DETERMINATION OF THEORETICAL MAXIMUM DRY DENSITY OF GRANULAR SOILS AND SOIL/AGGREGATES FOR USE AS A DENSITY STANDARD WAQTC TM 17

Scope

This procedure provides for the rapid determination of the theoretical maximum dry density of a soil-aggregate sample. This procedure is associated with the FOP for AASHTO T 310 and WAQTC TM 15. The percentage of material passing the 4.75 mm (No. 4) sieve of the in-place material is determined. This percentage is used to establish a density standard using the theoretical maximum dry density chart and curve developed in WAQTC TM 15 for the given material. The density standard is used to determine percent compaction for in-place density.

Apparatus

- Balance or scale: with a capacity of 5 kg, sensitive to 1 g. Meeting the requirements of AASHTO M 231.
- Sieve: 4.75 mm (No. 4), meeting the requirements of FOP for AASHTO T 27/T 11.
- Large absorbent towel

Procedure

All masses are determined to at least the nearest 0.1 percent of the total sample mass.

1. Determine in-place density of the soil-aggregate according to the FOP for AASHTO T 310.
2. Obtain a representative sample from directly beneath the gauge according to the FOP for AASHTO T 310.
3. Determine the percent retained on the 4.75 mm (No. 4) sieve by one of the following methods:

   Method 1 – for material that will easily pass through the sieve.

   a. Dry the sample until no visible free moisture is present (material may appear damp but not shiny).

   b. Determine and record the mass of the sample.

   c. Shake the sample by hand over a 4.75 mm (No. 4) sieve. Do not overload the sieve.

   Note 1: The sample may be sieved in increments to avoid overloading and then recombined.

   d. Determine and record the mass of the material retained on the 4.75 mm (No. 4) sieve.

   Method 2 – for material that will not easily pass through the 4.75 mm (No. 4) sieve due to fines adhering to the coarse aggregate.

   a. Determine and record the mass of the sample.

   b. Shake the sample by hand over a 4.75 mm (No. 4) sieve. Do not overload the sieve.

   c. Shake until no material appears to be passing the 4.75 mm (No. 4) sieve.

d. Rinse the material retained with water until it appears free of material that will pass the 4.75 mm (No. 4) sieve.

e. Blot the retained material with a large absorbent cloth until all visible films of water are removed (material may appear damp but not shiny).

f. Determine and record the mass of the material retained on the 4.75 mm (No. 4) sieve.

4. Determine the percent retained on the 4.75 mm (No. 4) sieve by dividing the mass of retained material by total sample mass and multiply by 100.

5. Determine the percent passing the 4.75 mm (No. 4) sieve by subtracting the percent retained from 100.

6. Enter the percent passing in the theoretical maximum dry density chart from the WAQTC TM 15 to determine the theoretical maximum dry density of the in-place material.

Calculations

Calculate the percent retained on the 4.75 mm (No. 4) sieve

$$\%\, retained = \frac{A}{B} \times 100$$

Where:

A = mass of material retained on the 4.75 mm (No. 4) sieve, 1 g

B = total sample mass, 1 g

Calculate the percent passing the 4.75 mm (No. 4 sieve)

$$\%passing = 100 - \%retained$$

Example

$$\%\, retained = \frac{3052\ g}{4120\ g} \times 100 = 74\%$$

$$\%passing = 100\% - 74\% = 26\%$$

Given:

A = 3052 g

B = 4120 g

Theoretical Maximum Dry Density = 129.0 lb/ft3

EXAMPLE
Theoretical Maximum Dry Density Chart

Density Curves			
Pass #4	Maximum	Pass #4	Maximum
0.0	104.8	31.0	133.7
1.0	105.6	32.0	134.5
2.0	106.4	33.0	135.2
3.0	107.1	34.0	135.8
4.0	107.9	35.0	136.4
5.0	108.7	36.0	137.0
6.0	109.5	37.0	137.5
7.0	110.3	38.0	137.9
8.0	111.1	39.0	138.3
9.0	112.0	40.0	138.6
10.0	112.8	41.0	138.9
11.0	113.7	42.0	139.0
12.0	114.5	43.0	139.2
13.0	115.4	44.0	139.2
14.0	116.4	45.0	139.2
15.0	117.3	46.0	139.2
16.0	118.2	47.0	139.1
17.0	119.2	48.0	139.0
18.0	120.2	49.0	138.8
19.0	121.3	50.0	138.6
20.0	122.3	51.0	138.3
21.0	123.4	52.0	138.1
22.0	124.5	53.0	137.8
23.0	125.6	54.0	137.5
24.0	126.8	55.0	137.1
25.0	127.9	56.0	136.8
26.0	129.0	57.0	136.4
27.0	130.0	58.0	136.0
28.0	131.0	59.0	135.7
29.0	132.0	60.0	135.3
30.0	132.8	61.0	135.0

Density Curves			
Pass #4	Maximum	Pass #4	Maximum
62.0	134.6	82.0	129.6
63.0	134.3	83.0	129.4
64.0	134.0	84.0	129.3
65.0	133.6	85.0	129.1
66.0	133.3	86.0	128.9
67.0	133.1	87.0	128.8
68.0	132.8	88.0	128.6
69.0	132.5	89.0	128.4
70.0	132.2	90.0	128.3
71.0	132.0	91.0	128.1
72.0	131.7	92.0	128.0
73.0	131.5	93.0	127.9
74.0	131.2	94.0	127.7
75.0	131.0	95.0	127.6
76.0	130.8	96.0	127.4
77.0	130.6	97.0	127.3
78.0	130.4	98.0	127.2
79.0	130.2	99.0	127.0
80.0	130.0	100.0	126.9
81.0	129.8		

Control Points for Density Curves		
Pass #4	Maximum	Loose
0.0	104.8	87.6
20.5	122.8	99.6
27.4	130.4	103.8
42.5	139.1	105.4
61.1	134.9	96.7
100.0	126.9	81.9

Report

- Results on forms approved by the agency
- Sample ID
- Theoretical maximum dry density to the nearest 1 kg/m^3 (0.1 lb/ft^3)