

KINGDOM OF SAUDI ARABIA  
MINISTRY OF COMMUNICATIONS

SUPPLEMENTAL SPECIFICATIONS  
FOR  
THE CONSTRUCTION OF AGRICULTURAL ROADS

NOVEMBER 1998

SUPPLEMENTAL SPECIFICATIONS FOR MINISTRY OF COMMUNICATIONS  
AGRICULTURAL ROAD CONSTRUCTION

These Supplemental Specifications amend and supplement the Ministry of Communications (M.O.C.) 1998 General Specifications for Road and Bridge Construction. They are applicable on all Agricultural Road Construction projects administered by the Ministry of Communications. In case any differences between these Supplemental Specifications and the 1998 M.O.C. General Specifications, these Supplemental Specifications shall govern.

In case of any differences between these Supplemental Specifications and specific project Special Specifications, the Special Specifications shall govern.

These Supplemental Specifications shall supplement, modify and/or replace the General Specifications in respect to the following provisions only. All other unchanged provisions shall remain in full effect.

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PART 1 - GENERAL

---- PART 1 -- PAGES 5 and 12 ----

Subsection 1.01.2 Definitions for Contractor and Subgrade are eliminated and the following substituted:

Contractor - The MOC Road District, firm, corporation or supplier contracting with the MOC or executing an agreement within the MOC for performance of the Work described in the Contract Documents.

Subgrade - A defined layer thickness of select material (normally twenty (20) centimeters for agricultural roads) on which the pavement structure, including shoulders, is constructed.

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Subsection 1.03.7 Cooperation With Utilities is supplemented as follows:

The Contractor shall consult authorities responsible for the overground services and utilities prior to removal or realignment of the such utilities and the related items. Before commencing of such works, the Contractor, the Authorities and MOC representatives should prepare minutes of meeting stating the works and procedures to be undertaken. After completion of the works, proper handover is to be made. The Contractor shall ensure full compliance with their requirements and the protection of their works as well as the handover of any such removed items to the concerned Department and record the items handed over and the obtained proper clearances. Unless otherwise provided in the Bill of Quantities, the Contractor will not be responsible for the removal or relocation of underground utilities in the areas included under the scope of work of this Contract. The Contractor shall, however, coordinate with the M.O.C. and the concerned authorities, concerning the relocation of these utilities. Should any damage be inflicted upon any of the utilities whether overground or underground due to negligence or insufficient coordination with concerned authorities to identify the locations or extent of utilities, the same will be repaired or replaced at the expense of the Contractor.

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Subsection 1.05.16 Responsibility For Damage Claims is supplemented as follows:

Any compensations and liquidated damages recovered from a third party for traffic accidents occurring during the construction and maintenance period of the project will be deposited in the Income Account at the Ministry. The Contractor shall not have the right to claim any of these compensations, as condition all the works remain under the custody of the Contractor until they are finally handed over. The Contractor shall bear

the cost of repairing all damages to the work, except in the case of Force Majeure where damage to the work is due to unforeseeable causes beyond his control.

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Subparagraph 1.06.2.6.5 CPM-PS Updates And CPM-PS Revisions - is supplemented to provide that the updates shall be submitted quarterly (every three (3) months) unless the percent of work accomplished falls more than one month behind the percent of time elapsed. When that happens, the Contractor shall submit monthly updates until such time as the percent work accomplished exceeds the percent time elapsed.

---- PART 1 -- PAGE 109 ----

Subsection 1.09.6 Survey Equipment Hardware is supplemented to require half the numbers of each piece of equipment specified in this Subsection in the General Specifications.

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PART 2 - EARTHWORK

---- PART 2 -- PAGE 19 ----

Subsection 2.03.3.6 Roadway Excavation in Cut Sections is eliminated and the following substituted:

2.03.3.6 Roadway Excavation in Cut Sections. In all areas of roadway excavation in cut areas, rock and other materials in the planned subgrade layer (bottom twenty (20) centimeters of the completed excavation) that do not conform to the requirements specified in the Subsection 2.05.2 Materials" in the General Specifications, shall be excavated to a depth of twenty (20) centimeters or as may be specified. The excavated materials shall be defined as Roadway Excavation - Unclassified and shall be incorporated into the Embankment or disposed of as specified in Subsection 2.03.4 Disposal of Surplus and Unsuitable Materials" in these General Specifications.

---- PART 2 -- PAGE 21 ----

Subsection 2.03.5 Quality Assurance Procedures is eliminated and the following substituted:

2.03.5 Quality Assurance Procedures. The total quantity of roadway excavation shall be evaluated and accepted in accordance with Subsection 1.08.4 "Measured or Tested Conformance" of the General Specifications. The Engineer shall perform or supervise the performance of all quality assurance measuring and testing. Quality assurance measuring or testing shall involve verification that the roadway excavation conforms to the lines, grades and typical cross sections shown on the plans or established by the Engineer within the following tolerances:

1. Slopes. Slopes shall be uniformly finished and no point on the slope shall deviate from the staked slope by more than thirty (30) centimeters when measured at right angles except in rock excavation where no point shall deviate more than fifty (50) centimeters measured along any line perpendicular to the staked slope.

2. Width. The total width between the ditch lines shall not be deficient by more than forty (40) centimeters from the deviations shown on the plans at any location.

3. Bottom of Excavation. The bottom of excavation shall be completed to within plus two (2) centimeters of the designated grade except that in rock, the tolerance shall be plus four (4) centimeters.

The Contractor shall be responsible for the payment of any claims from property owners for excavation quantities removed from beyond the staked slope and right-of-way (R.O.W.) lines.

---- PART 2 -- PAGE 61 ----

Subsection 2.05.7.4 Embankment Finishing Tolerances And Requirements is eliminated and the following substituted:

2.05.7.4 Embankment Finishing Tolerances and Requirements. Embankment Quality Assurance measuring of testing shall involve verification that the embankments are constructed, timely finished and trimmed in a neat, workmanlike manner to the lines, grades and typical cross sections shown on the plans or staked by the Engineer within the following tolerances and deadlines:

1. Embankment slopes shall be constructed in conformance with the lines and grades established by the Engineer. The completed slopes within one meter of top of embankment grade shall not vary by more than thirty (30) centimeters from the staked slope measured at right angles to the slope. Slopes below one meter shall not vary more than fifty (50) centimeters from the staked slope, measured at right angles to the slope.

2. Median and side slopes which are on a one (1) vertical to six (6) horizontal (6:1) or flatter slope in excavation as well as embankment shall be finished in accordance with the lines and grades established by the Engineer. The completed slopes shall not vary more than two (2) centimeters from the designated slope, measured at right angles to the slope. Flowlines within medians shall be carefully graded to drain and shall not vary more than five (5) centimeters from the grade line established by the Engineer.

3. Finished Grade of Top of Embankment. The elevation of the finished top of embankment shall be checked under the supervision of the Engineer. Each cross section shall be checked at each change in cross slope and intermediate points as directed. Cross sections shall be established at maximum intervals of twenty-five (25) meters with additional sections as directed by the Engineer. The allowable tolerance of the finished embankment above the staked elevation shall be two (2) centimeters.

4. Variations above the design elevation shall not result in the diminished thickness of any subsequent layer. The allowable tolerance of the finished embankment below the staked elevation shall be four (4) centimeters. Isolated variations below the staked elevation shall be compensated by additional thickness of the following subgrade layer.

5. Embankment slopes shall be finished in a timely manner preferable immediately following the finishing of the roadbed.



---- PART 2 -- PAGE 64 ----

Subsection 2.06.2 Materials is eliminated and the following substituted:

2.06.2 Materials. Materials from roadway excavation, tunnel excavation or imported borrow meeting the appropriate quality requirements shall be used to construct subgrade in accordance with the typical sections contained in the plans or as staked by the Engineer.

Subgrade layer materials shall be a minimum of twenty (20) centimeters (thirty (30) centimeters in dune sand areas) thick after compaction in both embankment and cut sections using materials meeting the following requirements:

1. Material classified by MRD TM 210 as A-1-a(0), A-1-b(0) and A-2-4(0) having no rock fragments larger than ten (10) centimeters.
2. Material being reasonably well-graded with sufficient fines to permit compaction and compaction testing.

---- PART 2 -- PAGE 67 ----

Paragraph 2.06.3.6 Subgrade in Earth Cuts is eliminated and the following substituted:

2.06.3.6 Subgrade in Earth Cuts. The depth of subgrade in earth cuts shall be twenty (20) centimeters. The material shall be Class A-1-a(0), A-1-b(0), or A-2-4(0) as determined by MRDTM 210, and shall meet a minimum soaked CBR of twenty five (25) as determined by MRDTM 213 when compacted to the specified density. If the natural material in the cut meets these requirements, then the top twenty (20) centimeters shall be scarified, brought to a uniform moisture content within the specified range, and compacted to ninety-five percent (95%) of maximum dry density.

If the natural material in the cut does not meet the above requirements for subgrade, then the subgrade shall be subexcavated to a depth of twenty (20) centimeters unless additional excavation is ordered by the Engineer. The twenty (20) centimeters below the excavated area shall be scarified, brought to a uniform moisture content within the specified range, and compacted to Type 90 density. The excavated material shall be replaced with material meeting the requirements of Class A-1-a(0), A-1-b(0), or A-2-4(0), with a minimum soaked CBR of twenty five (25) at the maximum specified density. The replacement material shall be brought to uniform moisture content within the specified range and compacted in one (1) layer or two (2) approximately equal layers to ninety-five (95%) of maximum dry density.

---- PART 2 -- PAGE 67 ----

Paragraph 2.06.3.7 Subgrade in Rock Cuts is eliminated and the following substituted:

2.06.3.7 Subgrade in Rock Cuts. When a cut area is identified by the Engineer as rock for purposes of subgrade preparation, the area shall be undercut to a depth of twenty (20) centimeters below top of subgrade. The material excavated shall be placed in embankments or disposed of as approved by the Engineer if there is a surplus of embankment material. Care shall be taken that undrained pockets shall not be left in the surface of the rock. Coarse aggregate material complying with the requirements of AASHTO M43 - Sizes of Aggregates for Road and Bridge Construction - Size numbers 1 through 467 shall be placed in the pockets or in the undercut rock surface and consolidated. After consolidation, the undercut subgrade surface shall be in substantial compliance with the grade and typical section shown on the plans. Placement and consolidation of the coarse aggregate is required to fill the voids and irregularities left in the subgrade from the Contractor's excavation operation. This operation will be considered subsidiary to the Excavation Item and the Contractor shall not receive additional compensation for his Work.

The excavated material shall be replaced with material meeting the requirements of Class A-1-a(0), A-1-b(0), or A-2-4(0), with a minimum soaked CBR of twenty five (25) at the maximum specified density. The material shall be brought to uniform moisture content within the specified range and compacted in one layer or two (2) approximately equal layers to ninety-five (95) percent of maximum dry density.

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Paragraph 2.06.3.8 Subgrade on Embankments (Including Sand Dune Areas) is eliminated and the following substituted:

2.06.3.8 Subgrade on Embankments (Including Sand Dune Areas). The twenty (20) centimeters of material (thirty (30) centimeters on dunes and embankments) placed on the embankment to form the subgrade layer shall meet the requirements of Class A-1-a(0), A-1-b(0), or A-2-4 as determined by MRDTM 210, with a minimum soaked CBR of twenty five (25) as determined by MRDTM 213 when compacted to ninety-five percent (95%) of maximum dry density. The entire subgrade layer shall be compacted to the specified density in one layer or two approximately equal layers.

---- PART 2 -- PAGE 89 ----

Paragraph 2.09.2.1 General is supplemented as follows:

The provision of dewatering equipment and all operations required to maintain a water free excavation shall be carried out and considered as included in the contract unit price for structural excavation.

Maintenance of natural waterways and allowance for the passage of surface water during construction of the works is the Contractor's responsibility and any damage occurring in this respect shall be corrected at the Contractor's expense.

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PART 3 - GRANULAR SUBBASE AND COURSES

---- PART 3 -- PAGE 15 ----

Paragraph 3.02.6.5 Surface Tolerances is eliminated and the following is substituted:

3.02.6.5 Surface Tolerances. The surface layer of the aggregate subbase shall be evaluated for compliance with the following surface tolerances:

The cross section of the finished subbase surface shall be checked by the Contractor in the presence of the Engineer at maximum intervals of twenty-five (25) meters and at intermediate points as directed by the Engineer. The deviation of the elevation of the surface above the design elevation shall be not more than twenty (20) millimeters. Deviations above the design elevation shall not result in the diminished thickness of any subsequent pavement course. The deviation of the elevation below the design elevation shall not be more than thirty (30) millimeters. Isolated deviations below the design elevation shall be compensated by additional thickness of the subsequent pavement layer. Additional cost and materials resulting from deviations from the design elevation shall be borne by the Contractor. Contractor shall furnish all devices necessary to check the surface, such as stringlines, straightedges, etc., and the labor necessary to handle the task.

---- PART 3 -- PAGE 28 ----

Paragraph 3.03.6.5 Surface Tolerances is eliminated and the following is substituted:

3.03.6.5 Surface Tolerances. The surface layer of the aggregate base shall be evaluated for compliance with the following surface tolerances:

1. The cross section of the finished aggregate base surface shall be checked by the Contractor in the presence of the Engineer at maximum intervals of twenty-five (25) meters and at intermediate points as directed by the Engineer. The deviation of the elevation of the surface above the design elevation shall be not more than fifteen (15) millimeters. Deviations above the design elevation shall not result in the diminished thickness of any subsequent pavement course. The deviation of the elevation below the design elevation shall not be more than fifteen (15) millimeters. Isolated deviations below the design elevation shall be compensated by additional thickness of the subsequent pavement layer. Additional cost and materials resulting from deviations from the design elevation shall be borne by the Contractor.

2. The surface shall also be checked with a four (4) meter straightedge in all areas of apparent roughness as directed by the Engineer. The finished surface of the base course shall not deviate from the straightedge between any two contact points more than fifteen (15) millimeters when the straightedge is placed parallel to centerline or

when the straightedge is placed perpendicular to centerline. The Contractor shall furnish all devices necessary to check the surface, such as stringlines, straightedges, etc., and the labor necessary to handle the task.

---- PART 3 -- PAGE 39 ----

Paragraph 3.04.9.5 Surface Tolerances is eliminated and the following substituted:

3.04.9.5 Surface Tolerances. The surface layer of the cement treated base shall be evaluated for compliance with the following surface tolerances:

1. The cross section of the finished cement treated base surface shall be checked by the Contractor in the presence of the Engineer at maximum intervals of twenty-five (25) meters and at intermediate points as directed by the Engineer. The deviation of the elevation of the surface above the design elevation shall be not more than fifteen (15) millimeters. Deviations above the design elevation shall not result in the diminished thickness of any subsequent pavement course. The deviation of the elevation below the design elevation shall not be more than fifteen (15) millimeters. Isolated deviations below the design elevation shall be compensated by additional thickness of the subsequent pavement layer. Additional cost and materials resulting from deviations from the design elevation shall be borne by the Contractor.

2. The surface shall also be checked with a four (4) meter straightedge in all areas of apparent roughness as directed by the Engineer. The finished surface of the base course shall not deviate from the straightedge between any two contact points more than fifteen (15) millimeters when the straightedge is placed parallel to centerline or when the straightedge is placed perpendicular to centerline. The Contractor shall furnish all devices necessary to check the surface, such as stringlines, straightedges, etc., and the labor necessary to handle the task.

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PART 4 - BITUMINOUS CONSTRUCTION

---- PART 4 -- PAGE 49----

Paragraph 4.05.2.2 Aggregate is eliminated but Tables 4.05-1 and 4.05-2 are not eliminated. The following narrative portion of Paragraph 4.05.2.2 Aggregate is substituted:

4.05.2.2 Aggregate. All aggregate shall be hard durable particles or fragments free from decomposed materials, organic materials and other deleterious substances.

Coarse aggregate shall be crushed stone, crushed slag or crushed gravel retained on a 4.75 millimeter (No. 4) sieve and containing no more than ten percent (10%) thin or elongated particles which have a maximum dimension more than five (5) times the minimum dimension as determined in accordance with ASTM D 4791 Standard Test Method for Flat or Elongated Pieces. Fifty-five percent (55%) of the coarse aggregate shall have at least one fractured face.

Fine aggregate shall be material passing the 4.75 millimeter (No. 4) sieve and may be produced from crushed stone, crushed slag or crushed gravel or manufactured sand. Natural sand may not be used without the prior written approval of the Engineer. If approved, the quantity of natural sand in the aggregate shall not exceed fifteen percent (15%) of the weight passing the 4.75 millimeter (No. 4) sieve and the quantity of dune sand included shall not be more than fifty percent (50%) of the weight of natural sand authorized by the Engineer.

Supplemental fine aggregate shall be mineral filler passing the 0.600 mm (No. 30) sieve, including dust from the dust collection system. When furnished as supplemental fine aggregate, mineral filler, at the time of use, shall be dry, free flowing, without lumps or agglomerations and conform to the requirements of AASHTO M-17.

Unless otherwise specified in the Special Specifications, the combined aggregate prior to the addition of bituminous material, shall conform to the gradation and quality requirements contained in Table 4.05-1 for Grading III, Class C.

The grading limits specified are based on materials of uniform specific gravity and shall be adjusted by the Engineer to compensate for any variations in specific gravity of the individual sizes. The gradings may be varied by the Engineer on the basis of Marshall Tests to obtain optimum stability and life of the completed Bituminous Concrete Pavement.

## Section 4.04 - Bituminous Emulsion Treated Base For Agricultural Roads

4.04.1 Description. This work consists of furnishing and cold-mixing aggregate and emulsified bituminous material, hauling, spreading, compacting and finishing the bituminous emulsion treated base to the lines, grades and thickness shown on the plans, all in accordance with the specifications and as directed by the Engineer.

### BITUMINOUS EMULSION TREATED BASE ITEMS IN BILL OF QUANTITIES:

Bituminous Emulsion Base

Type I Bituminous Emulsion Open-Graded Base

Type II Bituminous Emulsion Dense-Graded Base

Type III Bituminous Emulsion Sand Base

Type I bituminous emulsion treated base mixtures shall be produced at ambient temperatures only by central-mixing in a continuous mixing pugmill. Types II and III bituminous emulsion treated base mixtures shall be produced at ambient temperatures by central-mixing in a continuous mixing pugmill or screenless batch plant or by road-mixing using a travel plant or motor grader at the option of the Contractor.

### 4.04.2 Materials.

4.04.2.1 Bituminous Emulsion Material. Bituminous emulsion material for bituminous emulsion treated base shall consist of MS-2, MS-2h, CMS-2, CMS-2h, SS-1, SS-1h, CSS-1 or CSS-1h conforming to the requirements of Tables 4.01-4 and 4.01-5 in Section 4.01, "Bituminous Materials," in the General Specifications.

The type and grade of bituminous emulsion shall be specified in the Special Specifications.

4.04.2.2 Aggregate. All aggregate shall be hard durable particles or fragments of crushed stone, crushed slag, crushed gravel or sand free from decomposed materials, organic materials and other deleterious substances. The aggregate shall not contain more than one percent (1.0%) by weight of particles having a specific gravity below 1.95. Aggregate for Open-Graded Base retained on the 4.75 millimeter (No. 4) sieve shall not have more than one-tenth of one percent (0.1%) adherent material by washing.

Unless otherwise specified in the Special Specifications, the aggregate for Types I, II and III bituminous emulsion treated base, prior to the addition of bituminous emulsion material, shall conform to the following gradation and quality requirements:

AGGREGATE GRADING REQUIREMENTS - MRDTM 419

<u>Sieve Size</u>	<u>Type I Open-Graded Base</u>	<u>Type II Dense-Graded Base</u>	<u>Type III Sand Base</u>
37.5 mm (1 ½ inch)	100	100	
25 mm (1 inch)	95-100	90-100	
12.5 mm (½ inch)	25-60	60-80	100
4.75 mm (No. 4)	0-10	25-60	75-100
2.36 mm (No. 8)	0-5	15-45	
0.300 mm (No. 50)	-	3-18	15-30
0.075 mm (No. 200)	0-2	1-7	5-12
Bituminous Emulsion Material Content - Percent	4.5-7.5	6.0-12.0	6.0-12.0

## QUALITY REQUIREMENTS

Sand Equivalent MRDTM 313 - Percent, Min.	-	40	30
Stripping Loss MRDTM 413 - Percent, Max.	10	10	10
Abrasion Loss MRDTM - Percent, Max.	40	40	-
Percent Fracture - Min. 2 Face	75	75	-

Percent fracture shall be determined for the material retained on the 2.36 millimeter (No. 8) sieve. The fractured faces shall have a minimum dimension from edge to edge across each fractured face which is not less than one-third (1/3) the maximum dimension of the aggregate particle.

4.04.2.3 Choke Stone for Open-Graded Emulsion Base. Choke stone shall be clean sand, fine material remaining from production of the aggregate for open-graded emulsion base, or other fine material conforming to the following gradation:

<u>Sieve Size</u>	<u>Percentage Passing</u>
9.5 mm (3/8 inch)	100
4.75 mm (No. 4)	85-100
0.300 mm (No. 50)	15-45
0.075 mm (No. 200)	0-4



4.04.2.4 Portland Cement. Portland cement shall be Type I or II conforming to the requirements specified in Section 5.01, "Portland Cement Concrete," in the General Specifications.

4.04.2.5 Water. Water shall be free of matter deleterious to the quality of the bituminous emulsion treated mixture.

#### 4.04.3 Proportioning Bituminous Emulsion Treated Base Mixtures.

4.04.3.1 Job Mix Design Proposal. A proposed Job Mix Formula (JMF) shall be formulated by the Contractor and submitted to the Engineer for approval. The JMF shall be prepared by the Contractor in precise compliance with procedures and requirements set forth in the MRD Manual of Materials and Tests and all current circular letters issued by the Ministry of Communications.

The Contractor shall also use the Basic Asphalt Emulsion Manual," MS-19, published by the Asphalt Institute, Lexington, Kentucky, USA.

1. Type I Bituminous Emulsion Treated Base. Chapter XII Procedural Outline and Design Criteria for the Asphalt Institute Design Method for Open-Graded Mixes.

2. Types II and III Bituminous Emulsion Treated Base. Chapter XIV Marshall Method for Emulsified Asphalt-Aggregate Cold Mixture Design or, Chapter XI Modified Hveem Mix Design.

The Contractor shall select his sources of aggregate and bituminous emulsion material and, after sufficient quantities have been stockpiled or are available for use, obtain representative samples of the materials and test to determine if they conform to the requirements of these specifications.

The Contractor shall perform all testing required to establish the proportions of each material to be combined to produce the specified base (JMF).

The Contractor shall submit the Job Formula Mix (JMF) with the following information:

1. Pertinent data on the source of aggregate and test data on the fracture, gradation and other quality treatments shown in Paragraph 4.04.2.2, "Aggregate," in the General Specifications.

2. The type and grade of emulsified bituminous material to be used.

3. All laboratory trial mix test results.

4. The bituminous material content, based on total dry weight mixture. The quantity of bituminous emulsion material to be added to the mixture, based on total dry weight of material, shall be computed from the required bituminous material content and

the quantity of water in the bituminous emulsion material at the time it is removed from the storage tank.

5. The percentage of Portland cement, when required, by total dry weight of mixture.

6. The percentage of additional mixing water, based on total dry weight of mixture.

7. The percentage of total fluids (bituminous material and water) at compaction, based on the total dry weight of mixture.

8. The theoretical maximum density based on ASTM D 2041 for fully cured moisture free mixtures.

9. The type and location of each plant to be used for mixing each mix to be furnished.

10. The beginning date for producing bituminous emulsion treated base mixtures.

The Engineer shall be provided access to the materials sampling and testing operations at all times.

At the same time that the above information is provided, the Contractor shall supply to the Engineer one hundred (100) kilogram samples of each individual aggregate size, eight (8) liters of bituminous material and, when used, sufficient quantities of mineral filler and chemical admixture to complete two (2) mix design checks, all representing the materials which the Contractor proposes to furnish.

4.04.3.2 Acceptance of Job Mix Formula. The Engineer shall review the JMF to determine that it contains all required information. If it does not contain all required information, it shall be returned within seven (7) days to the Contractor for further action and resubmission by the Contractor.

If the proposed JMF contains all required information but fails to meet all of the requirements specified, it shall not be accepted by the Engineer and will be returned to the Contractor within fourteen (14) days. The Contractor shall prepare and submit to the Engineer a new JMF conforming to the requirements specified and propose a new date for beginning production of the bituminous mixtures.

When the Engineer is satisfied that JMF proposed by the Contractor conforms to all the requirements of the specifications, he shall order the Contractor to construct a two hundred (200) meter long field control strip of bituminous emulsion treated base. The Engineer shall evaluate the control strip as to its constructibility and the mix for conformance to the laboratory tested JMF within the tolerances contained in Paragraph 4.04.6.1, "Contractor Process Quality Control," in the General Specifications. Split samples of the cold bituminous mix and component raw materials along with the project laboratory test results are to be sent to the Materials and Research Department Central Laboratory for a one point check and documentation purposes. If the Engineer is not

satisfied with the control strip results, he shall state his objections in writing and request a revised JMF and new control strip. The control strip may only be kept in place if the results are satisfactory.

When the Engineer is satisfied that the JMF proposed by the Contractor conforms to all requirements of the specifications and the control strip results are acceptable, he will issue written acceptance to the Contractor to begin producing the mixes proposed.

Production of bituminous concrete mixtures shall not begin until the Engineer has given written acceptance of the Job Mix Formula.

Acceptance of the JMF by the Engineer does not relieve the Contractor of his obligation to produce bituminous concrete mixtures conforming to all specified requirements.

4.04.3.3 Job Mix Formula Revisions. The Contractor shall not alter his methods of crushing, screening, blending, or stockpiling from that used to produce materials for the approved JMF. Changes to the JMF will not be permitted without retesting and resubmission of a proposed (revised) JMF in accordance with all the steps in Paragraph 4.04.3.1, "Job Mix Design Proposal," in the General Specifications. Significant changes may include, but not be limited to, changes in the amount of type of materials rejected or wasted, changes in the amount of materials crushed, reductions in the amount of crushed fines, changes in the amount and type of mineral filler and mineral and chemical admixtures to be used.

Should the Contractor change his source of supply of aggregate and grade of bituminous material, he shall furnish a new information and samples of materials, as described in Paragraph 4.04.3.1, as determined by the Engineer to be necessary, at least twenty-one (21) days before their intended use.

At any time after the JMF is approved the Contractor may submit a new JMF for approval by the Engineer. If the revised JMF is approved it shall become the approved JMF.

4.04.4 Equipment. The Contractor shall supply the proper type and sufficient numbers of equipment to complete the work within the Contract time and in accordance with his Program of Work as approved by the Engineer. The equipment shall also conform to the following specific requirements:

1. Travel mixing plant shall not be used to produce open-graded base mixtures.
2. Water, when added to the mixture, shall be introduced into the mix by pumping through a volumetric rate meter, registering in liters per minute, which will accurately measure the flow of water. The flow of water shall be interlocked with the flow of aggregate, bituminous emulsion material and additives, if required.
3. Portland cement, when added to the mixture, shall be introduced into the mixture through a positive auger or belt feeder.

4. When batch plants are used for producing bituminous emulsion treated base, all screens except an oversize scalping screen shall be removed.

5. Cold-feed proportioning controls shall be used.

4.04.5 Weather Limitations. Bituminous emulsion treated mixtures shall not be placed on any wet or frozen surface, during dust or sand storms, or when the air temperature is less than fifteen degrees Celsius (15° C.).

4.04.6 Construction.

4.04.6.1 Contractor Process Quality Control. Testing to control the quality of bituminous emulsion treated base mixtures shall be the responsibility of the Contractor. Copies of all test results shall be forwarded to the Engineer at the end of each working day. The Engineer reserves the right to obtain samples of the materials at any point during the production operations for his own use.

The Contractor shall perform the following minimum testing for each type of bituminous emulsion treated base produced and each day's production.

1. Two samples of combined aggregate shall be obtained from the bin discharge gate at random times during the day just prior to the addition of bituminous emulsion material and the combined aggregate tested for gradation.

2. Two samples of the bituminous emulsion treated materials shall be obtained from hauling vehicles, and the water and bituminous material contents determined by oven drying and extraction testing.

Extracted aggregate shall be tested for gradation. The bituminous material content as extracted from the mixture shall conform to the requirement in the approved JMF within plus or minus four-tenths ("0.4) percentage points.

The combined aggregate, including Portland cement and other mineral additives, shall conform to the approved JMF grading within the following tolerances:

9.75 mm (3/8") and larger sieves,	± 8 percentage points
4.75 mm (No. 4) sieve,	± 7 percentage points
2.36 mm (No. 8) sieve and No. 50 sieves,	± 6 percentage points
0.300 mm (No. 50) sieve	± 4 percentage points
0.075 mm (No. 200) sieve,	± 2 percentage points

4.04.6.2 Preparation of Bituminous Emulsion Material. Bituminous emulsion material shall be stored at temperatures within the following ranges:

SS-1, SS-1h, CSS-1, CSS-1h	Minimum = 10 degrees Celsius Maximum = 60 degrees Celsius
MS-2, MS-2h, CMS-2, CMS-2h	Minimum = 50 degrees Celsius Maximum = 85 degrees Celsius

The bituminous emulsion materials shall be protected from freezing and periodically rolled or circulated to maintain uniformity. Forced air shall not be used for agitation.

4.04.6.3 Preparation of Aggregate. Aggregate shall be stockpiled and removed from stockpiles as required in Section 3.01, "Production, Handling and Stockpiling Aggregates," in the General Specifications.

4.04.6.4 Type I, Type II and Type III Bituminous Emulsion Treated Bases. Type I, Type II and Type III Bituminous Emulsion Treated Bases may be produced at centrally located continuous mixing plant. Aggregate, bituminous emulsion material, added water, Portland cement and other additives, when required, may be proportioned by weight or by volume.

The aggregate shall be fed from storage to the mixing chamber using a belt feeder equipped with devices by which the rate of aggregate feed can be determined while the plant is in full operation. Aggregate feed and the bituminous emulsion material metering pump shall be mechanically or electrically interlocked in a manner that maintains a constant ratio of aggregate and bituminous emulsion material.

Portland cement, when required, shall be introduced into the aggregate on the belt feeder.

Mixing water, when required, shall be introduced into the aggregate through a spray bar mounted at such a point that the water is added as the aggregate enters into the mixing chamber.

The bituminous emulsion material shall be introduced into the mixing chamber through a spray bar that can be adjusted to vary mixing times between five (5) and thirty (30) seconds.

The aggregate, water and Portland cement as required, and bituminous emulsion material shall be mixed until the aggregate has been coated and a uniform and homogeneous mixture has been obtained.

Type I open-grade bituminous emulsion treated base shall be discharged directly into hauling equipment or stored in bins or silos. Type I open-graded bituminous emulsion treated base shall not be stored on the ground.

Type II and Type III bituminous emulsion treated base may be discharged directly into hauling equipment or stored. Type II and Type III base shall not be stored for periods longer than forty-eight (48) hours without prior written approval from the Engineer.

4.04.6.5 Type II and Type III bituminous emulsion treated base may be mixed on the roadway using self-propelled travel mixing plant. Travel mixing plant may be of three types:

1. A plant that moves along an appropriately sized aggregate windrow on the roadbed, picking up the aggregate in the windrow, adding and mixing bituminous emulsion material and discharging the completed mixture at the rear.

2. A plant that receives aggregate into its hopper from hauling equipment as it moves forward along the roadbed, adding and mixing bituminous emulsion material and discharging the completed mixture at the rear. The aggregate may be delivered into the hopper directly from hauling equipment or by pickup equipment from aggregate deposited into a windrow by hauling equipment.

3. A rotary type mixing plant that moves along the roadbed adding bituminous emulsion material to aggregate situated in-place on the roadbed and mixing the materials. The bituminous emulsion material may be added through a spray bar located inside the rotary mixing chamber, or spread on the aggregate immediately in advance of mixing.

Rotary mixers may be used to cut into and scarify the in-place aggregate, either old bituminous concrete pavement or new aggregate, without introduction of bituminous emulsion material. Bituminous emulsion material shall be delivered to the mixing plant from hauling equipment traveling adjacent to the mixing plant.

The travel plant shall be capable of producing a uniform, properly coated, bituminous emulsion material-aggregate mixture conforming to the requirements of the JMF. Bituminous emulsion material and aggregate proportioning devices shall be keyed to the rate of forward travel of the mixer, or interlocked to ensure a constant bituminous emulsion material-aggregate blend.

Multiple passes of the travel plant may be required for higher bituminous emulsion material contents to achieve required uniformity of mix.

4.04.6.6 Spreading and Compacting. The surface to receive bituminous emulsion treated base shall conform to the compaction and other requirements for the material involved.

When the surface to receive the bituminous emulsion treated base does not conform to compaction and other requirements for the material involved, the Contractor, at his own expense, shall correct all deviations.

When the surface to receive bituminous emulsion treated base is a soil subgrade, aggregate subbase or aggregate base, and the total thickness of the bituminous emulsion treated base and surface course is less than ten (10) centimeters, the surface shall receive a prime coat in accordance with the requirements specified in Section 4.02, "Bituminous Prime and Tack Coat," in the General Specifications. The prime coat shall be allowed to cure for at least forty-eight (48) hours before placement of bituminous emulsion treated base.

Type I open-graded bituminous emulsion treated base shall be spread using a self-propelled paving machine. The maximum thickness of one lift shall not exceed ten (10) centimeters. Immediately after spreading, each lift shall be compacted with one coverage of a steel-drum tandem roller weighing not less than ten thousand (10,000) kilograms. After the initial coverage, choke stone shall be uniformly spread across the surface of the open-grade base at a rate between seven (7) and thirteen (13) kilograms per square meter using a self-propelled spreading device conforming to the requirements specified in Section 4.02, "Bituminous Prime Coat Tack Coat and Fogseal," the General Specifications immediately after spreading choke stone, the open-graded base shall receive three additional coverages with a steel-drum tandem roller weighing not less than ten thousand (10,000) kilograms. After completion of compaction, surplus choke stone shall be removed by sweeping. Each lift of open-graded base shall be allowed to cure for a period not less than seventy-two (72) hours before spreading successive lifts.

Type II and Type III bituminous emulsion treated base may be spread using a self-propelled paving machine, aggregate base spreader or other device which results in a base that is smooth, has a uniform texture, conforms to planned and specified thickness and is within the lines and grade shown on the plans. The maximum thickness of one lift shall not exceed ten (10) centimeters unless otherwise approved by the Engineer. Lift thicknesses greater than ten (10) centimeters may be approved by the Engineer when sufficient Portland cement has been added to the mixture to accelerate curing and the Contractor demonstrates that curing is effective.

Each lift shall be compacted using a steel-drum tandem roller weighing not less than ten thousand (10,000) kilograms until the relative compaction of each lot of bituminous emulsion treated base as described in Subsection 4.04.8, "Quality Assurance Procedures," in the General Specifications is between ninety-one percent (91%) and ninety-four percent (94%) of the theoretical maximum density determined from ASTM D 2041.

Each lift of Type II and Type III bituminous emulsion base shall be allowed to cure for the period specified in the Special Specifications, or for three (3) to five (5) days, or, when Portland cement has been added to the mixture, for such shorter period as approved by the Engineer.

Type II bituminous emulsion treated Base for Agricultural roads may be spread using a self-propelled paving machine, aggregate base spreader, motor grader or other device which results in a base that is smooth, has a uniform texture conforms to planned and specified thickness and is within the lines and grades of the plans. The

maximum thickness of one lift shall not exceed ten (10) centimeters unless otherwise approved by the Engineer. Lift thicknesses greater than ten (10) centimeters may be approved by the Engineer when sufficient Portland cement has been added to the mixture to accelerate curing and the Contractor demonstrates that the curing is effective.

4.04.6.7 Finishing. When shown on the plans, or specified in the Special Specifications, Type I, Type II and Type III bituminous emulsion treated base courses shall be sealed with a Class C, Medium Fine, surface treatment conforming to the requirements specified in Section 4.03, "Bituminous Surface Treatment," in the General Specifications.

4.04.7 Traffic Control. Traffic control shall conform to the requirements specified for traffic control in Section 9.02, "Traffic Control through Work Zones," in the General Specifications.

4.04.8 Quality Assurance Procedures. The bituminous emulsion treated base shall be accepted by lot. Unless otherwise stated in the Special Specifications, the lot size shall be ten thousand (10,000) square meters for each layer constructed. The bituminous emulsion treated base shall be sampled, tested, and evaluated in accordance with Section 1.08, "Acceptance of Work," in the General Specifications. The Engineer may, during the beginning of placement of bituminous emulsion treated base, at times when test results indicate erratic characteristics, and at any other time, reduce the lot size to sections of bituminous emulsion treated base with similar quality characteristics. This should facilitate the isolation and modification or replacement of low-quality materials with materials of acceptable quality to maintain the overall strength of the pavement structure.

The Engineer shall perform or supervise the performance of all quality assurance sampling and testing. The location of all samples and tests shall be recorded by roadway, lane and centerline station (kilometer). Quality assurance sampling and testing for each lot shall include:

1. Compaction
2. Thickness
3. Aggregate Gradation and Bituminous Material Content
4. Surface Smoothness

4.04.8.1 Compaction. The specified range of acceptable compaction is between 91 and 94 percent. The bituminous emulsion treated base course compaction will be sampled, tested and evaluated as detailed in Paragraph 4.05.8.1, "Compaction," in the General Specifications.

Type I base may be accepted without density testing when the specified equipment and operating procedures are verified and documented as being utilized.



4.04.8.2 Thickness. A lot shall be accepted when the average thickness is not less than the planned thickness. The bituminous emulsion treated base course thickness will be sampled, tested and evaluated as detailed in Paragraph 4.05.8.2, "Thickness," in the General Specifications.

The Contractor shall backfill density and thickness test holes with bituminous emulsion treated base or other material approved by the Engineer.

4.04.8.3 Aggregate Gradation and Bituminous Material Content. The upper and lower specification units are the approved job-mix target values plus or minus the allowable deviations shown in Paragraph 4.04.6.1, "Contractor Process Quantity Control," in the General Specifications.

The bituminous material content of the bituminous emulsion treated base shall be determined by extraction from five (5) randomly selected sample per lot taken from the road after all mixing is complete and prior to compaction. The average bituminous material content shall not vary from the approved job mix content by more than plus or minus five-tenths percent ( $\pm 0.5\%$ ). When the bituminous material content varies by more than plus or minus five-tenths percent ( $\pm 0.5\%$ ) the lot shall be removed, remixed with other materials added as necessary and/or replaced with other materials approved by the Engineer.

4.04.8.4 Surface Smoothness. When a straightedge four (4) meters in length is laid on the finished surface of the base parallel with the centerline, the surface shall have no depressions greater than five (5) millimeters from the lower edge of the straightedge. When the straightedge is laid transverse to the centerline, the surface shall have no depressions greater than eight (8) millimeters from the lower edge of the straightedge.

4.04.8.5 Acceptance. Bituminous materials will be accepted under Subsection 1.08.3 "Certification of Compliance" in accordance with Subsection 4.01.4, "Acceptance Procedures for Bituminous Materials," in the General Specifications.

Bituminous emulsion treated base construction including surface smoothness and bituminous material content will be accepted under Subsection 1.08.4, "Measured or Tested Conformance," in the General Specifications.

Bituminous emulsion treated base compaction, thickness and aggregate gradation, will be accepted under Subsection 1.08.5, "Statistical Evaluation of Work for Acceptance and Determination of Pay Factor (Value of Work)," in two stages as follows:

The first stage shall be the selection of the lowest of the two pay factors for the quality of the bituminous emulsion treated base relating to aggregate gradation and density. The second stage involves the selection and application of a quantity pay factor based on the thickness of the bituminous emulsion treated base. The reduced thickness pay factor for the lower courses of multiple course pavements will initially be applied provisionally based on the results of the depths of the cores taken from the lower courses. Additional cores will be taken of the total depth of all bituminous

courses within the lot represented by lower course reduced thickness pay factors. If the total thickness cores show that the increased upper level course thickness has resulted in total thickness acceptability, the lower level courses reduced thickness pay factor will be adjusted accordingly. The second stage thickness quantity pay factor will be applied to all the individual course lots in addition to the first stage lowest quality pay factor as determined in accordance with Subsection 1.08.5 in the General Specifications.

4.04.9 Measurement. Each Type bituminous emulsion treated base shall be measured by the cubic meter, as placed and compacted to the planned and specified thickness and within the lines and grades shown on the plans, as specified or directed by the Engineer. No measurement will be made for material placed outside authorized limits.

Mineral fillers, chemical admixtures and asphalt modifiers used by the contractor to meet the Job Mix Formula (JMF) requirements will be considered subsidiary to the construction of the bituminous emulsion base course and will not be measured separately unless specifically stated in the Special Specifications and listed in the Bill of Quantities. When they are listed in the Bill of Quantities and specified in the Special Specifications they shall be measured in liters, kilograms, or tons in accordance with Subsection 4.05.10 "Measurement" in the General Specifications.

Surface treatment shall be measured in square meters as specified in Section 4.02, "Bituminous Prime, Tack Coat, and Fog Seal" in the General Specifications.

Choke stone will be considered subsidiary to the construction of bituminous emulsion treated base and will not be measured.

4.04.10 Payment. Payment shall be made at the contract unit price, or adjusted contract unit price, per cubic meter for each Type bituminous emulsion treated base measured and calculated as described above for the pay items listed below that are shown in the Bill of Quantities.

When a lot of bituminous emulsion treated base is accepted with a deficiency, the adjusted contract unit price for said lot shall be the product of the contract unit price and the lowest quality and quantity pay factors specified in Subsection 3.04.8, "Quality Assurance Procedures," in the General Specifications.

Surface treatment shall be paid for at the contract unit price per cubic meter as measured and listed in the Bill of Quantities.

Mineral fillers, chemical admixtures, and asphalt modifiers used by the contractor to meet the Job Mix formula requirements will be considered subsidiary to the construction of bituminous emulsion base course and shall not be paid for separately unless specifically stated in the Special Specifications and listed in the Bill of Quantities. when they are listed in the Bill of Quantities and specified in the Special Specifications they shall be paid for as provided in Subsection 4.05.11 "Payment" in the General specifications.

Choke stone shall be considered subsidiary to the construction of Type I Bituminous Emulsion Open-Grade Base and separate payment shall not be made.

Such prices and payment shall cover and be compensation for furnishing labor, materials, equipment, tools and incidentals necessary for completing the work as specified in Subsection 1.07.2, "Scope of Payment," of the General Specifications.

PAYMENT WILL BE MADE UNDER ONE OR MORE OF THE FOLLOWING:

<u>ITEM NO</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
40401	Bituminous Emulsion Base	Cubic Meter
4040101	Type I Bituminous Emulsion Open-Graded Base	Cubic Meter
4040102	Type II Bituminous Emulsion Dense-Grade Base	Cubic Meter
4040103	Type III Bituminous Emulsion Sand Base	Cubic Meter

Section 4.15 Bitumen Stabilization of Granular Earth Materials is Added as Follows:

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#### Section 4.15 Bitumen Stabilization of Granular Earth Materials

##### 4.15.1 Description

This work shall consist of stabilization of granular sand or soils with cutback or emulsified bituminous materials by pulverizing, mixing, spreading, compacting, and curing to form a stabilized course of material. Stabilization shall be made at the locations and in conformity to the lines, grades, thicknesses, and cross sections shown on the plans or established by the Engineer.

##### Items in the Bill of Quantities

- Bituminous Stabilized Sand
- Bituminous Stabilized Granular Soil

##### 4.15.2 Materials

4.15.2.1 Cut back Asphalt. Cutback shall be of uniform consistency, free from water, show no separation or curdling prior to use, and shall not foam when heated to the applicable temperature.

1. Rapid-Curing Cutback Asphalt (RC). These materials shall conform to the requirements shown in Table 4.01-3A and 3B in Section 4.01 Bituminous Materials" in the General Specifications..

2. Medium-Curing Cutback Asphalt (MC). These materials shall conform to the requirements in Table 4.01-2A or 2B in Section 4.01 "Bituminous Materials" in the General Specifications.

3. Slow-Curing Cutback Asphalt (SC). These materials shall conform to the requirements shown in ASTM D2026.

4.15.2.2 Asphaltic Emulsion. Asphaltic emulsion materials shall be slow setting type (SS-1 or SS-1h conforming to the requirements of Table 4.01-4C in Section 4.01 "Bituminous Materials" in the General Specifications, CSS-1 or CSS-1h conforming to the requirements of Table 4.01-5 in Section 4.01 "Bituminous Materials" in the General Specifications) derived from a bituminous base of paving asphalt penetration Grade 60 - 70, uniformly emulsified with water and an emulsifying or stabilizing agent. When tested in accordance with the standard method of test AASHTO Designation T-59, the emulsion shall conform to the following requirements:

Viscosity at 25E C (77E F)	20-100 sec.
Modified miscibility with water-difference of asphalt residue	4.5% max.
Cement mixing test	2% max.
Residue at 73E C (163E F)	57% min.
No separation within	30 days

4.15.2.3 Granular Earth Materials. Granular sand or soils for stabilization shall conform to the requirements shown in the following Table 4.15-1:

TABLE 4.15-1

Sieve Size -----	Granular Soil-Bitumen % Passing	Sand-Bitumen % Passing
38 mm (1 ½ inch)	90-100	
4.25 mm (# 4)	50-100	100
2.00 mm (#10)		50-100
.425 mm (#40)	35-100	40-100
.075 mm (#200)	3-25	5-12
Liquid Limit (LL) and Plasticity Index (PI) or	30 max. 10 max.	10 max.
Sand Equivalent (SE)	20 min.	30 min.

Granular Earth Materials with a (SE) below the minimum listed may be used if the (LL) and (PI) limits are met.

4.15.2.4 Water. Potable water shall be of such quality that the asphalt will not separate from the emulsion before the material is in place. Brackish water, or water containing salt or soluble salts shall not be used.

4.15.2.5 Suitable Types of Bituminous Materials.

The following table lists the appropriate asphalt type to be used to stabilize granular earth materials depending on the gradation, temperature and moisture content of the granular earth materials.

TABLE 4.15-2

Percent Passing #200 Sieve	Soil Temperature, °F/°C			Soil Moisture Content	
	40-55°F 4-13°C	55-75°F 13-24°C	75-100°F 24-38°C	Wet 2-5%	Dry 0-2%
0-5	RC-1	RC-2	RC-3	SS-1h	SM-k
5-15	MC-1	MC-2	MC-3	SS-1, SS-1h	SM-k
15-25	SC-1	SC-2	SC-3	SS-1	SM-k

The spraying and mixing temperatures for the above asphalt materials shall be as shown in the following Table 4.15-3.

TABLE 4.15-3

<u>Asphalt Material</u>	<u>Temperature</u>	
	<u>Spraying</u>	<u>Mixing</u>
RC and MC 250	40 - 80°C/104-176°F	55 - 80°C/131-176°F
RC and MC 800	55 - 90°C/131-194°F	75 - 100°C/167-212°F
SS-1h and CSS-1h	20 - 70°C/68-158°F	10 - 70°C/50-158°F

4.15.3 Proportioning Bituminous Stabilized Granular Earth Materials.

4.15.3.1 Mix Design Proposal. A proposed Mix Design shall be formulated by the Contractor and submitted to the Engineer for approval. The Mix Design shall be prepared by the Contractor in precise compliance with procedures and requirements set forth in the MRD Manual of Materials and Tests and all current circular letters issued by the Ministry of Communications.

The Contractor shall also use the Basic Asphalt Emulsion Manual," MS-19, and the Mix Design Methods for Asphalt Concrete and other hot-mix types published by the Asphalt Institute, Lexington, Kentucky, USA as follows:

Chapter XIV Marshall Method for Emulsified Asphalt-Aggregate Cold Mixture Design or, Chapter XI Modified Hveem Mix Design.

The Contractor shall select his sources of granular soils and sand and bituminous cutback or emulsion material and, after sufficient quantities have been stockpiled or are

available for use, take representative samples of the materials, and test them to verify that they conform to the requirements of these Supplemental Specifications.

The Contractor shall perform all testing required to establish the proportions of each material to be combined to produce his proposed Mix Design.

The Contractor shall submit the proposed Mix Design with the following information:

1. Pertinent data on the source of granular sand or soil and test data on the fracture, gradation and other quality treatments shown in Paragraph 4.15.2.3, "Granular Earth Materials," and this paragraph in these Supplemental Specifications.

2. The type and grade of cutback or emulsified bituminous material to be used.

3. All laboratory trial mix test results.

4. The bituminous material content, based on total dry weight mixture. The quantity of bituminous emulsion material to be added to the mixture, based on total dry weight of material, shall be computed from the required bituminous material content and the quantity of water in the bituminous emulsion material at the time it is removed from the storage tank.

5. The percentage of Portland cement, when required to meet the mix design requirements, by total dry weight of mixture.

6. The percentage of additional mixing water, based on total dry weight of mixture.

7. The percentage of total fluids (bituminous material and water) at compaction, based on the total dry weight of mixture.

8. The theoretical maximum density based on ASTM D 2041 for fully cured moisture free mixtures.

9. The beginning date for producing bituminous stabilized granular earth material mixtures.

10. Test data showing compliance with the following mix design requirements:

Hveem Stability	20 Minimum
or	
Marshall Stability (Dry Condition)	500 Minimum
Air Voids	2-8 Percent
Estimated Asphalt Content*	6-15 percent

\*Formula for Determination of Estimated Cutback Asphalt Content

$$P = 0.02A + 0.07B + 0.15C + 0.2D$$

- Where P = Percent by weight of cutback asphalt based on weight of graded granular earth material  
A = Percent of material retained on the 0.300 mm (No. 50) sieve  
B = Percent of material passing the 0.300 mm (No. 50) sieve and retained on 0.150 mm (No. 100) sieve  
C = Percent of material passing the 0.150 mm (No. 100) and retained on 0.075 mm (No. 200) sieve  
D = Percent of material passing the 0.075 mm (No. 200) sieve

\*Formula for Determination of Estimated Percent Asphalt Emulsion Requirement

(A) 
$$P = 0.5A + 0.1B + 0.5C$$

- Where P = Percent by weight of asphalt emulsion based on weight of graded mineral aggregate  
A = Percent\* of mineral aggregate retained on 2.36 mm (No. 8) sieve  
B = Percent\* of mineral aggregate passing 2.36 mm (No. 8) sieve, retained on 0.075 mm (No. 200) sieve  
C = Percent of mineral aggregate passing 0.075 mm (No. 200) sieve

OR (B) 
$$P = 0.06A + 0.01B$$

- Where P = Percent by weight of asphalt emulsion based on weight graded mineral aggregate  
A = Percent\* passing 4.75 mm (No. 4) sieve  
B = Percent\* retained 4.75 mm (No. 4) sieve  
\*Expressed as a whole number

The Engineer shall be provided access to the materials sampling and testing operations at all times.

At the same time that the above information is provided, the Contractor shall supply to the Engineer one hundred (100) kilogram samples of each individual aggregate size, eight (8) liters of bituminous material and, when used, sufficient quantities of mineral filler and chemical admixture to complete two (2) mix design checks, all representing the materials which the Contractor proposes to furnish.

4.15.3.2 Acceptance of Mix Design. The Engineer shall review the proposed mix design to determine that it contains all required information. If it does not contain all required information, it shall be returned within seven (7) days to the Contractor for further action and resubmission by the Contractor.

If the proposed mix design contains all required information but fails to meet all of the requirements specified, it shall not be accepted by the Engineer and will be returned to the Contractor within fourteen (14) days. The Contractor shall prepare and submit to the Engineer a new mix design conforming to the requirements specified and propose a new date for beginning production of the bituminous mixtures.

When the Engineer is satisfied that mix design proposed by the Contractor conforms to all the requirements of the specifications, he shall order the Contractor to construct a two hundred (200) meter long field control strip of bituminous stabilized granular earth materials emulsion treated base. The Engineer shall evaluate the control strip as to its constructibility and the mix for conformance to the laboratory tested mix design. Split samples of the bituminous stabilized mixture and component raw materials along with the project laboratory test results are to be sent to the Ministry Materials and Research Department Central Laboratory for a one point check and documentation purposes. If the Engineer is not satisfied with the control strip results, he shall state his objections in writing and request a revised mix design and new control strip. The control strip may only be kept in place if the results are satisfactory.

When the Engineer is satisfied that the mix design proposed by the Contractor conforms to all requirements of the specifications and the control strip results are acceptable, he will issue written acceptance to the Contractor to begin producing and placing the proposed mixes.

Production of bituminous stabilized mixtures shall not begin until the Engineer has given written acceptance of the proposed mix design. Acceptance of the mix design by the Engineer does not relieve the Contractor of this obligation to produce bituminous stabilized mixtures conforming to all specified requirements.

4.15.4 Equipment. The Contractor shall furnish the proper type and operate sufficient numbers of equipment to complete the work within the Contract time in accordance with his Program of Work as approved by the Engineer. Said equipment shall include rollers, bituminous material distributors, motor graders and travel mixing plants for Bituminous stabilized materials.

Distributor trucks shall be of the pressure type with insulated tanks. Spray bars shall have a minimum length of two and seventy-five hundreds (2.75) meters and shall be of the full circulating type.

The valves shall be operated by levers so that one or all valves may be quickly opened or closed in one operation.

The spreading equipment shall be so designed and articulated that uniform application of bituminous material, in controlled amounts, may be made from nine hundredths (0.09) to four and six tenths (4.6) liters per square meter of surface and with a range of pressure from one and seven tenths (1.7) to five and sixteen hundredths (5.16) kilograms per square meter. If a spray bar extension is used to cover a greater width, it shall be of the full circulating type. The distributor shall be equipped with a hose and nozzle attachment to be used for spotting areas inaccessible to the distributor. The distributor shall also be equipped with pressure gauges and an accurate thermometer for determination of temperatures of the bituminous material. Distributor and booster tanks shall be so maintained at all times as to prevent dripping of bituminous material from any part of the equipment.



#### 4.15.5 Construction Requirements

##### 4.15.5.1 General Conditions and Sequence of Work

Asphalt materials shall be applied and road-mixed mixtures shall be placed only when the temperature of the air in the shade is above five degrees Celsius (5E C) and rising. No work shall be started if local conditions indicate that rain is imminent, or a sandstorm is anticipated.

All surfaces shall be cleaned of dirt, debris, and loose material prior to placing any asphalt material or road-mixed mixture.

Rolling of the mixture shall be done with pneumatic tire rollers or a combination of pneumatic tire and steel wheel.

The construction operations shall be undertaken in the following sequence:

1. Proportioning and placing granular soil or sand
2. Preparation of bituminous stabilized mixture
3. Aeration and spreading of bituminous mixture
4. Compaction of bituminous stabilized mixture

##### 4.15.5.2 Proportioning and Placing of Granular Soil or Sand

The Contractor shall determine the proportions of the granular soil or sand required to obtain a granular mixture uniformly graded within the limits specified, and shall calculate the quantity per station of the granular materials that shall be placed in the windrow.

If a single graded granular soil or sand is used for the mixture, it shall be placed in a uniform windrow by means of an aggregate spreader.

If two or more gradations of granular sand or soil are blended for the mixture, each gradation shall be placed in a uniform windrow with an aggregate spreader meeting the approval of the Engineer and then mixed thoroughly and placed in a windrow. If small quantities of aggregates are to be added to the windrow, and it is not feasible to use an aggregate spreader, they shall be placed by methods approved by the Engineer.

Granular soil or sand shall not be hauled when the weather or road conditions are such that the hauling operations will cause cutting up or rutting of the primed subgrade.

##### 4.15.5.3 Preparation of Bituminous Stabilized Mixture

The granular mixture shall have less than five (5) percent moisture and preferably less the two (2) percent moisture at the time of mixing with asphalt or materials. If necessary to reduce the moisture content, the granular mixture shall be aerated by laying the aggregate back and forth across the subgrade until the moisture content has been reduced to the specified amount. Immediately before the application of the

asphalt material, the granular mixture shall be shaped with a windrow evener. The windrow evener shall be adjusted so that the windrowed granular mixture will have the desired uniform cross-section.

The granular sand or soil and asphalt material as outlined in Tables 4.15-2 and 4.15-3 shall be mixed with road mixers, traveling plants, motor graders, or other equipment approved by the Engineer. The granular sand or soil and asphalt material shall be mixed so that a homogeneous mixture is obtained in which all granular particles are coated uniformly.

#### 4.15.5.3.1 Traveling Plant Method

When traveling plants are used for mixing, the amount of asphalt material applied shall be designated by the Contractor and may be adjusted by him as the work progresses. Material which may fall outside, or which is not picked up by the conveyor shall be picked up by hand labor and thrown directly into the elevating unit and not onto the windrow ahead.

The use of a windrow evener may be omitted when mixing is done with a traveling plant. The feed control of the traveling plant shall be calibrated and set by the Contractor as directed by the Engineer.

If one operation of the traveling plant does not produce a uniform mixture, the windrow shall be remixed with the traveling plant, motor grader, road mixer, or by other methods approved by the Engineer, until the mixture is uniform in color consistency and gradation. If the mixture does not contain the proper amount of liquid or emulsified asphalt, additional asphaltic material or granular materials shall be added and the windrow remixed as specified herein.

#### 4.15.5.3.2 Road-Mixing Methods

When road mixing equipment is used for mixing, the windrow of granular material shall be flattened before applying the asphalt material. The asphalt material shall be applied by means of a pressure distributor in at least three applications. The first application shall not exceed of the total quantity required. In general, the mixing operations shall be carried on in the central portion of the primed subgrade.

When road mixing equipment is used for mixing, the treated granular material shall be mixed after each application of asphalt material. Mixing shall be continued until the mixture is free from lumps, homogeneous, and of uniform color. When the total amount of granular materials necessary to construct the surface to the specified width and depth cannot be mixed at one time, it shall be mixed in portions and the mixed material shall be mixed and blended with a grader until it is uniform in color, consistency, and gradation.

The mixing shall be performed in such a manner as to prevent segregation of the various granular materials or loss of the fine material, and to agitate the entire mixture

but not disturb the subgrade. The mixture shall be kept within the limits of the subgrade, and no earth or other foreign matter shall be permitted in the mixture.

If, after mixing, it is the Engineer's decision that the mixture does not contain the proper amount of asphalt material, more asphaltic material or granular material shall be added at his discretion, and mixing continued until the mixture is homogeneous and uniform in color. The application rate of asphalt material shall be that amount in the Mix Design as proposed and accepted in accordance with Subsection 4.15.3 Proportioning Bituminous Stabilized Granular Earth Materials in these Supplemental Specifications.

#### 4.15.5.4 Aeration and Spreading of Mixture

After mixing, the mixture shall be aerated to the desired moisture and volatile content. Proper aeration is achieved when the volatile content has been reduced, in the judgment of the Engineer, to approximately fifty percent (50%) of that contained in the original asphalt material and the moisture content does not exceed two percent by weight of the total mixture. After aeration, the windrowed material shall be divided into two equal parts with motor graders having end plates attached to the blades. One part shall then be bladed across the centerline and spread uniformly upon the portion of the subgrade. The remaining portion of the windrow shall be spread uniformly upon the other portion of the primed subgrade.

Spreading shall be done in such a manner that segregation is kept to a minimum, and the finished surface will be smooth and of uniform texture. The mixture shall be spread to a true line along the edges of the pavement. Care shall be taken to smooth out junctions of successive operations.

If after spreading the mixture, there are any portions which are not homogeneous, do not contain sufficient asphaltic material or contain an excess of asphaltic material, such portions shall be corrected as directed by the Engineer.

Unless the mixture can be spread to the final cross-section and rolled the same day as mixed, it shall be left in the windrow. Should rain fall during road-mixing operations, or after the mixture has been spread and before it has been rolled, the mixture shall be windrowed and not disturbed until the area to be paved contains no visible moisture. The mixture shall then be bladed back and forth across the subgrade until the moisture in the mixture has been removed to the satisfaction of the Engineer.

#### 4.15.5.5 Compaction of Bituminous Stabilized Mixtures

After the mixture has been spread and aerated and when it will bear the weight of the roller without excess lateral movement, it shall be rolled longitudinally. Rolling shall start at the edges and progress toward the center, overlapping on successive trips by at least  $\frac{1}{2}$  the width of the roller. The entire surface shall be rolled in this manner until the specified density has been achieved.

All roller wheels shall be moistened lightly with water to prevent the mixture from sticking to them. If the surface mixture has absorbed moisture before rolling is completed, it shall be scarified, broken up, bladed back and forth until dry and then relaid.

The stabilized material shall be compacted to a density of not less than ninety-six percent (96%) of maximum Marshall density (Marshall samples based on fifty (50) blows of Marshall hammer to each side of the test specimen).

4.15.5.6 Contractor Process Quality Control. Testing to control the quality of bituminous granular soil or sand mixtures shall be the responsibility of the Contractor. Copies of all test results shall be forwarded to the Engineer at the end of each working day. The Engineer reserves the right to obtain samples of the materials at any point during production operations for his own use.

The Contractor shall perform the following minimum testing for each type of bituminous granular mixture produced and each days production.

1. Two samples of combined granular sand or soil mixtures shall be obtained from the Roadway Windrow at random times during the day just prior to the addition of bituminous emulsion material and the combined aggregate tested for gradation.

2. Two samples of the bituminous granular mixture shall be obtained from the Road after spreading and the water and bituminous material contents determined by oven drying and extraction testing. Extracted aggregate shall be tested for gradation. The bituminous material content as extracted from the mixture shall conform to the requirement in the approved mix design within plus or minus one (1) percentage point.

4.15.5.7 Quality Assurance Procedures. The bituminous stabilized sand and granular soil shall be accepted by lot. Unless otherwise stated in the Special Specifications, the lot size shall be ten thousand (10,000) square meters for each layer constructed. The bituminous stabilized mixtures shall be sampled, tested, and evaluated in accordance with Section 1.08, "Acceptance of Work," in the General Specifications. The Engineer may, during the beginning of placement of bituminous stabilized sand and granular soil, at times when test results indicate erratic characteristics, and at any other time, reduce the lot size to sections with similar quality characteristics. This should facilitate the isolation and modification or replacement of low-quality materials with materials of acceptable quality to maintain the overall strength of the pavement structure.

The Engineer shall perform or supervise the performance of all quality assurance sampling and testing. The location of all samples and tests shall be recorded by roadway, lane and centerline station (kilometer). Quality assurance sampling and testing for each lot shall include:

1. Compaction
2. Thickness
3. Gradation and Bituminous Material Content
4. Surface Smoothness

4.15.5.7.1 Compaction. Bituminous stabilized mixtures shall be compacted to the percent of maximum density detailed in Paragraph 4.15.5.5 Compaction of Bituminous Stabilized Mixtures" in these Supplemental Specifications.

The compacted density for each layer shall be determined by the sand cone method, MRDTM 215, or by nuclear method, MRDTM 218, using full depth penetration, at the option of the Engineer.

When the sand cone method is used, unless otherwise stated in the Special Specifications, the tests shall be made at a minimum of five (5) randomly selected locations in each lot.

When the nuclear method is used, unless otherwise stated in the Special Specifications, the test shall be made at a minimum of eight (8) randomly selected locations in each lot. Three (3) nuclear gauge readings shall be made at each test location within a radius of two (2) meters. The three (3) readings shall be averaged and the average considered to be the density for that test location.

Percent relative compaction shall be computed by comparing the average actual in-place compacted density from the nuclear gauge or sand cone test results with the maximum density determined as detailed in Paragraph 4.15.5.5 Compaction of Bituminous Stabilized Mixtures" in these Supplemental Specifications..

Any lot of subgrade that has a percent relative compaction below the minimum percent compaction specified in Paragraph 4.15.8.5 Compaction of Bituminous Stabilized Mixtures" in these Supplemental Specifications shall be removed and replaced by the Contractor at his expense.

4.15.5.7.2 Thickness. The thickness of each lot of bituminous stabilized mixture complete as placed and compacted, shall be measured from test holes obtained at a minimum of five (5) random locations within the lot. The thickness of each hole shall be determined after it is determined that the compacted density is acceptable. The average of the test hole thicknesses shall be reported as the thickness of the lot.

A lot shall be accepted when the average total thickness is not less than the Plan thickness.

When the average thickness of a lot of subgrade is less than the plan thickness, the Contractor, at his own expense, shall place and remix additional stabilized granular material with the original material and recompact before new test holes are dug.

4.15.5.7.3 Gradation and Bituminous Material Content. The gradation shall fall between upper and lower specification limits shown in Paragraph 4.15.2.3 "Granular Earth Materials" in these Supplemental Specifications. When the gradation does not fall between these limits, granular materials shall be added and the mixture remixed to bring the gradation to these limits while maintaining the bituminous material content within its limits.

The bituminous material content of the bituminous emulsion treated base shall be determined by the extraction from three (3) randomly selected samples per lot taken from the road after all mixing is complete and prior to compaction. The average bituminous material content shall not vary from the approved job mix content by more than plus or minus one percent (" 1%). When the bituminous material content varies by more than plus or minus one percent (" 1%) the lot shall be removed, remixed with other materials added as necessary and/or replaced with other materials approved by the Engineer.

4.15.5.7.4 Surface Smoothness. When a straightedge four (4) meters in length is laid on the finished surface of the base parallel with the centerline, the surface shall have no depressions greater than five (5) millimeters from the lower edge of the straightedge. When the straightedge is laid transverse to the centerline, the surface shall have no depressions greater than eight (8) millimeters from the lower edge of the straightedge. Depression areas outside these tolerances shall be corrected.

4.15.5.7.5 Acceptance. Bituminous materials will be accepted under Subsection 1.08.3 "Certification of Compliance" in accordance with Subsection 4.01.4, Acceptance Procedures for Bituminous Materials,"in the General Specifications.

Bituminous stabilized granular soils and sand construction including compaction, thickness, gradation surface smoothness and bituminous material content will be accepted under Subsection 1.08.4, Me asured or Tested Conformance," in the General Specifications.

#### 4.15.6 Measurement

When the Bill of Quantities includes Bituminous Stabilized Sand or Bituminous Stabilized Granular Soil" measurement will be by the cubic meters for the volume of stabilized material authorized, completed and accepted by the Engineer based on the minimum dimensions shown on the plans or ordered in writing by the Engineer. The material to be stabilized will be included in the approved cross sections and therefore measured separately and computed on a cubic meter basis.

#### 4.15.7 Payment

When the Bill of Quantities includes Bituminous Stabilized Sand - or Bituminous Stabilized Granular Soil," the amount of completed and accepted work, unit measured as provided above, will be paid for at the contract unit price or adjusted unit price per cubic meter, which price shall be full compensation for furnishing and placing all materials, for all labor, equipment, tools and all other items necessary for the proper completion of the work as specified in Subsection 1.07.2 Scope of Payment" in the General Specifications.

PAYMENT WILL BE MADE UNDER ONE OR MORE OF THE FOLLOWING:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
41501	Bituminous Stabilized Sand	Cubic Meter
41502	Bituminous Stabilized Granular Soil	Cubic Meter

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PART 5 - CONCRETE, STEEL AND STRUCTURES

---- PART 5 -- PAGE 77 ----

Subsection 5.03.9.1 Description is supplemented as follows:

This work includes all agricultural road concrete work except bridges and the top slab of multiple span reinforced concrete box culverts unless otherwise stated in the Special Specifications.



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PART 6 - INCIDENTAL CONSTRUCTION

--- PART 6 -- PAGE 17 ---

Paragraph 6.02.2.1 Concrete is eliminated and the following substituted:

6.02.2.1 Concrete. Portland cement concrete shall conform to Minor Concrete as described in Subsection 5.03.9 Concrete for Minor Structures" in the General Specifications.

--- PART 6 -- PAGE 24 ---

Paragraph 6.03.2.1 Concrete is eliminated and the following substituted:

6.03.2.1 Concrete. Portland cement concrete shall conform to Minor Concrete as described in Subsection 5.03.9 Concrete for Minor Structures" in the General Specifications.

--- PART 6 -- PAGE 75 ---

Paragraph 6.12.2.1 Concrete is eliminated and the following substituted:

6.12.2.1 Concrete. Portland cement concrete shall conform to Minor Concrete as described in Subsection 5.03.9 Concrete for Minor Structures" in the General Specifications.

SUPPLEMENTAL SPECIFICATIONS FOR MINISTRY OF COMMUNICATIONS  
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PART 9 - TRAFFIC CONTROL DEVICES AND WORK ZONES

--- PART 9 -- PAGE 2 ---

Subsection 9.02.2 Worksite Traffic Safety Supervisor - is revised to permit the Worksite Traffic Safety Supervisor for the project to be the Contractor's Project Manager Provided he meets the minimum, qualifications.

--- PART 9 -- PAGE 16 ---

Subsection 9.02.6 Method of Measurement, paragraph "Flaggers" and "Pilot Cars" are eliminated and the following substituted:

Subsection 9.02.6 Method of Measurement

"Flaggers" will be considered subsidiary to the Traffic Control Management Pay Item and will not be measured for payment.

"Pilot Car"(including operators) will be considered subsidiary to the Traffic Control Management Pay Item and will not be measured for payment.