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METHOD OF TEST FOR SOIL AND AGGREGATE SAMPLE PREPARATION

A. SCOPE

This test method describes the procedure for preparing untreated aggregate and disturbed soil samples, as received from the field, for the required tests. Separation by screening, weighing, removing soil coatings from coarse aggregate, breaking up clods, and splitting out representative samples of specified size are described.

B. REFERENCE

California Test 105 - Calculations Pertaining to Gradings and Specific Gravities
California Test 202 - Sieve Analysis of Fine and Coarse Aggregates
California Test 227 - Evaluating Cleanness of Coarse Aggregate
AASHTO M 92 - Wire-Cloth Sieves for Testing Purposes
AASHTO R 18 - Establishing and Implementing a Quality System for Construction Materials Testing Laboratories
ASTM E 11 - Standard Specification for Wire Cloth and Sieves for Testing Purposes

C. APPARATUS

1. Sieves: U. S. standard sieves conforming to AASHTO M 92. The standard sieve series includes the following sizes: 3 in., 2½ in., 2 in., 1½ in., 1 in., ¾ in., ½ in., ⅜ in., No. 4. Other U. S. standard sieves may be added for special purposes.

2. Sieve Shaker: any mechanical sieve shaker which accomplishes the thoroughness of sieving specified below:

   a. Not more than 0.5 % of the sample weight passes any sieve during 1 min of hand sieving.

   b. Hand sieving is by means of a lateral and vertical motion of the sieve, accompanied by a jarring action, which keeps the sample moving continuously over the surface of the sieve. Do not turn or manipulate particles through the sieve by hand.

3. Sample Splitters: sample splitters (riffle splitters) must have an even number of equal-width permanently fixed chutes which discharge alternately to each side of the splitter. There must be not less than a total of 8 chutes for splitters used for coarse aggregate and 12 chutes for fine aggregate. The minimum width of the individual chutes should be approximately 50 % larger than the largest particles in the sample to be split. The chutes must be fixed (not adjustable). For dry, fine aggregate in which the entire sample will pass the ⅜ in. sieve, the minimum width of the individual chutes should be at least 50 % larger than the largest particles in the sample to be split with a maximum width of ¾ in.

   The splitter must be equipped with 2 receptacles to hold the 2 halves of the sample following splitting. It must also be equipped with a hopper or straight-edged pan by which the sample may be fed at a controlled rate to the chutes. The hopper or straight-edged pan must have a width equal to or slightly less

than the overall width of the assembly of chutes. The splitter and accessory equipment must be so designed that the sample will flow smoothly without restriction or loss of material.

NOTE: Typically 3 different sized splitters (large, medium, and small) are sufficient.

4. Mechanical Quartering Device: mechanical quartering devices such as QuarterMaster™ or equivalent device (figure 1) can be used for a sample weighing between 25 and 100 lb. The mechanical quartering device must have 4 fixed chutes of equal width which will discharge the material in 4 approximately equal portions into appropriately sized containers. The mechanical quartering device must be designed with a receiving hopper that will hold the sample until a handle releases the material to fall through a divider. The mechanical quartering device must be designed so that the sample will flow smoothly and freely through the divider without loss of material.

5. Quartering Canvas: a sheet of canvas approximately 5 ft × 5 ft used to quarter aggregates in the field.

6. Crusher: a jaw crusher, which can be adjusted to produce material passing the No. 4 sieve. A sledgehammer may be used to reduce oversize particles enough to permit the material to be fed into the crusher.

7. Rock Cleaning and Clod-Breaking Device: a device for removing fines from coarse aggregate particles and for breaking up clods without appreciably reducing the natural individual particle sizes. The following devices may be used on most materials:

   a. Stiff fiber brush

   b. Mortar and rubber-covered pestle

   c. Soil-pulverizing apparatus consisting of the following:

      (1) Containers: steel drums approximately 11 in. in diameter, 15 in. in length, 6 gal capacity, and having positive seal covers with flowed-in rubber seals and lever-lock fastening devices.

      (2) Rollers: rubber-covered metal bars approximately 2 in outside diameter and 1 in. to 3 in. shorter than the inside length of the container. Cold rolled steel bars, 1½ in. in diameter, 13 in. to 14 in. long, covered with fuel oil hose (U. S. Royal P5196 or equivalent) are satisfactory for use with the 6 gal containers.

      The exact dimensions of the container and rollers are not critical provided adequate pulverizing can be accomplished without reducing the natural individual particle size.

      (3) Rotating Device: a motor-driven apparatus capable of rotating one or more containers at a rate of approximately 65 rpm.

      NOTE: For details of this soil-pulverizing apparatus see Suggested Mechanical Method for Breaking up Soil Aggregations by

C.M. Johnson and J.R. Blystone, "Procedures for Testing Soils", ASTM 1958.

8. Sample Containers: various-sized heat resistant containers are required, some of which should have the following approximate capacities: 30 000 g, 7000 g,3500 g, 300 g, and 100 g.

9. A facility to accommodate the removal of moisture from wet samples. When air drying is not practical, typical equipment may be fans with or without heating coils or a vented, forced draft oven capable of maintaining a temperature of 140˚F or lower.

D. SAMPLE IDENTIFICATION

Each sample must be given a unique identification number, which will be written on suitable cards or tickets. One of these cards or tickets bearing the sample identification number must accompany each portion of the sample throughout the processing and testing of the material.

E. DRYING OF SAMPLES

1. Dry wet samples sufficiently to permit a complete separation on the No. 4 sieve and to develop a free-flowing condition in the portion passing the No. 4 sieve. Drying may be performed by any means that does not heat the aggregate in excess of 140°F or cause degradation of the particles. Sunlight, oven, or forced drafts of warm air are the most common drying methods.

   a. Drying can be expedited by occasionally stirring the material during the drying process.

   b. Drying may be done at 230°F ± 9°F when all subsequent tests require or permit drying at this temperature or above.

2. When drying aggregate samples containing reclaimed asphalt pavement (RAP), the oven drying temperature must not exceed 100°F. After drying, particles of RAP can be separated by hand so that the particles of the fine aggregate portion are no larger than ¼ in. Care must be taken to avoid fracturing the aggregate.

F. SEPARATING COARSE AND FINE PORTIONS ON THE NO. 4 SIEVE

1. Follow the sieving instructions in accordance with California Test 202, Section F, to separate the material on the No. 4 sieve.

2. Separation of the coarse portion into individual coarse-size fractions may be done simultaneously with the separation on the No. 4 sieve if required.

3. Remove coatings from coarse aggregate and break up clods retained on the No. 4 sieve as prescribed in Section G.

4. Combine all of the passing No. 4 sieve material accumulated from the various steps of sieving, removing coatings, and clod breaking.

5. Retain the passing No. 4 sieve material and each separated coarse-size fraction in separate containers.

NOTE: RAP samples intended for use in hot mix asphalt (HMA) should not be separated into coarse and fine size fractions.

G. REMOVAL OF COATINGS FROM COARSE AGGREGATES AND BREAKING UP OF CLODS

1. Hard clods of material with a natural particle size smaller than the No. 4 sieve must be broken up to pass the No. 4 sieve.

   Coatings on coarse aggregate particles, excluding RAP samples, must also be removed and included with the passing No. 4 sieve material.

2. Any method, which does not appreciably reduce the natural individual particle sizes, may be used. Three approved methods are described below.

   a. Mortar and rubber-covered pestle.

      (1) Place a portion of the retained No. 4 sieve material in the mortar.

      (2) Use a pushing and twisting motion with the pestle to apply a grinding action to the material.

      (3) Do not pound the material in such a way as to cause fracturing of aggregate particles.

      (4) Separate the material on the No. 4 sieve and add the passing No. 4 portion to the fine material previously separated.

      (5) Repeat this procedure on all portions of the retained No. 4 material until the clods have been broken and the coarse particles appear to be free of coatings.

   b. Soil pulverizing apparatus.

      (1) Place a minimum of 5 lb of the retained No. 4 sieve material in the steel drum.

      (2) Place 2 or 3 rollers in the drum with the material and secure the dust-proof cover in place.

      (3) Position the drum horizontally on the rotating device.

      (4) Start the device and rotate the drum and its contents as necessary to break up clods and/or the coarse particles appear to be free of coatings.

      NOTE: When large quantities of fines are generated, the pulverizing process should be interrupted periodically to permit re-sieving and removal of the portion that will pass the No. 4 sieve. Because of variations in materials, operator judgment is required to determine the number of rollers and the rotation time to be used.

c. Wash method.

(1) Place the retained No. 4 sieve material in a suitable container and cover with water.

(2) Soak for sufficient time to soften the lumps and coatings.

(3) Hand wash the individual particles and disperse the lumps.

(4) Remove the cleaned retained No. 4 sieve particles from the wash water and dry to constant weight at 230°F ± 9°F when all subsequent tests require or permit drying at this temperature.

(5) Evaporate the water from the residual material at a temperature not to exceed 140˚F.

NOTE: When drying aggregate samples containing RAP, the oven-drying temperature must not exceed 100˚F.

H. ADJUSTING GRADING OF SAMPLES

1. When it is necessary to adjust the grading of a sample prior to testing in order to bring the material within a specified grading, the adjustments of scalping, wasting, or combining materials should be such that it can be duplicated under field conditions. See California Test 105 for information and instruction on aggregate grading adjustments.

2. When the sample submitted for preliminary tests represents aggregate which will require crushing on the job, crush the oversize aggregate to such a degree that a blend made with the crushed and uncrushed portions will conform to the proposed grading specifications. In accordance with California Test 202, perform a coarse sieve separation on the crushed portion and record the weight on the appropriate work card.

I. SECURING REPRESENTATIVE PORTIONS FOR SPECIFIED TESTS

1. Refer to the respective test methods for grading requirements and quantity of materials needed.

2. Samples of coarse aggregates, which have been separated into basic sizes using the standard coarse sieve series, may be obtained by scooping the required amount from each size fraction. Do not scoop or pour out samples of passing No. 4 sieve material or samples of coarse aggregate which have not been separated into basic sizes using the standard coarse sieve series.

3. After the required samples have been prepared, save the remainder of the sample for possible future check tests.

J. COMBINING OR REDUCING SAMPLES

It is practical to reduce the amount to a sample size equal to or slightly in excess of the minimum weight required before transporting or shipping to the laboratory. The use of a mechanical quartering device or riffle splitter is preferred. However, splitting with a quartering canvas is acceptable if carefully performed. Splitting with a quartering canvas of any HMA is not acceptable.

If combining samples will result in a sample weighing in excess of 100 lb, split each sample separately and combine the smaller portions.

For all combining or reducing of samples, always use the 2 diagonally opposite quarters.

1. Splitting samples with a mechanical quartering device.

   Use a mechanical quartering device for splitting a sample weighing between 25 and 100 lbs. The procedures for splitting samples with a mechanical quartering device to either combine samples or to reduce the sample are as follows:

   a. Secure the receiving hopper door. Place 4 sample containers of sufficient capacity to accommodate the reduced portion of the sample under the discharge chutes.

   b. Pour the sample evenly into the hopper to avoid segregation and release the hopper door.

   c. Combining or reducing samples:

      (1) Combining Samples: remove 2 diagonally opposite quarters from sample A and sample B. Load remaining quarters from samples A and B into hopper and repeat process so that samples A and B form a combined sample. Reduce the combined sample until the desired sample size is achieved.

      (2) Reducing Sample Size: remove 2 diagonally opposite quarters from an individual sample. Load remaining quarters into hopper and repeat the process until the sample is reduced to the desired size.

   d. Clean excess material from mechanical quartering device after each use.

2. Splitting samples with a riffle splitter.

   The procedures for splitting and reducing samples with riffle splitters are as follows:

   a. The sample must be at a free-flowing condition. Dry in accordance with Section E.

   b. Thoroughly mix the sample and spread it evenly across the pan or hopper.

   c. Open the hopper gate or pour the material from the pan so that material flows evenly through all the chutes. Control the rate of discharge as necessary to maintain a continuous flow of materials through the chutes.

   d. Continue to split or combine successive portions until the desired sample size is achieved.

   e. Clean excess material from riffle splitters after each use.

3. Splitting with a quartering canvas.

A quartering canvas can be used for splitting a sample weighing up to 100 lb. The procedures for splitting samples with a quartering canvas are as follows:

For samples weighing between 20 and 100 lb:

a. Place the sample in a conical pile in the center of the canvas. Mix the sample by shoveling material from around the bottom edges to the center of the pile. Place each shovelful so that the material spills over the cone equally in all directions.

b. Flatten the cone with the shovel, spreading the material to a circular layer of uniform thickness.

c. Insert a stick (or pipe or shovel handle) under the canvas at the center of the pile and lift both ends, dividing the sample into 2 equal parts. Remove the stick, leaving the canvas in a folded position. Insert the stick (or pipe or shovel handle) under the canvas at the center of pile at right angles to the first division and again lift both ends, dividing the sample into 4 equal parts. In lieu of dividing by use of a stick, a square point shovel may be used to divide the sample into 4 equal parts.

d. Take samples from 2 diagonally opposite quarters being careful to clean all the fines from the canvas.

e. Repeat Steps a through d, combining split portions as necessary until the desired sample size is achieved.

For samples weighing less than 20 lb:

a. Place the sample on the canvas or a clean sheet of paper. Mix thoroughly with a trowel and form into a conical pile.

b. Flatten the pile by pressing downward with the trowel.

c. Separate into quarters with trowel at right angles.

d. Take samples from 2 diagonally opposite quarters being careful to clean all the fines from the canvas or paper.

e. Repeat Steps a through d combining split portions as necessary until the desired sample size is achieved.

K. PRECAUTIONS

1. Frequently review the test procedures for which the samples are being prepared to make sure the samples are processed in accordance with these procedures.

2. When possible, attempt to duplicate field conditions when preparing samples. For example, do not remove coatings from HMA bin samples when the material is to be used in fabricating HMA test specimens.

3. Check sieves frequently for broken or distorted wires. Repair or replace defective sieves.

L. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Caltrans Laboratory Safety Manual is available at:

http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf

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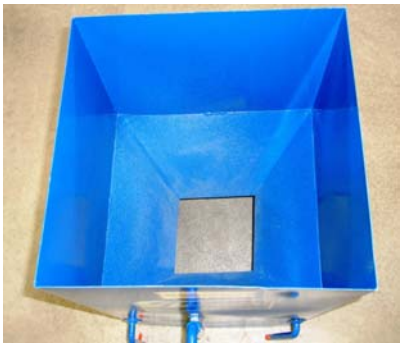
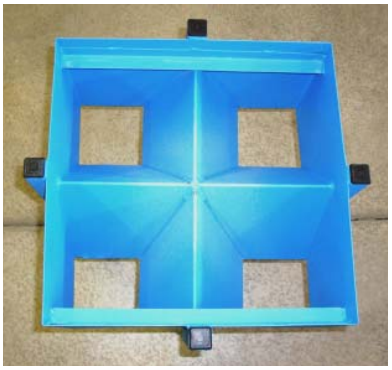
(California Test 201 contains 8 pages)



Top Piece (Top View)



Bottom Piece (Top View)

FIGURE 1. Example of a typical mechanical quartering device