DETERMINING PERCENT OF FRACTURED PARTICLES IN COARSE AGGREGATE

ASTM D 5821

GLOSSARY

Fractured Face - A fractured face is defined as being caused either by mechanical means or by nature and should **have sharp or slightly blunted edges**. Natural fractures, to be accepted, must be similar to fractures produced by a crusher. A broken surface constituting an area equal to at least 25% of the projected area of the particle, as viewed perpendicular to (looking directly at) the fractured face, is considered an acceptable fractured face.

Fractured Rock Particle - A rock particle having at least one or two fractured faces, as required for that class/type of aggregate in the specifications.

SCOPE

This test procedure determines the amount (percent) of fracture faced rock particles, by visual inspection that meets specific requirements. The fractured face of each rock particle must meet a minimum cross-sectional area. Specifications contain requirements for percentage of crushed aggregate particles, with the purpose of maximizing shear strength in either bound or unbound aggregate mixtures. This method can be used in determining the acceptability of coarse, dense-graded, and open-graded aggregates with respect to such requirements. This procedure is used primarily for hot mix asphalt aggregates.

SUMMARY OF TEST

Apparatus

Sieves, appropriate for the sample type.

Balance, appropriate for the size of sample and in accordance with AAASHTO M 231 for a class G_2 balance.

Spatula or similar tool to aid in sorting the aggregate particles.

Paper containers.

Sample Preparation

Air-dry the representative sample prior to the coarse gradation process so that there is a clean separation of the particles. A total + No. 4 (4.75 mm) sample could be used for testing but more commonly the + No. 4 (4.75 mm) material will be split into representative fractions. The minimum size of samples shall be as follows:

NOMINAL MAXIMUM SIEVE SIZES*	MINIMUM SAMPLE SIZE	
inch (mm)	lbm	grams
3/8 (9.5)	0.5	200
1/2 (12.5)	1	500
3/4 (19.0)	3	1500
1 (25.0)	6.5	3000
1 1/2 (37.5)	16.5	7500

***NOTE: Nominal maximum sieve size is defined as the smallest sieve opening through which the entire amount of the aggregate is permitted to pass.**

For aggregate with a nominal maximum size of 3/4 in. (19.0 mm) or larger, the test sample may be separated on the 3/8 in. (9.5 mm) sieve. The portion passing the 3/8 in. (9.5 mm) sieve may then be further reduced to a minimum of 0.5 lbm (200 g). This will reduce the number of particles to be separated during the procedure. In this case, percent fractured particles is determined on each portion and a weighted average percentage of fractured particles is calculated.

Procedure

1. Wash and dry sample to a constant weight. Weigh the test sample to the nearest 0.1g and record as "Test Sample Weight".

2. Spread the test sample on a clean flat surface large enough to permit the material to be spread thinly for careful inspection and evaluation.

3. Using the spatula or a similar tool separate the particles into one of the following three categories:

   Crushed Particles, using the criteria of "one or more fractured faces" or "two or more fractured faces" as is consistent with the requirements in the specifications.

   Uncrushed Particles

4. Determine the weight of the "Crushed Particles" and record the weights as "Weight of Crushed Particles".

Calculation

1. Calculate the percentage of crushed particles as follows:

$$\text{Percent Crushed Particles } (\mathbf{P}) = \frac{F}{F + N} \times 100$$

Where: F = Weight of crushed particles with at least the specified number of fractured faces, in grams.

N = Weight of uncrushed particles, in grams.

Example:

F = 730
N = 1016

$$\mathbf{P} = \frac{730}{730 + 1016} \times 100 = 41.8\%$$

2. For aggregate with a nominal maximum size of 3/4 in. (19.0 mm) or larger, the test sample may be separated on the 3/8 in. (9.5 mm) sieve. The percent fractured particles is determined on each portion and a weighted average percentage is calculated.

Example:

3/4 - 3/8 in. (19.0 - 9.5 mm) Material	=	3766g
3/8 - No. 4 (9.5 - 4.75 mm) Material	=	7314g

Total + No. 4 (4.75 mm) Material	=	11080g

$$\text{Percent 3/4 - 3/8 in. (19.0 - 9.5 mm)} = \frac{3766}{11080} \times 100 = 34\%$$

$$\text{Percent 3/8 in. - No. 4 (9.5 - 4.75 mm)} = \frac{7314}{11080} \times 100 = 66\%$$

Total Percent Crushed Particles =

(% Crushed Particles 3/4 to 3/8 in. [19.0 - 9.5 mm]) x
(% of 3/4 to 3/8 in. [19.0 - 9.5 mm] Material)

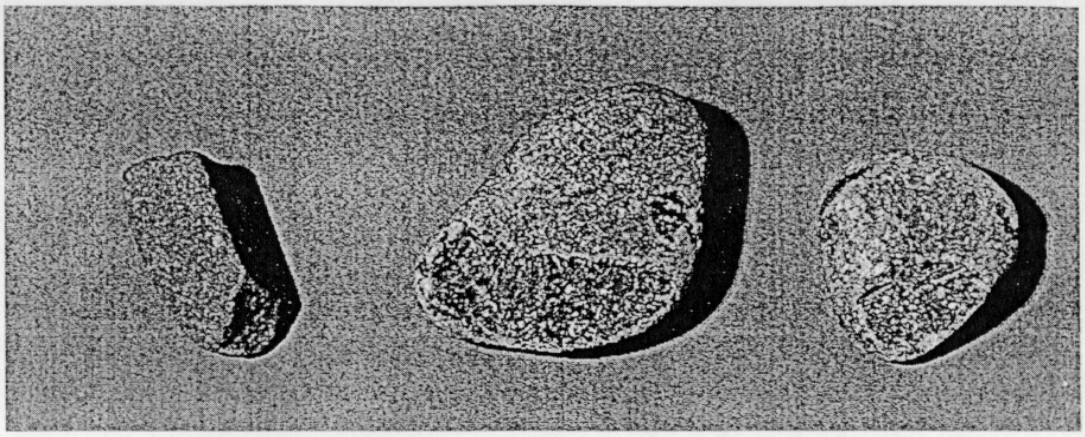
+

(% Crushed particles 3/8 in. - No.4 [9.5 - 4.75 mm]) x
(% of 3/8 in. - No. 4 [9.5 - 4.75 mm] Material)

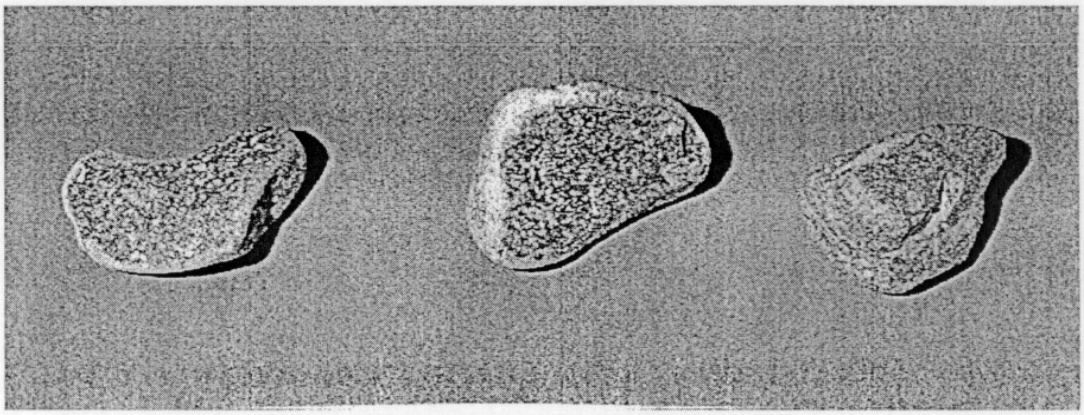
Using the following Data

% Crushed Particles 3/4 - 3/8 in. (19.0 - 9.5 mm) = 35.7%
% Crushed Particles 3/8 in. - No. 4 (9.5 - 4.75 mm) = 75.1%

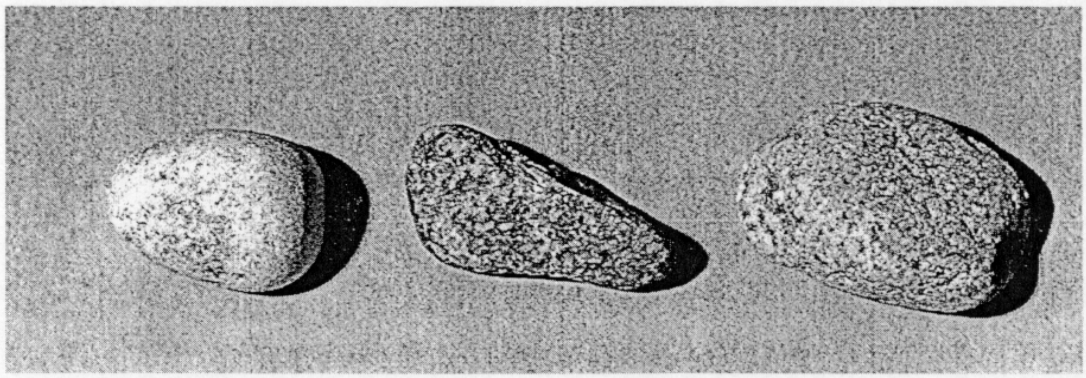
$$\text{\% Crushed Particles} = [(0.357 \times 0.34) + (0.751 \times 0.66)] \times 100$$
$$= [(0.121) + (0.496)] \times 100$$
$$= 61.7\%$$



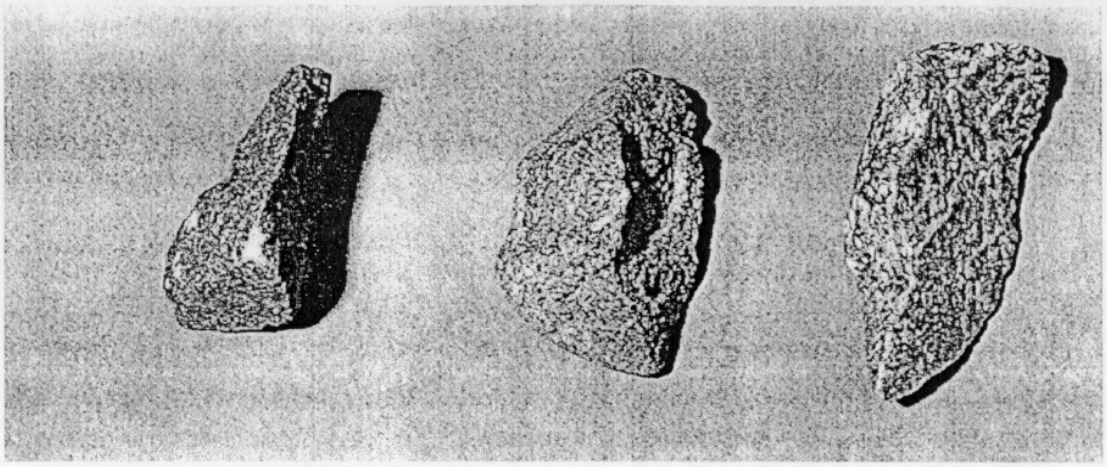
Fractured particle (center) flanked by two non-fractured particles (chipped only).



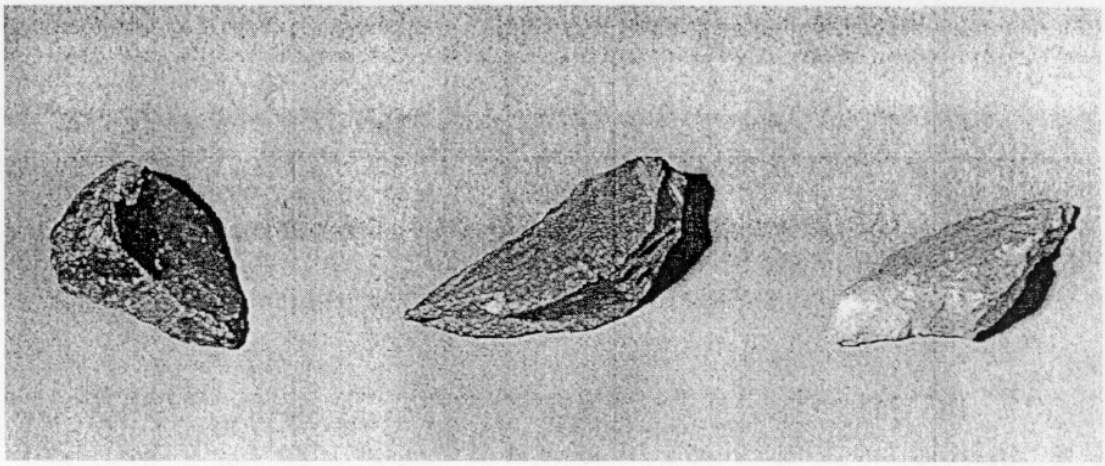
Non Fractured particle (round edges, smooth surfaces



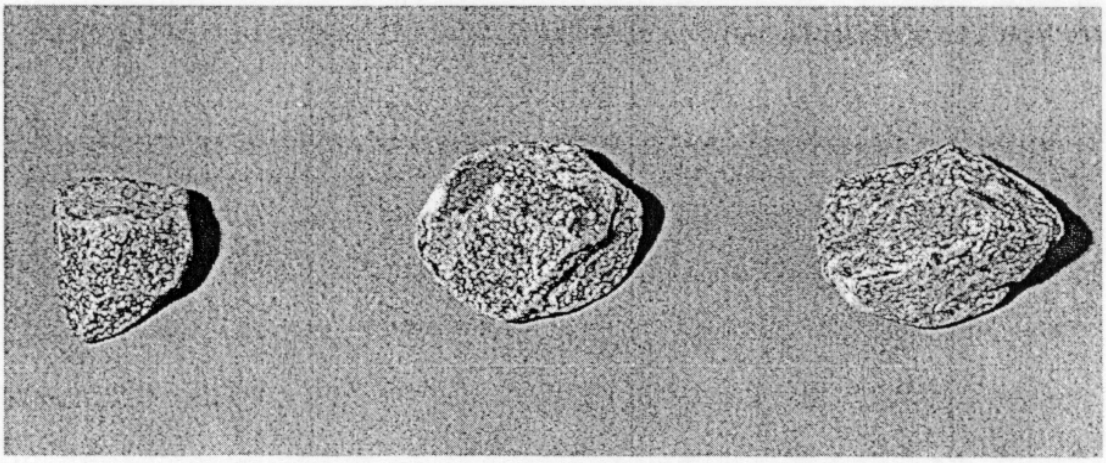
Non Fractured particle (rounded particles, smooth surfaces).



Fractured particle (sharp edges, rough surfaces).



Fractured particle (sharp edges, smooth surfaces



Fractured particle (round edges, rough surfaces).