Experiment #07 & 08

Determination of Flakiness Index and Elongation Index (Shape test of Coarse Aggregate)

Shape tests on coarse aggregates such as flakiness index and elongation Index, its importance in concrete construction, methods of determination is discussed.

Shape Tests on Coarse Aggregates:

Following tests are conducted on coarse aggregates under shape tests:

- The elongation index of the given aggregates
- The flakiness index of the given aggregates

Apparatus for Shape Tests

The apparatus for the shape tests consists of the following:

1. A standard thickness gauge
2. A standard length gauge
3. IS sieves of sizes 63, 50 40, 31.5, 25, 20, 16, 12.5,10 and 6.3mm
4. A balance of capacity 5kg, readable and accurate up to 1 gm.

Theory of Flakiness Index and Elongation Index Tests

The particle shape of aggregates is determined by the percentages of flaky and elongated particles contained in it. For base course and construction of bituminous and cement concrete types, the presence of flaky and elongated particles are considered undesirable as these cause inherent weakness with possibilities of breaking down under heavy loads.

Thus, evaluation of shape of the particles, particularly with reference to flakiness and elongation is necessary.

The Flakiness index of aggregates is the percentage by weight of particles whose least dimension (thickness) is less than three- fifths (0.6times) of their mean dimension. This test is not applicable to sizes smaller than 6.3mm.

The Elongation index of an aggregate is the percentage by weight of particles whose greatest dimension (length) is greater than nine-fifths (1.8times) their mean dimension. This test is not applicable for sizes smaller than 6.3mm.

Procedure of Shape Tests on Coarse Aggregates

1. Sieve the sample through the IS sieves (as specified in the table).
2. Take a minimum of 200 pieces of each fraction to be tested and weigh them.
3. To separate the flaky materials, gauge each fraction for thickness on a thickness gauge. The width of the slot used should be of the dimensions specified in column (4) of the table for the appropriate size of the material.
4. Weigh the flaky material passing the gauge to an accuracy of at least 0.1 per cent of the test sample.
5. To separate the elongated materials, gauge each fraction for length on a length gauge. The width of the slot used should be of the dimensions specified in column (6) of the table for the appropriate size of the material.
6. Weigh the elongated material retained on the gauge to an accuracy of at least 0.1 per cent of the test sample.

$$\textbf{Flakiness Index} = \frac{Wt.\ of\ aggregate\ passing\ through\ various\ guages}{Total\ Wt.\ of\ sample\ taken} x100$$

$$\textbf{Elongation Index} = \frac{Wt.\ of\ aggregate\ retain\ through\ various\ guages}{Total\ Wt.\ of\ sample\ taken} x100$$

Size of aggregates		Weight of fraction consisting of at least 200 pieces,g	Thickness gauge size, mm	Weight of aggregates in each fraction passing thickness gauge,mm	Length gauge size, mm	Weight of aggregates in each fraction retained on length gauge,mm
Passing through IS Sieve, mm	Retained on IS Sieve, mm					
1	**2**	**3**	**4**	**5**	**6**	**7**
63	50	W_1	23.90	X_1	–	–
50	40	W_2	27.00	X_2	81.00	Y_1
40	31.5	W_3	19.50	X_3	58.00	Y_2
31.5	25	W_4	16.95	X_4	–	–
25	20	W_5	13.50	X_5	40.5	Y_3
20	16	W_6	10.80	X_6	32.4	Y_4
16	12.5	W_7	8.55	X_7	25.5	Y_5
12.5	10	W_8	6.75	X_8	20.2	Y_6
10	6.3	W_9	4.89	X_9	14.7	Y_7
Total	**W =**		**X =**		**Y =**	

Record of Shape Test

Flakiness Index = $(X_1 + X_2 + ...) / (W_1 + W_2 + ...) \times 100$

Elongation Index = $(Y_1 + Y_2 + ...) / (W_1 + W_2 + ...) \times 100$

Recommended Values of Flakiness Index and Elongation Index

The shape tests give only a rough idea of the relative shapes of aggregates. Flaky and elongated particles should be avoided in pavement construction, particularly in surface course.

If such particles are present in appreciable proportions, the strength of pavement layer would be adversely affected due to possibility of breaking under loads. Workability is reduced for cement concrete. IRC recommendations for maximum limits of flakiness index are as given.

Sl No:	**Type of pavement**	**Maximum limits of flakiness index, %**
1	Bituminous carpet	30
2 (i)	Bituminous / Asphaltic concrete	25
(ii)	Bituminous Penetration macadam	
(iii)	Bituminous surface dressing (single coat, two coats & precoated)	
(iv)	Built up spray grout	
3 (i)	Bituminous macadam	15
(ii)	WBM base course and surface course	