. It shall conform to the requirements of Item 401, Bituminous Materials, whichever is called for in the Bill of Quantities.

303.2.3 Cover Aggregate

Cover aggregate for Type 2 seal coat shall consist of sand or fine screenings, reasonably free from dirt or other organic matter.

Aggregate for Type 3 seal coat shall be crushed stone, crushed slag or crushed gravel.

Aggregate gradation shall conform with Table 303.2 when tested by AASHTO T 27.

Table 303.2 - Grading Requirements

Sieve Designation		Mass Percent Passing			
Standard mm	Alternate U.S. Standard	Type 2	Type 3		
			Grading A	Grading B	
12.50	1/2 in.	-	-	100	
9.50	1/8 in.	100	100	85-100	
4.75	No. 4	85-100	85-100	10-30	
2.36	No. 8	60-100	10-40	0-10	
1.18	No. 16	-	0-10	0-5	
0.300	No. 50	-	0-5	-	
0.150	No. 100	0-10	-	-	

The aggregate shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96.

When crushed slag is used, it shall be of uniform density and quality and shall have a density of not less than 960 kg/m³ (60 lb/cu.ft.) as determined by AASHTO T 19.

303.3 Construction Requirements

303.3.1 Weather and Moisture Conditions

Seal coating shall not be undertaken during foggy or rainy weather or when the surface to be treated is wet. Wet cover coat material shall not be used on the work. No seal coating work shall be continued at night unless provided with sufficient lighting. The Engineer shall always be consulted before the commencement of the work and all work shall be terminated at once in the event of rain.

303.3.2 Preparation of Surface

Seal coating operations shall not be started until the bituminous surface is thoroughly compacted by traffic and rolling. In no event shall seal coat be placed on newly constructed or reconditioned surfaces in less than ten (10) days after such surface is laid and opened to traffic, unless ordered in writing by the Engineer.

Immediately prior to applying the bituminous material, the surface shall be cleaned of all dirt, sand, dust and objectionable material. This cleaning shall be effected by means of a rotary power broom or a power blower, unless other methods are authorized by the Engineer. Dried mud or other foreign material which cannot be removed otherwise shall be removed by hand methods.

303.3.3 Application of Bituminous Material

Bituminous material shall be applied by means of a pressure distributor at the rate of approximately 1.5 to 3.0 liters for cut-back asphalt, per square meter of surface, in a uniform, unbroken spread over the section to be treated. The pressure distributor used for applying asphaltic materials shall be equipped with pneumatic tires and shall be designed and operated so as to distribute the asphaltic material at the specified rate. It shall be equipped with a fifth wheel tachometer registering the speed and so located as to be visible to the truck driver. The distributor pump shall be equipped with a gauge registering liters per minute passing through the nozzles and readily visible to the operator. Other suitable measuring devices approved by the Engineer may be used. The exact quantity to be applied shall be determined by the Engineer. The temperature at the time of application shall be within the range of temperature specified under Item 401, Bituminous Materials. Care shall be taken that the application of bituminous material at the junction of spreads is not in excess of the specified quantities. Any excess shall be removed from the surface by a squeegee. If necessary, to obtain proper junction of spreads, a strip of manila paper approximately 1 meter wide and at least as long as the spray bar shall be used at the beginning and end of each spread. The paper shall be removed after use.

Any skipped areas or recognized deficiencies shall be corrected immediately by hand application and hand operated pressure devices or by other equally suitable means.

In the event that any structure becomes discolored with bituminous material, the Contractor, at his own expense, shall remove the discoloration to the satisfaction of the Engineer.

303.3.4 Spreading of Cover Aggregate

Immediately after the application of asphalt, the cover aggregate shall be evenly spread over the surface at the rate of approximately 0.004 to 0.007 cubic meter per square meter. The exact quantity shall be as directed by the Engineer. Spreading shall be accomplished by aggregate spreader only so that an even and accurate distribution is obtained. The use of spreader boards attached to tail gates of trucks shall not be permitted. The tires of the aggregate trucks shall at no time come in contact with the uncovered and newly applied asphalt.

As soon as the cover aggregate has been spread, the surface shall be broomed lightly with approved push or drag broom to insure an even distribution, and shall then be rolled with an approved power roller weighing not less than 5, nor more than 6 tonnes to a uniform surface.

303.3.5 Maintenance

The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer. The maintenance work shall consist of keeping any excess aggregate evenly spread over the asphalt surface by approved sweeping devices. It shall also consist of keeping all pot holes or failures which may occur, repaired by use of additional asphalt and necessary aggregate. All fat or bleeding surfaces shall be covered with approved cover aggregate so that the asphalt will not adhere to, or be picked up by the wheels of vehicles.

303.4 Method of Measurement

Bituminous material and cover aggregate for Bituminous Seal Coat shall be measured by the tonne (t). The quantity to be paid for shall be the number of tonnes of bituminous material and aggregate used and accepted in the completed work.

303.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 303.4, shall be paid for at the contract unit price for Bituminous Seal Coat, which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
303	Bituminous Seal Coat	
303 (1)	Cover Aggregate, Type 2	Tonne
303 (2)	MC-800 cut-back Asphalt	Tonne

ITEM 304 - BITUMINOUS SURFACE TREATMENT

304.1 Description

This Item shall consist of either a single application of bituminous material followed by a single application of bituminous material followed by a single spreading of aggregate (single surface treatment) or two applications of bituminous material each followed by a spreading of aggregate (double surface treatment) in accordance with the Plans and Specifications.

304.2 Material Requirements

304.2.1 Quantities of Materials

The approximate amounts of materials per square meter and sequence of operations for single and double surface treatment shall be as provided in Table 304.1, whichever is called for in the Bill of Quantities.

The quantities given in the Tables are those of aggregate having a bulk specific gravity of 2.65 as determined by AASHTO T 84 and T 85. Proportionate corrections will be made when the aggregate furnished on the job has a bulk specific gravity above 2.75 or below 2.55. In such case, the corrected amount will be the product of the quantity shown in the Tables and the ratio of the bulk specific gravity of aggregate to 2.65.

The amounts given in the Tables are approximate and the exact amounts will be set by the Engineer. Total amount of bituminous material per square meter may be varied by the Engineer as necessary to fit conditions, but the total amount of aggregate per square meter, after adjusting for specific gravity will not be changed.

Table 304.1 - Quantities of Materials and Sequence of Operations Using Cut-Back Asphalt or Asphalt Cement

Aggregate Grading and Sequence of Operations	Single S.T.	Double S.T.
First Course:		
Apply bituminous material, L/m ²	1.36	1.36
Spread Aggregate:		
Grading B, kg/m ²	13.60	27.20
Grading A, kg/m ²		
Second Course:		
Apply bituminous material, L/m ²		1.58
Spread Aggregate:		
Grading B, kg/m ²		10.88
Totals:		
Bituminous Material, L/m ²	1.36	2.94
Aggregate, kg/m ²	13.60	38.0

304.2.2 Bituminous Materials

Bituminous material shall be Medium Curing Cut-back Asphalt MC-800 whichever is called for in the Bill of Quantities. It shall conform to the requirements of Item 401, Bituminous Materials.

304.2.3 Aggregates

The aggregates shall be crushed stone, crushed slag, or crushed gravel. The gradation shall conform to Table 304.3.

Table 304.3 - Aggregate Grading Requirements

Sieve Designation		Mass Percent Passing	
Standard mm	Alternate U.S. Standard	Grading A	Grading B
25.0	1"	100	-
19.0	3/4"	90-100	-
12.5	1/2"	20-55	100
9.5	3/8"	0-15	85-100
4.75	No. 4	0-5	10-30
2.36	No. 8	-	0-10
1.18	No. 16	-	0-5
0.300	No. 50	-	-

The aggregate shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96.

When crushed gravel is used, not less than 50 mass percent of the particles retained on the 4.75 mm (no. 4) sieve shall have at least one fractured face.

When crushed slag is used, it must be of uniform density and quality and shall have a density not less than 960 kg/m³ (60 lb/cu.ft.) as determined by AASHTO T 19.

304.3 Construction Requirements

304.3.1 Rates of Application/Spreading of Asphalt and Aggregate

The rates of application/spreading of asphalt and aggregate shall be within the range in table 304.1. These quantities are given as guide only and will vary considerably according to the type and condition of the surface, the grading, type, shape and absorbency of the aggregate, the weather condition and the traffic. The actual quantities to be used for surface treatment shall be determined by the Contractor in accordance with the design methods for one size aggregate given in Asphalt Institute Manual (MS-13), Asphalt Surface Treatment. The proposed design shall be subject to the approval of the Engineer.

The Contractor shall furnish the Engineer a certified vendor's certificate in duplicate immediately upon delivery of asphaltic material to the Site.

The Contractor shall provide weighing equipment on the Site to control the application of aggregates. The weighing shall have an approved multiple beam type scale with indicator and other necessary dials be protected by a weather-proof house with a floor area not less than 10m². The Contractor shall at his own expense have the scale tested and approved by the Department of Public Works and Highways.

304.3.2 Equipment

Equipment for applying the bituminous material shall conform to the requirements of Sub-section 301.3.2, Equipment of Item 301, Bituminous Prime Coat. A mechanical spreader shall be used for spreading the aggregates. It shall be capable of spreading the aggregates uniformly over the full width of the area being treated and shall have controls to regulate the feed gates, the feed roll, the auger and the truck hatch. The equipment shall be subject to the approval of the Engineer.

304.3.3 Application of Bituminous Material

The application of bituminous material shall be done when the weather is warm and dry.

The required asphaltic material shall be applied to the surface at least twenty four (24) hours after it has been prime coated.

Prior to applying the asphaltic material, dirt and other objectionable material shall be removed from the surface. If so directed by the Engineer, the surface shall be cleaned by power broom until all dust and loose materials are removed. Bituminous material shall be applied on a dry surface only when cut-back asphalt is used.

Spraying shall not be done unless the road temperature has been above 20 C for at least one hour prior to the commencement of spraying operations, and the temperature shall not be less than 20 C during the spraying.

The application temperature for cut-back asphalt shall be within the range that produces a viscosity of 10 to 60 seconds Saybolt Fural and for cut-back asphalt shall be within the range given in Item 401, Bituminous Material. The temperature shall be such that no fogging occurs.

304.3.4 Spreading of Aggregate

Immediately after applying the asphaltic material, dry aggregate shall be uniformly and evenly distributed over the treated surface from an approved mechanical aggregate spreader. The truck carrying the aggregate shall move backward as it spreads the aggregate so as to prevent the

tires of the truck and the mechanical aggregate spreader from driving directly on the newly sprayed asphalt.

No portion of the sprayed surface shall remain uncovered for a period in excess of 2 minutes. Immediately after spreading the aggregate, the treated surface shall be rolled with an approved pneumatic-tire roller.

Where bituminous material is exposed during rolling, the area shall be covered with additional aggregate and further rolled until an even surface results.

304.3.5 Control of Traffic

The Contractor shall take all steps necessary to control traffic over newly-laid bituminous surface treatment so that the surface is not damaged in any way. Traffic shall be prohibited from traveling at speeds in excess of 40 km/h until the asphaltic material has set. The Contractor shall ensure that no vehicles, including those delivering aggregates, shall be permitted to turn around on newly-laid material.

304.4 Method of Measurement

Bituminous material and aggregate for Bituminous Surface Treatment will be measured by the tonne (t). The quantity to be paid for shall be the number of tonnes of bituminous material and aggregate used and accepted in the completed work.

304.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 304.4, shall be paid for at the contract unit price for Bituminous Surface Treatment, which price and payment shall be full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
304	Bituminous Surface Treatment	
304 (1a)	Aggregate, Grading-A	Tonne
304 (1b)	Aggregate, Grading-B	Tonne
304 (4)	MC-800 Cut-back Asphalt	Tonne

ITEM 305 - BITUMINOUS PENETRATION MACADAM PAVEMENT

305.1 Description

This Item shall consist of furnishing and placing one or more courses of graded aggregate and one or more application of bituminous material, followed by a seal coat with cover aggregate constructed on a prepared base in accordance with this Specification and in conformity with the lines, grades and typical cross-sections shown on the Plans.

305.2 Material Requirements

305.2.1 Quantities of Materials

The approximate amounts of materials per square meter and sequence of operations shall be as provided in Table 305.1, whichever is called for in the Bill of Quantities.

The weights given in the Table are those of aggregates having a bulk specific gravity of 2.65 as determined by AASHTO T 84 and T 85. Proportionate corrections will be made when the aggregates furnished on the job have a bulk specific gravity above 2.75 or below 2.55. In such case, the corrected amount will be the product of the weight given in the Table and the ratio of the bulk specific gravity of the aggregate to 2.65.

The amounts in the Table are approximate and the exact quantity will be set by the Engineer. Total amount of bituminous material per square meter may be varied by the Engineer as necessary to fit conditions, but the total amount of aggregate per square meter, after adjusting for specific gravity, will not be changed.

Table 305.1 - Quantities of Materials and Sequence of Operations

Type of Aggregate and Sequence of Operations	Type of Bituminous Material
	Cut-Back Asphalt MC-800
First Layer:	
Spread Aggregates	
Coarse Aggregate, kg/m ²	90
Choker Aggregate, kg/m ²	-
Apply bituminous material L/m ²	4.0
Second Layer:	
Spread Aggregate	
Key Aggregate, kg/m ²	13
Apply bituminous material L/m ²	1.8
Third Layer:	
Spread Aggregate	
Key Aggregate, kg/m ²	11
Apply bituminous material L/m ²	1.4
Fourth Layer:	
Spread Aggregate	
Cover Aggregate, kg/m ²	8
Total Quantities	
Bituminous Material, L/m ²	7.2
Aggregate, kg/m ²	122

305.2.2 Bituminous Material

The bituminous material shall be Cut-back Asphalt MC-800. It shall conform to the requirements of Item 401 Bituminous Materials.

305.2.3 Aggregate

The aggregate shall be crushed stone, crushed slag or crushed gravel and shall consist of clean, tough, durable fragments, free from excess of flat, soft or disintegrated pieces and free from stone coated with dirt or other objectionable matter. Natural gravel may be used for cover material. Gradation shall conform to Table 305.2.

Table 305.2 - Aggregate Grading Requirements

Sieve Designation		Mass Percent Passing			
Standard mm	Alternate U.S. Standard	Grade A	Grade B	Grade C	Grade D
63	2 1/2"	100	-	-	-
50	2"	90-100	-	-	-
37.5	1 1/2"	35-70	-	-	-
25	1"	0-15	-	100	-
19	3/4"	-	100	90-100	-
12.5	1/2"	0-5	90-100	20-55	100
9.5	3/8"	-	40-70	0-15	85-100
4.75	No. 4	-	0-15	0-5	10-30
2.36	No. 8	-	0-5	-	0-10
1.18	No. 16	-	-	-	0-5

The aggregate shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96.

When the crushed gravel is subjected to five cycles of the sodium sulfate soundness test (AASHTO T 104), the weighted loss shall not exceed 12 mass percent.

When crushed slag is used, it must be of uniform density and quality and shall have a density not less than 120 kg/m³ (70 lb/cu.ft.) as determined by AASHTO T 19.

305.3 Construction Requirements

305.3.1 Weather Limitations

Application of bituminous material shall be made only when the aggregate is dry and the atmospheric temperature in the shade is 15 C or above and when the weather is not foggy or rainy.

305.3.2 Equipment

The equipment to be used shall include hand or power operated brooms, shovels, rakes, self-powered bituminous material distributors or hand or power-operated spray pumps, broom dragging equipment and self-powered rollers. A sufficient number of stiff-fiber or steel-bristle push brooms shall be included. Application of the bituminous material by any means other than a pressure spray will not be approved and the equipment used shall be of such nature that the temperature of application of the bituminous material can be accurately controlled within the limits specified and such that the rates of application can be accurately controlled.

The rollers shall be self-propelled steel wheel, vibratory or pneumatic type. The number and weight of rollers shall be sufficient to compact the layer to the required condition.

305.3.3 Conditioning of Existing Base

Before spreading the aggregate, the base shall be cleaned of all loose foreign materials. The existing base shall be swept until the embedded large aggregate is exposed, or in the case of a previously constructed asphalt surface, until the surface is free of mud or other covering.

If shown on the Plans and called for in the Bill of Quantities, a prime coat shall be applied to the prepared untreated base in accordance with the Item 301, Bituminous Prime Coat.

305.3.4 Spreading and Compacting of Aggregate Layers

The number of layers in which the macadam pavement is to be constructed and the order and rates the bituminous material and mineral aggregates are to be spread shall be as indicated in Table 305.1.

The type of aggregate required in the order of spreading shall be placed in the required amount of approved aggregate spreaders, or by other approved mechanical methods. All areas with non-uniformly graded aggregate shall be removed and replaced with suitable materials before the rolling begins. These corrections shall be made by hand picking whenever necessary and shall be continued after initial rolling until the appearance and texture of the aggregate are uniform and all irregularities are corrected.

The aggregate shall be dry-rolled until it is compacted and keyed. Rolling shall progress gradually from the sides to the center, parallel with the center line of the road and overlapping uniformly each preceding rear wheel track by one-half the width of such track and shall continue until the aggregate does not creep or displace ahead of the rollers.

Materials which are crushed excessively under the roller or becomes segregated in such a manner as to prevent free and uniform penetration of the bituminous material shall be removed and replaced with suitable aggregate. The compacted aggregate shall have a firm and even surface.

Dry rolling shall be stopped when the surface of the aggregate will support the distributor and before the voids are closed sufficiently to prevent the free uniform penetration of the bituminous material.

Along curbs, headers and walls, and at all places not accessible to the roller, the aggregate shall be tamped thoroughly with mechanical tampers or with hand tampers. Each hand tamper shall have a mass of not less than 25 kg and a face area of not more than 250 mm by 250 mm.

Aggregate in any layer that becomes coated or mixed with dirt or clay prior to the application of the bituminous material shall be removed and replaced with clean aggregates and the area shall be re-rolled.

Prior to application of the bituminous material, the surface of the aggregate layer will be tested by the Engineer using a 3-m straight-edge at selected locations. The variation of the surface from the testing edge of the straight-edge between any two contacts with the surface shall at no point exceed 10 mm. All humps or depressions exceeding the specified tolerances shall be corrected by removing defective work and replacing it with the new materials as specified.

Each layer of aggregate shall be spread so that the bituminous material is covered before wheels or tracks pass over it.

305.3.5 Application of Bituminous Material

The bituminous material shall be uniformly applied at the rate specified in Table 305.1. Building paper shall be placed over the end of the previous application and the joining application shall start on the building paper. Building paper so used shall be removed and disposed off in a satisfactory manner. During the application of the bituminous material, care shall be taken to prevent spattering of adjacent pavements, structures and trees.

The distributor shall not be cleaned or discharged into ditches, borrow pits or shoulders along the right-of-way.

305.4 Method of Measurement

Bituminous Materials and Aggregate for Bituminous Penetration Macadam Pavement will be measured by the tonne (t). The quantity to be paid for shall be the number of tonnes of bituminous material and aggregate used and accepted in the completed work.

305.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 305.4, shall be paid for at the contract unit price for Bituminous Penetration Macadam Pavement, which price and payment shall be full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
305	Bituminous Penetration Macadam Pavement	
305 (1)	Aggregate	Tonne
305 (3)	MC-800 Cut-Back Asphalt	Tonne

ITEM 310 - BITUMINOUS CONCRETE SURFACE COURSE, HOT-LAID

310.1 Description

This Item shall consist of constructing a bituminous concrete surface composed of aggregates, mineral filler, and bituminous material mixed in a central plant, constructed and laid hot on the prepared base in accordance with this Specification and in conformity with the lines, grades, thickness and typical cross-section shown on the Plans.

310.2 Material Requirements

310.2.1 Bituminous Material

Bituminous material shall be Asphalt Cement 60/70. It shall conform to the requirements of Item 401, Bituminous Materials.

310.2.2 Aggregates

Coarse Aggregate

Coarse aggregate retained on the 2.36 mm (No. 8) sieve shall be crushed stone, crushed slag, or crushed or natural gravel, and unless otherwise stipulated, shall conform to the quality requirements of AASHTO M 79.

When crushed gravel is used, it shall meet the pertinent requirements of Section 2.1 and 3.1 of AASHTO M 62 and not less than 50 mass percent of the particles retained on the 4.75 mm (No. 4) sieve shall have at least one fractured face. The coarse aggregate shall be of such gradation that when combined with other required aggregate fractions in proper proportion, the resultant mixture will meet the gradation required under the composition of mixture for the specific type under contract.

Fine Aggregate

Fine aggregate passing the 2.36 mm (No. 8) sieve shall consist of natural sand, stone, stone screenings or slag screenings, or a combination thereof, and unless otherwise stipulated shall conform to the quality requirements of AASHTO M 29 (ASTM D 1073). Fine aggregate shall be of such gradation that when combined with other required aggregate fractions in proper proportion, the resultant mixture will meet the gradation required under the composition of mixture for the specific type under contract.

310.2.3 Mineral Filler

Mineral filler shall consist of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, fly ash, or other suitable mineral matter. It shall be free from organic impurities, and at the time of use, shall be sufficiently dry to flow freely and shall be essentially free from agglomerations.

Filler material for bituminous bases or pavements shall meet the requirements of AASHTO M 17, Mineral Filler for Bituminous Paving Mixtures.

Mineral filler shall be graded within the following limits:

Sieve	Maximum Perfect Passing
0.600 mm (No. 30)	100
0.300 mm (No. 50)	95-100
0.075 mm (No. 200)	70-100

The mineral filler shall have a plasticity index not greater than 4. Plasticity index limits are not appropriate for hydraulic lime and cement.

310.2.4 Combined Aggregate for Hot-Plant Mix Bituminous Concrete

The several aggregate fraction for the mixture shall be sized, graded, and combined in such proportions that the resulting composite blend meets one of the grading requirements of Table 310.1. The gradings to be used shall be Grading F.

The ranges apply to aggregates with bulk specific values that are relatively constant throughout a grading band. When such values vary from sieve to sieve, such as with lightweight aggregates, the ranges for each sieve size shall be adjusted to reflect the variations.

310.2.5 Composition and Quality of Bituminous Mixture (Job-Mix Formula)

The bituminous mixture shall be composed of aggregate, mineral filler, and bituminous material.

The proportion of bituminous material on the basis of total dry aggregate, shall be from 5.0 to 8.0 mass percent. The exact percentage to be used shall be fixed by the Engineer in accordance with the Marshall Test requirements for bituminous concrete shown in Table 310.2.

Table 310.1

Gradation Ranges - Hot Plant Mix Bituminous Concrete
(Mass percent passing square sieves, AASHTO T 11 and T 27)

Sieve Designation, mm	A	B	C	D	E	F	G
37.5 (1 1/2 inch)	100	-	-	-	-	-	-
25 (1 inch)	95-100	100	100	-	-	-	-
19 (3/4 inch)	75-95	95-100	95-100	100	-	100	-
12.5 (1/2 inch)	-	68-86	68-86	95-100	100	-	100
9.5 (3/8 inch)	54-75	56-78	56-78	74-92	95-100	-	95-100
4.75 (No. 4)	36-58	38-60	38-60	48-70	75-90	45-65	30-50
2.36 (No. 8)	25-45	27-47	27-47	33-53	62-82	33-53	5-15
1.18 (No. 16)	-	18-37	18-37	22-40	38-58	-	-
0.600 (No. 30)	11-28	11-28	13-28	15-30	22-42	-	-
0.300 (No. 50)	-	6-20	9-20	10-20	11-28	10-20	-
0.075 (No. 200)	0-8	0-8	4-8	4-9	2-10	3-8	2-5

At least three weeks prior to production, the Contractor shall submit in writing a job-mix formula for each mixture supported by laboratory test data along with samples and sources of the components and viscosity-temperature relationships information to the Engineer for testing and approval.

Each job-mix formula submitted shall propose definite single values for:

1. The percentage of aggregate passing each specified sieve size.
2. The percentage of bituminous material to be added.
3. The temperature of the mixture delivered on the road.
4. The kind and percentage of additive to be used.
5. The kind and percentage of mineral filler to be used.

After the job-mix formula is established, all mixture furnished for the project shall conform thereto within the following ranges of tolerances:

Passing No. 4 and larger sieves	+ 7 percent
Passing No. 8 to No. 100 sieves (inclusive)	+ 4 percent + 4 percent
Passing No. 200 sieve	+ 2 percent
Bituminous Material	+ 0.4 percent
Temperature of mixture	+ 10 C

Should a change in source of material be proposed or should a job-mix formula prove unsatisfactory, a new job-mix formula shall be submitted by the Contractor in writing and be approved by the Engineer prior to production.

Approval of a new job-mix formula may require laboratory test and verification.

Job-Mix

1. Marshall specimens are to be obtained from each of the base and wearing course materials supplied for trial laying purposes. The Marshall specimens shall be formed and compacted in proper moulds, in accordance with the procedure described in ASTM D 1559.

2. The Contractor shall demonstrate to the satisfaction of the Engineer by testing, carried out in the presence of the Engineer's Representative, in accordance with the procedures set out in the Marshall Method of Mix Design in the Asphalt Institute Manual, Mix Design Methods, for Asphalt Concrete and Other Hot mix Types, Manual Series No. 2 (MS-2), that the requirements given in Table 310.2 are achieved. The loss in Marshall stability by submerging specimens in water at 60°C for 24 hours shall be not more than 25 percent of

the stability of the job-mix. In addition, the Contractor shall demonstrate by approved tests to the satisfaction of the Engineer that the proposed mix is not subject to stripping of the asphalt cement from the aggregates.

3. To determine the Marshall Specimen Density, from each set of six Marshall specimens, the highest and lowest densities shall be ignored and the Marshall Specimen Density shall then be the mean of the densities of the remaining four specimens.

4. As Compacted densities shall be determined of samples taken from the materials laid and compacted for the mix trials as specified. At least four samples shall be taken for each of the binder and wearing course materials, under the direction of the Engineer's Representative, and the required percentage of the Marshall Specimen Density shall be achieved in each case. Testing shall be in accordance with ASTM D 1188 or ASTM D 2726.

5. When the Engineer's Representative is satisfied that the materials and methods demonstrated by the Contractor during trial laying comply with the requirements of the Contract, the Engineer shall determine the job-mix and shall inform the Contractor in writing of its composition. On receipt of such information the Contractor may proceed with the work.

Table 310.2 Marshall Test Requirement for Hot Plant Mix Bituminous Concrete

	Binder COURSE		Wearing COURSE	
	min.	max.	min.	max.
Stability (lbf)	1200	-	1200	-
Flow (0.01 in)	8	16	8	16
Air voids (1%)	3	8	3	6
Aggregate voids filled with Asphalt Cement (%)	60	75	70	80
Field Compacted Density Marshall Specimen Density %	97	-	97	-

310.3 Construction Requirements

310.3.1 Weather Limitations

Bituminous plant mix shall not be placed on any wet surface, or when weather conditions would prevent the proper handling or finishing of the bituminous mixtures.

310.3.2 Construction Equipment

1. Bituminous Mixing Plant

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 maintained neat and orderly and the separate stockpiles shall be readily accessible for sampling.

Plants used for the preparation of bituminous mixtures shall conform to the requirements for all plants under (a) below except that scale requirements shall apply only where weight proportioning is used. In addition, batch mixing plants and continuous mixing plants shall conform to the respective requirements which follow this Sub-section.

a. Requirements for all Plants

Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.

1) Plant Scales. Scales shall be accurate to 0.5 percent of the maximum load that may be required. Poises shall be designed to be locked in any position to prevent unauthorized change of position. In lieu of plant and truck scales, the Contractor may provide an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weight ticket for each load.

Scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than ten 20-kg weights for testing the scales.

2. Equipment for Preparation of Bituminous Material

Tanks for the storage of bituminous material shall be equipped with the proper devices to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the tank. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period. Provision shall be made for measuring and sampling storage tanks.

3. Feeder for Drier

The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and temperature will be obtained.

4. Drier

The plant shall include a drier or driers which continuously agitate during the heating and drying process. For cold-type bituminous mix, equipment for mechanical cooling of the dried aggregate to the temperature prescribed for cold mixtures shall be capable of supplying prepared material for the mixer to operate at full capacity.

5. Screens

Plant screens, capable of screening all aggregate to the specified sizes and proportions and having normal capacities in excess of the full capacity of the mixer, shall be provided.

6. Bins

The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the minimal aggregates. Separate dry storage shall be provided for filler or hydrated lime when used and the plant shall be equipped to feed such material into the mixer. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with individual outlet gate, constructed so that when closed, there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be equipped with adequate tell-tale devices to indicate the position of the aggregates in the bins at the lower quarter points.

7. Bituminous Control Gate

Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.

8. Thermometric Equipment

An armored thermometric of adequate range in temperature reading shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit.

The plant shall also be equipped with either an approved dial-scale, mercury-actuated thermometer, an electric pyrometer, or other approved thermometric instrument so placed at the discharge chute of the drier as to register automatically or indicate the temperature of the heated aggregates.

The Engineer may require replacement of any thermometer by an approved temperature-recording apparatus for better regulation of the temperature of aggregates.

9. Dust Collector

The plant shall be equipped with a dust collector constructed to waste or return uniformly all or any part of the material to the hot elevator collected as directed.

10. Truck Scales

The bituminous mixture shall be weighed on approved scales furnished by the Contractor or on public scales at the Contractor's expense. Such scales shall be inspected and sealed as often as the Engineer deems necessary to assure their accuracy. (See paragraph i).

11. Safety Requirements

Adequate and safe stairways to the mixer platform and sampling points shall be provided, and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the Engineer to obtain sampling and mixture temperature data. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment and other similar equipment from ground to the mixer platform and return. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected. Angle and unobstructed space shall be provided on the mixing platforms. A clear and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free from drippings from the mixing platforms.

a) Requirements for Batching Plants

1) Weigh box or hopper. The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the mixer while a batch is being weighed.

2) Bituminous Control. The equipment used to measure the bituminous material shall be accurate to plus or minus 0.5 percent. The bituminous material bucket shall be a non-tilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be less than 3/4 the length of the mixer. The bituminous material bucket, its discharge valve or valves and spray bar shall be adequately heated. Steam jackets, if used, shall be efficiently drained and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales. The capacity of the bituminous material bucket shall be at least 15 percent in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.

The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of bituminous material used in a batch. The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of bituminous material to each batch. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled so that it will begin when the dry mixing period is over. All of the bituminous material required for one batch shall be discharged in not more than 15 seconds after the flow has started. The section of the bituminous line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for a bituminous material bucket.

3. Mixer. The batch mixer shall be an approved type capable of producing a uniform mixture within the job-mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

The clearance of blades from all fixed and moving parts shall not exceed 25 mm (1 inch) unless the maximum diameter of the aggregate in the mix exceed 30 mm (1 1/5 inches), in which case the clearance shall not exceed 40 mm (1 1/2 inches).

4. Control of Mixing Time. The mixer shall be equipped with an accurate time lock to control the operation of a complete mixing cycle. It shall lock the weigh box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the bituminous material bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate and start of introduction of bituminous material. The wet mixing period is the interval of time between the start of

introduction of bituminous material and the opening of the mixer gate.

The control of the timing shall be flexible and capable of being set at intervals of 5 seconds or less throughout a total cycle of up to 3 minutes. A mechanical batch counter shall be installed as a part of the timing device and shall be so designed as to register only completely mixed batches.

The setting of time intervals shall be performed in the presence and at the direction of the Engineer who shall then lock the case covering the timing device until such time as a change is to be made in the timing periods.

b) Requirements for Continuous Mixing Plants

1) Aggregate Proportioning. The plant shall include means for accurately proportioning each size of aggregate.

The plant shall have a feeder mounted under each compartment bin. Each compartment bin shall have an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from each compartment. The feeding orifice shall be rectangular with one dimension adjustable by positive mechanical means provided with a lock.

Indicators shall be provided for each gate to show the respective gate opening in millimeter.

2) Weight Calibration of Aggregate Feed.

The plant shall include a means for calibration of gate openings by weighing test samples. Provision shall be made so that materials fed out of individual orifice may be bypassed to individual test boxes. The plant shall be equipped to conveniently handle individual test samples weighing not less than 90 kilograms. Accurate scales shall be provided by the Contractor to weigh such test samples.

3) Synchronization of Aggregate Feed and Bituminous Material Feed.

Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of bituminous material from the meter or other proportioning device. This control shall be accomplished by interlocking mechanical means or by any other positive method satisfactory to the Engineer.

4) Mixer. The plants shall include a continuous mixer of an approved type, adequately heated and capable of producing a uniform mixture within the job-mix tolerances. It shall be equipped with a discharge hopper with dump gates which will permit rapid and complete discharge of the mixture.

The paddles shall be adjusted for angular position on the shafts and reversible to retard the flow of the mix. The mixer shall have a manufacturer's plate giving the net volumetric contents of the mixer of the several heights inscribed on a permanent gauge. Charts shall be provided showing the rate of aggregate per minute for the aggregate being used.

2. Hauling Equipment

Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds which have been thinly coated with approved material to prevent the mixture from adhering to the beds. Each truck shall have a cover of canvass or other suitable material of such size as to protect the mixture from the weather. When necessary, such that the mixture will be delivered on the road at the specified temperature, truck beds shall be insulated and covers shall be securely fastened.

Trucks beds shall be drained prior to loading.

3. Bituminous Pavers

The equipment shall be self-contained, power-propelled units, provided with an adjustable activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thickness shown on the Plans.

Pavers shall be equipped with a control system capable of automatically maintaining the screed elevation as specified herein. The control system shall be automatically actuated from either a reference line or surface through a system of mechanical sensors or sensor directed mechanisms or devices which will maintain the paver screed at a pre-determined transverse slope and at the proper elevation to obtain the required surface. When directed, the transverse slope control system shall be made inoperative and the screed shall be controlled by sensor directed automatic mechanisms which will independently control the elevation of each end of the screed form reference lines or surface.

The controls shall be capable of working in conjunction with any of the following attachments:

- a. Ski-type device of not less than 9 m (30 feet) in length or as directed by the Engineer.
- b. Taut stringline (wire) set to grade
- c. Short ski or shoe

The Contractor shall furnish the long ski, the short ski or shoe and furnish and install all required stakes and wire for a taut stringline.

Should the automatic control system become inoperative during the day's work, the Contractor will be permitted to finish the day's work using manual controls, however, work shall not be resumed thereafter until the automatic control system has been made operative.

The Contractor shall provide and have ready for use at all times enough covers, as may be necessary, for use in any emergency such as rain, chilling wind, or unavoidable delay, for the purpose of covering or protecting any material that may have been dumped and not spread.

4. Rollers

The equipment shall be of the steel and /or pneumatic tire type and shall be in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. The use of equipment which results in excessive crushing of the aggregate will not be permitted.

310.3.3 Conditioning of Existing Surface

Immediately before placing the bituminous mixture, the existing surface shall be cleaned of loose or deleterious material by brooming or other approved means.

Contact surface or curbs, gutters, manholes and other structures shall be painted with a thin, uniform coating of bituminous material prior to the bituminous mixture being placed against them.

310.3.4 Preparation of Bituminous Material

The bituminous material shall be heated so as to avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature. The temperature of asphalt cement delivered to the mixer shall be as required to achieve a kinematic viscosity in the range of 150-300 mm²/s, as determined by AASHTO T 201. Asphalt cement shall not be used while it is foaming nor shall be heated above 159 C (320 F) at any time after delivery to the project.

310.3.5 Preparation of Aggregate

Aggregates for pugmill mixing shall be heated, dried and delivered to the mixing unit at a temperature within the range + 17 C (+30 F) of the bitumen. Moisture content of the aggregate shall not exceed one mass percent at the time it is introduced into the mixing unit. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot on the aggregate. Moisture content of the mixture from drum-dryer plants shall not exceed three (3) percent at the output, as determined by AASHTO T 110.

310.3.6 Mixing

The dried aggregates and the bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.

After the required amounts of aggregate and bituminous material have been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured.

310.3.7 Spreading and Finishing

The mixture shall be spread and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

The longitudinal joint in one layer shall offset that in the layer immediately below approximately 15 cm (6 inches); however, the joint in the top layer shall be at the center line of the pavement if the roadway comprises two (2) lanes, or at lane lines if the roadway is more than two (2) lanes, unless otherwise directed.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture may be placed and finished by hand tools.

The mixture shall be placed at a temperature not less than 107 C (225 F) as measured in the truck just prior to dumping into the spreader.

When tar is used, the mixture shall be placed at between 66 C and 107 C (150 F and 225 F).

When production of the mixture can be maintained and when practical, pavers shall be used en echelon to place the wearing course in adjacent lanes.

310.3.8 Compaction

Immediately after the mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by roller as specified under paragraph no. 4 of Sub-section 310.3.2.

The surface shall be rolled when the mixture is in proper condition and when the rolling does not cause under displacement, cracking and shoving. Rolling shall begin at the sides and proceed longitudinally parallel toward the road centerline, each trip overlapping one-half the roller width, gradually progressing to the crown of the road. When paving en echelon or abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure. On superelevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the center line.

Rollers shall move at a slow but uniform speed with the drive roll or wheels nearest the paver. Rolling shall be continued until all roller marks are eliminated and a minimum density of 90 mass percent of the theoretical maximum density made in the proportions of the job-mix formula has been obtained.

Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons or with mechanical tampers.

310.3.9 Joints

Placing of the bituminous paving shall be as continuously as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. When directed by the Engineer, a brush coat of bituminous material shall be used on contact surfaces of transverse joints before additional mixture is placed against the previously rolled material.

310.3.10 Accepting Sampling and Testing

The Contractor shall cut full depth samples as directed, from the finished pavement, for testing. Samples shall be neatly cut by a saw or core drill. Each sample shall be at least 150 mm x 150 mm or 100 mm diameter full depth. At least one, but not more than three samples shall be taken for each 50 m interval of finished paving lane. The Contractor shall supply and finish new material to backfill voids left by the samples taken.

The samples obtained will be used to measure the thickness of the pavement. The same samples will be used to test the density of the compacted pavement by AASHTO T 186. The compacted pavement shall have a density equal to, or greater than, 97 mass percent of the density of a laboratory specimen prepared in accordance with the Marshall Stability Test.

310.3.11 Surface Tolerances

The surface will be checked by the use of a 3-m straight-edge at sites selected by the Engineer. The straight-edge will be applied at right angles, as well as, parallel to the centerline of the roadbed.

The variation of the surface from the testing edge of the straight-edge between any two contacts with the surface shall not exceed 6 mm.

Tests will be made immediately after initial compaction and any variations detected shall be corrected by removing or adding materials, as may be necessary. Rolling shall then be continued as specified. After final rolling, the smoothness of the course shall be checked again and any area defective in texture or composition shall be corrected, including removal and replacement of unsatisfactory material at the Contractor's expense, as directed by the Engineer.

310.4 Method of Measurement

Bituminous mixtures will be measured by the tonne. The quantity to be paid for shall be the number of tonnes of bituminous mixture in the accepted pavement, computed based on the cores taken in accordance with section 307.3.10 (Accepting Sampling and Testing) by applying the thicknesses and densities of the cores obtained therein to the width and length of the pavement represented by the core; otherwise, core samples shall be taken from the completed pavement for every 100 L.M. per lane to determine the corresponding thicknesses and densities as in the above and made the basis for computing or estimating the weight in tonnes of the mix used in the accepted pavement. No deduction will be made for the weight of bituminous material in the mixture.

Batch weights will not be permitted as a method of measurement.

310.5 Basis of Payment

The accepted quantity, measured as prescribed in Section 310.4, shall be paid for at the contract unit price for Bituminous Concrete Surface Course, Hot-Laid, which price and payment shall be full compensation for furnishing materials, handling, mixing, hauling, placing, rolling, compacting, labor, equipment, tools and incidentals necessary to complete this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
310	Bituminous Concrete Surface Course, Hot - Laid	Tonne