WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

STANDARD METHOD FOR DETERMINATION OF $\bar{A}$ OF THE TOTAL SOLIDS IN PORTLAND CEMENT CONCRETE

1.0 PURPOSE

1.1 To establish a procedure for determining the $\bar{A}$ of the total solids contained in portland cement concrete.

1.2 To establish a uniform definition of $\bar{A}$.

2.0 SCOPE

2.1 This procedure shall apply in all cases where the specification requires the determination of $\bar{A}$ of the total solids in portland cement concrete.

3.0 PROCEDURE

3.1 Since the solids contained in a portland cement concrete mix consist of coarse aggregate, fine aggregate, and portland cement this procedure will address the determination of $\bar{A}$ of these solids in combination.

3.1.1 The mass of the solid materials used in the mix proportions shall be used to determine the percent of each constituent material in the total solids.

3.1.1.1 Total mass of solids:

$$M_{ca} + M_{fa} + M_c = M_t$$

Where:

M_{ca} = mass of coarse aggregate (SSD) used in one cubic meter of concrete.

M_{fa} = mass of fine aggregate (SSD) used in one cubic meter of concrete.

M_c = mass of cement used in one cubic meter of concrete.

M_t = total mass of solids in one cubic meter of concrete.

3.1.1.2 Percent of each material in the total solids:

$\frac{M_{ca}}{M_t}$ (100) = % of coarse aggregate

$\frac{M_{fa}}{M_t}$ (100) = % of fine aggregate

$\frac{M_c}{M_t}$ (100) = % of cement

3.1.2 Determine the gradation of each of the individual materials using standard procedures with the following modification.

3.1.2.1 When determining the fine aggregate gradation, include Standard Sieve sizes 9.5 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 µm, 300 µm, 150 µm, and 75 µm.

3.1.3 Determine the $\bar{A}$ of each of the individual solid constituents. The $\bar{A}$ shall be determined by adding the cumulative percentages by mass of material passing each of Standard Sieve sizes 37.5 mm, 19 mm, 9.5 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 µm, 300 µm, 150 µm, and 75µm and dividing by 100.

3.1.4 Determine the $\bar{A}$ of the total solids as follows, using the component percentages from 3.1.1.2.

$\bar{A}_{ca}$ x percent of coarse aggregate $= \bar{A}_{f1}$

$\bar{A}_{fa}$ x percent of fine aggregate $= \bar{A}_{f2}$

$\bar{A}_c$ x percent of cement $= \bar{A}_{f3}$

$\bar{A}$ total solids $= \bar{A}_{f1} + \bar{A}_{f2} + \bar{A}_{f3}$

Where:

$\bar{A}_{ca}$ = $\bar{A}$ of coarse aggregate
$\bar{A}_{fa}$ = $\bar{A}$ of fine aggregate
$\bar{A}_c$ = $\bar{A}$ of cement

3.2 Several mechanical devices are available that can be used to extract the total solids from a sample of plastic concrete. The $\bar{A}$ of the total solids may be determined on such an extracted sample or by other alternate methods with the approval of the Engineer.

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Attachments

EXAMPLE OF CALCULATIONS
A TOTAL SOLIDS

1. Total mass of solids

M_{ca} = Mass of SSD Coarse Aggregate (kg/m³) = 1068

M_{fa} = Mass of SSD Fine Aggregate (kg/m³) = 652

M_c = Mass of cement (kg/m³) = 356

M_t = Total mass of Solids (kgs/m³) = 2076

2. Fractional percentage of each material

$$\frac{M_{ca}}{M_t} = \frac{1068}{2076}(100) = 51.4$$

$$\frac{M_{fa}}{M_t} = \frac{652}{2076}(100) = 31.4$$

$$\frac{M_c}{M_t} = \frac{356}{2076}(100) = 17.2$$

3. Determination of $\bar{A}$ each solid

Sieve Size	PERCENT PASSING Coarse Aggregate	Fine Aggregate	Cement
37.5 mm	100	100	100
19 mm	84	100	100
9.5 mm	21	100	100
4.75 mm	2	98	100
2.36 mm	1	83	100
1.18 mm		65	100
600 μm		48	100
300 μm		13	100
150 μm		3	100
75 μm	0.5	1.5	100
Totals	208.5	611.5	1000
$\bar{A}$	2.08	6.11	10

4. Determine $\bar{A}$ total solids

Coarse Aggregate Fraction	=	.514 x 2.08	=	1.07
Fine Aggregate Fraction	=	.314 x 6.11	=	1.92
Cement Fraction	=	.172 x 10	=	1.72
$\bar{A}$ Total Solids	=			4.71