DETERMINATION OF PERCENT CRUSHED PARTICLES IN PROCESSED COARSE AGGREGATE

LS-607 R33

1. SCOPE

1.1 This method covers the visual determination of the percent, by mass, of crushed particles in a processed coarse aggregate.
1.2 In conjunction, this method also covers the visual determination of the percent, by mass, of cementations in a coarse aggregate.
1.3 Two procedures are given. Method A is suitable for well-graded materials with equal representation from all particle sizes passing the 26.5 mm sieve, retained by the 4.75 mm sieve. Method B is suitable for materials that have an uneven distribution of particles across the various sieve fractions between the 26.5 mm and the 4.75 mm sieves, i.e., gap-graded or poorly graded materials, or where greater accuracy is required, e.g. referee testing.
Note 1: This test method covers only the fractions of coarse aggregate passing 26.5 mm and retained on 4.75mm sieve.

3. DEFINITION

3.1 A CRUSHED PARTICLE is defined as a piece of coarse aggregate with at least one well defined face resulting from fracture. The area of the crushed face should be at least 20 percent of the total surface area and the edges should be sharp (See Figures 1, 2 and 3 in the LS). Particles with smooth faces and rounded edges, or with only small chips removed, are not considered crushed (See Figures 4, 5 and 6 in the LS).
3.2 A CEMENTATION is defined as a group of aggregate particles cemented together which may or may not include a host (dominant) particle.

4. APPARATUS

4.1 BALANCE: Of sufficient capacity and readable to 1 g or less and accurate to within 0.1% of the test load at any point within the range of use..... _____

5. PREPARATION OF TEST SAMPLE

5.1 Prepare the coarse aggregate according to LS-600. NO further crushing of the test sample is required..... _____
5.2 Dry the sample sufficiently to obtain a clean separation of particles on the 4.75 mm sieve..... _____

Method A

5.3 Separate the sample into the following three fractions by sieving according to LS-602:
(i) material retained on the 26.5 mm sieve; ..... _____
(ii) material passing the 26.5 mm sieve, retained on the 4.75 mm sieve, ... _____
(iii) material passing the 4.75 mm sieve..... _____
5.4 Reduce the fraction passing the 26.5 mm sieve, retained on the 4.75 mm sieve by splitting or quartering to approximately the masses given in Table 1..... _____
Note 2: The largest particle size is determined from the smallest sieve in Table 1 that 95% or more of the material passes.

Table 1 –Sample Preparation for Method A

Largest particle size (>95% passing sieve)	Mass (minimum), g
26.5 mm	1000
16.0 mm	850
13.2 mm	500
9.5 mm	200
6.7 mm	75

5.5 When the sample tested contains a mixture of natural aggregate, recovered crushed concrete and/or recovered asphaltic material, the size of test sample shall be increased so that the amount of natural aggregate in the test sample meets the requirements of Table 1..... _____
5.6 Weigh and record the mass of material to the nearest 1 g..... _____

Method B

5.7 Separate the sample by sieving according to LS-602 into one or more of the individual fractions indicated in Table 2..... _____
5.8 Prepare the test sample from each coarse aggregate fraction representing at least 5 % or more of the submitted sample according to the minimum masses shown in Table 2..... _____

Table 2 – Sample Preparation for Method B

Coarse Aggregate Fraction		Mass (minimum), g
Passing	Retained	
26.5 mm	19.0 mm	200 particles, minimum
19.0 mm	13.2 mm	1250
13.2 mm	9.5 mm	500
9.5 mm	6.7 mm	200
6.7 mm	4.75 mm	75

5.9 When the test sample contains a mixture of natural aggregate, recovered crushed concrete, recovered asphaltic material, glass and/or ceramic material, the size of test sample shall be increased so that the amount of natural aggregate and recovered crushed concrete in the test sample meets the requirements of Table 2..... _____
5.10 Weigh and record the mass of material of each fraction to the nearest 1 g..... _____

6. TEST PROCEDURE

6.1 Spread the test sample (Method A) or each fraction of the test sample (Method B) on a clean, flat surface large enough to permit individual particles to be visually inspected..... _____
6.2 Separate any asphaltic, glass or ceramic material from test sample. Do not separate any asphalt stained particles as defined by LS-621..... _____
6.3 Separate any crushed recovered concrete particles from the test sample and classify them as crushed particles..... _____
6.4 Separate the natural aggregate particles into crushed and uncrushed portions..... _____

DETERMINATION OF PERCENT CRUSHED PARTICLES IN PROCESSED COARSE AGGREGATE

LS-607 R33

Separation of cemented particles shall be according to whether the host particle is crushed or uncrushed..... _____
When there is no host particle present, cemented particles shall be considered as uncrushed cementations..... _____
Note 3: If dirt or dust films make it difficult to determine if the particles have well-defined fractured faces, it is permissible to wash the particles. However, the sample should be dried before weighing
6.5 Weigh and record the mass of each crushed, uncrushed and cementation portion of the sample or fraction to the nearest 1 g..... _____
Table 3 in the LS is a laboratory worksheet for recording test data and calculations..... _____

7. CALCULATION

Method A

7.1 Calculate the percentage of crushed particles for the test sample (to one decimal place) using the following formula: ..... _____

$$\% \text{ crushed particles} = \frac{A + B}{A + B + C + D} \times 100$$

where
A = mass of crushed particles
B = mass of crushed cementations
C = mass of uncrushed particles
D = mass of uncrushed cementations

Method B

7.2 If the test sample was prepared according to Method B, calculate the percent of crushed natural aggregate particles for each fraction (to one decimal place), using the following formula: ..... _____

$$\% \text{ crushed particles} = \frac{A + B}{A + B + C + D} \times 100$$

where
A = mass of crushed particles
B = mass of crushed cementations
C = mass of uncrushed particles
D = mass of uncrushed cementations

7.3 Compute the percent of each fraction specified in Table 2 using the gradation test (LS-602) of the coarse aggregate portion of the as-received sample. The computation should be based on the total mass of the material retained on 4.75 mm sieve..... _____
Note 4: DO NOT use the minimum mass required for the test to compute the percent of each fraction.
7.4 Calculate the percent crushed particles weighted average value for each fraction as the product of the percentage of each fraction calculated in Section 7.3 and the percent crushed particles for that fraction..... _____

DETERMINATION OF PERCENT CRUSHED PARTICLES IN PROCESSED COARSE AGGREGATE

7.5 Calculate the percent crushed particles weighted average value of the test sample as the sum of the weighted average value for each fraction divided by 100..... _____

7.6 If the amount of cemented particles is required, use the following formula: ..... _____

$$\% \text{ cemented particles} = \frac{B + D}{A + B + C + D} \times 100$$

Then calculate the weighted average value.

7.7 For the purpose of calculating the weighted average, consider any fraction (not tested) containing less then 5% of the test sample to have a value equal to the average of the next smaller and the next larger fractions. If one of these sizes is missing, assign the same value as the next larger or smaller fraction, whichever is present..... _____

8. REPORTING OF RESULTS

8.1 Report the method used for sample preparation and testing (Method A or Method B) ..... _____

8.2 Report the % crushed particles (Method A) or weighted average % crushed particles (Method B) to the nearest whole percent..... _____

9. GENERAL NOTES

9.1 Material used in this test may be re-used if insufficient material is available for other required tests..... _____

COMMENTS