1208 FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATE ASTM Designation D 4791 (Mn/DOT Modified)

1208.1 Scope

The flat & elongated test determines by mass the percent of +9.5mm (3/8") coarse aggregate particles that exceeds the maximum length to thickness ratio of five to one.

Flat and elongated particles in a +9.5mm (3/8") aggregate could interfere with and/or make it difficult to consolidate and place these materials.

1208.2 APPARATUS

A. Proportional Caliper Device – This apparatus is suitable for this testing procedure. Consisting of a base with two fixed posts and a swinging arm mounted between them so that the openings between the arm and posts maintain a constant ratio. The axis position can be adjusted to provide the ratio dimensions of 1:2, 1:3 or 1:5.

B. Balance - A balance conforming to the requirements of AASHTO M 231 (Class G2) with a minimum capacity of 2000g, a readability and sensitivity of 0.1g and an accuracy of 0.1g or 0.1%.

C. Oven - Capable of maintaining a temperature of 110 ± 5 °C (230 ± 9 °F).

1208.3 SAMPLE PREPARATION

A. Reduce the +4.75mm (#4) aggregate sample to a representative suitable amount for testing by using an appropriate procedure from Manual Section 1002. The required mass of the pre-test sample will conform to the following:

Nominal Maximum Size In mm	Nominal Maximum Size In Inches	Minimum Mass In kg	Minimum Mass In lbs.
12.5	½	2	4
19.0	¾	5	11
25.0	1	10	22
37.5	1 ½	15	33
50	2	20	44

Sieve the above representative samples of coarse aggregate in accordance with Manual Section1202. Set up a pre-test sample from each size fraction listed above that has at least 10% of the original sample retained on that sieve. MN/DOT's laboratory testing procedure requires that test sample sizes as submitted conform to the values in the table above.

1208.4 TESTING PROCEDURE

A. Wash and oven dry samples to a constant weight at 110 ± 5 °C. (230 ± 9 °F.)

B. Reduce the test samples by using an appropriate Manual Section 1002 sample reduction procedure so that the final sample includes approximately 100 representative particles.

C. Test each of the particles in each size fraction using the proportional caliper device and separate those particles in each size fraction into two groups:

Particles that are Flat and Elongated
Particles that are not Flat and Elongated

1. Flat and Elongated Particle Test

a. Set the larger opening in the proportional caliper device to equal the particle length. The particle is flat and elongated if the thickness can be passed completely through the smaller opening.

D. After the particles have been classified into the groups described in Section 1208.4C (above) determine the proportion of the sample in each group by mass (weight).

1208.5 CALCULATIONS FOR AN INDIVIDUAL SAMPLE

(C ÷ D) **X** (A ÷ B) **X** 100 **=** % Flat & Elongated Particles

Where:

A **=** Original percent retained on a given sieve
B **=** Total percent retained above the 3/8'' sieve
C **=** Mass in grams of flat & elongated particles on a given sieve
D **=** Total mass in grams of the test sample on a given sieve.

- Record the answer for each sieve size tested to the nearest tenth of a percent.

- Round all the numbers to the nearest 1%.

- The sum of the rounded numbers is reported as the total percent flat and elongated particles in that material.

NOTE 1: Sieve sizes not tested (less than 10% of sample) are assumed to have the same percent of flat and elongated particles as the next smaller or next larger size.

1208.6 CALCULATIONS - FORMULA FOR A BLENDED (MULTIPLE AGGREGATE) SAMPLE

A. Use the previous formula to calculate each portion of a "Blended Aggregate" sample and then insert the value for each individual aggregate into the composite formula to calculate the total percent flat & elongated for a blended aggregate.

Calculation for total percent flat & elongated of a blended aggregate:

B = Total percent retained above the 3/8'' sieve
E **=** Percent flat & elongated for an individual aggregate
F **=** Percent of total blend

$$\frac{(B_1 \times E_1 \times F_1) + (B_2 \times E_2 \times F_2) + (B\ldots \times E\ldots \times F\ldots)}{(B_1 \times F_1) + (B_2 \times F_2) + (B\ldots \times F\ldots)} = \%\ \text{Total of Flat \& Elongated}$$

B. Example Calculation:
Bituminous Aggregate 3/4 – is 25% of total blend with 10% F & E and 40% + 3/8
Bituminous Aggregate ½ - is 33% of total blend with 15% F & E and 10% + 3/8

$$\%\ \text{Total of Flat \& Elongated} = \frac{(40 \times 10 \times 25) + (10 \times 15 \times 33)}{(40 \times 25) + (10 \times 33)} = 11\%$$

1208.7 WORKSHEET

FLAT & ELONGATED PARTICLES IN COARSE AGGREGATE ASTM D 4791

Laboratory No. _____ Type of Material _____

Source _____

Location _____

Tested By _____ Date _____

SIEVE SIZES	(A) ORIGINAL PERCENT RETAINED ON A GIVEN SIEVE	(D) MASS TESTED (g)	(C) MASS FAILING (g)	PERCENT FLAT and ELONGATED WTD. AVERAGE
37.5mm (1 ½")				*
25.0mm (1")				*
19.0mm (3/4")				*
12.5mm (1/2")				*
9.5mm (3/8")				*

TOTAL % RETAINED _(B)_____ **TOTAL (E) _____**

Formula for each individual sieve: (C ÷ D) x (A ÷ B) x 100

A = Percent retained on a given sieve
B = Total percent retained above the 3/8'' sieve
C = Mass in grams of flat & elongated particles on a given sieve
D = Total mass in grams of the test sample on a given sieve

*** Calculate the answer for each sieve size tested, round all the answers to the nearest 1% and record as PERCENT FLAT AND ELONGATED WEIGHTED AVERAGE.**

E = The sum of the rounded numbers is reported as the total flat and elongated particles in that material.

NOTE 1: Sieve sizes not tested (less than 10% of sample) are assumed to have the same percent of flat and elongated particles as the next smaller or next larger size.

Remarks:_____

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