

**ALDOT-442-09**  
**METHOD OF DETERMINING  $D_{50}$**

**1. Scope**

- 1.1. These methods outline the procedures to be followed for determining the median particle size diameter,  $D_{50}$ , for soil material obtained for calculating scour at bridges.

**2. Reference Documents**

2.1. AASHTO STANDARDS:

- M 92 Standard Specification for Wire-Cloth Sieves for Testing Purposes.
- M 231 Weighting Devices Used in the Testing of Materials
- T 11 Materials Finer Than 75- $\mu\text{m}$  (No. 200) Sieve in Mineral Aggregates by Washing
- T 27 Sieve Analysis of Fine and Coarse Aggregates
- T 87 Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test
- T 265 Laboratory Determination of Moisture Content of Soils

**3. Equipment**

- 3.1. Balances – The balances shall conform to AASHTO M 231, Class D for samples less than 2000 g and Class E for samples of 2000 g or more.
- 3.2. Oven - The oven shall be capable of maintaining a uniform temperature not to exceed 140°F (60° C).
- 3.3. Sieves – Suitable sieve sizes shall be selected.

**4. Sample Preparation**

- 4.1. Dry sample in a 140°F (60° C) oven.
- 4.2. After removing the sample from the oven, pulverize it by hand using just enough force to break it down so that the clumps are small enough that a soda ash solution will easily penetrate them. The use of grinding machines to break up the sample is not allowed as this will alter the grain size structure of the sample.
- 4.3. If the sample is too large, it shall be split to a more suitable size. Generally one or two passes through a splitter are sufficient. After the sample has been pulverized, weigh it and record the weight as the “initial weight” ( $W_1$ ).
- 4.4. Soak the sample in a soda ash solution that acts as a wetting agent to aid in the loosening of the material. Perform a standard 200 wash on the sample according to AASHTO T 11.
- 4.5. Dry the sample and record the weight as the “weight after wash” ( $W_2$ ) according to AASHTO T 265.
- 4.6. If  $W_2$  is less than half of  $W_1$ , then the sample will not need to be mechanically shaken in a nested set of sieves. Calculate the percent passing the #200 sieve and determine the  $D_{50}$  as follows:

D50 = % passing the #200 sieve.

- 4.7. If  $W_2$  is more than half of  $W_1$  shake the sample for approximately 3 minutes in the following nested set of sieves. Use a Ro-Tap or an equivalent mechanical shaker.

**SIEVES REQUIRED**

# 4  
# 10  
# 40  
# 200  
# 325  
PAN

- 4.8. After the sample has been mechanically shaken, weigh the material retained on each sieve starting with the #4 sieve and ending with the #325 sieve.

**5. Calculations**

- 5.1. The retained weights are used to calculate the % retained and the % passing for each sieve in the series. The % retained is calculated by dividing the retained weight by  $W_1$  and the result multiplied by 100. The % passing is calculated by subtracting the % retained from 100.

$$\% \text{ retained} = \frac{\text{weight retained on sieve}}{W_1} \times 100$$

$$\% \text{ passing} = 100 - \% \text{ retained}$$

Example:

$$W_1 = 500 \text{ g}$$

$$\text{Weight retained on \# 4 sieve} = 9.7 \text{ g (material from \#4 sieve)}$$

$$\text{Weight retained on \# 10 sieve} = 39.5 \text{ g (material from \#10 sieve)}$$

# 4 Sieve:

$$\% \text{ retained} = \frac{9.7}{500} \times 100 = 1.9\%$$

$$\% \text{ passing} = 100 - 1.9 = 98.1\%$$

# 10 Sieve

$$\% \text{ retained} = \frac{39.5}{500} \times 100 = 7.9\%$$

$$\% \text{ passing} = 100 - 7.9 = 92.1\%$$

**6. Report**

- 6.1. Plot the % passing versus the sieve opening on a semi-logarithmic graph paper.
- 6.2. Draw a straight line from one plotted point to next plotted point until all the points are joined together.
- 6.3. Draw a horizontal line from the 50% passing to intersect the plot. Project up the point of intersection to the upper scale of the graph paper.
- 6.4. Report this reading as the  $D_{50}$  value. See Figure 1 for example.

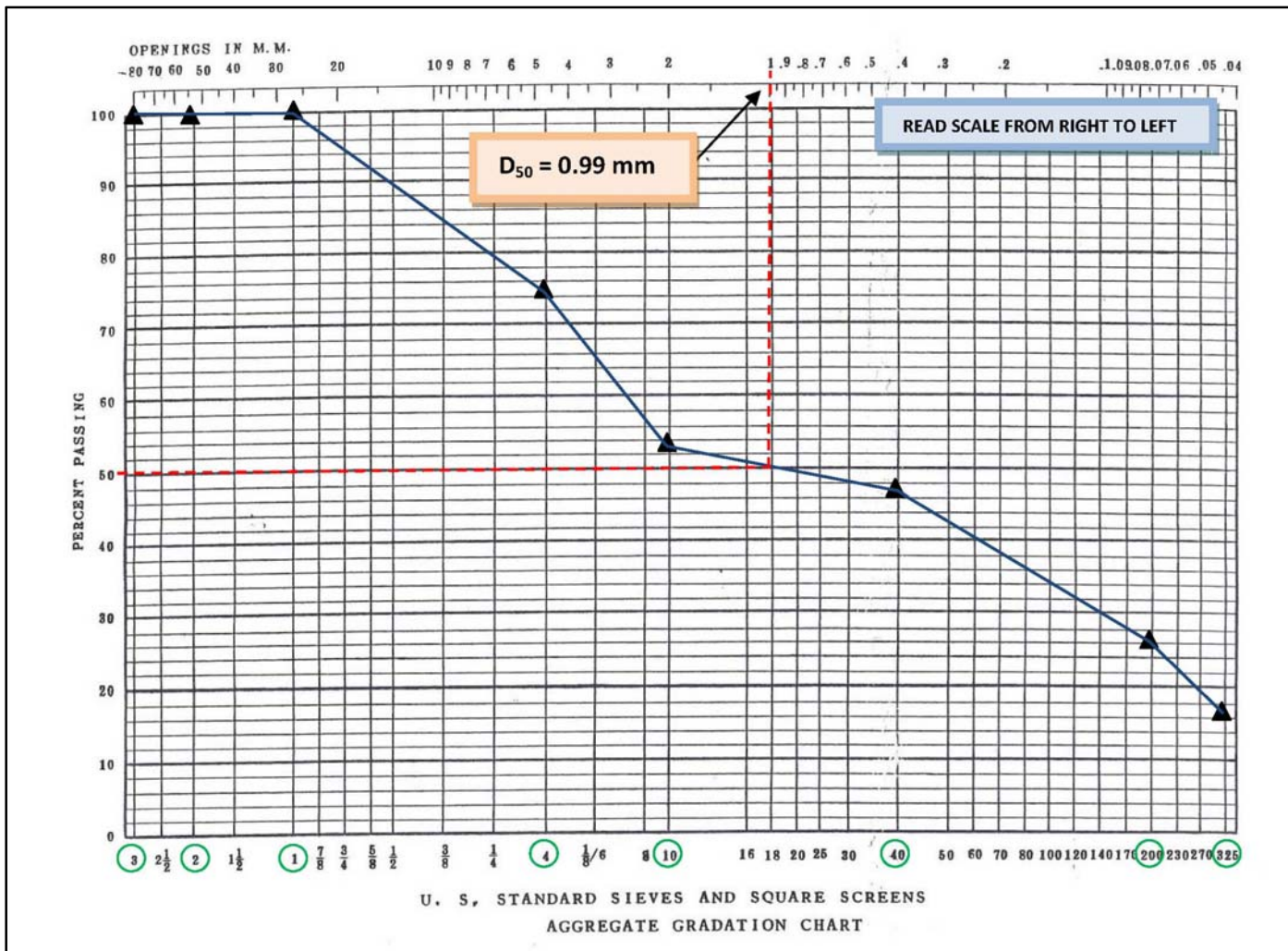


Figure 1: Example of graphically determination of  $D_{50}$