

BUILDING MATERIALS – PRACTICAL SESSION

Lab 2

GEOMETRICAL PROPERTIES OF AGGREGATES

Determination of particle shape – flakiness index

European Standard

PN-EN 933-3:2012 Tests for geometrical properties of aggregates. Part 3: Determination of particle shape. Flakiness index.

Terms and definitions

Laboratory sample – sample intended for laboratory testing.

Test portion – sample used as a whole in a single test.

Principle

This European Standard applies to natural, manufactured or recycled aggregates. The test procedure is not applicable to particle sizes less than 4 mm or greater than 100 mm. The test consists of two sieving operations. First, using test sieves, the sample is separated into various particle size fractions d_i/D_i . Each of the particle size fractions d_i/D_i is then sieved using bar sieves which have parallel slots of width $D_i/2$. The overall flakiness index is calculated as the total mass of particles passing the bar sieves expressed as a percentage of the total dry mass of particles tested.

Apparatus

Test sieves with square apertures with the following aperture sizes: 100 mm, 80 mm, 63 mm, 50 mm, 40 mm, 31,5 mm, 25 mm, 20 mm, 16 mm, 12,5 mm, 10 mm, 8 mm, 6,3 mm, 5 mm and 4 mm.

Corresponding bar sieves comprising parallel cylindrical bars conforming to the requirements in table.

Ventilated oven, thermostatically controlled to maintain a temperature of $(110 \pm 5) ^\circ\text{C}$, or other suitable equipment for drying the aggregates, if it does not cause any particle size breakdown.

Balances or scales, accurate to $\pm 0,1\%$ of test portion mass.

Particle size fraction d/D mm	Width of slot in bar sieve mm
63/80	40
5,/63	31,5
4,/50	25
31,5/40	20
25/31,5	16
20/25	12,5
16/20	10
12,5/16	8
10/12,5	6,3
8/10	5
6,3/8	4
5/6,3	3,15
4/5	2,5

TEST PROCEDURE

Dry the test portion at the $(110 \pm 5) ^\circ\text{C}$ to constant mass. Allow to cool, weigh and record the mass as M_0 . The mass of the test portion shall be as specified in EN 933-1.

Aggregate size D (max) mm	Test portion mass (min) kg
63	40
32	10
16	2,6
8	0,6
≤ 4	0,2

Using the appropriate range of test sieves, sieve the test portion.

Weigh and discard all particles passing the 4 mm sieve and retained on the 100 mm sieve.

Weigh and retain separately all the particles in each particle size fraction d_i/D_i .

Sieve each particle size fraction d_i/D_i obtained from sieving on test sieves, on the corresponding bar sieve given in table. This sieving operation can be carried out manually or mechanically and shall ensure complete separation.

Weigh the material from each particle size fraction passing through the corresponding bar sieve.

Calculate the sum of the masses of the particle size fractions d_i/D_i and record as M_1 .

Calculate the sum of the masses of the particles in each of the particle size fractions d_i/D_i which pass through a corresponding bar sieve of slot width $D_i/2$ and record as M_2 .

The overall flakiness index FI is calculated from the following equation:

$$FI = (M_2/M_1) \cdot 100.$$

The overall FI shall be recorded to the nearest whole number.

The flakiness index for each particle size fraction FI_i shall be calculated, if required from the following equation:

$$FI_i = (m_i/R_i) \cdot 100.$$

If the sum of the masses R_i together with the masses of any discarded particles and any size fractions that are not tested differs by more than 1% from the mass M_0 , the test shall be repeated, using another test portion.

Determination of particle shape – shape index

European Standard

PN-EN 933-4:2008 Tests for geometrical properties of aggregates. Part 4: Determination of particle shape. Shape index.

Terms and definitions

Laboratory sample – sample intended for laboratory testing.

Test portion – sample used as a whole in a single test.

Particle length L – maximum dimension of a particle as defined by the greatest distance between two parallel planes tangential to the particle surface.

Particle thickness E – minimum dimension of a particle as defined by the least distance between two parallel planes tangential to the particle surface.

Principle

Individual particles in a sample of coarse aggregate are classified on the basis of the ratio of their length L to thickness E using a particle slide gauge where necessary. The shape index is calculated as the mass of particles with a ratio of dimensions L/E more than 3 expressed as a percentage of the total dry mass of particles tested. The test procedure is applicable to particle size fractions d_i/D_i where $D_i \leq 63$ mm and $d_i \geq 4$ mm.

Apparatus

Particle slide gauge.

Test sieves with tightly fitting pan and lid.

Ventilated oven, thermostatically controlled to maintain a temperature of $(110 \pm 5) ^\circ\text{C}$, or other suitable equipment for drying the aggregates, if it does not cause any particle size breakdown.

Balances or scales, accurate to $\pm 0,1\%$ of test portion mass.

TEST PROCEDURE

Dry the sample at the $(110 \pm 5) ^\circ\text{C}$ to constant mass.

Sieve on appropriate test sieves with sufficient vigour to ensure complete separation of particles greater than 4 mm. Discard the particles retained on the 63 mm test sieve and those passing the 4 mm test sieve.

Record the mass of the test portion as M_0 .

The mass of the test portion shall be as specified in table below.

Upper aggregate size D (max) mm	Test portion mass (min) kg
63	45
32	6
16	1
8	0,1

Sample reduction shall yield a test portion with a mass larger than the minimum but not of an exact predetermined value.

Separate the test portion into particle size fractions d_i/D_i where $D_i \leq 2 d_i$ by sieving with test sieves.

Record the mass to each particle size fraction (M_{1i}) and calculate and record the percentage by mass of each particle size fraction d_i/D_i to the test portion mass M_0 as V_i .

Discard any size fraction d_i/D_i which comprises less than 10% of M_0 .

If any remaining size fraction contains less than 100 particles, it should if required be recorded in the test report.

Assess the length L and thickness E of each particle using a particle slide gauge and set aside those particles in each size fraction which have a dimensional ratio $L/E > 3$. These are classified as non-cubical.

Record the mass of non-cubical particles in each of these size fraction as M_{2i} .

Calculate the percentage on non-cubical particles in each size fraction tested with the following equation:

$$SI_i = \frac{\sum M_{2i}}{\sum M_{1i}} \cdot 100.$$

Calculate the weighted mean percentage of non-cubical particles (SI) in accordance the following equation:

$$SI = \frac{\sum (V_i \cdot SI_i)}{\sum V_i}.$$

Record the shape indexes to the nearest whole number and determine the category SI.

