# AGGREGATE BASE AND SURFACE COURSE ITEMS

# ITEM P-207 IN-PLACE FULL DEPTH RECLAMATION (FDR) RECYCLED ASPHALT AGGREGATE BASE COURSE

## DESCRIPTION

**207-1.1** This item consists of a recycled asphalt aggregate base course resulting from the in-place full depth reclamation (FDR) of the existing pavement section (asphalt wearing surface and aggregate base), plus mechanical stabilization with additional aggregate or chemical stabilization with Portland cement, or asphalt emulsion, when shown on the plans.

## MATERIALS

**207-2.1 AGGREGATE.** The FDR shall consist of materials produced by recycling (pulverizing and mixing) the existing asphalt pavement, aggregate base, subgrade, and any additional aggregate as necessary. .

The FDR shall meet the gradation in Table 207-1, below.

**TABLE 207-1. FDR GRADATION**

| Sieve | Minimum Percentage by weight passing sieves |
|---|---|
| 2-inch | |
| 1-1/2-inch | 100 |
| 1-inch | 90-100 |
| No. 4 | |
| No. 200 | |

**a. Deleterious substances.** Materials for aggregate base shall be kept free from weeds, sticks, grass, roots and other foreign matter.

**b. Uniformity**. The materials shall be thoroughly recycled (pulverized and mixed) to ensure a uniform gradation.

**207-2.2 STABILIZATION.**

**a. Mechanical stabilization.** Addition of corrective aggregate material to adjust gradation shall be equivalent to P-209 Crushed Aggregate Base Course.

**b. Chemical Stabilization**. Provide the specific chemical stabilization material designated in the Plans. Portland cement shall meet the requirements of AASHTO M 85. Emulsified asphalt cement shall meet the requirements of AASHTO M 140. Cationic emulsified asphalt shall meet the requirements of AASHTO M 208. Materials shall be handled, stored, and applied in accordance with all federal, state, and local requirements.

**207-2.3 WATER.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

**207-2.4 QUALITY CONTROL (QC) SAMPLING AND TESTING.** The Contractor shall take at least two FDR samples per day of production in the presence of the Engineer to check the gradation. Sampling shall be per ATM 301. Material shall meet the requirements in paragraph 207-2.1. Samples shall be taken from the in-place, un-compacted material at random sampling locations according to ATM SP 4.

## CONSTRUCTION METHODS

**207-3.1 MILLING**. The existing asphalt pavement shall be milled to the depth below surface grade shown on the plans.

**207-3.2 CONTROL STRIP.** The control strip shall be 12 feet in width and 300 feet in length. The Engineer will designate the location of control strips. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

**207-3.3 RECYCLING (PULVERIZATION AND MIXING)**. The asphalt pavement and aggregate base shall be recycled (pulverized and mixed) into a uniformly blended mixture to the depth shown on the plans. Add mechanical and chemical stabilization materials of the type(s) and in proportions shown on the plans to the mixture of asphalt pavement and aggregate base. All material over approximately 1-1/2 inches will be removed by the Contractor. The mixture shall be brought to the desired moisture content.

The maximum lift thickness of the recycled aggregate base course material to be compacted is shown on the plans.

**207-3.4 GRADING AND COMPACTION**. Immediately upon completion of recycling (pulverization and mixing), the material shall be shaped and graded in accordance with the project plans. The Engineer will use ATM 412 to determine the density standard from the control strip. The recycled asphalt aggregate base course shall be compacted within the same day to an in-place density of 98 percent as determined by ATM 213. Compact the remainder of the project to not less than 98 percent of the density standard, in accordance with ATM 213. The number, type and weight of rollers shall be sufficient to compact the material to the required density.

**207-3.5 FINISHING**. The surface of the aggregate base course shall be finished by blading or with automated equipment designed for this purpose. If the top layer is 1/2 inch or more below grade, the top layer shall be scarified to a depth of at least 3 inches, new material added, and the layer blended and re-compacted to bring it to grade. The addition of layers less than 3 inches shall not be allowed.

**207-3.6 PROOF ROLLING.** Compacted asphalt aggregate base course shall be proof rolled with a tandem axle dual wheel dump truck loaded to the legal limit with tires inflated to 80 psi in the presence of the Engineer. Soft areas that deflect greater than 0.5 inch or show permanent deformation greater than 0.5 inch shall be removed and reworked at the Contractor's expense.

**207-3.7 WEATHER LIMITATIONS.** When weather conditions detrimentally affect the construction process and/or quality of the materials, the Contractor shall stop construction. Portland cement shall not be applied when wind conditions affect the distribution of the materials. Do not use any frozen material or compact on a frozen base. Construction shall not be performed unless the atmospheric temperature is above 35°F and rising or approved by the Engineer. When the temperature falls below 35°F, protect all completed areas against detrimental effects of freezing by approved methods. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

**207-3.8 MAINTENANCE.** The asphalt aggregate base course shall be maintained in a satisfactory condition until the work is accepted by the Engineer. Equipment used in the construction of an adjoining section may be routed over completed sections of asphalt aggregate base course, provided that no damage results and equipment is routed over the full width of the completed asphalt aggregate base course. Any damage to the recycled asphalt aggregate base course shall be repaired by the Contractor at the Contractor's expense.

**207-3.9 SURFACE TOLERANCES.** The finished surface shall be tested for smoothness and accuracy of grade. Any area failing smoothness or grade shall be scarified to a depth of at least 3 inches, reshaped and re-compacted by the Contractor at the Contractor's expense.

**a. Smoothness.** The finished surface shall not vary more than 3/8-inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade shall be measured on a 50-foot grid and shall be within +0 and -1/2 inch of the specified grade.

**207-3.10 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY.** FDR base course will be accepted for density and thickness on an area basis. One (1) test for density and thickness will be made for each 1200 square yds. Sampling locations will be determined on a random basis in accordance with ATM SP 4.

**a. Density**. The Engineer will perform all density tests.

Each area will be accepted for density when the field density is at least 98 percent of the density standard of the FDR base course in accordance with ATM 412. The in-place field density will be determined in accordance with ATM 213, and ATM 213 will be used to determine the moisture content of the material. The machine will be calibrated in accordance with ATM 213. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two additional random tests made. This procedure will be followed until the specified density is reached.

**b. Thickness.** The thickness of the base course shall be within +0 and -1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Engineer for each area. Where the thickness is deficient by more than 1/2-inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches, adding new material, and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

## METHOD OF MEASUREMENT

**207-4.1** See GCP Section 90, and the following:

**a.** FDR asphalt aggregate base course, by the area of the finished top surface.

**b.** Emulsified asphalt, by the ton.

**c.** Portland cement, by the ton**.**

**d.** FDR asphalt aggregate base course, by Lump Sum. Chemical stabilization is subsidiary.

## BASIS OF PAYMENT

**207-5.1** Payment will be made at the contract unit price, per unit of measurement, accepted in place. Corrective aggregate material, if required, will be paid under Item P-209.

Payment will be made under:

| | | |
|---|---|---|
| P207.110.0000 | FDR Asphalt Aggregate Base Course | per square yard |
| P207.120.0000 | FDR Asphalt Aggregate Base Course | per lump sum |
| P207.130.0000 | Emulsified Asphalt | per ton |
| P207.140.0000 | Portland Cement | per ton |

## References

ASTM C1602 Mixing Water Used in the Production of Hydraulic Cement Concrete

| | |
|---|---|
| AASHTO M 85 | Portland Cement |
| AASHTO M 140 | Emulsified Asphalt |
| AASHTO M 208 | Cationic Emulsified Asphalt |
| ATM 213 | In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth), FOP for AASHTO T 310 |
| ATM 301 | Sampling of Aggregates FOP for AASHTO T 2 |
| ATM 412 | Relative Standard Density of Treated Mixtures by the Control Strip Method |
| ATM SP 4 | Random Sampling |

# ITEM P-209 CRUSHED AGGREGATE BASE COURSE

## DESCRIPTION

**209-1.1** This item consists of a base course composed of crushed aggregate constructed on a prepared course in accordance with these Specifications and to the dimensions and typical cross-sections shown on the Plans.

## MATERIALS

**209-2.1 CRUSHED AGGREGATE BASE.** Crushed aggregate shall consist of clean, sound, durable particles of crushed stone or crushed gravel and shall be free from excess coatings of clay, silt, organic material, clay lumps or balls or other deleterious materials. The method used to produce the crushed gravel shall result in the fractured particles in the finished product as consistent and uniform as practicable. Fine aggregate passing the No. 4 sieve shall consist of fines from the coarse aggregate crushing operation. If necessary, fine aggregate may be added to produce the correct gradation. The fine aggregate shall be produced by crushing stone and gravel that meet the coarse aggregate requirements for wear and soundness. Aggregate base material requirements are listed in Table 209-1.

**TABLE 209-1**

**CRUSHED AGGREGATE BASE MATERIAL REQUIREMENTS**

| Material Test | Requirement | Standard |
|---|---|---|
| **Coarse Aggregate** | | |
| Resistance to Degradation | Loss: 45% maximum | AASHTO T 96 |
| Soundness of Aggregates by Use of Sodium Sulfate | Loss after 5 cycles: 12% maximum using Sodium sulfate | AASHTO T 104 |
| Percentage of Fractured Particles | Minimum 90% by weight of particles with at least two fractured faces and 100% with at least one fractured face[1] | ATM 305 |
| Flat Particles, Elongated Particles, or Flat and Elongated Particles | 10% maximum, by weight, of flat, elongated, or flat and elongated particles [2] | ATM 306 |
| Degradation Value | 45%, minimum | ATM 313 |
| **Fine Aggregate** | | |
| Liquid limit | Less than or equal to 25 | ATM 204 |
| Plasticity Index | Not more than six (6) | ATM 205 |

[1] The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

[2] A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

**209-2.2 GRADATION REQUIREMENTS.** The gradation of the final aggregate base material shall meet the requirements of the gradation given in Table 209-2 when tested per ATM 304. The gradation shall be well graded from coarse to fine and shall not vary from the lower limit on one sieve to the high limit on an adjacent sieve or vice versa. Use Gradation D-1 unless specified otherwise.

**TABLE 209-2**

**REQUIREMENTS FOR GRADATION OF AGGREGATE**

| Sieve Size | Design Range Percentage by Weight passing | | Contractor's Final Gradation | Job Control Grading Band Tolerances[1] (Percent) |
|---|---|---|---|---|
| | C-1 | D-1 | | |
| 1-1/2 inch | 100 | | | 0 |
| 1 inch | 70-100 | 100 | | ±5 |
| 3/4 inch | 60-90 | 70-100 | | ±8 |
| 3/8 inch | 45-75 | 50-80 | | ±8 |
| No. 4 | 30-60 | 35-65 | | ±8 |
| No. 8 | 22-52 | 20-50 | | ±8 |
| No. 50[2] | 6-30 | 6-30 | | ±5 |
| No. 200[2] | 0-5 | 0-5 | | ±3 |

[1] The "Job Control Grading Band Tolerances for Contractor's Final Gradation" in the table shall be applied to "Contractor's Final Gradation" to establish a job control grading band. The full tolerance still applies if application of the tolerances results in a job control grading band outside the design range.

[2] The fraction of material passing the No. 200 sieve shall not exceed two-thirds the fraction passing the No. 50 sieve.

**209-2.3 SAMPLING AND TESTING.**

**a. Aggregate base materials.** The Contractor shall take samples of the aggregate base in accordance with ATM 301 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in Subsection 209-2.1. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

**b. Gradation requirements.** The Contractor shall take at least two aggregate base samples per day in the presence of the Engineer to check the final gradation. Sampling shall be per ATM 301. Material shall meet the requirements in Subsection 209-2.2. The samples shall be taken from the in-place, un-compacted material at sampling points and intervals designated by the Engineer.

**209-2.4 SEPARATION GEOTEXTILE.** Not Used.

**CONSTRUCTION METHODS**

**209-3.1 CONTROL STRIP.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the Specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined.

Control strips that do not meet Specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. The Contractor shall use the same equipment, materials, construction methods, and sequence and manner of rolling for the remainder of base course construction, unless adjustments made by the Contractor are approved by the Engineer.

**209-3.2 PREPARING UNDERLYING COURSE**. The underlying subgrade and/or subbase shall be checked and accepted, in writing, by the Engineer before base course placing and spreading operations

begin. Any ruts or soft, yielding areas shall be corrected and compacted to the required density before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope, or as directed by the Engineer.

**209-3.3 PRODUCTION**. The aggregate shall be uniformly blended and, when at a satisfactory moisture content according to Subsection 209-3.5, the approved material may be transported directly to the spreading equipment. The plant shall blend and mix the materials to meet the Specifications.

**209-3.4 PLACEMENT**.

The crushed aggregate base material shall be placed on the approved subgrade in uniform, equal-depth layers, each not exceeding 6 inches of compacted depth. The aggregate shall meet gradation and moisture requirements prior to compaction. . Crushed aggregate base course shall not be placed on frozen material.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the Specifications at the Contractor's expense.

**209-3.5 COMPACTION**. Immediately after completion of the spreading operations, and within the same day that the aggregate is placed, compact each layer of the base course to the required density.

The field density of each compacted lift of material shall be at least 98% of the maximum density of laboratory specimens prepared from samples of the crushed aggregate base material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ATM 207 or ATM 212. The moisture content of the material during placing operations shall be within ±2 percentage points of the optimum moisture content as determined by ATM 207 or ATM 212. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

**209-3.6 WEATHER LIMITATIONS.** Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

**209-3.7 MAINTENANCE.** The base course shall be maintained in a condition that will meet all Specification requirements until the work is accepted. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course to avoid rutting or uneven compaction. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at the Contractor's expense.

**209-3.8 SURFACE TOLERANCES.** After the course has been compacted, the surface will be tested by the Engineer for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches, reshaped and recompacted to grade until the required smoothness and accuracy are obtained and approved by the Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

**a. Smoothness.** The finished surface shall not vary more than 3/8-inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within +0 and -1/2 inch of the specified grade.

**209-3.9 ACCEPTANCE SAMPLING AND TESTING.** Crushed aggregate base course shall be accepted for density and thickness on an area basis. Two tests shall be made for density and thickness for each 1200 square yards. Sampling locations will be determined on a random basis according to ATM SP 4.

**a. Density.** The Engineer will perform all density tests. Base course will be accepted for density when the field density is not less than 98% of the maximum density, as determined according to ATM 207 or ATM 212. The in-place field density and moisture content will be determined according to ATM 213. If the specified density is not attained, the material shall be reworked and/or recompacted until the specified density is reached.

**b. Thickness.** The thickness of the finished base course will be determined by the Engineer by taking before and after elevation measurements, or by depth tests, at random locations. The completed thickness of the base course shall be within 1/2 inch of the design thickness. Where the thickness is deficient by more than 1/2 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

## METHOD OF MEASUREMENT

**209-4.1** The quantity of crushed aggregate base course will be determined by the ton or measured by the cubic yard of material in final position according to Subsection 90-02.

## BASIS OF PAYMENT

**209-5.1** Payment shall be made at the contract unit price per unit of measurement, accepted in place.

Payment will be made under:

| | |
|---|---|
| Item P209.010.0000 | Crushed Aggregate Base Course - per cubic yard |
| Item P209.020.0000 | Crushed Aggregate Base Course - per ton |
| Item P209.030.0000 | Crushed Aggregate Base Course Stockpile – per ton |
| Item P209.070.0000 | Base Course Reconditioning – per square yard |

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

| | |
|---|---|
| AASHTO T 96 | Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| AASHTO T 104 | Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate |
| ATM 204 | WAQTC FOP for AASHTO T 89 Determining the Liquid Limit of Soils |
| ATM 205 | WAQTC FOP for AASHTO T 90 Determining the Plastic Limit and Plasticity Index of Soils |
| ATM 207 | WAQTC FOP for AASHTO T 99/ T 180 Moisture-Density Relations of Soils |

| | |
|---|---|
| ATM 212 | Determining the Standard Density of Coarse Granular Materials Using the Vibratory Compactor |
| ATM 213 | WAQTC FOP for AASHTO T 310 In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)* |
| ATM 301 | WAQTC FOP for AASHTO T 2 Sampling of Aggregates |
| ATM 304 | WAQTC FOP for AASHTO T 27/T 11 Sieve Analysis of Fine and Coarse Aggregates * |
| ATM 305 | WAQTC FOP for AASHTO T 335 Determining the Percentage of Fracture in Coarse Aggregate* |
| ATM 306 | Determining the Percentage of Flat and Elongated Particles in Coarse Aggregate |
| ATM 313 | Degradation Value of Aggregates |
| ATM SP 4 | Random Sampling |

# ITEM P-220 CEMENT TREATED SOIL BASE COURSE

## DESCRIPTION

**220-1.1** This item shall consist of constructing a base course by uniformly mixing soil, Portland cement, and water. The mixed material shall be spread, shaped, and compacted in accordance with these Specifications and in conformity to the dimensions and typical cross-section shown on the Plans. Tests shall be required for each approved soil included within the treated layer.

Runway, taxiway, or apron pavements shall be built in a series of parallel lanes using a plan that reduces the number of longitudinal and transverse joints to a minimum.

Provide an experienced Soil-Cement technician on site to supervise the Soil-Cement process and the related process control testing.

## MATERIALS

**220-2.1 CEMENT.** Portland cement shall conform to the requirements of AASHTO M 85, Type I or II.

**220-2.2 WATER.** Water used in mixing or curing shall be from potable water sources or shall meet the requirements of ASTM C1602.

**220-2.3 SOIL.** The soil for this work shall consist of an approved select soil. The soil shall be free of roots, sod, weeds, have an organic content less than 1.5% as determined by ATM 203, shall meet the gradation in Table 220-1, as determined by ATM 304, and have a sulfate content of less than 0.3%.

**TABLE 220-1**
**GRADATION REQUIREMENTS**

| SIEVE DESIGNATION PER ATM 304 | PERCENTAGE BY WEIGHT PASSING SIEVES |
|---|---|
| 1 inch | 100 |
| No. 4 | 55-100 |
| No. 200 | 0-20 |

**220-2.4 ASPHALT MATERIAL.** Not used.

## MIX DESIGN

**220-3.1 PROPORTIONS.** Before the start of base course construction, tests shall be made on the soil or soil-aggregate material to be stabilized to determine the quantity of cement required for the job mix design.

Test specimens containing various amounts of Portland cement shall be compacted per AASHTO T 134, and the optimum moisture determined for each test specimen. Samples at the optimum moisture shall be subjected to the wet-dry and the freeze-thaw test in accordance with ASTM D559 and ASTM D560, respectively.

Cement shall be added at an application rate determined by the job mix design to achieve the strength parameters required by the embankment design. When not specified in the job mix design, molded soil-cement cylinders tested according to ASTM D1633 Method A shall have a 7-day compressive strength of 300 to 800 psi.

Submit the following to the Engineer at least 30 days before the production of soil-cement base course:

**a.** A letter stating the source of soil, Portland cement, and water proposed for use.

**b.** Furnish a minimum 300 pound representative soil sample for laboratory tests.

**c.** Furnish one sack (94 pounds) of Portland cement proposed for use in the mixture.

The Engineer will evaluate the material using procedures and test methods contained in the Portland Cement Association's "Soil-Cement Laboratory Handbook" and establish the approved job mix design which will become a part of the contract.

The approved job mix design will specify the target values for Portland cement content, the maximum density, and optimum moisture content of the soil-cement. The amount of Portland cement shall not vary more than 1% from the designated rate.

The following table provides the pre soil-cement job mix design estimating factors, and specifies the tolerance allowed the Contractor during production.

**TABLE 220-2**
**ESTIMATING FACTORS FOR BIDDING CEMENT TREATED SOIL BASE ITEM**

| MATERIAL | PRE SOIL-CEMENT JOB MIX DESIGN ESTIMATING FACTOR | PRODUCTION TOLERANCE |
|---|---|---|
| Soil | Dry Unit Weight = 107 lb/ft$^3$ (AASHTO T 99)<br>Optimum Moisture Content = 14% | |
| Soil-Cement Mixture | Dry Unit Weight = 111 lb/ft$^3$ (AASHTO T 134)<br>Optimum Moisture Content = 13% | |
| Portland Cement | 7% Portland Cement by weight of soil | ±1% Portland Cement |

**220-3.2 CONTRACTOR'S SOIL-CEMENT TECHNICIAN.** At the start of production, the Contractor shall provide an onsite technician to supervise the soil-cement process and the related process control of the product for at least 10 days of production. This technician shall have successfully supervised at least five (5) successful projects using soil-cement with similar base material and equipment. The technician must also be qualified to supervise the process control.

At the preconstruction conference, provide a submittal that includes the following information:

**a.** Resume of technician including; successful project(s) listing, owners- contact, address, and telephone number; location of projects and description of soil-cement equipment used on the projects.

**b.** Construction plan including equipment to be used and procedures to be used for mixing and paving.

**220-3.3 PRE SOIL-CEMENT PRODUCTION MEETING.** Submit a soil-cement base course production plan at the pre soil-cement production meeting to be held a minimum of 10 working days before initiating soil-cement operations. Address the sequence of operations and joint construction. Outline steps to assure product consistency, protection, and curing of the soil-cement base course. Provide calibration records of cement distributor.

## CONSTRUCTION METHODS

**220-4.1 CONTROL STRIP.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the Specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The Engineer must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet Specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has

been accepted by the Engineer. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved by the Engineer.

**220-4.2 WEATHER LIMITATIONS.** The material shall not be mixed or placed while the atmospheric temperature is below 40°F or when conditions indicate that the temperature may fall below 40°F within 24 hours, or when the weather is foggy or rainy, or to soils that are frozen or contain frost, or when the underlying material is frozen.

**220-4.3 MAINTENANCE.** The material shall be maintained in a condition that will meet all Specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all Specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at their expense.

**220-4.4 EQUIPMENT.** The course may be constructed with any equipment that will meet the requirements for soil pulverization, cement application, mixing, water application, incorporation of materials, compaction, finishing, and curing specified here. The cement distributor shall be designed to spread a uniform coverage of Portland cement at a specified rate. The spread rate shall be integrated with the speed of travel to maintain a uniform coverage. Equipment must be calibrated prior to use.

**220-4.5 PREPARATION.** The area to be stabilized shall be graded and shaped to conform to the lines, grades and cross-section shown on the Plans. Any soft or yielding areas in the subgrade shall be removed and replaced with acceptable soil and compacted to the specified density.

**220-4.6 PULVERIZATION.** After completion of moist-mixing, the soil for the base course shall be pulverized so that 100% by dry weight passes a 1-inch sieve and a minimum of 80% passes a No. 4 sieve.

**220-4.7 CEMENT APPLICATION, MIXING, AND FINISHING.** Mixing of the soil, Portland cement, and water shall be accomplished by the mixed-in-place method or the central plant mixed method.

**a. Method A – Mixed-in-place.** Shape pulverized material to the cross-section indicated. Portland cement shall be applied so that when uniformly mixed with the soil, the specified cement content is obtained, and a sufficient quantity of cement-treated soil is produced to construct a compacted cement-treated course conforming to the lines, grades, and cross-section indicated.

Immediately after the cement has been distributed, it shall be mixed with the soil. The cement shall not be mixed below the required depth. Continue mixing until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied.

Determine moisture content of the mixture immediately after completion of mixing of the soil and cement. Provide water supply and pressure distributing equipment that will permit the application within three (3) hours of all mixing water on the section being processed. Incorporate water in the mix so that concentration of water near the surface does not occur. After all mixing water has been applied, continue mixing until the water is uniformly distributed throughout the full depth of the mixture.

Do not apply cement if the soil moisture content exceeds the optimum moisture content specified for the cement-treated mixture. After mixing is complete, the proportions of the mixture shall be in accordance with the approved job mix design.

**b. Method B – Central plant mixed.** The soil, Portland cement, and water shall be mixed in either a batch or continuous-flow type pugmill. The plant shall be equipped with feeding and metering devices that will add the soil, cement, and water into the mixer in the specified quantities. Soil and

cement shall be mixed sufficiently to prevent cement balls from forming when water is added. Mixing shall continue until a uniform mixture of soil, cement, and water is obtained.

The mixture shall be hauled to the project in trucks equipped with protective covers. The mixture shall be placed on the moistened subgrade in a uniform layer by an approved spreader. Not more than 30 minutes shall elapse between the placement of soil-cement in adjacent lanes.

The layer of soil-cement shall be uniform in thickness and surface contour and of sufficient quantity that the completed base conforms to the required line, grade and cross-section. Dumping of the mixture in piles or windrows on the subgrade shall not be permitted.

Not more than 60 minutes shall elapse between the start of moist mixing and the start of compaction of soil-cement.

**220-4.8 COMPACTION.** Compaction of the course shall begin within 30 minutes after mixing the cement into the subgrade. All compaction operations shall be completed within 2 hours from the start of mixing.

The field density of the compacted mixture shall be at least 98% of the maximum density of laboratory specimens prepared from the job mix design and compacted and tested in accordance with AASHTO T 134. The in-place field density shall be determined in accordance with ATM 213. The in-place moisture content shall be determined in accordance with ASTM D2216. Test the in-place field density and moisture content at a frequency of 1 test per 1,000 $yd^2$, but not less than four (4) tests per day of production. The moisture content of the mixture at the start of compaction shall be within ±2 percentage points of the optimum moisture content.

**220-4.9 FINISHING AND CURING.** After the final lift or course of treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the cross sections.

Finished portions of treated subgrade shall be protected to prevent equipment from marring, permanently deforming, or damaging completed work.

Not later than 24 hours after completion of final finishing, the surface shall be cured by being kept continuously moist for a period of 7 days with a fog-type water spray. The curing material shall be maintained and applied as needed by the Contractor during the 7-day protection period.

Sufficient protection from freezing shall be provided for at least 7 days after its construction or as approved by the Engineer.

**220-4.10 CONSTRUCTION LIMITATIONS.** At the end of each day's construction and/or when operations after application of the cement are interrupted for more than 30 minutes, a straight transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true vertical face.

Completed portions may be opened to light traffic, if approved by the Engineer, and provided the curing is not impaired.

**220-4.11 SURFACE TOLERANCE.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

**a. Smoothness**. The finished surface shall not vary more than +/- 3/8 inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within +/-0.05 feet of the specified grade.

**220-4.12 ACCEPTANCE SAMPLING AND TESTING.** Cement Treated Solid Base course shall be accepted for density and thickness on an area basis. Two tests will be made for density and thickness for each 1,000 square yards, but not less than four (4) tests per day of production. Sampling locations will be determined on a random basis per ATM SP 4.

**a. Density.** The Engineer will perform all density tests.

Each area shall be accepted for density when the field density is at least 98% of the maximum density of laboratory specimens compacted and tested according to AASHTO T 134. The in-place field density shall be determined according to ATM 213. The in-place moisture content shall be determined in accordance with ASTM D2216. Perform in-place density test immediately after completion of compaction to determine degree of compaction. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted at the Contractor's expense and two additional random tests made. This procedure shall be followed until the specified density is reached.

**b. Thickness.** Depth tests shall be made for each sublot by test holes or cores at least 3 inches in diameter that extend through the base. Depth tests shall be taken by the Contractor in the presence of the Engineer. For sublots where the thickness is deficient by more than 1/2-inch, the material shall be removed to full depth and replaced, at Contractor's expense.

## METHOD OF MEASUREMENT

**220-5.1** The quantity of cement treated soil base course shall be the number of square yards of completed and accepted base course.

**220-5.2** Portland cement shall be measured by the ton.

## BASIS OF PAYMENT

**220-6.1** Payment shall be made at the contract unit price per square yard for cement treated soil base course. This price shall be full compensation for furnishing all materials, except Portland cement, and for all preparation, delivering, placing, and mixing of these materials; and for all labor, equipment, tools and incidentals necessary to complete the item.

**220-6.2** Payment shall be made at the contract unit price per ton for cement. This price shall be full compensation for furnishing this material and for all delivery, placing, and incorporation of this material, and for all labor including the experienced soil-cement technician, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

| | |
|---|---|
| Item P220.010.0000 | Cement Treated Soil Base Course - per square yard |
| Item P220.020.0000 | Portland Cement - per ton |

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

| | |
|---|---|
| AASHTO M 85 | Portland Cement |
| AASHTO T 99 | Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop |

| | |
|---|---|
| AASHTO T 134 | Moisture-Density Relations of Soil-Cement Mixtures |
| ASTM D559 | Wetting and Drying Compacted Soil-Cement Mixtures |
| ASTM D560 | Freezing and Thawing Compacted Soil-Cement Mixtures |
| ASTM C1602 | Mixing Water Used in the Production of Hydraulic Cement Concrete |
| ASTM D1633 | Compressive Strength of Molded Soil-Cement Cylinders |
| ASTM D2216 | Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass |
| ATM 203 | Organic Content of Soils |
| ATM 213 | In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |
| ATM 304 | Sieve Analysis of Fine and Coarse Aggregates and Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregate by Washing |
| ATM SP 4 | Random Sampling |

# ITEM P-299 AGGREGATE SURFACE COURSE

## DESCRIPTION

**299-1.1** This item consists of an aggregate surface course composed of crushed or uncrushed coarse aggregate bonded with either soil or fine aggregate or both. It shall be constructed on a prepared course according to these Specifications and to the dimensions and typical cross section shown on the Plans.

## MATERIALS

**299-2.1 GENERAL.** Aggregates shall consist of hard, durable particles or fragments of stone or gravel mixed or blended with sand, stone dust, or other similar binding or filler materials produced from approved sources. The aggregate shall be free from vegetation, lumps, or excessive amounts of clay and other objectionable substances. The coarse aggregate shall have a minimum degradation value of 45 when tested according to ATM 313. The aggregate shall have a percent of wear not more than 50 at 500 revolutions as determined by AASHTO T 96 and shall not show evidence of disintegration nor show loss greater than 12% when subjected to 5 cycles of sodium sulfate accelerated soundness test using AASHTO T 104.

**a. Crushed Aggregate Surface Course.** The aggregates shall consist of both fine and coarse fragments of crushed stone or crushed gravel mixed or blended with sand, screenings, or other similar approved materials. The material shall consist of hard, durable particles or fragments of stone and shall be free from excess soft or disintegrated pieces, dirt, or other objectionable matter.

The fractured particles in the finished product shall be as uniform as practicable. At least 75% by weight of material retained on the No. 4 sieve shall have one or more fractured faces, when tested according to ATM 305.

If necessary to meet this requirement, or to eliminate an excess of fine, uncrushed particles, the gravel shall be screened before crushing.

The fine, aggregate portion, defined as the portion passing the No. 4 sieve, produced in crushing operations, shall be incorporated in the base material to the extent permitted by the gradation requirements.

**b. Uncrushed Aggregate Surface Course.** This material may consist of natural pit-run aggregate. However, screening, blending, ripping, washing, and/or necessary mixing of the material or other processing may be necessary to meet the gradation and performance requirements of this specification.

**299-2.2 GRADATION.** The gradation of the uncrushed or crushed material shall meet the requirements of the gradations indicated in Table 1, when tested according to ATM 304.

**TABLE 1**
**AGGREGATE GRADATION REQUIREMENTS**

| Sieve Designation(Square Openings) | Percentage by weight passing sieves For E-1 |
|---|---|
| 1.0 in. | 100 |
| 3/4 in. | 70-100 |
| 3/8 in. | 50-85 |
| No. 4 | 35-65 |
| No. 8 | 20-50 |
| No. 50 | 15-30 |
| No. 200 | 8-15 |

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

The portion of the material passing the No. 40 sieve shall have a liquid limit not more than 35 and a plasticity index not more than 10, when tested according to ATM 204 and ATM 205.

**299-2.3 FINES FOR BLENDING.** If additional fine material is necessary, it shall be obtained from approved sources and uniformly blended with the aggregate at the crushing plant, the mixing plant, or as approved by the Engineer. Silt, stone dust, or other similar fine material may be used as binder.

## CONSTRUCTION METHODS

**299-3.1 (RESERVED).**

**299-3.2 PREPARING UNDERLYING COURSE.** The underlying course will be checked and accepted by the Engineer before placing and spreading operations are started. Any ruts or soft areas shall be corrected and compacted to the required density before placing aggregate surface course.

To protect the underlying course and to ensure proper drainage, the spreading of the aggregate surface course shall begin along the centerline on a crowned section or on the high side of sections with a one-way slope.

**299-3.3 METHODS OF PRODUCTION.** The aggregate shall be uniformly blended and when at the satisfactory moisture content per paragraph 299-3.5, the approved material may be transported directly to the spreading equipment.

**299-3.4 PLACING.** The surface course shall be constructed without segregation of the aggregate. The material shall be placed in uniform, equal-depth layers, each not exceeding 6 inches of compacted depth. No material shall be placed in snow or on a soft uncompacted, muddy, or frozen course.

During the mixing and spreading process, sufficient caution shall be exercised to prevent the incorporation of subgrade, subbase, or shoulder material in the surface course mixture.

**299-3.5 COMPACTION.** Immediately upon completion of the spreading operations, the aggregate shall be thoroughly compacted to the required density. The moisture content of the material shall be ± 2 percentage points of the optimum moisture content.

**299-3.6 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY.** The surface course will be accepted for density when the field density is not less than 95% of the maximum density, as determined according to ATM 207, ATM 212, or ATM 309. The control strip for ATM 309 shall be compacted by a vibratory compactor with a minimum operating weight of 22,000 pounds. The in-place field density and moisture content will be determined according to ATM 213. If the specified density is not attained, the material shall be reworked and/or recompacted until the specified density is reached.

**299-3.7 FINISHING.** The surface of the aggregate surface course shall be finished by blading or with automated equipment specifically designed for this purpose.

In no case shall thin layers of material be added to the top of surface course to meet grade. If the compacted elevation of the top layer is 0.05 foot or more below grade, it shall be scarified to a depth of at least 3 inches, new material added, and the layer shall be blended and compacted to bring it to grade. If the finished surface is above plan grade, it shall be cut back to grade and recompacted.

**299-3.8 SURFACE TEST.** After the course has been completely compacted, the surface will be tested by the Engineer for smoothness and accuracy of grade and crown. The finished grade elevation shall not vary more than 0.05 foot from the design elevation. The finished surface shall not vary more than 3/8 inch from a 12-foot straightedge when applied to the surface parallel with, and at right angles to, the

centerline. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be corrected to within the specified tolerances and approved by the Engineer.

**299-3.9 PROTECTION.** Work on the surface course shall not be accomplished during freezing temperatures or when the subgrade is wet. When the aggregates contain frozen materials or when the underlying course is frozen, the construction shall be stopped.

Hauling equipment may be routed over completed portions of the surface course, provided no damage results and provided that such equipment is routed over the full width of the surface course to avoid rutting or uneven compaction. However, the Engineer in charge will have full and specific authority to stop all hauling over completed or partially completed surface course when, in their opinion, such hauling is causing damage. Any damage resulting to the surface course from routing equipment over the surface course shall be repaired by the Contractor at their own expense.

**299-3.10 MAINTENANCE.** Following the completion of the aggregate surface course, the Contractor shall satisfactorily remove all blue tops, fill and compact the voids, and perform all maintenance work on this surface until final acceptance unless otherwise stated in the Specifications. The surface course shall be properly drained at all times.

## METHOD OF MEASUREMENT

**299-4.1** Aggregate Surface Course will be weighed by the ton or measured by the cubic yard in final position according to GCP Subsection 90-02.

## BASIS OF PAYMENT

**299-5.1** Aggregate Surface Course will be paid for at the contract price, per unit of measurement, accepted in place.

Payment will be made under:

| | |
|---|---|
| Item P299.010.0000 | Crushed Aggregate Surface Course – per cubic yard |
| Item P299.020.0000 | Crushed Aggregate Surface Course – per ton |
| Item P299.030.0000 | Crushed Aggregate Surface Course – per contingent sum |
| Item P299.040.0000 | Uncrushed Aggregate Surface Course – per cubic yard |

## TESTING REQUIREMENTS

| | |
|---|---|
| AASHTO T 96 | Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| AASHTO T 104 | Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate |
| ATM 212 | WAQTC FOP for AASHTO T 27/T 11 Sieve Analysis of Fine and Coarse Aggregates * |
| ATM 313 | Degradation Value of Aggregates |
| ATM 304 | WAQTC FOP for AASHTO T 27/T 11 Sieve Analysis of Fine and Coarse Aggregates * |
| ATM 204 | WAQTC FOP for AASHTO T 89 Determining the Liquid Limit of Soils |
| ATM 205 | WAQTC FOP for AASHTO T 90 Determining the Plastic Limit and Plasticity Index of Soils |
| ATM 207 | WAQTC FOP for AASHTO T 99/ T 180 Moisture-Density Relations of Soils* |

| | |
|---|---|
| ATM 213 | WAQTC FOP for AASHTO T 310 In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)* |
| ATM 305 | WAQTC FOP for AASHTO T 335 Determining the Percentage of Fracture in Coarse Aggregate* |