

7.3. Shape Tests for Aggregates

7.3.1 Flakiness index

7.3.1.1 Introduction. Flaky or elongated materials, when used in the construction of a pavement, may cause the pavement to fail due to the preferred orientation that the aggregates take under repeated loading and vibration. It is important that the flakiness and elongation of the aggregate are contained to within permissible levels.

7.3.1.2 Scope. The scope of this test is to provide test methods for determining the flakiness index of coarse aggregate. An aggregate is classified as being flaky if it has a thickness (smallest dimension) of less than 0.6 of its mean sieve size. The flakiness index of an aggregate sample is found by separating the flaky particles and expressing their mass as a percentage of the mass of the sample tested. The test is not applicable to materials passing the 6.30 mm test sieve or retained on the 63.00 mm test sieve.

7.4.1.3 Equipment

- a) A sample divider, of size appropriate to the maximum particle size to be handled or alternatively a flat shovel and a clean, flat metal tray for the quartering.
- b) A ventilated oven, thermostatically controlled to maintain a temperature of 105⁰C plus or minus 5⁰C.
- c) A balance of suitable capacity and accurate to 0.1% of the mass of the test portion. Balances of 0.5 kg, 5.0 kg, or 50 kg capacity may be required depending on the size of aggregate and size of sample.
- d) Test sieves.
- e) A mechanical sieve shaker (optional).
- f) Trays of adequate size, which can be heated in the oven without damage or change in mass.
- g) A metal thickness gauge, of the pattern shown in Figure 7.3.1, or similar, or special sieves having elongated apertures. The width and length of the apertures in the thickness gauge and in the sieves shall be within the tolerances given in Table 7.3.3. The gauge shall be made from 1.5 mm thickness sheet steel.

7.3.1.4 Preparation of test portion. Produce a test portion that complies with Table 7.3.2. Dry the test portion by heating at a temperature of 105⁰C plus or minus 5⁰C to achieve a dry mass which is constant to within 0.1%. Allow to cool and weigh.

7.3.1.5 Procedure

- a) Carry out a sieve analysis using the test sieves in Table 7.3.1. Discard all aggregates retained on the 63.0 mm test sieve and all aggregate passing the 6.30 mm test sieve.

Table 7.3.1 Particulars of test sieves

Nominal aperture size (square hole perforated plate 450 mm or 300 mm Diameter)
63.0 mm
50.0 mm
37.5 mm
28.0 mm
20.0 mm
14.0 mm
10.0 mm
6.3 mm

Table 7.3.2 Minimum mass of test portion

Nominal size of material mm	Minimum mass of test portion after rejection of oversize and undersize particles kg
50	35
40	15
28	5
20	2
14	1
10	0.5

Table 7.3.3 Data for determination of flakiness index

Aggregate size-fraction mm	Aggregate size-fraction mm	Width of slot in thickness gauge or special sieve mm	Minimum mass for subdivision kg
100% passing	100% retained		
63.0	50.0	33.9±0.3	50
50.0	37.5	26.3±0.3	35
37.5	28.0	19.7±0.3	15
28.0	20.0	14.4±0.15	5
20.0	14.0	10.2±0.15	2
14.0	10.0	7.2±0.1	1
10.0	6.30	4.9±0.1	0.5

- b) Weigh each of the individual size-fraction retained on the sieves, other than the 63.0 mm and store them in separate trays with their size mark on the tray.
- c) From the sums of the masses of the fractions in the trays (M_1), calculate the individual percentage retained on each of the various sieves. Discard any fraction whose mass is 5% or less of M_1 . Record the mass remaining M_2 .
- d) Gauge each fraction by using either of the procedures given in (i) or (ii) below.
 - (i) Using the special sieves, select the special sieve appropriate to the size-fraction under test. Place the whole of the size-fraction into the sieve and shake the sieve until the majority of the particles have passed through the slots. Then gauge the particles retained by hand.
 - (ii) Using the gauge, select the thickness gauge appropriate to the size-fraction under test and gauge each particle of that size-fraction separately by hand.
- e) Combine and weigh all the particles passing each of the gauge M_3 .

7.3.1.6 Calculation and expression of results. The value of the flakiness index is calculated from the expression:

Flakiness Index = $100 \times M_3 / M_2$ Express the Flakiness Index to the nearest whole number.

Where,
 M_2 is the total mass of test portion
 M_3 is the mass of the flaky portion

7.3.1.7 Test Report. The test report shall affirm that the flakiness index test was performed according to the stated method and whether a sampling certificate was issued. If available the sampling certificate should be provided. The test report shall include the following additional information:

- a) Sample identification
- b) Flakiness index
- c) Sieve analysis obtained from this test.

A data sheet is given as Form 7.3.1.

7.3.2 Elongation index

7.3.2.1 Scope. The scope of this test is to provide test methods for determining the elongation index of coarse aggregate. An aggregate is classified as being elongated if it has a length (greatest dimension) of more than 1.8 of its mean sieve size. The elongation index of an aggregate sample is found by separating the elongated particles and expressing their mass as a percentage of the mass of the sample tested. The test is not applicable to materials passing the 6.30 mm test sieve or retained on the 50.00 mm test sieve.

7.3.2.2 Equipment. The equipment used in the flakiness index are also used in the elongation index test except a metal length gauge instead of a thickness gauge shown in Figure 7.3.2.

Table 7.3.4 Particulars of test sieves

Nominal aperture size (square hole perforated plate 450 mm or 300 mm Diameter)	
	50.0 mm
	37.5 mm
	28.0 mm
	20.0 mm
	14.0 mm
	10.0 mm
	6.3 mm

Table 7.3.5 Minimum mass of test portion

Nominal size of material mm	Minimum mass of test portion after rejection of oversize and undersize particles kg
40	15
28	5
20	2
14	1
10	0.5

Form 7.3.1

WORKSHEET

Name of testing agent and Designation Md. Jahangir Alam, ARO
 Client RRMP-II
 Contractor's name Unknown Date sampled 4/5/2000
 Contract Training Course
 Sample description Stone Chips
 Location BRRL
 Sample number TJ Weight of bulk sample - Kg

Sieve size	FLAKINESS			ELONGATION		
	Test weight g	Weight Passing g	% Flaky	Test Weight	Weight retained	% Elongated
50-37.5	1850	192	10.38	1700	152	8.94
37.5-28	2375	725	30.53	2155	225	10.44
28-20	2500	510	20.4	2490	299	12.00
Total	6725	1427	-	6345	676	-

$$\text{Flakiness Index \%} = \frac{\text{Total weight passing thickness gauge} \times 100}{\text{Total weight of test sample}} = \frac{1427 \times 100}{6725} = 21.2\%$$

$$\text{Elongation \%} = \frac{100 \times \text{Total weight retained on length gauge}}{\text{Total weight of test sample}} = \frac{676 \times 100}{6345} = 10.7\%$$

Date sampled	Date tested	Name and designation of tester	Signature
4/5/2000	4/5/2000	Md. Jahangir Alam ARO	

Table 7.3.6 Data for determination of elongation index

Aggregate size-fraction mm	Aggregate size-fraction mm	Width of slot in thickness gauge or special sieve mm	Minimum mass for subdivision kg
100% passing	100% retained		
50.0	37.5	78.7±0.3	35
37.5	28.0	59.0±0.3	15
28.0	20.0	43.2±0.3	5
20.0	14.0	30.6±0.3	2
14.0	10.0	21.6±0.1	1
10.0	6.30	14.7±0.1	0.5

7.3.2.3 Preparation of test portion. Produce a test portion that complies with Table 7.3.4. Dry the test portion by heating at a temperature of 105⁰C plus or minus 5⁰C to achieve a dry mass which is constant to within 0.1%. Allow to cool and weigh.

7.3.2.4 Procedure

- Carry out a sieve analysis using the test sieves in Table 7.3.5 or 7.3.6. Discard all aggregates retained on the 63.0 mm test sieve and all aggregate passing the 6.30 mm test sieve.
- Weigh each of the individual size-fraction retained on the sieves, other than the 50.0 mm and store them in separate trays with their size mark on the tray.
- From the sums of the masses of the fractions in the trays (M₁), calculate the individual percentage retained on each of the various sieves. Discard any fraction whose mass is 5% or less of M₁. Record the mass remaining M₂.
- Gauge each fraction as follows: select the length gauge appropriate to the size-fraction under test and gauge each particle separately by hand. Elongated particles are those whose greatest dimension prevents them from passing through the gauge, and these are placed to one side.
- Combine and weigh all the particles passing each of the gauges M₃.

7.3.2.5 Calculation and expression of results. The value of the elongation index is calculated from the expression:

Elongation Index = 100 x M₃ / M₂ Express the Elongation Index to the nearest whole number.

Where, M₃ is the mass of test portion being elongated
M₂ is the total mass of test portion

7.3.2.6 Test Report. The test report shall affirm that the elongation index test was performed according to the stated method and whether a sampling certificate was issued. If available the sampling certificate should be provided. The test report shall include the following additional information:

- Sample identification
- Elongation index
- Sieve analysis obtained from this test.

A data sheet is given as Form 7.3.1.

