U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Change 24 to STANDARDS FOR SPECIFYING CONSTRUCTION OF AIRPORTS--Updates Crushed Aggregate Base Course Specification

Date: 4/16/86
Initiated by: AAS-200

AC No: 150/5370-10
Change: 24

1. PURPOSE. Item P-209, Crushed Aggregate Base Course has been revised and updated.

2. PRINCIPAL CHANGES. Principal changes include:

   a. Revision of gradations and addition of job mix tolerances.

   b. Provision for non-frost susceptible material.

   c. Addition of a statistically based specification for acceptance for density.

The change number and date of change are carried at the top of each page.

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ITEM P-209 CRUSHED AGGREGATE BASE COURSE

1. DESCRIPTION

1.1 This item consists of a base course composed of crushed aggregates constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross sections shown on the plans.

2. MATERIALS

2.1 AGGREGATE. Aggregates shall consist of clean, sound, durable particles of crushed stone, crushed gravel, or crushed slag and shall be free from coatings of clay, silt, vegetable matter, and other objectionable materials and shall contain no clay balls. Fine aggregate passing the number 4 (9.5 mm) sieve shall consist of fines from the operation of crushing the coarse aggregate. If necessary, fine aggregate may be added to produce the correct gradation. The fine aggregate shall be produced by crushing stone, gravel, or slag that meet the requirements for wear and soundness specified for coarse aggregate.

The crushed slag shall be an air-cooled, blast furnace slag and shall have a unit weight of not less than 70 pounds per cubic foot (1.12 Mg/m3) when tested in accordance with ASTM C29.

The crushed aggregate portion which is retained on the number 4 sieve shall contain not more than 15 percent, by weight, of flat or elongated pieces as defined in ASTM D693 and shall have at least 90 percent by weight of particles with at least two fractured faces and 100 percent with at least one fractured face. The area of each face shall be equal to at least 75 percent of the smallest midsectional 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.

The percentage of wear shall not be greater than 45 percent when tested in accordance with ASTM C131. The sodium sulfate soundness loss shall not exceed 12 percent, after 5 cycles, when tested in accordance with ASTM C88.

The fraction passing the No. 40 (0.042 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 D4318. The fine aggregate shall have a minimum sand equivalent value of 35 when tested in accordance with ASTM D2419.

a. Sampling and Testing. Aggregates for preliminary testing shall be furnished by the Contractor prior to the start of production. All tests for initial aggregate submittals necessary to determine compliance with the specification requirements will be made by the Engineer at no expense to the Contractor.

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Samples of aggregates 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 samples will be the basis of approval of specific lots of aggregates from the standpoint of the quality requirements of this section.

In lieu of testing, the Engineer may accept certified State test results indicating that the aggregate meets specification requirements.

Samples of aggregates to check gradation shall be taken by the Engineer at least once daily. Sampling shall be in accordance with ASTM D75, and testing shall be in accordance with ASTM C136 and C117.

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 C117 and C136. The final gradation shall be continuously well 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 1. REQUIREMENTS FOR GRADATION OF AGGREGATE 1/

Sieve Size	Design Range Percentage by Weight Passing Sieves	Job Mix Tolerances Percent
2 in (50.0 mm)	100	
1½ in (37.0 mm)	95-100	± 5
1 in (25.0 mm)	70-95	± 8
3/4 in (19.0 mm)	55-85	± 8
No. 4 (4.75 mm)	30-60	± 8
No. 30 (0.60 mm)	12-30	± 5
No. 200 (0.075 mm)	0-8	± 3

1/ Where environmental conditions (temperature and availability of free moisture) indicate potential damage due to frost action, the maximum percent of material, by weight, of particles smaller than 0.02 mm shall be 3 percent. It also may be necessary to have a lower percentage of material passing the No. 200 sieve to help control the percentage of particles smaller than 0.02 mm.

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

The fraction of the final mixture that passes the No. 200 (0.075 mm) sieve shall not exceed 60 percent of the fraction passing the No. 30 (0.60 mm) sieve.

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3. CONSTRUCTION METHODS

3.1 PREPARING UNDERLYING COURSE. The underlying course shall be checked and accepted 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 subgrade.

3.2 MIXING. The aggregate shall be uniformly blended during crushing operations or mixed in a plant. The plant shall blend and mix the materials to meet the specifications and to secure the proper moisture content for compaction.

3.3 PLACING. The crushed aggregate base material shall be placed on the moistened subgrade in layers of uniform thickness with a mechanical spreader.

The maximum depth of a compacted layer shall be 6 inches (15.2 cm). If the total depth of the compacted material is more than 6 inches it, shall be constructed in two or more layers. In multi-layer construction, the base course shall be placed in approximately equal-depth layers.

The previously constructed layer should 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.

3.4 COMPACTION. Immediately upon completion of the spreading operations, the crushed aggregate shall be thoroughly compacted. The number, type, and weight of rollers shall be sufficient to compact the material to the required density.

The moisture content of the material during placing operations shall not be below, nor more than 1½ percentage points above, the optimum moisture content as determined by ASTM D1557, Method D, or ASTM D698, Method D. The Engineer shall designate the appropriate ASTM standard.

3.5 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY. Aggregate base course shall be accepted for density on a lot basis. A lot will consist of one day's production where it is not expected to exceed 2400 square yards (2000 square meters). A lot will consist of one-half day's production where a day's production is expected to consist of between 2400 and 4800 square yards (2000 and 4000 square meters).

Each lot shall be divided into two equal sublots. One test shall be made for each sublot. Sampling locations will be determined by the Engineer on a random basis in accordance with statistical procedures contained in ASTM D3665.

Each lot will be accepted for density when the field density is at least 100 percent of the maximum density of laboratory prepared specimens. The laboratory density shall be determined in accordance with ASTM D1557, Method D, or D698, Method D The Engineer shall designate the appropriate ASTM standard. The in-place field

density shall be determined in accordance with ASTM D1556 or D2167. If the specified density is not attained, the entire lot shall be reworked and/or recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached.

In lieu of the core method of field density determination, acceptance testing may be accomplished using a nuclear gage in accordance with ASTM D2922. The gage should be field calibrated in accordance with paragraph 4 of D2922. Calibration tests shall be conducted on the first lot of material placed that meets the density requirements.

Use of D2922 results in a wet unit weight, and when using this method, ASTM D3017 shall be used to determine the moisture content of the material. The calibration curves furnished with the moisture gages shall be checked as described in paragraph 7 of D3017. The calibration checks of both the density and moisture gages shall be made at the beginning of a job and at intervals as determined by the Engineer.

If a nuclear gage is used for density determination, two random readings shall be made for each sublot.

3.6 FINISHING. The surface of the aggregate base course shall be finished by blading or with automated equipment especially designed for this purpose.

In no case will the addition of thin layers of material be added to the top layer of base course to meet grade. If the elevation of the top layer is ½ inch or more below grade, the top layer of base shall be scarified to a depth of at least 3 inches, new material added, and the layer shall be blended and recompacted to bring it to grade. If the finished surface is above plan grade, it shall be cut back to grade and rerolled.

3.7 SURFACE TOLERANCE. The finished surface shall not vary more than 3/8 inch (10 mm) when tested with a 16-foot (5m) straight-edge applied parallel with or at right angles to the centerline. Any deviation in excess of this amount shall be corrected by the Contractor at the Contractor's expense.

3.8 THICKNESS CONTROL. The completed thickness of the base course shall be within 1/2 inch (12 mm) of the design thickness. Four determinations of thickness shall be made for each lot of material placed. The lot size shall be consistent with that specified in paragraph 3.5. Each lot shall be divided into four equal sublots. One test shall be made for each sublot. Sampling locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665. Where the thickness is deficient by more than ½ inch, 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.

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3.9 MAINTENANCE. The base course shall be maintained in a condition that will meet all specification requirements until the work is accepted. Equipment used in the construction of an adjoining section may be routed over completed portions of the base course, provided no damage results and provided that the equipment is routed over the full width of the base course to avoid rutting or uneven compaction.

4. METHOD OF MEASUREMENT.

4.1 The quantity of crushed aggregate base course to be paid for will be determined by measurement of the number of square yards (square meters) or cubic yards (cubic meters) of material actually constructed and accepted by the Engineer as complying with the plans and specifications. On individual depth measurements, thicknesses more than ½ inch (12mm) in excess of the design thickness shall be considered as the specified thickness, plus ½ inch in computing the number of cubic yards for payment.

5. BASIS OF PAYMENT

5.1 Payment shall be made at the contract unit price per square yard (square meter) or cubic yard (cubic meter) for crushed aggregate base course. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-209-5.1	Crushed Aggregate Base Course - per square yard (square meter)
Item P-209-5.2	Crushed Aggregate Base Course - per cubic yard (cubic meter)

6. TESTING REQUIREMENTS

ASTM C29	Unit Weight of Aggregate
ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Materials Finer than 75um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

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ASTM C136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D75	Sampling Aggregate
ASTM D693	Crushed Stone, Crushed Slag, and Crushed Gravel for Dry-or Water-Bound Macadam Base Courses and Bituminous Macadam Base and Surface Courses of Pavements.
ASTM D698	Moisture-Density Relations of Soils and Soil - Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in (305mm) Drop
ASTM D1556	Density of Soil in Place by the Sand - Cone Method
ASTM D1557	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5kg) Rammer and 18 in. (145)mm Drop
ASTM D2167	Density of Soil in Place by the Rubber-Ballon Method
ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D3017	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D3665	Random Sampling of Paving Materials
ASTM D4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D2922	Density of Soil and Soil - Aggregate in Place by Nuclear Methods
ASTM D3017	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D3665	Random Sampling of Paving Materials
ASTM D4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils

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