

## PART III -- BASE COURSES

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## **Section 301**

### **Class I Base Course**

**301.01 DESCRIPTION.** This work consists of furnishing and placing Class I Roadway and Shoulder Base Courses on a subgrade layer conforming to Section 305 in accordance with these specifications and in conformance with the lines, grades, thicknesses and typical cross sections shown on the plans or established. The contractor shall control the selection, placement, mixing and compaction of materials so that the completed base course is uniform and conforms to plan dimensions and other acceptance requirements.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankments and Base Course."

When not specified, any of the following types may be used.

- (1) Soil Cement
- (2) Stone or Crushed Slag
- (3) Cement Stabilized Sand-Clay-Gravel
- (4) Asphaltic Concrete Base Course on Treated Layer
- (5) Recycled Portland Cement Concrete

The base course shall be a selected base course type required to meet the structural requirements for a specific pavement structure. Unless approved in writing, the same type of Class I Base Course shall be used throughout the project.

With concurrence of the project engineer, concrete complying with Section 901, or asphaltic concrete base course complying with Section 502, may be used in lieu of the specified base course material, on an inch (mm) for inch (mm) basis, in areas inaccessible to compaction equipment in turnouts and crossovers, and in other isolated or irregular areas. Concrete shall be placed, consolidated, finished and cured as directed in accordance with Section 706.

**301.02 MATERIALS.** Materials shall comply with the following Sections and Subsections and requirements.

Asphaltic Concrete	502
Portland Cement Concrete	901
Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Emulsified Asphalt	1002
Asphalt Materials	1002
Sand-Clay-Gravel	1003.01 & 1003.03(a)
Stone	1003.01 & 1003.03(b)
Recycled Portland Cement Concrete	1003.01 & 1003.03(c)
Crushed Slag	1003.01 & 1003.03(d)
Water	1018.01

**(a) Soils for Soil Cement:** Soils for soil cement base course shall consist of materials that will stabilize with cement in accordance with DOTD TR 432. Such materials are those soils classified as A-1-a, A-1-b, A-2-4, A-2-6, A-4 and A-6 in accordance with DOTD TR 423. Soil with a Liquid Limit greater than 35, a Plasticity Index greater than 12, or an organic content greater than 2 percent shall not be used. Liquid Limit and Plasticity Index will be determined in accordance with DOTD TR 428. Organic content will be determined in accordance with DOTD TR 413. Soil with over 79 percent sand or 60 percent silt when tested in accordance with DOTD TR 407, shall not be used. Soils which do not meet any of these requirements shall not be blended or treated. Topsoil shall not be used. The contractor shall obtain the material to be stabilized from outside right-of-way limits except as provided in Subsection 106.02(c).

**(b) Portland Cement:** Portland cement shall be Type I or II. The quantity of cement used shall be supported by Certificate of Delivery.

**(c) Portland-Pozzolan Cement:** The cement shall be Type IP. The quantity of cement used shall be supported by Certificate of Delivery.

**(d) Asphaltic Concrete Base Course:** The material requirements for asphaltic concrete base course shall be as described in Section 502.

**(e) Treated Layer Under Asphaltic Concrete Base Course:** The treated layer under asphaltic concrete shall consist of the same material and treatment as the top layer of embankment, including the prime coat requirements. No raw, untreated material shall be placed between a treated embankment and the asphaltic concrete.

**301.03 EQUIPMENT.** Equipment shall be approved prior to use.

**(a) Soil Cement and Cement Stabilized Sand-Clay-Gravel:**

### 301.03

**(1) General:** Central mix plants shall be certified in accordance with current Department procedures. Central mix plants may be either batch or continuous mix process and shall proportion aggregates, soils, and additives in a manner that will meet specification requirements. Safe, convenient facilities shall be provided for sampling mixture components prior to their introduction into the weigh hopper or pugmill. Mixing units shall have no dead areas which allow materials to remain unmixed or which permit improperly mixed materials to be discharged into hauling or storage units. The minimum capacity shall be 100 tons per hour (90 Mg/hr).

A control system shall be provided that will automatically stop plant operations when the material in any storage facility or working bin becomes empty or the flow of material is interrupted. The plant will not be permitted to operate unless this automatic control system is in good working order. When this control system malfunctions during production, operations shall be immediately discontinued.

The soil or aggregate feeder system shall be interlocked with the feeder system for cement, additives, and water such that the proportions of the components of the approved mix design are continuously maintained.

The complete process, including the plant with necessary auxiliary equipment and controls, operating procedures, and sampling and testing methods shall be approved by the Department prior to use. Any modifications to plant equipment or operations shall be approved prior to use.

The contractor shall provide plant site and project site laboratories conforming to Section 722 at no direct pay.

Measuring devices shall be subject to approval and shall be tested, inspected and certified by an approved independent scale service or the Weights and Measures Division, Louisiana Department of Agriculture and Forestry, at no direct pay, every 90 days or as often as deemed necessary to ensure their accuracy.

Scales shall be accurate to  $\pm 0.5$  percent throughout the range of use. Maximum graduation on scales shall be 0.1 percent of the rated scale capacity.

The cement, soil and aggregate feeders, and water measuring devices shall be equipped with devices by which the rate of feed can be determined while the plant is in operation.

Water measuring devices shall be accurate to 1 percent of the metered quantity. Water meters shall have a maximum graduation of 1 gallon (4 L).

Methods and equipment for adding liquid additives shall be approved. Equipment for metering additives shall be capable of measuring the component to an accuracy of 3 percent of the required weight.

**(2) Batch Process:** When a batch mixing process is used, the mixer shall be equipped with a timing device which will indicate by an obvious signal the completion of the mixing period. The time of mixing a batch shall begin after all components are in the mixer and shall continue until the mixture is uniformly blended. The mixing time shall be approved. Cement for each batch shall be weighed on scales separate from those weighing other components and shall meet the requirements of this subsection.

**(3) Continuous Mix Process:** When a continuous mix operation is controlled by weight (mass), the contractor shall provide belt scales for conveyor systems for all components except water.

**(4) Hauling Equipment:** The mixture shall be hauled from the plant in approved covered trucks that will maintain the moisture content and prevent segregation and the loss of fine material. The cover shall be waterproof, shall completely cover the bed of the truck, shall be equipped with tie downs, and shall not have any rips, tears or holes.

**(5) Compaction Equipment:** Compaction equipment shall be conventional sheepsfoot type roller or a self-propelled tamping foot compactor-type roller for initial compaction. The spikes shall be sufficient in size and number to provide uniform compaction for the full width and depth of the base course. Finish rolling shall be with a pneumatic tire roller. For depths over 9 inches (225 mm), the contractor shall establish a rolling pattern to obtain the required density. Based on these results, the Department may allow 1 lift construction. Otherwise, lift thickness will be 9 inches (225 mm) maximum.

**(b) Asphaltic Concrete:** Equipment for asphaltic concrete shall conform to Section 503.

**(c) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** Equipment used to mix stone, crushed slag, and recycled portland cement concrete shall produce a uniform blend conforming to the requirements elsewhere herein. When a central mix plant is used, it shall conform to Heading (a).

**(1) Hauling Equipment:** Stone, crushed slag, and recycled portland cement concrete shall be hauled in trucks with tight, smooth beds of sufficient size and condition to prevent segregation and the loss of material.

### 301.03

**(2) Compaction Equipment:** Stone and recycled portland cement concrete compaction equipment shall be designed for the compaction of these materials and may be static or vibratory. Finish rolling shall be with static, smooth steel-wheel or pneumatic tire rollers. Pneumatic tires shall have smooth tread, shall be the same size and ply rating, shall be inflated to a uniform pressure not varying more than  $\pm 5$  psi ( $\pm 35$  kPa) between tires. Wheels shall not wobble and shall be aligned such that gaps between tires on one axle are covered by tires of the other axle.

**(d) Automatic Finishing Machine:** For all Class I Base Courses except asphaltic concrete an approved automatic finishing machine shall be used. The approved automatic finishing machine shall be capable of operating from an erected stringline capable of automatically controlling grade and cross-slope conforming to Subsection 502.08(b)(2).

**301.04 STORAGE AND HANDLING OF MATERIALS PRIOR TO MIXING.** Stockpiles of materials shall be uniform; separation into material sizes may be required. Equipment and methods for stockpiling shall be such that no segregation will result. Foreign material shall not be incorporated into the materials. Materials, which have become contaminated, shall not be used. Stockpiles shall be of uniform moisture content and well drained.

Soils and aggregates shall be stockpiled in dedicated stockpiles and shall be approved prior to mixing with cement. The moisture content of the stockpiles shall be controlled so that the blended mixture when tested in accordance with DOTD TR 403 shall be within  $\pm 2.0$  percent of the optimum moisture content at the time of compaction. Storage facilities containing soil or fine aggregate shall be equipped with vibrators which will effectively vibrate the side walls of the feeder, prevent any accumulation of material and ensure a constant, uniform supply of material to the mixing unit.

**(a) Storage of Cement:** Cement shall be transported in watertight conveyances and stored in watertight buildings, silos or other approved facilities to protect the cement from dampness or water intrusion. Cement which has become contaminated, partially set, or which contains lumps of caked cement will be rejected.

Cement shall be certified by the manufacturer in accordance with the Department's current procedure. The contractor shall keep accurate records of cement deliveries and its use. Copies of these records shall be supplied to the engineer as required.

**(b) Soils for Soil Cement:** Soils for soil cement shall be one or more components, each meeting the requirements of Subsection 301.02(a).

**(c) Sand-Clay-Gravel:** Sand-clay-gravel for cement stabilized sand-clay-gravel shall be a single component which meets the requirements of Subsection 1003.03(a) or multiple components which, when combined, meet the requirements of Subsection 1003.03(a). The single component material or each separate component of a composite material shall be sampled, tested and approved prior to mixing with cement.

**(d) Asphaltic Concrete:** Asphaltic concrete shall be stored and handled in accordance with Section 502.

**(e) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** Stone, crushed slag, and recycled portland cement concrete base courses shall be sampled, tested, and approved from dedicated stockpiles prior to placement on the subgrade.

**301.05 GENERAL CONSTRUCTION REQUIREMENTS.** Class I Base Courses shall be placed on a subgrade layer prepared in accordance with Section 305.

**(a) Cement Stabilized Base Course:** All cement stabilized base courses shall be mixed in a central mix plant conforming to Subsection 301.03. The percentage of cement for soil cement will be determined in accordance with DOTD TR 432 prior to mixing. Samples for determination of the percent cement will be obtained from material in stock piles. For cement stabilized sand-clay-gravel, the minimum cement content shall be 5.0 percent by weight (mass) if Type I cement is used. Depending on the type of cement and soil or soil-aggregate to be used, normal testing time to determine suitability of the soil and the required cement content may require up to 21 calendar days. The cement content using Types II and I-P cement will be determined in accordance with DOTD TR 432 for sand-clay-gravel.

**(b) Asphaltic Concrete:** Asphaltic concrete base course shall be constructed in accordance with Section 502. The treated layer under asphaltic concrete base course shall be constructed in accordance with Section 305.

**(c) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** Stone, crushed slag, and recycled portland cement concrete base courses shall not segregate during construction. Water added to facilitate compaction shall not cause moisture damage to the subgrade layer.

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**301.06 MIXING OF SOIL CEMENT AND CEMENT STABILIZED SAND-CLAY-GRAVEL.** Soil cement, and cement stabilized sand-clay-gravel materials shall be mixed in a central mix plant by either batch or continuous mixing process. Soils, aggregates, additives, and water may be proportioned by either weight (mass) or volume. The plant shall be calibrated by weight (mass) and equipped with a means to readily verify the quantity of each component. The time and points at which each component is introduced into the mixing process will be approved. The components shall be combined and mixed to produce a uniform, well-blended mixture. The total quantity of materials introduced into the mixing unit shall not exceed the approved capacity of the mixer.

When a continuous mix process is used, soils and aggregates shall be drawn from the storage area by a feeder or feeders which will continuously supply the correct amount of soil or aggregate in proportion to the cement. Soil and aggregate storage areas or feed bins shall be arranged so that the proportion of each size can be separately adjusted if more than one size is used.

Individual aggregates and soils shall be blended within 2 percent of the individual weight (mass) of that component and the total weight (mass) of aggregate and soils shall be within 1 percent of the required weight (mass) of the total material. Cement shall be incorporated within 1.0 percent of the required weight (mass) of cement.

Optimum moisture of the mixture will be determined in accordance with DOTD TR 415 or TR 418. The percentage of moisture in the mixture, by dry weight, shall not vary from optimum moisture within  $\pm 2.0$  percent at the time of compaction. Moisture content at the time of mixing shall be controlled so that these tolerances are met. When these tolerances are not met and satisfactory control adjustments are not being made, operations shall be discontinued until proper adjustments and uniform operations are established.

**301.07 QUALITY CONTROL OF PLANT OPERATIONS.** The contractor shall have a Certified Soil and Base Course Technician at the plant at all times when the plant is producing material for the Department.

The Certified Soil and Base Course Technician shall be capable of conducting any test or analysis necessary to put the plant into operation and producing cement stabilized mixtures conforming to the specifications. Daily plant operations shall not begin unless the Certified Soil and Base Course Technician is at the plant. The Soil and Base Course Technician



certification will be awarded by the Department upon satisfactory completion of the Department's requirements.

**(a) Soil Cement and Cement Stabilized Sand-Clay-Gravel:**

The contractor shall be responsible for quality control of materials during handling, storing, blending, mixing, and transport. The contractor shall be responsible for adjusting equipment to provide the approved percent of each component in the mixture at optimum moisture content. The contractor shall provide suitable equipment for the determination of moisture content, gradation, proper pulverization, and proper combination of components as required.

The contractor shall be responsible for building and maintaining stockpiles of soils and aggregates which meet Department requirements and shall perform testing as necessary to ensure that materials delivered to the plant site meet the Department's specifications prior to requesting acceptance sampling and testing. The contractor shall be responsible for maintaining the quality of materials placed in dedicated stockpiles which have been approved for use. When inspection by the Department indicates contamination or segregation of dedicated stockpiles, the affected materials will be rejected and shall be removed from the dedicated stockpile. Materials shall be sampled, tested and approved by the Department prior to inclusion in an approved dedicated stockpile.

Water shall be incorporated into the mixing chamber through a multi-nozzle spray bar capable of spraying water uniformly, leaving no wet or dry areas. Water shall be added after mixing soils, soil aggregates, and cement.

The contractor's Certified Soil and Base Course Technician shall continually monitor plant operations to ensure that systems are functioning properly and that the proportions of materials are correct. At the beginning of each day's operation, and at least four times daily during continuous operation, the contractor shall check the percent cement being incorporated into the mixture. The contractor's Certified Soil and Base Course Technician shall test for moisture content of the soil or aggregate components in accordance with DOTD TR 403 at the beginning of each day's operations and at least twice per day during continuous operation. The contractor's Certified Soil and Base Course Technician shall test the moisture content of the mixture including the cement, as needed, to control the finished product within specification requirements. When a composite gradation is specified for the soil or aggregate material, gradation shall be checked at least twice per day in accordance with DOTD TR 112 and TR

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113. Tests shall be documented in accordance with the Department's current procedures.

The contractor's Certified Soil and Base Course Technician shall check the percent pulverization in accordance with DOTD TR 431 at least twice per day. At least 80 percent shall pass the No. 4 (4.75 mm) sieve.

When any quality control test does not meet the applicable specifications, the contractor shall make immediate corrections and notify Department personnel of the change, or the operations shall be discontinued.

**(b) Asphaltic Concrete:** Asphaltic concrete plant operations shall conform to Section 502.

**(c) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** When stone, crushed slag, or recycled portland cement concrete are mixed in a central mixing plant, the requirements of Heading (a) shall be met.

### **301.08 LOADING, TRANSPORTING AND PLACING ON SUBGRADE.**

The base course materials shall not segregate during loading. Soil cement or cement stabilized sand-clay-gravel mixtures shall be covered immediately with an approved waterproof cover that will prevent loss of moisture or fines or exposure to the elements. The cover shall be tied securely in place and shall not be removed until placement of the mixture.

Transportation, placing and spreading methods shall not damage the subgrade. The contractor shall place and spread sufficient material to obtain required width and compacted thickness within the tolerances set forth in Subsection 301.16. Soil cement and cement stabilized sand-clay-gravel shall be placed and spread within 1 hour of mixing cement with the soils or soil-aggregates. Base course materials shall not be contaminated with subgrade layer. Any contamination will require retesting and correction of deficiencies. Base course material shall not be placed or spread on portland cement concrete or asphaltic concrete pavements. Pavement surfaces, edges and joints shall not be damaged during construction.

**301.09 GRADE AND CROSS SLOPE CONTROL.** Unless otherwise specified, Class I Base Courses (except asphaltic concrete) shall be constructed to the required grade and cross slope, using an automatic finishing machine controlled from an erected stringline conforming to Subsection 502.08(b)(2). Asphaltic concrete base course shall be

constructed with an erected stringline in accordance with Subsection 502.08(b)(2).

### **301.10 COMPACTING AND FINISHING.**

#### **(a) Soil Cement and Cement Stabilized Sand-Clay-Gravel:**

The mixture shall be compacted immediately after placement. Initial compaction shall be completed with an approved conventional sheepsfoot-type roller or a self-propelled tamping foot compactor-type roller in such a manner that no internal laminations occur in the completed base course. Final compaction shall be with a pneumatic-tire roller operated so that no surface laminations occur. The surface shall be kept uniformly moist during compaction and shaping.

During the compaction and finishing, areas which are low or have surface imperfections which need correction shall be corrected using fresh material. The surface shall be thoroughly scarified before placing and blending new base material. Final compaction of the corrected surface shall be completed within the same time limit applied to the initial placement of base materials as outlined in this subsection.

Compaction and initial finishing shall be completed within 2 hours after initial mixing of cement with base course materials. Each lift of base course shall meet the requirements of Subsection 301.16. After the base has been compacted, water shall be uniformly applied as needed to maintain the proper moisture content for intermediate finishing (tight blading). The surface shall be thoroughly rolled and finished to grade; loosened material shall be removed from the section. The surface shall be finish rolled with either a pneumatic-tire or static steel-wheel roller to provide a smooth, tightly knit surface conforming to finish grade or slightly higher.

Final finishing shall be with an automatic finishing machine and shall result in a surface free of cracks, ridges, waves, surface laminations, or loose material. The cross-slope shall not vary by more than  $\pm 0.003$  ft/ft ( $\pm 3$  mm/m). The grade shall not vary by more than  $\pm 0.04$  ft. ( $\pm 12$  mm) from plan grade. In areas inaccessible to the automatic finishing machine, final finishing will not be required provided the grade and cross-slope is satisfactory to the project engineer. Final finishing shall be done far enough in advance to allow the Department to perform width and depth check tests.

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At places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted using devices that will obtain the specified density without damage to adjacent structures.

Transport vehicles and heavy construction equipment shall not operate on compacted base course for a period of 72 hours after placement.

**(b) Asphaltic Concrete Base:** Compaction and finishing requirements shall be as follows.

**(1)** The asphaltic concrete layer shall be compacted and finished in accordance with Section 502. Vibratory rollers will not be allowed when it is detrimental to the underlying layers or areas with high water table.

**(2)** The treated layer under asphaltic concrete shall meet the requirements of the subgrade layer.

**(c) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** Compacting and finishing requirements shall be the same as specified in Heading (a), except that the time limitations will not apply. Water added to facilitate compaction shall not damage underlying materials. Vibratory rollers will not be allowed when it is detrimental to the underlying layers or in areas with high water table.

**301.11 QUALITY CONTROL OF ROADWAY OPERATIONS.** The contractor shall control the selection, placement, compaction, moisture content, density, thickness, width, surface finish, and grade so that the completed base course is uniform and conforms to plan dimensions and other acceptance requirements as provided herein. The base course shall be constructed so that contamination, segregation, soft spots, wet spots, laminations, and other deficiencies are prevented. The contractor shall perform tests to control moisture content, thickness, width and density.

### 301.12 PROTECTION AND CURING.

**(a) Soil Cement, Cement Stabilized Sand-Clay-Gravel, and Treated Layer Under Asphaltic Concrete:** Upon completion of intermediate finishing, the base course shall immediately be protected against drying by applying an asphalt curing membrane in accordance with Section 506. Asphalt curing membrane shall be placed on the same day as treatment. Complete coverage of curing membrane shall be maintained from initial application until the placement of the next course. When traffic, including construction equipment, is allowed on the base course, at least the first lift of surfacing shall be placed within 30 calendar days unless otherwise directed.

**(b) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** The completed base course shall be covered with asphalt prime coat in accordance with Section 505 as soon as practical to prevent water infiltration due to rainfall. Complete coverage of asphalt prime coat shall be maintained from initial application until the placement of the next course. When traffic, including construction equipment, is allowed on the base course, the prime coat application may be delayed. However, the first lift of surfacing shall be placed within 30 calendar days unless otherwise directed.

**301.13 CONSTRUCTION JOINTS.** On soil cement base courses, each day's construction shall be tied into the completed work of the previous day by a straight transverse construction joint formed by cutting back into the total width of the base to form a true vertical face free of loose and broken material at a point where the base conforms to the typical section shown on the plans.

Longitudinal joints constructed between parallel lanes or similar joints between lanes and ramps, etc., shall be reasonably vertical and free of contaminated loose and/or broken material.

The base at all joints is to be constructed so that the materials at and adjacent to the joint are stable, uniformly compacted and are tightly knit.

**301.14 MAINTENANCE OF BASE COURSE.** The contractor shall protect the completed base course from damage from public traffic or the contractor's operations, and shall satisfactorily maintain the completed base course including the asphalt curing membrane or prime coat. Damaged base course shall be repaired by the contractor at no direct pay. When patching of the base course is required, in addition to removing damaged or unsound base course, the contractor shall remove a sufficient width and depth of base course to ensure satisfactory placement of patching material. The engineer will approve the type of patching material before use. Patching or other base course repair shall restore a uniform surface, shall conform to the requirements of the material being used, and shall be completed before paving operations begin. Failures detected during paving may be patched as detected.

When maintenance of traffic is not required, neither public traffic nor construction traffic shall be allowed on the completed base course during the 72-hour curing period. When maintenance of traffic is required, both public traffic and construction traffic shall be routed off the completed base

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course onto shoulders or other suitable areas during the 72-hour curing period, when conditions permit.

When traffic is permitted to use the completed base course subsequent to the 72-hour curing period and prior to construction of the surface course, the base shall be further protected by additional applications of asphalt curing membrane or prime coat as directed in accordance with Subsection 301.12 at no direct pay.

Prior to surface course construction, the contractor shall correct deficiencies, clean the base course surface, repair any damages caused by traffic, and apply additional asphalt curing membrane or prime coat as directed at no direct pay. This work shall be completed at least 24 hours prior to construction of the next layer.

Any weak spots that develop shall be satisfactorily corrected and the base kept free from deficiencies and true to grade and cross section at no direct pay.

When the surfacing is asphaltic concrete and traffic, including construction equipment, is allowed on the base, the first lift of surfacing shall be placed within 30 calendar days.

**301.15 WEATHER LIMITATIONS.** Construction of the base course will not be permitted when the subgrade or stockpiles are frozen, when raining, or, in the case of cement treated bases, when the ambient air temperature is below 35°F (2°C), or the temperature is forecasted by the U.S. Weather Service to be 25°F (-3°C) or less within the 24 hour period following placement.

**301.16 ACCEPTANCE REQUIREMENTS.** Soils and aggregates will be tested for acceptance by the Department prior to the addition to a dedicated stockpile.

Plant operations will be checked for uniformity and the proportioning of the components. The percent cement will be checked at least twice per day in accordance with DOTD TR 436. The percent cement being incorporated into the mixture shall not be more than 0.1 percent by weight (mass) of the total material below the approved percent cement, or operations shall be discontinued until corrections have been made.

The moisture content of the soil cement or cement stabilized mixtures will be tested for conformance to optimum moisture content in accordance with DOTD TR 403 at placement at least twice per day. When the moisture content is not within specification limits, the contractor shall take immediate corrective actions or operations shall be discontinued. When

the moisture content is not within specification limits the in-place material may be required to be removed.

Pulverization of the soil cement or cement stabilized mixtures will be tested in accordance with DOTD TR 431 at the plant at least twice per day. At least 80 percent shall pass the No. 4 (4.75 mm) sieve.

Base courses, except asphaltic concrete, will be checked for determining acceptance in increments of 1,000 linear feet (300 lin m) per roadway or 2,000 linear feet (600 lin m) per shoulder constructed separately. Asphaltic concrete base course will be accepted in accordance with Section 502.

**(a) Density Requirements:** Upon completion of compaction operations, base course density, except asphaltic concrete, will be determined in accordance with DOTD TR 401. Density requirements of asphaltic concrete base course shall be in accordance with Section 502.

The density requirements for Class I Base Course materials shall be in accordance with Table 301-1.

**Table 301-1  
Class I Base Course Density**

Base Course Type	Maximum Density Test Method	Percent of Maximum Density (Min.)
Soil Cement	DOTD TR 418	95.0
Cement Stabilized Sand-Clay-Gravel	DOTD TR 418	95.0
Stone, Crushed Slag, Recycled Portland Cement Concrete	DOTD TR 418	98.0
Treated Layer Under Asphaltic Concrete	DOTD TR 418	95.0

**(1) Soil Cement, Cement Stabilized Sand-Clay-Gravel, and Treated Layer Under Asphaltic Concrete:** When the density test value for the section is below 95.0 percent, a payment adjustment will be applied in accordance with Table 301-2.

**Table 301-2**  
**Density Acceptance and Payment Schedule**

Density Test Value	Percent of Contract Unit Price
95.0 & Above	100
94.0 to 94.9	90
93.0 to 93.9	75
Below 93.0	50 or Remove <sup>1</sup>

<sup>1</sup>At the option of the Department after investigation.

**(2) Asphaltic Concrete:** The density requirements for asphaltic concrete base course shall be as specified in Section 502.

**(3) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** When any test value is less than that required in Table 301-1, compaction shall continue until the specified density is obtained.

**(b) Thickness Requirements:** The thickness of the completed base course will be determined in accordance with DOTD TR 602. The underthickness requirements for asphaltic concrete base course shall be in accordance with Section 502.

Underthickness of base courses, except asphaltic concrete, shall not vary from plan thickness in excess of 1/2 inch (15 mm). Base course thickness deficiencies in excess of this tolerance shall be corrected as specified herein at no direct pay. When reconstruction is used as a method of correction, this tolerance shall apply.

Overthickness may be waived at no direct pay when grade requirements are met. When grade requirements are not met and no grade adjustments are permitted, correction will be required at no direct pay.

Failing areas will be isolated longitudinally for purposes of correction for the entire width.

**(1) Soil Cement, Cement Stabilized Sand-Clay-Gravel and Treated Layer Under Asphaltic Concrete:** When no grade adjustments are permitted, underthickness deficiencies shall be corrected by removing and replacing the full depth of base course in deficient areas with one of the following materials:

- a. The same type of base course.
- b. Asphaltic concrete complying with Section 502.
- c. Concrete complying with Section 901.

When grade adjustments are permitted, the contractor shall have the option of correcting underthickness deficiencies by furnishing and placing a supplemental layer of asphaltic concrete conforming to Section 502 for the full width of base course in lieu of removing and replacing deficient



base course. Thickness of the supplemental layer of asphaltic concrete shall be in accordance with Table 301-3 as follows.

**Table 301-3  
Supplemental Asphaltic Concrete Layer Thickness**

Underthickness, Inches (mm)	Minimum Thickness of Supplemental Asphaltic Concrete, Inches (mm) <sup>1</sup>
3/4 to 1 1/4 (20 to 35)	1 1/4 (35)
1 1/2 to 1 3/4 (40 to 45)	1 1/2 (40)
2 to 2 1/2 (50 to 65)	2 (50)
Over 2 1/2 (Over 65)	Remove and Replace <sup>2</sup>

<sup>1</sup>May be included in the subsequent lift.

<sup>2</sup>At the option of the Department after investigation.

**(2) Asphaltic Concrete Base Course:** When grade adjustments are not permitted, underthickness in excess of the tolerances given in Subsection 502.12 shall be corrected to plan thickness by removing and replacing the full depth of base course. When grade adjustments are permitted, underthickness shall be corrected by placing and compacting a 1 1/4-inch (35 mm) thick minimum supplemental layer of asphaltic concrete complying with Section 502 at no direct pay.

**(3) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** When grade adjustments are permitted, underthickness in excess of 1/2 inch (15 mm) shall be corrected to plan thickness by furnishing, placing, mixing, reworking, shaping, and compacting an additional thickness of the same type of base course material. When grade adjustments are not permitted, the base course shall be removed and replaced.

**(c) Width Requirements:** The width of the completed base course will be determined in accordance with DOTD TR 602. Roadway base course width shall not vary from plan width in excess of +6 inches (+150 mm). Shoulder base course width shall not vary from plan width in excess of +3 inches (+75 mm). No tolerances are provided for underwidths of shoulder or roadway bases. When the base course for both roadway and shoulders are constructed at the same time, the 6-inch (150 mm) tolerance will be applied. Base course width deficiencies in excess of the above tolerances shall be corrected as follows at the contractor's expense:

**(1) Overwidth:** Overwidths on all base courses may be waived at no direct pay.

## 301.16

**(2) Underwidth:** Underwidths of all base courses shall be corrected to plan width by furnishing and placing additional materials; however, the width of widening materials shall be not less than 12 inches (300 mm). The thickness of the widening shall be plan thickness. Materials for widening deficient base course shall be one of the following:

1. The same type of base course.
2. Asphaltic concrete complying with Section 502.
3. Concrete complying with Section 901.

**(d) Correction of Other Deficiencies:** The contractor shall correct deficiencies in surface finish, grade, contamination, segregation, soft spots, wet spots, laminations and other deficiencies at no direct pay. These deficiencies shall be corrected by removing and replacing or as directed.

**(e) Grade and Cross-Slope:** The finished grade shall be within  $\pm 1/2$  inch ( $\pm 15$  mm) of the established grade. The cross-slope shall not vary by more than  $\pm 0.003$  ft/ft ( $\pm 3$  mm/m).

**301.17 MEASUREMENT.** The quantities of Class I base course for payment will be the design volumes or areas specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions and theoretical compacted thickness of the completed base course shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary.

**301.18 PAYMENT.** Payment for Class I Base Course will be made at the contract unit price, adjusted as specified in Subsection 301.16 and the following provisions, which includes furnishing and placing required base course materials, portland cement, portland-pozzolan cement, water, erected stringline, asphalt curing membrane and prime coat.

Failure to add the specified amount of cement in soil cement and cement stabilized sand-clay-gravel will result in a payment adjustment in accordance with Table 301-4 below.

Any payment adjustment in asphaltic concrete shall be in accordance with Section 502 and shall apply to the cubic yard (cu m) total quantity of base course. For other materials, when payment adjustments are made for more than one deficiency, they shall be cumulative.

**Table 301-4  
Payment Adjustment Schedule**

	Percent of Contract Unit Price			
	100	90	80	50 or Remove and Replace <sup>1</sup>
Cement content (Percent by dry weight) less than required	0.0-0.1	0.2-0.4	0.5-1.0	more than 1.0

<sup>1</sup>At the option of the Department after investigation.

Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
301-01	Class I Base Course	Cubic Yard (Cu m)
301-02	Class I Base Course ____in(mm) Thick	Square Yard (Sq m)
301-03	Class I Base Course for Shoulders	Cubic Yard (Cu m)
301-04	Class I Base Course for Shoulders ____in(mm) Thick	Square Yard (Sq m)

## **Section 302**

### **Class II Base Course**

**302.01 DESCRIPTION.** This work consists of furnishing and placing Class II roadway and shoulder base course on a prepared surface in accordance with these specifications, in conformity with the lines, grades, thickness, and typical sections shown on the plans or established. The contractor shall control the selection, placement, mixing and compaction of materials so that the completed base course is uniform and conforms to plan dimensions and other acceptance requirements.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

When not specified, any of the following types may be used.

- (1) Soil Cement
- (2) Cement Treated Sand-Clay-Gravel
- (3) Stone or Crushed Slag
- (4) Asphaltic Concrete Base Course on Embankment Layer
- (5) Recycled Portland Cement Concrete

Unless approved in writing, the same base course material shall be used throughout the project.

With approval, concrete complying with Section 901 or asphaltic concrete base course complying with Section 502 may be used in lieu of the specified Class II Base Course material in areas inaccessible to mixing and compacting, in turnouts and crossovers, and in other isolated or irregular areas. Concrete shall be placed, consolidated, finished and cured as directed in accordance with Section 706.

In order to meet air quality standards, the contractor may be required to use central plant mixing of cement treated mixtures in dust sensitive areas at no direct pay. The contractor may use other types of Class II Base Course in dust sensitive areas at no direct pay. The Department will identify the dust sensitive areas in the plans.

**302.02 MATERIALS.** Materials shall comply with the following Sections or Subsections and requirements.

Geotextile Fabric	203.11 & 1019
Asphaltic Concrete	502
Portland Cement Concrete	901
Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Asphalt Materials	1002
Sand-Clay-Gravel	1003.01 & 1003.03(a)
Stone	1003.01 & 1003.03(b)
Recycled Portland Cement Concrete	1003.01 & 1003.03(c)
Crushed Slag	1003.01 & 1003.03(d)
Water	1018.01

**(a) Soils for Soil Cement:** Soils for soil cement base course shall consist of materials that will stabilize with cement in accordance with DOTD TR 432. Such materials are those soils classified as A-1-a, A-1-b, A-2-4, A-2-6, A-4 and A-6 in accordance with DOTD TR 423. Soil with a Liquid Limit greater than 35, a Plasticity Index (PI) greater than 15, or an organic content greater than 2 percent shall not be used. Liquid Limit and Plasticity Index will be determined in accordance with DOTD TR 428. Organic content will be determined in accordance with DOTD TR 413. Soil with over 79 percent sand or 60 percent silt when tested in accordance with DOTD TR 407 shall not be used. Soils may be blended to adjust the percentages of sand or silt to meet specification requirements; however, in-place blending will not be allowed. The District Laboratory Engineer will approve materials prior to blending and the final product. Soils that do not meet Liquid Limit or PI requirements shall not be blended or treated to reduce Liquid Limit or PI. Topsoil shall not be used. The contractor shall obtain the material to be stabilized from outside right-of-way limits except as provided in Subsection 106.02(c).

**(b) Portland Cement:** Portland cement shall be Type I or II. The quantity of cement used shall be supported by Certificate of Delivery.

**(c) Portland-Pozzolan Cement:** The cement shall be Type IP. The quantity of cement used shall be supported by Certificate of Delivery.

**(d) Asphaltic Concrete Base Course:** The material requirements for asphaltic concrete base course shall be as described in Section 502. The top half of the base thickness shall be asphaltic concrete and the remaining thickness shall be the same type and construction as the top layer of embankment.

### **302.03**

**302.03 EQUIPMENT.** Equipment shall be subject to approval prior to use. When in-place mixing is used, the equipment shall conform to Subsection 303.03. When central mixing is used, the equipment shall conform to Subsection 301.03(a). Compaction equipment shall conform to Subsection 301.03(a)(5).

**302.04 GENERAL CONSTRUCTION REQUIREMENTS.** Base course material shall be placed on a subgrade prepared in accordance with Sections 203, 304, 305 or 306 as specified. Asphaltic concrete base course shall be constructed in accordance with Section 502.

If an aggregate base course is to be placed on untreated or lime-treated soils, a Class D geotextile separator fabric will be required.

### **302.05 MIXING.**

**(a) Soil Cement:** Soil shall be combined with cement and water by in-place mixing or in a central plant and shaped on the subgrade. When in-place mixing is done, the cement shall be spread and mixed prior to any additional water being added.

A minimum of 70 percent of the pulverized soil, as determined by DOTD TR 431, shall pass the No. 4 (4.75 mm) sieve after mixing. The optimum moisture of the mixture will be determined in accordance with DOTD TR 415 or TR 418. The percentage of moisture in the mixture, by dry weight, shall not vary from the optimum moisture by more than  $\pm 2.0$  percent at the time of compaction when tested in accordance with DOTD TR 403.

**(1) In-Place Mixing:** After placement of soil and prior to mixing with cement, the soil shall be shaped to required section and compacted to at least 93.0 percent of maximum dry density at the required grade. Samples to determine optimum moisture, percent cement, and maximum dry density will be taken by the project engineer. Maximum dry density will be determined in accordance with DOTD TR 415 or TR 418 and in place density will be determined in accordance with DOTD TR 401.

The percentage of cement will be determined in accordance with DOTD TR 432 prior to mixing, from materials sampled in-place on the project. Water needed to bring the moisture content of the mixture within the tolerance shall be added and uniformly mixed with the materials. During the mixing process, water shall be added only through the spray bar of the in-place mixer which is adjusted to provide uniform coverage across the completed width of the roadway for the full depth of the base. Wet streaks or spots will not be allowed. Depending on the type of cement and soil to

be used, normal testing time to determine required cement content may require 21 calendar days.

The method of cement distribution shall be such that the amount of cement used can be readily determined. The spread rate of cement shall be determined in accordance with DOTD TR 436.

When the moisture content is not within  $\pm 2.0$  percent of optimum, operations shall be discontinued and will not be allowed to resume until the contractor demonstrates that moisture content is controlled within this tolerance. No more than one transport shall be placed and pulverized until moisture content is within  $\pm 2.0$  percent of optimum.

**(2) Central Plant Mixing:** Mixing in a central mix plant shall conform to Section 301. When central plant mixing is used, a reduction of 1.0 percent in the volume of cement required will be permitted.

**(b) Cement Treated Sand-Clay-Gravel:** Sand-clay-gravel shall be combined with cement and water by in-place mixing or in a central plant and shaped on the subgrade.

Optimum moisture of the mixture will be determined in accordance with DOTD TR 415 or TR 418. The percentage of moisture in the mixture, by dry weight, shall not vary from optimum moisture by more than  $\pm 2.0$  percent at the time of compaction when tested in accordance with DOTD TR 403.

**(1) In-Place Mixing:** In-place mixing shall conform to Heading (a)(1) except that the percentage of Types I or IB portland cement required will be 6 percent by volume. The cement content for Types II or I-P cement will be determined in accordance with DOTD TR 432.

When the moisture content is not within  $\pm 2.0$  percent of optimum, operations will be discontinued and will not be allowed to resume until the contractor demonstrates that moisture content is controlled within this tolerance. No more than one cement transport shall be placed and pulverized until moisture content is within  $\pm 2.0$  percent of optimum.

**(2) Central Plant Mixing:** Central plant mixing shall conform to Section 301 except that a reduction of 0.5 percent in the required volume of cement will be permitted.

**(c) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** Stone, crushed slag, and recycled portland cement concrete base courses shall not segregate during construction. Water added to facilitate compaction shall not cause moisture damage to the subgrade layer.

## 302.06

### **302.06 TRANSPORTING AND PLACING ON SUBGRADE.**

Transportation and spreading methods shall not damage the subgrade. The contractor shall place and spread sufficient base course material to obtain required width and compacted thickness within the tolerances set forth in Subsection 302.12. Subgrade material shall not contaminate the base course. Any contamination will require retesting and correction of deficiencies. Base course material shall not be placed, spread or mixed on portland cement concrete or asphaltic concrete pavements. Base course construction operations shall not damage adjacent pavement surfaces, edges and joints.

### **302.07 COMPACTING AND FINISHING.**

**(a) General:** The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, waves, laminations or loose material. The surface shall be thoroughly rolled and finished to grade. The cross-slope shall not vary by more than  $\pm 0.003$  ft/ft ( $\pm 3$  mm/m). Density requirement shall be in accordance with Subsection 302.12.

**(b) Soil Cement and Cement Treated Sand-Clay-Gravel:** When central plant mixing is used, these materials shall be compacted and finished in accordance with Subsection 301.10, except that the automatic grade machine will not be required. When in-place mixing is used, these materials shall be compacted and finished in accordance with Subsection 303.06.

Compaction and finishing operations shall be completed within 3 hours after initial placement of cement on base course materials. Upon expiration of the 3-hour period after initial placement, only tight blading of the base course surface will be allowed. Bladed material shall not be drifted along the base, but shall be wasted. Stabilized material shall be utilized in the base course except for that small amount necessary for tight blading. Excessive blading to achieve plan depth will not be allowed. The contractor shall complete operations, including tight blading, before beginning the next day's operations. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, waves, laminations, or loose materials. No cement shall be spread within 2 hours of sunset, unless otherwise approved by the project engineer.

**(c) Stone and Recycled Portland Cement Concrete:** These materials shall be compacted using an approved sheepsfoot-type roller and finish-rolled with an approved pneumatic tire roller or a smooth steel wheel roller. The surface shall be kept uniformly moist during compaction and final finishing.



**(d) Asphaltic Concrete:** Asphaltic concrete shall be compacted and finished in accordance with Section 502. The soil layer shall be compacted and finished in accordance with the top layer of embankment.

**302.08 QUALITY CONTROL OF ROADWAY OPERATIONS.** The contractor shall control the selection, placement, compaction, cement spread, mixing, moisture content, density, thickness, width, surface finish, cross-slope and grade to produce a completed base course that is uniform and conforms to plan dimensions and other acceptance requirements as provided herein. The contractor shall control his operations to prevent contamination, segregation, soft spots, wet spots, laminations and other deficiencies. The contractor shall be responsible for taking tests necessary to adequately control the work.

**302.09 PROTECTION AND CURING.**

**(a) Soil Cement and Cement Treated Sand-Clay-Gravel:** Upon completion of intermediate finishing, the base course shall immediately be protected against drying by applying an asphalt curing membrane in accordance with Section 506. Asphalt curing membrane shall be placed on the same day as treatment. Complete coverage of curing membrane shall be maintained from initial application until the placement of the next course. When traffic, including construction equipment, is allowed on the base course, at least the first lift of surfacing shall be placed within 30 calendar days unless otherwise directed.

**(b) Stone, Recycled Portland Cement Concrete, and Soil Layer Under Asphaltic Concrete:** The base course shall be covered with asphalt prime coat in accordance with Section 505 as soon as practical to avoid water infiltration due to rainfall. Complete coverage of asphalt prime coat shall be maintained from initial application until the placement of the next course.

**302.10 MAINTENANCE OF BASE COURSE.** The contractor shall protect the base course from damage from public traffic or the contractor's operations, and shall satisfactorily maintain the base course including the asphalt curing membrane or prime coat. Damaged base course shall be repaired by the contractor at no direct pay. When patching of the base course is required, in addition to removing damaged or unsound base course, the contractor shall remove a sufficient width and depth of base course to ensure satisfactory placement of patching material. The engineer will approve the type of patching material before use. Patching or other

## **302.10**

base course repair shall restore a uniform surface, shall conform to the requirements of the material being used, and shall be completed before paving operations begin. Failures detected during paving may be patched as detected.

When maintenance of traffic is not required, neither public traffic nor construction traffic shall be allowed on the completed base course during the 72-hour curing period. When maintenance of traffic is required, both public traffic and construction traffic shall be routed off the completed base course onto shoulders or other suitable areas during the 72-hour curing period, when conditions permit.

When traffic is permitted to use the completed base course subsequent to the 72-hour curing period and prior to construction of the surface course, the base shall be further protected by additional applications of asphalt curing membrane or prime coat as directed in accordance with Subsection 301.12 at no direct pay.

Prior to surface course construction, the contractor shall correct deficiencies, clean the base course surface, repair any damages caused by traffic, and apply and maintain additional asphalt curing membrane or prime coat as directed at no direct pay.

Any weak spots that develop shall be satisfactorily corrected and the base kept free from deficiencies and true to grade and cross section at no direct pay.

When the surfacing is asphaltic concrete the first lift of surfacing shall be placed within 30 calendar days.

**302.11 WEATHER LIMITATIONS.** Construction of base course will not be permitted when the subgrade or stockpiles are frozen, when raining, or, in the case of cement treated bases, when the ambient air temperature is below 35°F (2°C), or the temperature forecasted by the U.S. Weather Service is to be 25°F (-3°C) or less within the 24 hour period following placement.

**302.12 ACCEPTANCE REQUIREMENTS.** Soils and aggregates will be sampled for acceptance by the Department in accordance with the Materials Sampling Manual.

For central plant mixing, the cement content will be determined in accordance with Subsection 301.16. For in-place mixing, the cement content will be determined in accordance with Subsection 302.05.

The moisture content of the soil cement or cement treated mixtures will be tested for conformance to optimum moisture content in accordance with DOTD TR 403.

The pulverization of the soil cement or cement treated mixtures will be tested in accordance with DOTD TR 431 and shall be at least 70 percent passing the No. 4 (4.75 mm) sieve.

Base course, except asphaltic concrete, will be checked for determining acceptance in increments of 1,000 linear feet (300 lin m) per roadway or 2,000 linear feet (600 lin m) per shoulder constructed separately. Asphaltic concrete will be accepted in accordance with Section 502.

**(a) Density Requirements:** Upon completion of compaction operations, base course density, except asphaltic concrete, will be determined in accordance with DOTD TR 401. The density requirements for asphaltic concrete base course will be determined in accordance with Section 502.

The density requirements for Class II Base Course materials shall be in accordance with Table 302-1 as follows.

**Table 302-1  
Class II Base Course Density**

Base Course Type	Maximum Density Test Method	Percent of Maximum Density (Min.)
Soil Cement	DOTD TR 418	95.0
Cement Treated Sand-Clay-Gravel	DOTD TR 418	95.0
Stone, Crushed Slag, Recycled Portland Cement Concrete	DOTD TR 418	95.0
Treated Layer under Asphaltic Concrete	DOTD TR 418	95.0
Soil Layer Under Asphaltic Concrete	DOTD TR 418	95.0

**(1) Soil Cement, Cement Treated Sand-Clay-Gravel, and Treated Layer Under Asphaltic Concrete:** When the density test value for the section is below 95.0 percent, a payment adjustment will be applied in accordance with Table 302-2 as follows.

**Table 302-2  
Density Acceptance and Payment Schedule**

Density Test Value	Percent of Contract Unit Price
95.0 & Above	100
94.0 to 94.9	90
93.0 to 93.9	75
Below 93.0	50 or Remove <sup>1</sup>

<sup>1</sup>At the option of the Department after investigation.

**(2) Stone, Crushed Slag, Recycled Portland Cement Concrete, and Soil Layer under Asphaltic Concrete Base Course:** When any test value is less than the required density, compaction shall continue until the specified density is obtained.

**(b) Thickness Requirements:** The thickness of the completed base course will be determined in accordance with DOTD TR 602.

The completed base course shall not vary from plan thickness in excess of the tolerances in Table 302-3 below. Base course thickness deficiencies in excess of these tolerances shall be corrected as specified herein at no direct pay.

**Table 302-3  
Base Course Thickness Tolerance**

(All Bases Except Asphaltic Concrete) Underthickness, Inches (mm)	(Stabilized & Treated Bases) Overthickness, Inches (mm)
3/4 (20)	1 1/2 (40)

Any failing area will be isolated for purposes of correction.

Asphaltic concrete base thickness will be determined in accordance with Section 502.

When central plant mixing is used, overthickness may be waived at no direct pay.

**(1) Soil Cement, Cement Treated Sand-Clay-Gravel, and Treated Layer Under Asphaltic Concrete:** When no grade adjustments are permitted, underthickness deficiencies in excess of tolerance shall be corrected by removing and replacing the full depth of base course in deficient areas with one of the following materials:

- a. The same type of base course.
- b. Asphaltic concrete complying with Section 502.
- c. Concrete complying with Section 901.

When grade adjustments are permitted, the contractor shall have the option of correcting thickness deficiencies by furnishing and placing a supplemental layer of asphaltic concrete complying with Section 502 for the full width of base course in lieu of removing and replacing deficient base course. When approved, corrections may be made by restabilizing the existing material in accordance with this section. Thickness of the supplemental layer of asphaltic concrete shall be in accordance with Table 302-4 as follows.

**Table 302-4  
Supplemental Asphaltic Concrete Layer Thickness**

Underthickness, Inches (mm)	In-Place Mixing Overthickness, Inches (mm)	Minimum Thickness of Supplemental Asphaltic Concrete, Inches (mm) <sup>1</sup>
1 to 1 1/4 (30 to 35)	1 3/4 to 2 (45 to 50)	1 1/4 (35)
1 1/2 to 1 3/4 (40 to 45)	2 1/4 to 2 1/2 (60 to 65)	1 1/2 (40)
2 to 2 1/2 (50 to 65)	2 3/4 to 3 (70 to 80)	2 (50)
Over 2 1/2 (Over 65)	Over 3 (Over 80)	Remove and Replace <sup>2</sup>

<sup>1</sup> May be included in the subsequent lift

<sup>2</sup> At the option of the Department after investigation.

When reconstruction is the method of correction, the above tolerances shall apply.

**(2) Stone, Crushed Slag, and Recycled Portland Cement Concrete:** When grade adjustments are allowed, underthickness in excess of 3/4 inch (20 mm) shall be corrected to plan thickness by furnishing, placing, reworking, shaping, and compacting additional base course material as required. When no grade adjustments are allowed the material shall be removed and replaced at no direct pay.

**(3) Asphaltic Concrete Base Course:** When no grade adjustments are allowed, underthickness in excess of the tolerances given in Subsection 502.12 shall be corrected to plan thickness by removing and replacing the full depth of base course. When grade adjustments are allowed, underthickness in excess of the tolerances given in Subsection 502.12 shall be corrected to plan thickness by placing and compacting a 1 1/4 inch (35 mm) thick minimum supplemental layer of asphaltic concrete complying with Section 502 at no direct pay.

**(c) Width Requirements:** The width of the completed base course will be determined in accordance with DOTD TR 602. Roadway base course width shall not vary from plan width in excess of +6 inches (+150 mm). Shoulder base course width shall not vary from plan width in excess

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of +3 inches (+75 mm). No tolerances are provided for underwidths of shoulder or roadway bases. When the base course for both roadway and shoulders are constructed at the same time, the 6-inch (150 mm) tolerance will be applied. Base course width deficiencies in excess of the above tolerances shall be corrected as follows at the contractor's expense:

### **(1) Soil Cement, Cement Treated Sand-Clay-Gravel, and Asphaltic Concrete Base Course:**

**a. Overwidth:** Overwidths of asphaltic concrete and treated base courses mixed in a central plant may be waived at no additional cost to the Department. When no grade adjustments are allowed, the full depth and width of base course in areas having overwidths in excess of the foregoing tolerances shall be removed and replaced to the plan width with one of the following materials:

1. The same type of base course.
2. Asphaltic concrete complying with Section 502.
3. Concrete complying with Section 901.

In lieu of removing and replacing the overwidth areas of base course, at the Department's option, any base course less than 12 inches (300 mm) overwidth will be allowed to remain in place at an adjusted payment of 90 percent of the contract unit price for the complete section. Overwidth in excess of 12 inches (300 mm) shall be removed and replaced as indicated above. When approved, corrections may be made by restabilizing the existing material in accordance with this subsection.

When grade adjustments are permitted, the contractor shall correct base course width deficiencies by removing and replacing as specified above, or by furnishing and placing a 1 1/4 inch (35 mm) thick supplemental layer of asphaltic concrete complying with Section 502 on the 1,000-foot (300 m) section for the full width of the base course.

**b. Underwidth:** Underwidths of base course in excess of the foregoing tolerances shall be corrected to plan width and thickness by furnishing and placing additional materials; however, the width of widening materials shall be not less than 12 inches (300 mm). When approved, corrections may be made by restabilizing the existing material in accordance with this section. Materials for widening deficient base course shall be either asphaltic concrete complying with Section 502 or concrete complying with Section 901, at the option of the contractor.

**(2) Sand-Clay-Gravel, Stone, Crushed Slag, and Recycled Portland Cement Concrete:** Overwidths will be waived at no additional cost to the Department. Underwidths in excess of the foregoing tolerances shall be corrected to plan widths by furnishing, placing, reworking, shaping, and compacting additional base course material as required.

**(d) Grade and Cross-slope:** The finished grade shall be within  $\pm 1/2$  inch ( $\pm 15$  mm) of the established grade. The cross-slope shall not vary by more than  $\pm 0.003$  ft/ft ( $\pm 3$  mm/m).

**(e) Correction of Deficiencies:** The contractor shall correct deficiencies in surface finish, cross-slope, grade, contamination, segregation, soft spots, wet spots, laminations and other deficiencies at no direct pay. Deficiencies shall be corrected by removing and replacing or as directed.

**302.13 MEASUREMENT.** The quantities of base course for payment will be the design volumes or areas specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions and compacted thickness of the completed base course shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary.

Geotextile fabric used beneath the base course will not be measured for payment.

**302.14 PAYMENT.** Payment for base course will be made at the contract unit price, adjusted as specified in Subsection 302.12 and the following provisions, which includes furnishing and placing required base course materials, portland cement, portland-pozzolan cement, water, asphaltic curing membrane and prime coat.

Any payment adjustment in asphaltic concrete shall be in accordance with Section 502 and shall apply to the cubic yard (cu m) total quantity of base course when payment is by cubic yard (cu m). For other materials, when payment adjustments are made for more than one deficiency, they shall be cumulative.

Payment for geotextile fabric will be included in the contract unit price for base course.

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Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
302-01	Class II Base Course	Cubic Yard (Cu m)
302-02	Class II Base Course _____in(mm)Thick	Square Yard (Sq m)



## **Section 303**

### **In-Place Cement Stabilized Base Course**

**303.01 DESCRIPTION.** This work consists of scarifying, pulverizing, blending, shaping and stabilizing roadbed material with portland cement or portland-pozzolan cement in accordance with the lines, grades, thickness and sections established or shown on the plans.

This cement stabilization is primarily for existing roadbed materials. When specified, the contractor shall furnish and place materials under different pay items to be stabilized in accordance with this section.

With approval, concrete complying with Section 901 or asphaltic concrete complying with Section 502 may be used in lieu of the specified base course material in areas that are inaccessible for mixing and compacting in turnouts and crossovers, and in other isolated or irregular areas. The concrete shall be placed, consolidated, finished, and cured as directed in accordance with Section 706. The contractor shall remove and satisfactorily dispose of existing materials as required to accommodate placement of the portland cement concrete or asphaltic concrete at no direct pay. Excess material shall be disposed of in accordance with Subsection 202.02.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

**303.02 MATERIALS.** Materials shall comply with the following Sections or Subsections:

Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Emulsified Asphalt	1002
Water	1018.01

Portland cement shall be Type I or II. Portland-pozzolan cement shall be Type IP. The quantity of cement used shall be supported by proof of delivery.

## **303.02**

Soils or soil-aggregate combinations furnished by the contractor for stabilization in accordance with this section shall comply with the requirements of Subsection 302.02(a).

**303.03 EQUIPMENT.** Equipment necessary to produce a finished base course which meets specification requirements shall be furnished and maintained by the contractor. Equipment shall be approved prior to use. Pulverization shall be accomplished using an approved in-place mixer.

The in-place mixer shall be equipped with a spray bar which has the capability of applying water across the full width of the cut and shall be adjustable to prevent overlap of water distribution on adjacent paths. Cement may be distributed from transports using spreader bars approved by the engineer. The engineer may require the use of a cement spreader capable of width adjustment and equipped with a calibrated spreader box if a uniform cement spread cannot be achieved, or to control dust. The distribution of dry additives shall be monitored using DOTD TR 436, Method A.

Compaction equipment shall be conventional sheepsfoot type roller or a self-propelled tamping foot compactor-type roller for initial compaction. The spikes shall be sufficient in size and number to provide uniform compaction for the full width and depth of the base course. Finish rolling shall be with a pneumatic tire roller.

**303.04 PREPARATION OF ROADBED.** Unless otherwise designated in the plans, all existing asphaltic concrete surfacing except the bottom 1 inch (25 mm) shall be removed in accordance with Section 509 prior to cement stabilization. Removed asphaltic concrete surfacing shall be used in accordance with Subsection 509.03 as amended by the project specifications. During these removal and replacement operations, the contractor shall maintain the areas being used by public traffic in a safe condition. The contractor shall scarify and pulverize materials to be stabilized for the full width and depth of the base course. Existing asphaltic surfacing which is not removed shall be pulverized and uniformly mixed with materials below the surfacing.

Preparation of roadbed shall not be performed in excess of 2 miles (3 km) in advance of roadway base course stabilization. When approved by the project engineer, the 2-mile (3 km) limit may be extended. However, when the 2 mile (3 km) limit is extended, the lag between preparation of roadbed and base stabilization shall not exceed 5 working days. When

shoulders are stabilized separately from roadway base, the 2-mile (3 km) limitation will not apply.

The scarified and pulverized material shall be blended from edge of base to edge of base to achieve uniform blending. When existing material is not uniform across the full width to be stabilized, the material shall be blended to form a uniform blend for the full width and depth of the base course.

The roadbed shall be scarified and pulverized to at least 60 percent passing the No. 4 (4.75 mm) sieve in accordance with DOTD TR 431 prior to mixing with cement. The contractor shall identify and remove existing concrete or asphaltic concrete patches encountered during roadbed preparation operations. Patches will be removed and disposed of in accordance with Subsection 202.02. The provisions of Subsections 303.12 and 303.13 will apply for measurement and pay.

After the roadbed has been prepared as specified above, the contractor shall shape the roadbed to the required section and uniformly compact the roadbed material to at least 93.0 percent of maximum dry density prior to mixing with cement. Maximum dry density will be determined in accordance with DOTD TR 415 or TR 418 and in-place density will be determined in accordance with DOTD TR 401. Areas which cannot be compacted to 93.0 percent of maximum dry density shall be corrected at no direct pay.

**303.05 MIXING.** The percent of cement to be used will be determined by the laboratory in accordance with DOTD TR 432 from materials sampled in-place on the project. If the percent cement has not been predetermined, samples to determine percent cement shall be taken from isolated areas selected by the project engineer, prepared for sampling by the contractor. Depending on the type of cement to be used and materials to be stabilized, normal testing time to determine the required cement content may require up to 21 calendar days. The sampling area shall be thoroughly pulverized and mixed to the satisfaction of the project engineer. Sampling areas shall be resurfaced as directed after samples are taken and maintained to the satisfaction of the project engineer. Payment for resurfacing will be made under the appropriate asphaltic concrete roadway or maintenance aggregate items.

The method of spread shall be such that the amount of cement used can be readily determined when tested in accordance with DOTD TR 436. Cement shall be uniformly spread and mixed with the material. A

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minimum of two passes with the mixer (stabilizer) will be required. The mixture shall be shaped to the required section.

Water shall be added as needed by means of the mixer and shall be uniformly incorporated in the mixture in amounts required to attain optimum moisture for the mixture. During the mixing process, water shall be added only through the spray bar of the in-place mixer which is adjusted to provide uniform coverage across the completed width of the roadway for the full depth of the base. Wet streaks or spots will not be allowed.

Optimum moisture of the mixture will be determined in accordance with DOTD TR 415 or TR 418. The percentage of moisture determined in accordance with DOTD TR 403 in the mixture by dry weight shall not vary from optimum moisture by more than  $\pm 2$  percent at the time of compaction.

**303.06 COMPACTING AND FINISHING.** The mixture shall be uniformly compacted immediately upon completion of mixing to the specified depth and width shown in the plans. Initial compaction shall be completed with an approved sheepsfoot-type roller or a self-propelled tamping foot compactor-type roller in such a manner that no internal laminations occur in the completed base course. Final compaction shall be with a pneumatic tire roller.

The surface shall be kept uniformly moist during compacting and final finishing. Compaction shall continue until each lift of base course has met the requirements of Subsection 303.11.

At places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted using devices that will obtain the specified density without damage to adjacent structures.

Compaction and finishing operations shall be completed within 3 hours after initial placement of cement on base course materials. Upon expiration of the 3-hour period after initial placement, only tight blading of the base course surface will be allowed. Bladed material shall not be drifted along the base, but shall be wasted. Stabilized material shall be utilized in the base course except that small amount necessary for tight blading. Excessive blading to achieve plan depth will not be allowed. The contractor shall complete operations, including tight blading, before the end of the day. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, waves, laminations, or loose material. No cement shall be spread within two hours of sunset, unless otherwise approved by the project engineer.

**303.07 QUALITY CONTROL.** The contractor shall control the preparation of roadbed, selection and placement of materials, cement spread, mixing, compaction, moisture content, density, thickness, width, surface finish, grade and cross slope so that the completed base course is uniform and conforms to plan dimensions and other acceptance requirements as provided herein. The contractor shall control his operations so that contamination, segregation, soft spots, wet spots, laminations and other deficiencies are prevented. The contractor shall be responsible for taking such tests as necessary to adequately control the work.

**303.08 PROTECTION AND CURING.** Upon completion of final finishing, the base shall be immediately protected against rapid drying by applying an asphalt curing membrane in accordance with Section 506. Asphalt curing membrane shall be placed on the same day as stabilizing. Complete coverage of curing membrane shall be maintained from initial application until the placement of the next course. When traffic, including construction equipment, is allowed on the base course, at least the first lift of surfacing shall be placed within 30 calendar days unless otherwise directed.

**303.09 MAINTENANCE.** The contractor shall protect the completed base course from damage due to either public traffic or the contractor's operations, and shall satisfactorily maintain the completed base course including asphalt curing membrane. Damaged base course shall be repaired by the contractor at no direct pay. When patching of the base course is required, in addition to removing damaged or unsound base course, the contractor shall remove a sufficient width and depth of base course to ensure satisfactory placement of patching material. The engineer will approve the type of patching materials before use. Patching or other repair of the base course shall be made in such manner as to restore a uniform surface, shall conform to the requirements of the material being used and shall be completed prior to surfacing operations.

When maintenance of traffic is not required, neither public traffic nor construction traffic shall be allowed on the completed base course for a 72-hour curing period. When maintenance of traffic is required, both public traffic and construction traffic shall be routed off the completed base course onto shoulders or other suitable areas during the 72-hour curing period when conditions permit.

When traffic is permitted to use the completed base after a 72-hour curing period and prior to the construction of the surface course, the base

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shall be further protected by additional applications of asphalt curing membrane as directed at no direct pay in accordance with Subsection 302.10.

Prior to surface course construction, the contractor shall clean the base course and apply and maintain additional asphalt curing membrane as directed at no direct pay.

Any weak spots that develop shall be satisfactorily corrected and the base kept free from deficiencies and true to grade and cross section at no direct pay. When the surfacing is asphaltic concrete the first lift of surfacing shall be placed within 30 calendar days.

**303.10 WEATHER LIMITATIONS.** Mixing will not be permitted when the base course material is frozen, when raining, when the ambient air temperature is below 35°F (2°C), or the temperature forecasted by the U.S. Weather Service is to be 25°F (-3°C) or less within the 24 hour period following placement.

**303.11 ACCEPTANCE REQUIREMENTS.** Soils and aggregates will be tested by the Department from samples taken after preparation of the roadbed.

Cement spread rate will be tested in accordance with DOTD TR 436.

The moisture content of the cement stabilized mixtures will be tested for compliance with optimum moisture content in accordance with DOTD TR 403 at placement at least twice per day.

The pulverization of the prepared roadbed will be tested in accordance with DOTD TR 431, and shall be at least 60 percent passing the No. 4 (4.75 mm) sieve.

The completed base course will be checked for determining acceptance in increments of 1,000 linear feet (300 lin m) per roadway or 2,000 linear feet (600 lin m) per shoulder constructed separately.

**(a) Density Requirements:** Upon completion of compaction operations, in-place density will be determined in accordance with DOTD TR 401.

The density requirement as based on DOTD TR 415 or TR 418 will be 95.0 percent of maximum density.

When the density test value for the section is below 95.0 percent, a payment adjustment will be applied in accordance with Table 303-1 below.

**Table 303-1  
Density Acceptance and Payment Schedule**

Density Test Value	Percent of Contract Unit Price
95.0 & Above	100
93.0 to 94.9	90
90.0 to 92.9	75
Below 90.0	50 or Remove <sup>1</sup>

<sup>1</sup>At the option of the Department after investigation.

**(b) Thickness Requirements:** The thickness of the completed base course will be determined in accordance with DOTD TR 602.

The completed base course shall not vary from plan thickness in excess of the tolerances in Table 303-2 as follows. Base course thickness deficiencies in excess of these tolerances shall be corrected as specified herein at no direct pay.

**Table 303-2  
Base Course Thickness Tolerance**

Underthickness, Inches (mm)	Overthickness, Inches (mm)
3/4 (20)	1 1/2 (40)

Any failing area will be isolated for purposes of correction. Base course thickness deficiencies in excess of the foregoing tolerances shall be corrected as follows.

When no grade adjustments are permitted, thickness deficiencies shall be corrected by restabilizing with cement or removing and replacing the full depth of base course in deficient areas with one of the following materials:

- (1) Cement stabilized base course.
- (2) Asphaltic concrete complying with Section 502.
- (3) Concrete complying with Section 901.

When grade adjustments are permitted, the contractor shall have the option of correcting deficiencies by furnishing and placing a supplemental layer of asphaltic concrete complying with Section 502 for the full width of base course in lieu of removing and replacing deficient base course. When approved, corrections may be made by restabilizing the existing material in accordance with this section. Thickness of the supplemental layer of asphaltic concrete shall be in accordance with Table 303-3 as follows.

**Table 303-3  
Supplemental Asphaltic Concrete Layer Thickness**

Underthickness, Inches (mm)	Overthickness, Inches (mm)	Minimum Thickness of Supplemental Asphaltic Concrete <sup>1</sup> , Inches (mm)
1 to 1 1/2 (30 to 40)	1 3/4 to 2 (45 to 50)	1 1/4 (35)
1 3/4 to 2 (45 to 50)	2 1/4 to 2 1/2 (60 to 65)	1 1/2 (40)
2 1/4 to 2 1/2 (60 to 65)	2 3/4 to 3 (70 to 80)	2 (50)
Over 2 1/2 (Over 65)	Over 3 (Over 80)	Remove and Replace <sup>2</sup>

<sup>1</sup>May be placed with subsequent lift of asphaltic concrete.

<sup>2</sup>At the option of the Department after investigation

**(c) Width Requirements:** The width of the completed base course will be determined in accordance with DOTD TR 602. Roadway base course width shall not vary from plan width in excess of +6 inches (+150 mm). Shoulder base course width shall not vary from plan width in excess of +3 inches (+75 mm). No tolerances are provided for underwidths of shoulder or roadway bases. When the base course for roadway and shoulders are constructed at the same time, the 6-inch (150 mm) width tolerance will be applied. Base course width deficiencies in excess of foregoing tolerances shall be corrected as follows at the contractor's expense.

**(1) Overwidth:** When no grade adjustments are permitted, the full depth and width of base course in isolated areas having overwidths in excess of the foregoing tolerances shall be restabilized full width with cement or removed and replaced to the plan width with asphaltic concrete complying with Section 502 or concrete complying with Section 901.

In lieu of removing and replacing overwidth base course, areas of the deficient base course will be allowed to remain in place at a payment adjustment of 90 percent of the contract unit price for the entire lot.

When grade adjustments are permitted, the contractor shall correct base course width deficiencies by removing and replacing as specified above, or by furnishing and placing a 1 1/4 inch (35 mm) thick supplemental layer of asphaltic concrete complying with Section 502 for the full width of the roadway.

**(2) Underwidth:** Underwidths of base course in excess of the foregoing tolerances shall be corrected to plan width by restabilizing the full width with cement or by furnishing and placing additional materials; however, the width and thickness of the widening materials shall be not less than 12 inches (300 mm). Materials used for widening the deficient



base course shall be the same as specified for overwidth correction in Heading (1).

**(d) Grade and Cross-slope:** The finished grade shall be within  $\pm 1/2$  inch ( $\pm 15$  mm) of the established grade. The cross-slope shall not vary by more than  $\pm 0.003$  ft/ft ( $\pm 3$  mm/m).

**(e) Correction of Deficiencies:** The contractor shall correct deficiencies in surface finish, grade, contamination, segregation, soft spots, wet spots, laminations and other deficiencies at no direct pay. Deficiencies shall be corrected by removing and replacing or as directed.

**303.12 MEASUREMENT.** The quantity of in-place cement stabilized base course for payment will be the design areas as specified in the plans and adjustments thereto. The design quantity is based on the horizontal dimensions of the completed base course shown on the plans. The design quantity will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven, or if design changes are necessary.

Removal of existing patches will be measured by the square yard (sq m). This measurement will be determined and documented jointly by the contractor and project engineer. If no item is included in the contract, measurement will be in accordance with 109.04.

**303.13 PAYMENT.** Payment for in-place cement stabilized base course will be made at the contract unit price, adjusted as specified in Subsection 303.11 and the following provisions, which include furnishing required portland cement, water, and asphalt curing membrane, and performing necessary roadbed preparation. Payment for removing all existing asphaltic concrete surfacing will be made under Section 509 except for the bottom 1 inch (25 mm). No direct payment will be made for removal and disposal of the remaining [bottom 1 inch (25 mm)] of asphaltic surfacing or maintaining the areas in safe condition for traffic.

If the actual required percent of cement differs from that required by the contract documents, payment will be increased or decreased based on the difference in required quantity of cement at the price of cement shown on paid invoices (total of all charges). The contractor shall provide copies of paid invoices for this determination. If the contract documents do not specify a percent cement, 8 percent cement will be used for bid purposes.

Removal of existing patches will be paid at the contract unit price or if no item is provided, in accordance with Subsection 109.04. However, no payment will be made unless the contractor identifies the patches and participates in the measurement and documentation.

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Payment adjustments will be applied for specification deviations of asphalt materials in accordance with Section 1002 based on the invoice price per gallon (L). The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials.

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
303-01	In-Place Cement Stabilized Base Course ___ in (mm) Thick	Square Yard (Sq m)
303-02	Removal of Existing Patches	Square Yard (Sq m)

## **Section 304 Lime Treatment**

**304.01 DESCRIPTION.** This work consists of constructing one or more courses of a mixture of lime and soil, or soil-aggregate, and water in accordance with these specifications, in conformity with the lines, grades, thickness and sections shown on the plans.

Lime treatment will be designated as Type B, C, D, or E. Type B shall be used for base or subbase. Type C shall be used for conditioning for cement treatment or stabilization. Type D shall be used for working table treatment under an embankment. Type E shall be used for conditioning and drying of subgrades under a base course. Lime treatment shall be in accordance with these specifications and Table 304-2.

**304.02 MATERIALS.** Materials shall comply with the following Sections and Subsections:

Emulsified Asphalt	1002
Water	1018.01
Lime	1018.03

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

In order to meet air quality standards, the contractor may be required to use central plant mixing, lime slurry, or granular lime in dust sensitive areas at no direct pay. The Department will identify dust sensitive areas in the plans.

**304.03 EQUIPMENT.** Equipment necessary to produce a finished product meeting specification requirements shall be furnished and maintained by the contractor. An approved in-place mixer meeting the requirements of Subsection 303.03 shall be used for Type B and C treatments. An approved in-place mixer meeting the requirements of Subsection 303.03 shall be used for Types D and E treatments unless the engineer approves other equipment.

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**304.04 GENERAL CONSTRUCTION REQUIREMENTS.** Lime shall be protected from moisture prior to use. Water shall be added as needed during mixing and remixing operations, during the curing period, and to keep the cured material uniformly moist until covered.

When granular quicklime is applied in dry form, precautions shall be taken to prevent injury to persons, livestock and plants. Quicklime spilled or deposited outside areas designated for treatment shall be immediately collected and buried or satisfactorily slaked.

Lime shall not be applied on a frozen foundation or when the ambient air temperature is below 35°F (2°C).

**(a) Type B Treatment:** Lime shall be incorporated in the following sequence: Spreading the lime; initial mixing; watering; sealing and mellowing for at least 48 hours; and mixing until pulverization requirements are met; compacting; finishing; and maintaining in accordance with Subsection 304.10. The percent of lime for Type B treatment will be determined in accordance with DOTD TR 416. After lime treatment, the treated soil shall have a maximum Liquid Limit of 40 and a maximum PI of 10.

**(b) Type C Treatment:** Lime shall be incorporated in the following sequence: Spreading the lime; initial mixing; watering; sealing and mellowing for a minimum of 48 hours; mixing until pulverization requirements are met; compacting; finishing; and maintaining. The percent lime for Type C treatment will be as required by the plans or as directed.

**(c) Type D Treatment:** One increment of lime shall be spread and mixed with materials to be treated, watered as required and compacted to the satisfaction of the engineer. The percent of lime for Type D treatment will be as required by the plans or as directed.

**(d) Type E Treatment:** One increment of lime shall be spread and mixed with materials to be treated and compacted and finished in accordance with the normal embankment construction procedures of Section 203. Unless specified, the percent of lime for Type E treatment will be determined in accordance with DOTD TR 416.

**304.05 SPREADING AND MIXING.** The percentage of lime to be incorporated shall be as specified. When not specified, the required percentage of lime will be determined by the laboratory in accordance with DOTD TR 416.

A unit weight of 35 pounds per cubic foot (560 kg/cu m) will be used to compute the required application rate of hydrated lime or granular quicklime regardless of the actual unit weight of the lime used.

Lime may be furnished in bags or bulk and distributed, in powder form, granular or in a slurry, and in the required proportion. Dry lime shall be prevented from blowing by adding water or by other suitable means.

Lime shall be uniformly spread and mixed with the soil to the width and depth shown on the plans or as directed. The Department will determine lime spread rate in accordance with DOTD TR 436. Any procedure, which results in excessive loss, or displacement of lime, shall be discontinued.

Areas to which lime is applied shall be processed on the same day as application is made. Any lime not processed within 6 hours and lime lost or damaged before incorporation due to rain, wind or other cause will be rejected, deducted from measured quantities, and shall be replaced by the contractor. At no time will the contractor be paid more than once for lime treatment of a section of roadway.

**(a) Type B Mixing:** After the 48-hour mellowing period, the lime treated mixture shall be kept moist and be manipulated with an in-place mixer until the pulverization requirements of Subsection 304.06 have been met.

**(b) Type C Mixing:** Following the 48-hour mellowing period, the lime treated mixture shall be thoroughly manipulated with an in-place mixer to the satisfaction of the engineer. The mixture shall meet the pulverization requirements of Subsection 304.06 prior to subsequent stabilization or treatment with portland cement.

**(c) Types D and E:** Mixing shall be accomplished with an in-place mixer unless the engineer approves other equipment.

**304.06 PULVERIZATION.** For Types B and C treatment, the pulverized mixture, when tested in accordance with DOTD TR 431, shall meet the gradation requirements in Table 304-1 below.

**Table 304-1  
Gradation Requirements for Types B & C Lime Treatment**

U. S. Sieve, Inches (mm)	Percent Passing By Weight (Mass)
3/4 (19.0)	95
No. 4 (4.75)	50

Pulverization requirements for Type B and C treatments shall be met prior to final compaction and finishing.

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### 304.07 COMPACTING AND FINISHING.

**(a) Type B:** After meeting the pulverization requirement, the mixture shall be uniformly compacted to at least 95.0 percent of maximum dry density. The maximum dry density will be determined in accordance with DOTD TR 415 or TR 418 and in-place density in accordance with DOTD TR 401. Compaction and finishing operations shall be completed within 6 hours after meeting pulverization requirements. One density test will be taken per 1,000 linear feet (300 lin m) per roadway or 2,000 linear feet (600 lin m) per shoulder constructed separately in accordance with DOTD TR 401. At places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted using devices that will obtain uniform compaction to required density without damage to adjacent structures. Any section not meeting the required density shall be reconstructed in accordance with these specifications at no direct pay. Reconstruction shall include the addition of the specified amount of lime.

The final finish shall meet grade and cross-slope requirements and shall have a smooth, uniform, closely knit surface, free from ridges, waves, loose material or laitance.

**(b) Type C:** Type C lime conditioned materials shall be shaped and uniformly compacted to the required sections. The contractor shall make reasonable efforts to conform to the compaction requirements of (a) above. When conditions, such as a yielding subgrade, make this impractical or detrimental, the contractor shall establish an optimum rolling pattern.

**(c) Type D:** Type D lime treated materials shall be uniformly compacted and finished to the satisfaction of the engineer. The contractor shall make reasonable efforts to conform to the compaction requirements of (a) above. When conditions, such as a yielding subgrade, make this impractical or detrimental, the contractor shall establish an optimum rolling pattern.

**(d) Type E:** Type E lime treated materials shall be compacted and finished in accordance with the normal embankment construction procedures of Section 203.

**304.08 QUALITY CONTROL.** Construction methods shall prevent contamination, segregation, soft spots, wet spots, laminations and other deficiencies. The contractor shall be responsible for taking such tests as necessary to adequately control the work.

**(a) Type B Lime Treatment:** The contractor shall control the grade, cross-slope, lime spread, mixing, pulverization, thickness, width,

density and curing to construct a completed course that is uniform and conforms to the acceptance requirements.

**(b) Type C Lime Treatment:** The contractor shall control the lime spread, mixing and pulverization to construct a completed course that is uniform and conforms to the acceptance requirements.

**(c) Type D Lime Treatment:** The contractor shall control the lime spread and mixing to construct a completed course that is uniform and conforms to the acceptance requirements.

**(d) Type E Lime Treatment:** The contractor shall control the lime spread, mixing and density to construct a completed layer that is uniform and conforms to the acceptance requirements.

### **304.09 PROTECTION AND CURING (TYPE B TREATMENT).**

After finishing operations have been completed, the material shall be protected against rapid drying for 72 hours by applying an asphalt curing membrane complying with Section 506. The application shall be placed immediately following smooth rolling and shall be adequately maintained during the 72-hour curing period.

### **304.10 MAINTENANCE.**

**(a) Type B Lime Treatment:** Maintenance of Type B Lime Treatment will be in accordance with Subsection 303.09.

**(b) Types C, D and E Treatments:** These treatments shall be maintained by the contractor to prevent damage to the lime treated layer as directed.

### **304.11 DIMENSIONAL TOLERANCES (TYPE B TREATMENT).**

**(a) General:** Thickness and width of completed lime treated courses will be checked for acceptance in accordance with DOTD TR 602.

Areas not meeting tolerances specified herein will be delineated and shall be corrected to plan dimensions by scarifying, adding lime, remixing, and recompacting deficient areas at no direct pay.

**(b) Thickness Requirements:** Underthickness shall not exceed 3/4 inch (20 mm) and overthickness shall not exceed 1 inch (25 mm).

**(c) Width Requirements:** Roadway base course width shall not vary from plan width in excess of +6 inches (+150 mm). Shoulder base course width shall not vary from plan width in excess of +3 inches (+75 mm). No tolerances are provided for under widths of shoulder or roadway bases. When the base course for roadway and shoulders are constructed at the same time, the 6-inch (150 mm) width tolerance will be applied. Base

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course width deficiencies in excess of foregoing tolerances shall be corrected at the contractor's expense.

### 304.12 MEASUREMENT.

**(a) Lime:** Lime will be measured by the ton (Mg). When lime is furnished in bags, the number of bags used and the weight (mass) per bag will be used for measurement. When lime is furnished in bulk, the contractor shall furnish certified weights (mass) for each transport load.

**(b) Treatment:** The quantities of Type B, C and D lime treatment for payment will be the design areas as specified on the plans and adjustments thereto. Design quantities are based on the horizontal dimensions of the completed lime treatment shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven, or if design changes are necessary.

No measurement for payment will be made for Type E lime treatment other than as specified.

**(c)** Water and asphalt curing materials will not be measured for payment.

### 304.13 PAYMENT.

**(a) Lime:** Payment for lime will be made at the contract unit price per ton (Mg). If quicklime is used in a slurry, payment will be made at the unit price for hydrated lime after converting the quicklime to the equivalent weight (mass) of hydrated lime by multiplying the weight (mass) of quicklime by 1.32 then multiplying that product by the purity of the lime.

**(b) Treatment:** Payment for Types B, C and D lime treatment will be made at the contract unit prices per square yard (sq m). Type B lime treatment will be adjusted as specified in Section 1002 for specification deviations of asphalt materials. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphalt materials. Payment for Type E Treatment will be at the contract unit price per ton (Mg) of lime used.



Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
304-01	Lime	Ton (Mg)
304-02	Lime Treatment (Type B) ____in (mm) Thick	Square Yard (Sq m)
304-03	Lime Treatment (Type C) ____in (mm) Thick	Square Yard (Sq m)
304-04	Lime Treatment (Type D) ____in (mm) Thick	Square Yard (Sq m)
304-05	Lime Treatment (Type E)	Ton (Mg)

**Table 304-2  
Types of Lime Treatment**

B	Base or Subbase	<ol style="list-style-type: none"> <li>1. One application of lime</li> <li>2. Initial mixing</li> <li>3. 48-hour mellowing or aging period</li> <li>4. Pulverization<sup>1</sup></li> <li>5. Density control</li> <li>6. Minimum thickness and width</li> <li>7. 72-hour cure with asphalt curing membrane</li> </ol>
C	Conditioning for Cement Treatment or Stabilization	<ol style="list-style-type: none"> <li>1. One application of lime</li> <li>2. Initial mixing</li> <li>3. 48-hour mellowing or aging period</li> <li>4. Pulverization<sup>1</sup></li> <li>5. Compact to engineer's satisfaction</li> <li>6. No cure required</li> </ol>
D	Working Table (Under Embankment)	<ol style="list-style-type: none"> <li>1. One application of lime</li> <li>2. Mixing<sup>2</sup></li> <li>3. Compact to engineer's satisfaction</li> <li>4. No cure required</li> </ol>
E	Conditioning and Drying (Subgrades Under a Base Course)	<ol style="list-style-type: none"> <li>1. One application of lime per embankment lift</li> <li>2. Mixing<sup>2</sup></li> <li>3. Embankment construction requirements including density</li> <li>4. No cure required</li> </ol>

<sup>1</sup>In-place mixer shall be required.

<sup>2</sup>In-place mixer shall be required unless the engineer approves other equipment.

## Section 305 Subgrade Layer

**305.01 DESCRIPTION.** This work consists of treating subgrade soil materials with portland cement, portland-pozzolan cement, or a combination of portland cement and lime, or constructing a subgrade layer of stone, crushed slag, recycled portland cement concrete, blended calcium sulfate, or asphaltic concrete in accordance with plan details or as directed. When traffic is required to be placed on the completed, unsurfaced subgrade layer, or when the subgrade layer is below natural ground, blended calcium sulfate will not be an allowable alternate. When not specified, the subgrade layer may be composed of any of the types of materials listed above, at the option of the contractor. The same subgrade layer shall be used throughout the project unless otherwise approved by the project engineer. The plans may limit the types of subgrade layer allowed.

These specifications set forth the minimum requirements for construction of the subgrade layer; however, the contractor shall construct a subgrade layer that will provide adequate support for his construction equipment and processes.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

In order to meet air quality standards, the contractor may be required to use central plant mixing of cement or cement and lime treated mixtures in dust sensitive areas at no direct pay. The Department will identify the dust sensitive areas in the plans.

**305.02 MATERIALS.** Materials shall comply with the following Sections and Subsections:

Geotextile Fabric	203.11 & 1019
Asphaltic Concrete	502
Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Emulsified Asphalt	1002
Stone	1003.01 & 1003.10
Recycled Portland Cement Concrete	1003.01 & 1003.10
Crushed Slag	1003.03(d)

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Blended Calcium Sulfate	1003.01 & 1003.10
Water	1018.01
Lime	1018.03

Blended calcium sulfate shall be sampled in accordance with the requirements for stone in Section 302 of the Materials Sampling Manual.

Asphaltic concrete shall meet the requirements of Section 502 base course.

**305.03 EQUIPMENT.** Equipment necessary to produce a finished product meeting specification requirements shall be furnished and maintained by the contractor. The equipment will be approved prior to use.

## 305.04 CONSTRUCTION REQUIREMENTS.

**(a) Treated Subgrade Layer:** Materials to be treated shall be existing materials or materials placed under other pay items.

**(1) Subgrade Soils:** Subgrade soils to be treated shall be not more than 79 percent sand or 69 percent silt, when tested in accordance with DOTD TR 407, and shall have a Plasticity Index (PI) not exceeding 35 when tested in accordance with DOTD TR 428. Blending to adjust the percents sand or silt will not be allowed for subgrade layers for Class I base course. Blending or treating to reduce PI will not be allowed.

**(2) Treatment:** Treatment of subgrade soils consists of mixing with portland cement or a combination of portland cement and lime conditioning, and compacting, finishing, and curing. In-place treatment with portland cement shall be in accordance with Section 303. When central plant mixing is used, it shall conform to Section 301. Treatment with lime shall be in accordance with Section 304 for Type C treatment. The minimum quantities of portland cement and lime shall be in accordance with the following:

<u>P.I.</u>	<u>Lime or Cement (Percent by volume)</u>
0-15	9 % cement
16-25	6 % lime and 9 % cement
26-35	9 % lime and 9 % cement

The engineer has the option of increasing or decreasing the percentages of cement and lime based on field conditions. The contract unit price for pay

item 305-01, Subgrade Layer, will be adjusted for the actual percentages of cement and lime required.

**(3) Pulverization:** After treatment the pulverized mixture shall conform to the gradation requirements in Table 305-1 below when tested in accordance with DOTD TR 431.

**Table 305-1**  
**Gradation Requirements for Treated Subgrade Layer**

U. S. Sieve, Inches (mm)	Percent Passing By Weight (Mass)
3/4 (19.0)	95
No. 4 (4.75)	50

**(b) Aggregate Subgrade Layer:** Unless otherwise specified, the contractor has the option of furnishing stone, crushed slag, or recycled portland cement concrete. The aggregate subgrade layer shall be placed, compacted, finished, and protected in accordance with Section 302.

If an aggregate subgrade layer is used, a Class D geotextile fabric will be required to separate the aggregate subgrade layer from untreated soil.

**(c) Asphaltic Concrete Subgrade Layer:** Asphaltic concrete shall be constructed in accordance with Section 502.

**(d) Blended Calcium Sulfate:** Calcium sulfate shall be blended with an approved aggregate prior to placement. The blended calcium sulfate material shall be uniformly mixed and sampled from dedicated stockpiles.

Water shall be added or other suitable means taken to prevent dust during the transporting and placing of dry blended calcium sulfate.

Blended calcium sulfate shall be placed, spread, and compacted to produce layers not exceeding 12 inches (300 mm) compacted thickness. Each layer shall be placed for the full width, brought to optimum moisture content, and compacted to at least 95 percent of maximum dry density before the next layer is placed. Optimum moisture and maximum density shall be determined in accordance with DOTD TR 415 or TR 418 Method G modified to include a maximum drying temperature of 140°F (60°C). A forced draft type oven capable of maintaining the temperature shall be provided by the contractor for field moisture content determination for density control.

Blended calcium sulfate shall not be placed within 10 feet (3.0 m) of metal pipe.

Protection and curing of blended calcium sulfate shall be in accordance with Subsection 301.12(b).

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**305.05 MEASUREMENT.** The quantities of subgrade layer for payment will be the design areas as specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions of the completed subgrade layer shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary.

DOTD TR 602 measurements for width and thickness will not be made, but the width and thickness will be checked by the engineer during construction.

When aggregate, blended calcium sulfate, asphaltic concrete, or central mixing is used, the removal of existing soil materials from the subgrade will not be measured for payment.

Geotextile fabric used beneath the subgrade layer will not be measured for payment.

**305.06 PAYMENT.** Payment for subgrade layer will be made at the contract unit price which includes cement, water, stone, recycled portland cement concrete, crushed slag, blended calcium sulfate, asphaltic concrete, and asphalt curing membrane or prime coat, subject to the payment adjustment provisions of Section 1002 for specification deviations of asphalt materials and Subsection 303.11(a) for density deficiencies of cement treated materials. Adjustments in pay for increase or decrease in the percent cement ordered by the engineer will be in accordance with Subsection 303.13. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphalt materials.

Payment for geotextile fabric will be included in the contract unit price for subgrade layer.

Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
305-01	Subgrade Layer ____ in (mm) Thick	Square Yard (Sq m)

## **Section 306**

### **Scarifying and Compacting Roadbed**

**306.01 DESCRIPTION.** This work consists of scarifying, shaping and compacting an existing roadbed to form a subbase or base course in accordance with these specifications, and in conformity with the lines, grades, depth and cross section shown on the plans or established.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application for Quality Assurance Specifications for Embankment and Base Course."

**306.02 CONSTRUCTION REQUIREMENTS.** Existing materials shall be scarified for the full width of roadbed and a minimum depth of 6 inches (150 mm), shaped to the required section, and uniformly compacted to at least 95 percent of maximum dry density for subbase, and 100 percent for base, as determined in accordance with DOTD TR 401 and TR 415 or TR 418. Any damage to the scarified roadbed prior to compaction shall be corrected at no direct pay. The scarified, shaped and compacted roadbed shall have a smooth, uniform, closely knit surface, free from ridges, waves, depressions or loose material. Scarifying of the roadbed shall not be performed in excess of 1 mile (1.5 km) in advance of compacting the roadbed. The recompacted roadbed shall be primed in accordance with Section 505.

**306.03 MAINTENANCE OF COMPACTED ROADBED.** The contractor shall protect the compacted roadbed from damage due to either public traffic or construction operations and shall maintain the roadbed in satisfactory condition at all times, including the asphalt prime coat. Any damage shall be immediately repaired by the contractor at no direct pay.

**306.04 MEASUREMENT.** The quantities of scarifying and compacting roadbed for payment will be the design lengths or areas as specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions of the roadbed shown on the plans. Design quantities will be adjusted when the engineer makes changes to adjust to field conditions, if plan errors are proven, or when design changes are necessary.

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**306.05 PAYMENT.** Payment for scarifying and compacting roadbed will be at the contract unit price, which includes asphalt prime coat.

Payment adjustments will be applied for specification deviations of asphalt materials in accordance with Section 1002. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphalt materials.

Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
306-01	Scarifying and Compacting Roadbed ___ in (mm) Thick	Mile (km)
306-02	Scarifying and Compacting Roadbed ___ in (mm) Thick	Square Yard (Sq m)



## Section 307 Permeable Bases

**307.01 DESCRIPTION.** This work consists of constructing a permeable asphalt base or permeable concrete base on a prepared subbase in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical sections shown on the plans or as directed.

When a permeable base is included in the contract, the contractor shall have the option to furnish either a permeable asphalt base or a permeable concrete base unless otherwise specified. The same type of base shall be used throughout the project unless otherwise specified on the plans or approved in writing.

The permeable asphalt base shall consist of a mixture of aggregate, polymer modified asphalt cement and approved anti-strip additive. The permeable concrete base shall consist of a mixture of aggregate, portland cement, admixtures and water.

**307.02 MATERIALS.** Materials shall comply with the following requirements.

**(a) Aggregates:** The aggregates for both the permeable asphalt base and the permeable concrete base shall be 100 percent crushed stone conforming to the requirements of Subsection 1003.06 and Table 307-1 below.

**Table 307-1  
Gradation Requirements for Permeable Base Aggregates**

Sieve Size, Inches (mm)	Percent Passing By Weight (Mass)
1 (25)	100
3/4 (19.0)	90 - 100
3/8 (9.5)	20 - 55
No. 4 (4.75)	0 - 10
No. 8 (2.36)	0 - 5

**(b) Asphalt:** The asphalt for asphalt treated permeable base shall be an approved polymer modified asphalt cement, PG 76-22m complying with Section 1002. The percentage of asphalt cement shall be 2.0 percent to 4.0 percent by weight (mass) of the total mixture. Asphalt cement content and mixing process shall be such that all aggregates are visibly coated. The

## 307.02

mixture shall retain 90 percent coating when tested in accordance with DOTD TR 317.

A job mix formula shall be submitted and approved in accordance with Section 502.

**(c) Anti-Strip Additive:** Anti-Strip additive for the permeable asphalt base shall be an approved product listed on the QPL 57.

The anti-strip additive shall be added at the minimum rate of 0.5 percent by weight (mass) of asphalt and shall be thoroughly mixed with the asphalt cement at the plant. Additional anti-strip additive may be added up to 1.2 percent by weight (mass).

The proposed job mix formula shall indicate a single anti-strip additive rate which is 0.1 percent greater than the percentage which will yield a minimum of 90 percent coating when tested in accordance with DOTD TR 317. The approved range shall be 0.2 percent by weight (mass) of asphalt, with the lower limit being the quantity determined in accordance with DOTD TR 317 and the maximum limit not to exceed 1.2 percent by weight (mass) of asphalt.

**(d) Permeable Portland Cement Concrete:** Cement for permeable concrete base shall be a Type I portland cement complying with Section 1001.

Permeable concrete base shall have a minimum cement content of 235 pounds of portland cement per cubic yard (140 kg/cu m) of concrete. The water cement ratio of the mixture shall be not more than 0.37.

**(e) Admixtures:** Admixtures for the permeable concrete base shall comply with Subsection 1011.02. The rate shall be as indicated in the QPL 58.

## 307.03 CONSTRUCTION.

**(a) Permeable Asphalt Base:** The permeable asphalt base shall be placed in accordance with Section 502. Compaction shall be with one to three passes of a 5 to 10 ton (4.5 to 9 Mg) smooth steel-wheel roller conforming to Section 503.

Permeable asphalt base shall be placed at a temperature between 200°F to 260°F (90°C to 125°C) when measured in the hopper of the paving machine. Compaction shall begin when the temperature of the permeable asphalt base has cooled to approximately 160°F (70°C) and shall be completed before the temperature falls below 100°F (35°C).

**(b) Permeable Concrete Base:** The permeable concrete base shall be placed by slip forming in accordance with Section 601 or by an asphaltic concrete paver in accordance with Section 503. Compaction shall

be performed by using vibrating screeds or plates as directed. No construction joints will be required.

Immediately after concrete placement, the permeable concrete base shall be cured by covering the entire surface and exposed edges with white pigmented curing compound in accordance with Subsection 601.10.

**307.04 PROTECTION.** The contractor shall protect the permeable asphalt base and permeable concrete base from severe weather conditions and contamination by dust, dirt, mud or other fine grained material. The base shall be protected by an approved method from the time of placement until placement of the following pavement layer. No traffic will be permitted on the permeable asphalt base or permeable concrete base. Equipment required to place the pavement will be allowed provided that it enters and exits as near as possible to the paving operation. Any damage to the permeable bases caused by the contractor's equipment shall be repaired by the contractor at no direct pay.

Any portion of the permeable bases which become contaminated to the extent that drainage is reduced or inhibited shall be removed and replaced at no direct pay.

The permeable bases shall be covered with the pavement within 15 working days after placement.

**307.05 TOLERANCES.** The finished surface of permeable asphalt base and permeable concrete base shall be uniform and shall not vary at any point more than 0.05 foot (15 mm) above or below the established grade. The cross-slope shall not vary by more than  $\pm 0.003$  ft/ft ( $\pm 3$  mm/m).

Permeable asphalt base or permeable concrete base with a surface higher than 0.05 foot (15 mm) above the established grade shall be removed and replaced with permeable base which complies with these specifications, or when permitted, the high spots may be removed to within specified tolerance by any method that does not produce contaminating fines nor damage the base to remain in place. Grinding will not be permitted.

Permeable base with a surface lower than 0.05 foot (15 mm) below the established grade shall be removed and replaced with permeable base which complies with these specifications. When permitted, low areas not exceeding 1 inch (25 mm) shall be filled with pavement at the time and in the same operation in which the pavement is placed at no direct pay.

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**307.06 TESTING.** Before placing surfacing, the contractor shall core the permeable bases at the locations determined by the engineer in accordance with DOTD TR 602. All cores taken by the contractor shall be given to the engineer for verification of base thickness.

**307.07 MEASUREMENT.** Permeable asphalt base and permeable concrete base will be measured by the square yard (sq m) from the design quantities shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven or if design changes are necessary. Design areas of permeable base are based on the horizontal dimensions shown on the plans, the length being along the centerline of the base.

**307.08 PAYMENT.** Payment for permeable asphalt base and permeable concrete base will be made at the contract unit price per square yard (sq m), which shall include all materials, tools, incidentals and the performance of work necessary to complete these items.

Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
307-01	Permeable Base ____ in (mm) Thick	Square Yard (Sq m)

## **Section 308 In-Place Cement Treated Base Course**

**308.01 DESCRIPTION.** This work consists of scarifying, pulverizing, blending, shaping and treating roadbed material with portland cement, portland-pozzolan cement, or portland blast-furnace slag cement in accordance with the lines, grades, thickness and sections established or shown on the plans.

Cement treatment is primarily used for recycling existing roadbed materials typically 12 inches (300 mm) thick, unless specified otherwise. When specified, the contractor shall furnish and place materials under different pay items to be treated in accordance with this section or stabilized in accordance with Section 303.

With approval, concrete complying with Section 901 or asphaltic concrete complying with Section 502 may be used in lieu of the specified base course material in areas that are inaccessible for mixing and compacting in turnouts and crossovers, and in other isolated or irregular areas. The concrete shall be placed, consolidated, finished, and cured as directed in accordance with Section 706. The contractor shall remove and satisfactorily dispose of existing materials as required to accommodate placement of the portland cement concrete or asphaltic concrete at no direct pay. Excess material shall be disposed of in accordance with Subsection 202.02.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

**308.02 MATERIALS.** Materials shall comply with the following Sections or Subsections:

Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Portland Blast-Furnace Slag Cement	1001.04
Emulsified Asphalt	1002
Water	1018.01

## **308.02**

Portland cement shall be Type I or II. Portland-pozzolan cement shall be Type IP. Portland blast-furnace slag cement shall be Type IS. The quantity of cement used shall be supported by proof of delivery.

Portland blast-furnace slag cement shall contain a maximum of 50 percent ground granulated blast-furnace slag by weight. Pre-blending of Types I or II portland cement and ground granulated blast-furnace slag will be allowed if blended at an approved blending facility and mixed thoroughly to insure a uniform blend. The ground granulated blast-furnace slag used in pre-blending shall be from a source listed in QPL 70 and shall meet the requirements of Subsection 1018.27.

Soils or soil-aggregate combinations furnished by the contractor for treatment in accordance with this section shall comply with the requirements of Subsection 302.02(a), except that if an A-4 or A-6 Soil Group material is used, it shall meet the durability requirements of DOTD TR 432, Method D.

**308.03 EQUIPMENT.** Equipment necessary to produce a finished base course shall be in accordance with Subsection 303.03.

**308.04 PREPARATION OF ROADBED.** Unless otherwise designated in the plans, roadbed preparation shall be in accordance with Subsection 303.04.

**308.05 CEMENT TREATMENT.** For portland cement, the roadbed material shall be treated with a rate of cement by volume as shown on the plans. For portland-pozzolan cement and portland blast-furnace slag cement, the rate of blended cement will be determined prior to mixing using TR 432, Method B or C, whichever is applicable, using 150 psi (1050 kPa) as the design compressive strength criteria. In addition, the durability of base courses utilizing portland-pozzolan cement or portland blast-furnace slag cement shall be determined in accordance with DOTD TR 432, Method D, utilizing the rate of cement determined from Method B or C.

The laboratory testing specified above for portland-pozzolan cement and portland blast-furnace slag cement shall be performed at the contractor's expense at a laboratory approved by the Materials Engineer Administrator. Sufficient material shall be obtained at the time of sampling to provide the District laboratory with approximately 200 pounds (90 kg) of the base material to be treated for verification testing. Approximately 10

pounds (5 kg) of the cementitious material to be used shall also be provided to the District laboratory. Materials for verification testing shall be provided at no cost to the Department. Verification testing will consist of molding and curing of three specimens at the percentage of cementitious material to be used determined by the contractor's laboratory to meet the minimum strength and durability criteria as specified above. The specimens shall be cured and tested according to TR 432, using the Method that required the higher percent cement. If the verification testing results do not produce an average compressive strength of 150 psi (1050 kPa), or meet the durability requirements of TR 432, Method D, the contractor shall halt construction of the base until such time as a new mix design can be developed and verified.

The method of spread shall be such that the amount of cement used can be readily determined when tested in accordance with DOTD TR 436. Cement shall be uniformly spread and mixed with the material. Pulverization, in accordance with Subsection 303.04, shall be maintained throughout the treatment process. A minimum of two passes with the mixer (stabilizer) will be required. The mixture shall be shaped to the required section.

Water shall be added as needed by means of the mixer and shall be uniformly incorporated in the mixture in amounts required to attain optimum moisture for the mixture. During the mixing process, water shall be added only through the spray bar of the in-place mixer which is adjusted to provide uniform coverage across the completed width of the roadway for the full depth of the base. Wet streaks or spots will not be allowed.

Optimum moisture of the mixture will be determined in accordance with DOTD TR 415 or TR 418. The percentage of moisture determined in accordance with DOTD TR 403 in the mixture by dry weight shall not vary from optimum moisture by more than  $\pm 2$  percent at the time of compaction.

**308.06 COMPACTING AND FINISHING.** Unless otherwise designated on the plans, compaction and finishing of cement treated base course shall be accordance with Subsection 303.06.

**308.07 QUALITY CONTROL.** The contractor shall control the preparation of roadbed, selection and placement of materials, cement spread, mixing, compaction, moisture content, density, thickness, width, surface finish, grade and cross slope so that the completed base course is uniform and conforms to plan dimensions and other acceptance requirements as provided herein. The contractor shall control his operations

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so that contamination, segregation, soft spots, wet spots, laminations and other deficiencies are prevented. The contractor shall be responsible for taking such tests as necessary to adequately control the work.

**308.08 PROTECTION AND CURING.** Upon completion of final finishing, the cement treated base shall be immediately protected against rapid drying by applying an asphalt curing membrane in accordance with Section 506. Asphalt curing membrane shall be placed on the same day as treatment. Complete coverage of curing membrane shall be maintained from initial application until the placement of the next course. When traffic, including construction equipment, is allowed on the base course, at least the first lift of surfacing shall be placed within 30 calendar days unless otherwise directed.

**308.09 MAINTENANCE.** The contractor shall protect the completed base course from damage due to either public traffic or the contractor's operations, and shall satisfactorily maintain the completed base course including asphalt curing membrane in accordance with Section 303.

**308.10 WEATHER LIMITATIONS.** Mixing will not be permitted when the base course material is frozen, when raining, when the ambient air temperature is below 35°F (2°C), or the temperature forecasted by the U.S. Weather Service is to be 25°F (-3°C) or less within the 24 hour period following placement.

**308.11 ACCEPTANCE REQUIREMENTS.** Cement spread rate will be tested in accordance with DOTD TR 436.

The moisture content of the cement treated mixtures will be tested for compliance with optimum moisture content in accordance with DOTD TR 403 at placement at least twice per day.

The pulverization of the prepared roadbed will be tested in accordance with DOTD TR 431, and shall be at least 60 percent passing the No. 4 (4.75 mm) sieve.

The completed base course will be checked for determining acceptance in increments of 1,000 linear feet (300 lin m) per roadway or 2,000 linear feet (600 lin m) per shoulder constructed separately.

**(a) Density Requirements:** Upon completion of compaction operations, in-place density will be determined in accordance with DOTD TR 401.



The density requirement as based on DOTD TR 415 or TR 418 will be 95.0 percent of maximum density.

When the density test value for the section is below 95.0 percent, a payment adjustment will be applied in accordance with Table 308-1 below.

**Table 308-1**  
**Density Acceptance and Payment Schedule**

Density Test Value	Percent of Contract Unit Price
95.0 & Above	100
93.0 to 94.9	90
90.0 to 92.9	75
Below 90.0	50 or Remove <sup>1</sup>

<sup>1</sup>At the option of the Department after investigation.

**(b) Thickness Requirements:** The thickness of the completed base course will be determined in accordance with DOTD TR 602.

The completed base course shall not vary from plan thickness in excess of the tolerances in Table 308-2 as follows. Base course thickness deficiencies in excess of these tolerances shall be corrected as specified herein at no direct pay.

**Table 308-2**  
**Base Course Thickness Tolerance**

Underthickness, Inches (mm)	Overthickness, Inches (mm)
3/4 (20)	1 1/2 (40)

Any failing area will be isolated for purposes of correction. Base course thickness deficiencies in excess of the foregoing tolerances shall be corrected as follows.

When no grade adjustments are permitted, thickness deficiencies shall be corrected by retreatment with cement or removing and replacing the full depth of base course in deficient areas with one of the following materials:

- (1) Cement treated base course.
- (2) Asphaltic concrete complying with Section 502.
- (3) Concrete complying with Section 901.

When grade adjustments are permitted, the contractor shall have the option of correcting deficiencies by furnishing and placing a supplemental layer of asphaltic concrete complying with Section 502 for the full width of base course in lieu of removing and replacing deficient base course. When approved, corrections may be made by retreatment of the existing material

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in accordance with this section. Thickness of the supplemental layer of asphaltic concrete shall be in accordance with Table 308-3 as follows.

**Table 308-3  
Supplemental Asphaltic Concrete Layer Thickness**

Underthickness, Inches (mm)	Overthickness, Inches (mm)	Minimum Thickness of Supplemental Asphaltic Concrete <sup>1</sup> , Inches (mm)
1 to 1 1/2 (30 to 40)	1 3/4 to 2 (45 to 50)	1 1/4 (35)
1 3/4 to 2 (45 to 50)	2 1/4 to 2 1/2 (60 to 65)	1 1/2 (40)
2 1/4 to 2 1/2 (60 to 65)	2 3/4 to 3 (70 to 80)	2 (50)
Over 2 1/2 (Over 65)	Over 3 (Over 80)	Remove and Replace <sup>2</sup>

<sup>1</sup>May be placed with subsequent lift of asphaltic concrete.

<sup>2</sup>At the option of the Department after investigation

**(c) Width Requirements:** The width of the completed base course will be determined in accordance with DOTD TR 602. Roadway base course width shall not vary from plan width in excess of +6 inches (+150 mm). Shoulder base course width shall not vary from plan width in excess of +3 inches (+75 mm). No tolerances are provided for underwidths of shoulder or roadway bases. When the base course for roadway and shoulders are constructed at the same time, the 6-inch (150 mm) width tolerance will be applied. Base course width deficiencies in excess of foregoing tolerances shall be corrected as follows at the contractor's expense.

**(1) Overwidth:** When no grade adjustments are permitted, the full depth and width of base course in isolated areas having overwidths in excess of the foregoing tolerances shall be retreated full width with cement or removed and replaced to the plan width with asphaltic concrete complying with Section 502 or concrete complying with Section 901.

In lieu of removing and replacing overwidth base course, areas of the deficient base course will be allowed to remain in place at a payment adjustment of 90 percent of the contract unit price for the entire lot.

When grade adjustments are permitted, the contractor shall correct base course width deficiencies by removing and replacing as specified above, or by furnishing and placing a 1 1/4 inch (35 mm) thick supplemental layer of asphaltic concrete complying with Section 502 for the full width of the roadway.

**(2) Underwidth:** Underwidths of base course in excess of the foregoing tolerances shall be corrected to plan width by retreating the full width with cement or by furnishing and placing additional materials;

however, the width and thickness of the widening materials shall be not less than 12 inches (300 mm). Materials used for widening the deficient base course shall be the same as specified for overwidth correction in Heading (c) (1) above.

**(d) Grade and Cross-slope:** The finished grade shall be within  $\pm 1/2$  inch ( $\pm 15$  mm) of the established grade. The cross-slope shall not vary by more than  $\pm 0.003$  ft/ft ( $\pm 3$  mm/m).

**(e) Correction of Deficiencies:** The contractor shall correct deficiencies in surface finish, grade, contamination, segregation, soft spots, wet spots, laminations and other deficiencies at no direct pay. Deficiencies shall be corrected by removing and replacing or as directed.

**308.12 MEASUREMENT.** The quantity of in-place cement treated base course for payment will be the design areas as specified in the plans and adjustments thereto. The design quantity is based on the horizontal dimensions of the completed base course shown on the plans. The design quantity will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven, or if design changes are necessary.

Removal of existing patches will be measured by the square yard (sq m). This measurement will be determined and documented jointly by the contractor and project engineer. If no item is included in the contract, measurement will be in accordance with Subsection 109.04.

**308.13 PAYMENT.** Payment for in-place cement treated base course will be made at the contract unit prices, adjusted as specified in Subsection 308.11 which include furnishing cement, water, asphalt curing membrane, labor and equipment, and performing necessary roadbed preparation. Payment for removing all existing asphaltic concrete surfacing will be made under Section 509 except for the bottom 1 inch (25 mm). No direct payment will be made for removal and disposal of the remaining [bottom 1 inch (25 mm)] of asphaltic surfacing or maintaining the areas in safe condition for traffic.

If the actual required percent of cement differs from that required by the contract documents, payment will be increased or decreased based on the difference in required quantity of cement at the price of cement shown on paid invoices (total of all charges). The contractor shall provide copies of paid invoices for this determination. If the contract documents do not specify a percent cement, 6 percent cement will be used for bid purposes.

Removal of existing patches will be paid at the contract unit price or if no item is provided, in accordance with Subsection 109.04. However, no

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payment will be made unless the contractor identifies the patches and participates in the measurement and documentation.

Payment adjustments will be applied for specification deviations of asphalt materials in accordance with Section 1002 based on the invoice price per gallon (L). The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials.

Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
308-01	In-Place Cement Treated Base Course ___ in (mm) Thick	Square Yard (Sq m)
308-02	Removal of Existing Patches	Square Yard (Sq m)