SECTION 509 -- BITUMINOUS SAND BASE COURSE

509.01 -- Description

This work will consist of furnishing all materials and constructing a compacted base course composed of sand from the roadbed, aggregate, mineral filler, and cut-back asphalt or emulsified asphalt. Materials shall be mixed using a traveling mixing plant method or with a grader blade.

509.02 -- Material Requirements

1. All materials shall be furnished by the Contractor and shall conform to the requirements in Table 509.01.

Table 509.01

Material Requirements	
Applicable Materials	**Section**
Mineral Aggregates	1033.01, 1033.02, Para. 1., 2., 5.
Mineral Filler	1033.02, Para. 1., 2., 4.
Liquid Asphalts	1030

2. Emulsified asphalt for use in bituminous sand base course shall be HFE-300 or CM-4 conforming to the requirements of Sections 1031 and 1032.

3. The type and quantity of asphaltic material to be applied to the bituminous mixture will be indicated in the plans.

4. Mineral aggregate shall meet gradation requirements in Table 1033.05.

509.03 -- Equipment

1. a. Blade machines shall be equipped with pneumatic tires and designed, constructed, and maintained to insure thorough mixing of the asphaltic materials and aggregates and uniform spreading and finishing of the mixed materials.

b. Blade machines shall be equipped with suitable moldboards.

c. Blade machines that cause corrugations or other damage to the finished base are unacceptable.

2. a. Traveling mixing plants shall be designed to prevent the loss of any filler material during mixing.

b. Traveling mixing plants shall be designed to deliver thoroughly mixed material in a uniform manner without damage to the subgrade or mixing surface.

c. All traveling mixing plants shall be equipped with sufficient valves and a by-pass in the oil line between the pump and the spray bar to help calibrate the pump's output.

d. The traveling mixing plants shall be equipped with a thermometer well and thermometer of sufficient range to always accurately determine the temperature of the asphaltic material.

e. The plants shall also be equipped with a meter that will show the actual liters delivered by the plant and a gauge that will show the rate of delivery in liters per minute.

f. (1) Tandem rollers shall be self-propelled by engines of sufficient power to insure smooth operation at speeds up to 10 km/h.

(2) The roller shall be of such size and capacity that it may be loaded to a total mass of 7000 kg.

(3) Both roller drums shall have a minimum width of 1.2 m. The drive drums shall have a minimum diameter of 1.2 m. The roller shall be designed so that it may be loaded to develop a minimum compression of 3.62 kg/mm of roller width.

509.04 -- Construction Methods

1. Roadbed Preparation:

a. The Contractor shall grade the bituminous sand base course and the subgrade to the profile shown in the plans.

b. The Contractor shall limit the grading operations to those sections of the project where it is anticipated the work of applying the asphaltic material will be performed during the same construction season.

c. The Contractor will not be allowed to place base course material until the subgrade is at the proper density and moisture content.

d. When material is obtained from local pits, it shall be obtained in accordance with the provisions of Sections 205 and 209.

2. Hauling, Measuring, and Distributing Aggregates and Filler:

a. (1) The Contractor shall establish a method of numbering, labeling, and tallying the hauling vehicles so that the correct quantities and distribution of the materials delivered on the road may be determined at any time.

(2) Mineral aggregates and mineral fillers shall be measured in cubic meters at the point of delivery. The Contractor will be required to strike off the materials to uniform heights for volume determination.

(3) All vehicles hauling the same type of material shall be loaded with the same volume of material unless otherwise allowed by the Engineer.

(4) To establish a mass-volume conversion factor, the Contractor shall daily measure the mass of 2 loads of each material being hauled.

b. (1) The materials approved for delivery to the road surface shall be distributed by the Contractor as shown in the plans. When several types of aggregates are required, the Contractor shall haul the aggregates in the order specified by the Engineer. The aggregates and mineral filler shall be distributed uniformly over the full width of the proposed bituminous sand base course. The use of a spreader box will be required if other methods fail to provide uniform distribution.

(2) When using a traveling mixing plant designed to proportion only the asphaltic material, then 40 to 60 percent of the required asphaltic material shall be applied to the upper subgrade for the full width and depth of the base course before placing mineral filler on the roadbed.

(3) Additional mixing with blades or other equipment shall begin immediately on the upper portion of the subgrade on which the partial application of asphaltic material has been made. This mixing shall continue until the asphaltic material is uniformly dispersed with a sufficient volume of the subgrade to shape and compact a 40-50 mm thick layer of mixed material.

(4) The mixed material shall be shaped with a blade and rolled with a pneumatic-tired roller as necessary to provide a stable foundation for the distribution of the mineral filler and to reduce the loss of moisture or distillate.

(5) The mineral filler shall be the last material to be incorporated in the combined windrow and shall be pulverized before placement on the roadbed. The Contractor shall pulverize this material as prescribed in Subsection 1033.02, Paragraph 4.

(6) The material shall be folded into the windrow immediately and in such a manner to avoid loss of material.

c. Hauling will not be allowed when the weather and road conditions are such that hauling operations might produce ruts or otherwise damage the surface of the roadbed.

3. Heating Asphaltic Materials:

a. (1) The Contractor shall furnish and heat asphaltic materials with equipment conforming to the requirements of Section 501. If asphaltic material is heated in the distributor or supply tank, adequate provision shall be made for circulating the material during the heating process. Agitation and heating methods used shall not introduce any free steam or moisture into the asphaltic material.

(2) (i) Asphaltic materials heated to temperatures higher than the maximum temperatures shown in Table 501.01 shall be rejected.

(ii) The material may be resampled and retested.

(iii) The resampled material will be accepted if retests show it was not damaged.

b. When the designated application temperature cannot be maintained, the Contractor shall use hauling or storage units equipped with insulated tanks and/or auxiliary heater equipment.

4. Applying and Mixing Asphaltic Materials:

a. The Contractor shall combine the sand, mineral aggregate, mineral filler, and asphaltic materials in the proportions shown in the plans.

b. (1) After the Contractor hauls, measures, and distributes the aggregates and filler, the materials shall be uniformly mixed, dried, and windrowed.

(2) The maximum allowable moisture content of the combined aggregate before the application of asphaltic oil will be 5.0 percent.

(3) The allowable moisture content of the combined aggregate will be 5.0 to 9.0 percent before the application of emulsified asphalt.

c. The Contractor may add water to increase the moisture content of the combined aggregate. The application of water and subsequent mixing operations shall be arranged so that the moisture content is uniform throughout the width and depth of the combined material.

d. (1) When a traveling mixing plant designed to proportion both the aggregate and asphaltic material is used, the mineral aggregates shall be picked up, proportioned, and mixed with the required quantity of asphaltic materials.

(2) The windrow shall be evened with a materials gauge to insure a uniform end area before mixing begins.

(3) The windrow shall be evened until all measured end areas taken at 50 m intervals are not less than 95 percent or more than 105 percent of the end area required.

(4) The pick-up device shall pick up the aggregate as cleanly as practicable, and any remaining aggregate shall be swept into the windrow of bituminous aggregate.

e. When the traveling plant is of the type which measures only the asphaltic material and incorporates it into the aggregate, care shall be taken to avoid applying the asphaltic material to a greater depth (volume) of base course than that shown in the typical cross section.

f. Cut-back asphalts shall not be applied to the aggregates when the ambient temperature is below 15°C. The application of asphaltic materials will not be allowed after September 15.

g. The application of asphaltic material shall be limited to a quantity of base course materials that can be mixed completely during the next 5 days of work.

h. Before a winter shut down, the Contractor shall protect graded areas that are to receive a bituminous sand base course later. The protection shall include:

(1) Mixing half the required asphaltic material with the upper subgrade material for the full width of the planned base course.

(2) (i) Applying "Prime Coat" as directed by the Engineer after the Contractor has compacted the mixture.

(ii) No aeration, other than that accomplished during the mixing operation, will be required for this application.

(iii) The requirements for minimum temperature, maximum moisture content, seasonal limitations on construction, and aeration are void as far as the above "Prime Coat" applications are concerned.

(3) Performing erosion control on all disturbed areas outside the bituminous course.

5. Mixing and Aerating:

a. The Contractor's method of mixing may be either the blade mix method or traveling mixing plant method.

b. (1) Mixing shall begin immediately following completion of the application of asphaltic material.

(2) The mixing must be sufficient to result in thorough dispersion of the bituminous material throughout the proper quantity of the combined aggregate.

(3) Care shall be taken to avoid the inclusion of excessive quantities of sand from the roadbed.

c. The degree of thoroughness of the mixing with the traveling plant will be at the Contractor's option, but if the material deposited by the plant is not mixed thoroughly, further mixing shall be done with blades or other equipment. Sufficient equipment shall be provided so that the aggregates can be thoroughly and uniformly coated.

d. All mixing with blade machines shall be conducted to prevent segregation of the various aggregate sizes, drifting of the material, or damage to the existing surface.

e. (1) The bituminous aggregate shall be aerated to allow the volatile portion of the asphaltic oils to evaporate to increase the viscosity of the asphaltic material remaining in the mixture and to reduce the moisture content to less than 2 percent.

(2) The upper 80 percent of the base course material shall be aerated uniformly to the required degree, but such aeration shall not exceed 75 percent, as determined by the method described below:

Percent of Aeration

A = Percent aeration = $100 - \frac{100E(100 + N)}{5\ ND}$

E = milliliters of distillate in a 500 g sample tested as described in NDR T 110.

N = Actual percent of oil applied to combined aggregate (based on the dry mass of the aggregate)

D = Percent of distillate in the asphaltic oil at 360°C

f. (1) If bituminous aggregate becomes aerated to the required degree before thorough mixing and reduction of the moisture content are accomplished, the Contractor shall apply a sufficient quantity of distillate to restore the workability of the bituminous aggregate.

(2) No aeration of bituminous sand base course containing emulsified asphalt will be required except to reduce moisture content for mixing and compaction.

g. If rain falls during the mixing or aerating operations, the work shall be suspended until resumption of the work will facilitate evaporation and reduce the moisture content of the mixture. All mixing operations shall be suspended when the ambient temperature falls below 15°C.

6. Laying, Compacting, Finishing, and Sealing:

a. (1) After the combined aggregate and asphaltic material are mixed thoroughly, the windrow of bituminous aggregate shall be made uniform in cross section by the Contractor.

(2) All materials that have drifted during mixing operations shall be hauled to sections where a deficiency exists.

(3) The windrow of bituminous aggregate will be considered uniform when its cross sectional area at any location is within 10 percent of the average cross sectional area of the section.

b. (1) Bituminous aggregate shall be spread only on a base or prepared subgrade that has no free moisture on the surface.

(2) Before bituminous aggregate mixed with asphaltic oil is approved for spreading, it shall contain less than 2.0 percent moisture by mass.

(3) Before bituminous aggregate mixed with emulsified asphalt is approved for spreading, the moisture content shall be reduced sufficiently so that proper compaction and a satisfactory surface may be attained.

c. All oversize or foreign materials brought into the mixture from the shoulders or subgrade shall be removed by the Contractor.

d. (1) The bituminous aggregates shall be spread with blade machines in several uniform layers to the dimensions shown in the plan typical cross sections.

(2) The entire windrow of bituminous aggregate shall be moved from its original position during spreading operations.

(3) All subgrade beneath the original position of the windrow that does not meet moisture and density requirements shall be repaired before spreading the bituminous aggregate on that portion of the roadbed.

(4) Rolling with at least 2 rollers shall proceed as the material is being spread in several uniform layers.

(5) When satisfactory compaction or alignment of the edges is not accomplished in any other manner, the Engineer may require the Contractor to spread the material to a width greater than that shown in the plan typical cross sections and then trim the edges back to the required width.

(6) The final blading of the surface shall continue until the base course is smooth. If irregularities develop which cannot be removed by rolling, the portion of the surface that is not smooth shall be scarified and relaid.

e. (1) The entire base course shall be compacted thoroughly and uniformly by rolling.

(2) Rolling shall be done in a direction parallel to the centerline of the roadway being laid and shall begin near the edge of the base and proceed toward the center, lapping at least one-half the width of the roller.

(3) Alternate trips of the roller shall be stopped at least 1 m from any preceding stop.

(4) At least one trip of the roller shall be made over the edges of the layer not previously rolled.

(5) The final roller coverage over the bituminous base course shall be performed with a tandem roller to remove pneumatic tire marks.

f. All laying operations shall be suspended when the atmospheric temperature falls below 15°C, unless otherwise ordered by the Engineer.

g. After final compaction, the surface of the bituminous sand base course shall be smooth and true to the established crown and grade. Any low or defective areas shall

be remedied as directed by the Engineer. The finished surface will be checked for smoothness with a 3 m straightedge placed parallel to the centerline of the roadbed. The allowable surface variation is 5 mm.

h. Before the placement of the earth shoulder material, the Contractor shall trim the outer edge of the bituminous sand base course to a vertical face in accordance with the typical cross sections shown in the plans.

i. "Tack Coat" shall be applied to the entire base course surface at a rate of 0.5 to 0.7 L/m² in accordance with Subsection 504.03, Paragraphs 1., 3.a., and 3.b. The tack coat emulsion type will be identified in the plans.

7. a. The bituminous aggregate for intersections or other irregular areas shall be obtained from the windrow in the quantity and locations designated by the Engineer. The aggregate will be loaded, hauled, and delivered to the designated points.

b. Not more than 14 m³ of bituminous material will be obtained from each kilometer of bituminous surfacing.

c. The haul distance shall never exceed 3 km.

d. The material shall be dumped on subgrade that has been previously prepared and shall be laid, finished, and compacted as prescribed in this Subsection.

8. Maintenance:

a. (1) The Contractor shall maintain the completed base course until the surface course is placed.

(2) This maintenance shall consist of maintaining a smooth, well-compacted surface by blading and rolling, if necessary, and correcting any sections that have failed due to faulty construction operations.

(3) Multiple-wheel, pneumatic-tired rollers or tandem rollers shall be used in the maintenance work, as required.

b. When bituminous material absorbs any appreciable quantity of moisture, the Contractor shall tear it up, remix it until it is dry, and then replace it at no additional cost to the Department.

c. In the event that it becomes necessary to add distillate to restore the workability of the bituminous aggregate, it shall be added at no additional cost to the Department.

509.05 -- Method of Measurement

1. All mineral aggregates and mineral filler will be measured by the cubic meter at the point of delivery. The Contractor will be required to strike off the materials to uniform heights for volume determination.

2. Asphaltic oil and emulsified asphalt material used in constructing bituminous sand base course will be measured for payment in kiloliters. The measured volume will be corrected to a standard volume at 15°C.

3. a. Bituminous sand base course construction shall be measured horizontally in 100 m stations.

b. Extra construction for intersection returns and stubs, tapered sections, or irregular areas will be measured in equivalent 100 m stations. The number of stations will be the quotient obtained by dividing the actual surface area of the section involved by the surface area of one station of the adjacent traveled way base course as shown in the plans.

4. Water used in adjusting the moisture content of the combined mineral aggregate when emulsified asphalt is used will be measured as prescribed in Subsection 302.04.

509.06 -- Basis of Payment

1.

Pay Item	Pay Unit
Bituminous Sand Base Course Asphaltic Oil	Kiloliter (kL)
Bituminous Sand Base Course Emulsified Asphalt	Kiloliter (kL)
Bituminous Sand Base Course	Station (StaM)
Mineral Filler for Bituminous Sand Base Course	Cubic Meter (m^3)
Mineral Aggregate	Cubic Meter (m^3)
Water	Kiloliter (kL)

2. When materials do not meet plan and specification requirements, deductions will be made according to Tables 503.01A and B.

3. The prime coat is subsidiary to "Bituminous Sand Base Course."

4. Payment is full compensation for all work prescribed in this Section.