Item P-219 Recycled Concrete Aggregate Base Course

DESCRIPTION

219-1.1 This item consists of a base course composed of recycled concrete aggregate, crushed to meet a particular gradation, constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross sections shown on the plans.

MATERIALS

219-2.1 AGGREGATE. Recycled concrete aggregate shall consist of Portland Cement Concrete (PCC) or other concrete containing pozzolanic binder material. The recycled concrete material shall be free of reinforcing steel, expansion material, or any material other than PCC. An incidental amount of recycled asphalt concrete pavement and other foreign material may be present in the recycled concrete aggregate per the following table. Any recycled concrete shall be tested with a petrographic examination using ASTM C 856 to confirm it does not contain any deleterious reactions such as alkali-silica of sulfate-aluminate reaction. Sampling shall be representative of all material to be used on the project and within 30 days of installation and the testing laboratory shall conform to ASTM C 1077. Recycled concrete aggregate for base course shall consist of at least 97 percent, by weight, Portland cement concrete, with the following materials making up the remaining 3.0 percent. ASTM C 295 shall be used to determine the conformance to the following table:

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>0.1 percent maximum</td>
</tr>
<tr>
<td>Brick, mica, schist, or other friable materials</td>
<td>0.9 percent maximum</td>
</tr>
<tr>
<td>Asphalt concrete</td>
<td>2 percent maximum</td>
</tr>
</tbody>
</table>

Virgin aggregates may be added to meet the 97 percent minimum concrete requirement.

The percentage of wood, brick, mica, schist, other friable materials, and asphalt concrete shall be determined by weighing that material retained on the No. 4 sieve, and dividing by the total weight of recycled concrete aggregate material retained on the No. 4 sieve.

Fine aggregate passing the No. 4 (4.75-mm) sieve shall consist of fines from the operation of crushing the recycled concrete aggregate. If necessary, fine aggregate may be added to produce the correct gradation. The fine aggregate shall be produced by crushing stone, gravel, slag, or recycled concrete that meet the requirements for wear and soundness specified for coarse aggregate.

The amount of flat and elongated particles in recycled concrete aggregate shall not exceed 20 percent for the fraction retained on the 0.5 in (13 mm) sieve nor 20 percent for the fraction passing the 0.5 in (13 mm) sieve when tested in accordance with ASTM D 4791. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3.
The percentage of wear shall not be greater than 45 percent when tested in accordance with ASTM C 131. The sodium sulfate soundness test (ASTM C 88) requirement is waived for recycled concrete aggregate.

The fraction passing the No. 40 (0.42-mm) sieve shall have a liquid limit no greater than 25 and a plasticity index of not more than 4 when tested in accordance with ASTM D 4318. The fine aggregate shall have a minimum sand equivalent value of 35 when tested in accordance with ASTM D 2419.

**a. Sampling and Testing.** Recycled concrete aggregate samples and preliminary test results shall be furnished by the Contractor prior to the start of base construction. All tests for initial aggregate submittals necessary to determine compliance with the specification requirements will be made by the Contractor and reviewed and approved by the Engineer. Samples and test results of processed base material, including gradation, shall be provided and submitted by the Contractor for review and approval by the Engineer. Cost associated with this testing shall be considered incidental to this item.

Test results and samples of recycled concrete aggregate shall be furnished by the Contractor at the start of production and at intervals during production. The sampling points and intervals will be designated by the Engineer. The sample along with test results will be the basis of approval of specific lots of recycled concrete aggregate for the quality requirements.

Samples of recycled concrete aggregate to check gradation shall be taken and tested at least once daily. Sampling shall be in accordance with ASTM D 75, and testing shall be in accordance with ASTM C 136 and C 117.

**b. Gradation Requirements.** The gradation (job mix) of the final mixture shall fall within the design range indicated in Table 1, when tested in accordance with ASTM C 117 and C 136. The final gradation shall be continuously graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on an adjacent sieve or vice versa.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percentage by Weight Passing Sieves</th>
<th>Job Mix Tolerances Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 in (50.8 mm)</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>1-1/2 (37.5 mm)</td>
<td>95 – 100</td>
<td>+/- 5</td>
</tr>
<tr>
<td>1 in (25.0 mm)</td>
<td>70 – 95</td>
<td>+/- 8</td>
</tr>
<tr>
<td>3/4 in (19.0 mm)</td>
<td>55 – 85</td>
<td>+/- 8</td>
</tr>
<tr>
<td>No. 4 (4.75 mm)</td>
<td>30 – 60</td>
<td>+/- 8</td>
</tr>
<tr>
<td>No. 30 (0.60 mm)</td>
<td>12 – 30</td>
<td>+/- 5</td>
</tr>
<tr>
<td>No. 200 (0.075 mm)</td>
<td>0 – 5</td>
<td>+/- 3</td>
</tr>
</tbody>
</table>

The job mix tolerances in Table 1 shall be applied to the job mix gradation to establish a job control gradation band. The full tolerance still will apply if application of the tolerances results in a job control gradation band outside the design range.


EQUIPMENT

219-3.1 GENERAL. All equipment necessary to mix, transport, place, compact, and finish the recycled concrete aggregate base course shall be furnished by the Contractor. The Contractor shall provide written certification to the Engineer that all equipment meets the requirements for this section. The equipment shall be inspected by the Engineer at the job site prior to the start of construction operations.

219-3.2 MIXING EQUIPMENT. Base course shall be thoroughly mixed in a plant suitable for recycled concrete aggregate. The mixer shall be a batch or continuous-flow type and shall be equipped with calibrated metering and feeding device that introduce the aggregate and water into the mixer in specified quantities. If necessary, a screening device shall be installed to remove oversized material greater than 2 in (50 mm) from the recycled concrete aggregate feed.

Free access to the plant shall be provided to the Engineer at all times for inspection of the plant’s equipment and operation and for sampling the mixed recycled concrete aggregate materials.

219-3.3 HAULING EQUIPMENT. The mixed recycled concrete aggregate base course shall be transported from the plant to the job site in hauling equipment having beds that are smooth, clean, and tight. Truck bed covers shall be provided and used to protect the mixed recycled concrete aggregate base course from rain during transport.

219-3.4 PLACING EQUIPMENT. Recycled concrete aggregate shall be placed using a mechanical spreader or machine capable of receiving, spreading, and shaping the material without segregation into uniform layer or lift. The placing equipment shall be equipped with a strike off plate that can be adjusted to the layer thickness. The placing equipment shall have two end gates or cut off plates, so that the recycled concrete aggregate may be spread up to a lane width.

219-3.5 COMPACTION EQUIPMENT. Recycled concrete aggregate base course compaction shall be accomplished using one or a combination of the following pieces of equipment:

- Steel-wheeled roller
- Vibratory roller
- Pneumatic-tire roller
- Hand-operated power tampers (for areas inaccessible to rollers)

219-3.6 FINISHING EQUIPMENT. Trimming of the compacted recycled concrete aggregate to meet surface requirements shall be accomplished using a self-propelled grader or trimming machine, with a mold board cutting edge of 12 ft (3.7 m) minimum width automatically controlled by sensors in conjunction with an independent grade control from a taut string line. String line will be required on both sides of the sensor controls for all lanes.

CONSTRUCTION METHODS

219-4.1 WEATHER LIMITATIONS. Construction is allowed only when the atmospheric temperature is at or above 35 °F (2 °C). When the temperature falls below 35 °F (2 °C), the contractor shall protect all completed areas against detrimental effects of freezing. Areas damaged by freezing, rainfall, or other weather conditions shall be corrected.

Recycled Concrete Aggregate Base Course
Page P-219-3 Addendum 4, December 2, 2014
219-4.2 PREPARING UNDERLYING COURSE. The underlying course shall be checked by the Engineer before placing and spreading operations are started. Any ruts or soft yielding places caused by improper drainage conditions, hauling, or any other cause shall be corrected at the Contractor’s expense before the base course is placed thereon. Material shall not be placed on frozen material.

To protect the existing layers and to ensure proper drainage, the spreading of the recycled concrete aggregate base course shall begin along the centerline of the pavement on a crowned section or on the greatest contour elevation of a pavement with a variable uniform cross slope.

219-4.3 GRADE CONTROL. Grade control between the edges of the recycled concrete aggregate base course shall be accomplished by grade stakes, steel pins, or forms placed in lanes parallel to the centerline and at intervals of 50 ft (15 m) or less on the longitudinal grade and 25 ft (7.5 m) or less on the transverse grade.

219-4.4 MIXING. The recycled concrete shall be uniformly blended during crushing operations and mixed with water in a mixing plant suitable for recycled concrete aggregate. The plant shall blend and mix the materials to meet the specifications and to secure the proper moisture content for compaction.

219-4.5 PLACING. The recycled concrete aggregate base material shall be placed on the moistened subgrade or base in layers of uniform thickness with an approved mechanical spreader.

The maximum depth of a compacted layer shall be 6 in (150 mm). If the total depth of the compacted material is more than 6 in (150 mm), it shall be constructed in two or more layers. In multi-layer construction, the material shall be placed in approximately equal-depth layers.

The previously constructed layer shall be cleaned of loose and foreign material prior to placing the next layer. The surface of the compacted material shall be kept moist until covered with the next layer.

Adjustments in placing procedures or equipment shall be made to obtain grades, to minimize segregation grading, to adjust the water content, and to ensure an acceptable recycled concrete aggregate base course.

219-4.6. EDGES OF BASE COURSE. The recycled concrete aggregate shall be placed so that the completed section will wider, on all sides, than the next layer that will be placed above it, as shown on the plans. Approved fill material shall be placed along the free edges of the recycled concrete aggregate in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple course, allowing in each operation at least a 2 ft (0.6-m) width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of base course. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along the edge at the same time.

219-4.7 COMPACTION. Immediately upon completion of the spreading operations, the recycled concrete aggregate shall be compacted. The number, type, and weight of rollers shall be sufficient to compact the material to the required density.

Each layer of the recycled concrete aggregate base course shall be compacted to the required density using the compaction equipment. The moisture content of the material during placing operations shall not be below, nor more than 1-1/2 percentage points above, the optimum moisture content as determined by ASTM D 1557.
The compaction shall continue until each layer has a degree of compaction that is at least 100 percent of the laboratory maximum density through the full depth of the layer. The contractor shall make adjustments in compacting or finishing techniques to obtain true grades, to minimize segregation and degradation, to reduce or increase water content and to ensure a satisfactory base course. Any materials found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, so that the requirements of this specification are met.

219-4.8 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY.

Contractor’s laboratory shall perform all density and gradation tests in the Engineer’s presence and provide the test results upon completion daily to the Engineer for acceptance. All costs associated with this testing shall be considered incidental to this item. Recycled concrete aggregate shall be accepted for gradation and density on a lot basis. A lot will consist of one day’s production where it is not expected to exceed 2,400 sq yd (2,000 sq m) per lift. A lot will consist of one-half day’s production, where a day’s production is expected to consist of between 2,400 and 4,800 sq yd (2,000 and 4,000 sq m) per lift.

Each lot shall be divided into two equal sublots. One gradation and density test shall be made for each sublot. Sampling locations will be determined on a random basis in accordance with statistical procedures contained in ASTM D 3665. Sample for gradation shall be collected from material in-place prior to start of the compaction.

Each lot will be accepted for gradation when it falls within the limits and tolerances shown in Table 1 when tested in accordance with ASTM C 117 and C 131. If the proper gradation is not attained the gradation test will be repeated. If the re-test does not indicate gradations within the limits of the table above, the entire lot shall be rejected and replaced by the Contractor at the Contractor’s expense.

Each lot will be accepted for density when the field density is at least 100 percent of the maximum density of laboratory specimens prepared from samples of the base course material delivered to the job site. The specimens shall be compacted and tested in accordance with ASTM D 1557. The in-place field density shall be determined in accordance with ASTM D 1556, D 2167 or ASTM D6938. The field density shall be determined in accordance with ASTMD6938 using Procedure A, the direct transmission method and the machines shall be calibrated in accordance with per ASTM D6938. When using the nuclear method, ASTM D4643 shall be used to determine the moisture content of the material. The calibration curve furnished with the nuclear gauges shall be checked in accordance with ASTM standards. The calibration checks gauge shall be made at the beginning of a job and at regular intervals.

If a nuclear gauge is used for density determination, two random measurements shall be made and averaged for each sublot.

If the specified density is not attained, the entire lot shall be reworked and two additional random tests made. This procedure shall be followed until the specified density is reached.

219-4.9 FINISHING. The surface of the recycled concrete aggregate base course shall be finished by equipment designed for this purpose.

In no case will thin layers of material be added to the top of base course to meet grade. If the elevation of the layer is 1/2 in (12 mm) or more below grade, the layer shall be scarified to a depth of at least 3 in (75 mm), new material added, and the layer shall be recompacted. If the finished surface is above plan grade, it shall be cut back to grade and rerolled. The grade shall be measured on a maximum 25-foot (7.5-m) grid (longitudinal and transverse). Thickness results shall be furnished to the Engineer daily for acceptance determination.
Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, and recompacted or replaced at Contractor’s expense.

219-4.10 SURFACE TOLERANCES. Surface tolerance shall be tested by the Engineer. The finished surface shall not vary more than 3/8 in (9 mm) when tested with a 12 ft (3.7 m) straightedge applied parallel with or at right angles to the centerline. The Contractor shall correct any deviation in excess of this amount, at the Contractor’s expense.

219-4.11 THICKNESS CONTROL. The completed thickness of the base course shall be within 0.5 in (13 mm) of the design thickness. Four determinations of thickness shall be made for each lot of material placed. Each lot shall be divided into four equal sublots. One test shall be made for each sublot. Sampling locations will be determined on a random basis in accordance with procedures contained in ASTM D 3665. Where the thickness is deficient by more than 0.5 in (13 mm), the Contractor shall correct such areas at no additional cost by excavating to the required depth and replacing with new material. Additional test holes may be required to identify the limits of deficient areas. Contractor will core for thickness and fill in the holes.

219-4.12 TRAFFIC. Equipment used in construction may be routed over completed portions of the base course, provided no damage results and provided that the equipment is distributed evenly over the full width of the base course to avoid rutting or uneven compaction.

219-4.13 MAINTENANCE. The base course shall be maintained until the base course is completed and accepted. Maintenance will include immediate repairs to any defects and shall be repeated as often as necessary to keep the completed work intact. Any area of the recycled concrete aggregate base course that is damaged shall be reworked as necessary by the Contractor at Contractor’s expense.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The following item shall be measured and paid for as described in Project Requirements PR–4 of these specifications.

- Recycled Concrete Aggregate Base Course (6-Inch Deep)

TESTING REQUIREMENTS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C 29</td>
<td>Unit Weight of Aggregate</td>
</tr>
<tr>
<td>ASTM C88</td>
<td>Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate</td>
</tr>
<tr>
<td>ASTM D75</td>
<td>Standard Practice for Sampling Aggregates</td>
</tr>
<tr>
<td>ASTM C 117</td>
<td>Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing</td>
</tr>
<tr>
<td>ASTM C 131</td>
<td>Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine</td>
</tr>
<tr>
<td>ASTM C 136</td>
<td>Sieve or Screen Analysis of Fine and Coarse Aggregate ASTM D 75 Sampling Aggregate</td>
</tr>
<tr>
<td>ASTM D 693</td>
<td>Crushed Stone, Crushed Slag, and Crushed Gravel for Dry-or Water-Bound Aggregate</td>
</tr>
</tbody>
</table>
Macadam Base Courses and Bituminous Macadam Base and Surface Courses of Pavements

ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

ASTM D 1556 Density of Soil in Place by the Sand-Cone Method

ASTM D 1557 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18 in (457-mm) Drop

ASTM D 2167 Density of Soil in Place by the Rubber-Balloon Method ASTM D 2419 Sand Equivalent Value of Soils and Fine Aggregate


ASTM D3665 Standard Practice for Random Sampling of Construction Materials

ASTM D 6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods

ASTM D 3665 Random Sampling of Paving Materials

ASTM D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D 4643 Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating

ASTM D 4718 Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

ASTM D 4791 Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

END OF ITEM P-219
Section 302-5  Asphalt Concrete Pavement (Greenbook)


The CONTRACTOR shall provide a Nuclear Gauge Technician during all paving operations to ensure that the minimum compaction is achieved in accordance with FAA Specifications Nuclear Gauge (FAA 120).

Testing for density and smoothness shall be completed by the Contactor for Engineer’s review and approval.

302-5.2 MATERIALS.

a. Surface or Base Course Mixes shall be as follows:
   1. Type C2, 3/4–inch MAX Aggregate, Coarse
   b. Binder shall be PG 64-10 for surface courses and or base or leveling courses.
   c. Tack Coat shall be PG 64-10 paving asphalt

302-5.3 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Job Mix Formula
   1. Aggregates
   2. Bitumen
b. Plant and Equipment
c. Laboratory Certifications
d. Testing Facility Certifications
e. Laydown Plan

302-5.6.2 Density and Smoothness-

a. All paved areas shall be compacted to a minimum 95 percent of the density obtained from California Test 304

MEASUREMENT AND PAYMENT

The following item shall be measured and paid for as described in Project Requirements PR–4 of these specifications.

• Asphalt Concrete Pavement (Greenbook)

END OF SECTION 302-5