

## **DETERMINING THE PERCENTAGE OF FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATE WAQTC TM 16**

### **Scope**

This procedure covers the determination of the percentage, by mass, of flat and elongated particles in coarse aggregates for comparison with specification limits.

Flat and elongated particles of aggregates, for some construction applications, may interfere with consolidation and result in harsh, difficult to place materials and a potentially unstable mixture.

For purposes of this test procedure, the term “Elongated Pieces” in applicable specifications shall be taken to be equivalent to the term “Flat and Elongated Particles” used in this test method.

### **Apparatus**

- Balance or scale: Capacity sufficient for the principle sample mass, accurate to 0.1 percent of the sample mass or readable to 0.1 g, meeting the requirements of AASHTO M 231, Class G2.
- Sieves, meeting requirements of the FOP for AASHTO T 27/T 11.
- Proportional Caliper Device, meeting the requirements of ASTM D4791 and approved by the Agency.

### **Terminology**

- Flat and Elongated Particles – aggregate particles with a ratio of length to thickness greater than a specified value.
- Length – maximum dimension of the particle.
- Thickness – maximum dimension perpendicular to the length and width.

### **Sample Preparation**

1. Sample and reduce the aggregate in accordance with the FOPs for AASHTO R 90 and R 76.
2. Dry the sample sufficiently to obtain separation of coarse and fine material and sieve over the 4.75 mm (No. 4) sieve in accordance with the FOP for AASHTO T 27/T 11.
3. Reduce the retained sample according to AASHTO R 76. Meet the minimum sample mass listed in Table 1.

**Table 1**  
**Required Sample Size**

<b>Nominal Maximum Size* mm (in)</b>	<b>Minimum Sample Mass Retained on 4.75 mm (No. 4) Sieve g</b>
37.5 (1 1/2)	2500
25 (1)	1500
19.0 (3/4)	1000
12.5 (1/2)	700
9.5 (3/8)	400
4.75 (No. 4)	200

\*One sieve larger than the first sieve to cumulatively retain more than 10 percent of the material, using all the sieves listed in Table 1 of the FOP for AASHTO R 90.

- Determine the dry mass of the reduced portion to the nearest 0.1 g. Designate as *MS*.

**Note 1:** If the test is performed in conjunction with the FOP for AASHTO T 335, recombine material from the fracture test and reduce to the appropriate sample size given in Table 1. The test may also be performed in conjunction with the FOP for AASHTO T 335 on individual sieves and combined to determine an overall result if material on each individual sieve is not further reduced from the original mass retained on each sieve.

## Procedure

- Set the proportional caliper device to the ratio required by the agency: (2:1, 3:1, or 5:1).
- Visually separate particles which obviously are not flat and elongated.
- Test each remaining particle by setting the larger opening of the proportional caliper device equal to the maximum dimension of the particle's length.
- Determine the dimension which represents the particle thickness (the smallest dimension).
- Pass the particle horizontally through the smaller opening without rotating, maintain contact with the fixed post. If the entire particle thickness can be passed through the smaller opening, the particle is flat and elongated.
- Repeat until all particles have been tested.
- Determine the dry mass of the flat and elongated particles to the nearest 0.1 g. Designate this mass as *FE*.

**Calculation**

Calculate the percent of flat and elongated pieces to the nearest 1 percent according to the following equation.

$$\%FE = \frac{FE}{MS} \times 100$$

Where:

%FE = Percent of flat and elongated pieces

FE = Mass of flat and elongated pieces

MS = Mass of retained sample

**Example:**

$$\%FE = \frac{132.6 \text{ g}}{1082.8 \text{ g}} \times 100 = 12.2\% \quad \text{Report 12\%}$$

where:

FE = 132.6 g

MS = 1082.8 g,

**Report**

- Results on forms approved by the agency
- Sample ID
- Flat and elongated to the nearest 1 percent.

