84-027 SIEVE ANALYSIS (Mechanical Method)

1. Application

1.1 The grain-size analysis is used in the classification of soils for engineering purposes. The resulting grain-size distribution curves are used as part of the criteria for road and embankment construction and for prediction of a soils susceptibility to frost action.

The grain-size analysis is an attempt to determine the relative proportions of the different grain-sizes which make up a given soil mass.

2. Apparatus and Materials

2.1 Sieves and pan (20 cm diam).

2.1.1 Recommended ASTM Sieve sizes
No. 4 (4.76 mm), No. 10 (2.00 mm), No. 40 (.42 mm) and a No. 200 (.074 mm)

2.2 Sieve brush.

2.3 1-500 mL glass beaker.

2.4 Porcelain evaporation dish (20 cm diam).

2.5 Balance (capacity 1000 g; sensitivity 0.1 g.

2.6 Mortar and rubber-tipped pestal.

2.7 Drying oven (Capable of 105°C).

2.8 Sieve shaker.

3. Procedure

3.1 Thoroughly clean and weigh each sieve to be used to 0.1 g.

NOTE: Sieves should always be brushed clean from the bottom side. Particles which are forced through the sieve from the top enlarge the opening and reduce the life expectancy of the sieve. Particles which are tightly lodged in the mesh may be loosened by tapping the side wall of the sieve against the palm of the hand.

3.2 Select and weigh a representative sample of approximately 500 gm, break the soil into individual particles by crushing with either the fingers or a rubber-tipped pestle.

3.2.1 The size of sample which is considered to be representative is dependent upon the maximum size fragment present or to be analysed. The following representative sample guidelines are commonly employed;

Particles up to 5 mm - 500 g
Particles up to 20 mm - 5 kg
Particles up to 75 mm - 20 kg

Note: For fine grained soils which dry into hard aggregates the most reliable and most easily duplicated method of performing the sieve analysis is to take an oven-dry quantity of soil, break it as fine as possible, wash it on the No. 200 sieve, oven-dry it and sieve the residue through a stack of sieves by shaking horizontally by hand or mechanically for at least 10 minutes.

3.3 The initial washing of the soil should be carefully conducted to avoid damaging the sieve or losing any soil by splashing the material out of the sieve. The soil is washed through the sieve using tap water until the water runs clear.

3.4 Using a wash bottle, carefully back wash the residue into a large porcelain evaporation dish, decant as much of the excess water as possible ensuring that none of the sample is lost in the process, oven-dry the remaining soil-water suspension for 16-24 hrs.

3.5 Remove the sample from the drying oven, place watch glass on top of the evaporation dish and allow the dish and contents to cool to room temperature. Record the weight of the sample.

3.6 Pass the sample through the stack of sieves, using as an "absolute" minimum the following sieve sizes, #4, #10, #40, #200. Since the object of this exercise is to obtain a semi-logarithmic curve it is highly recommended that the following sieves be included in the sieve stack, #20, #60, #100 or #140.

3.7 Following the required 10 minutes of shaking, weigh each sieve and record the gross weight of the sieve plus soil. Subtract the weight of the sieve as determined on step 3.1 and determine the amount of the total sample retained on each sieve as a percentage of 100.

3.8 Sum the weight of the residue collected on each sieve and compare this to the sample weight recorded in step 3.5. A discrepancy of more than 2% by weight is considered unsatisfactory and the test should be repeated.

3.9 Compute the percentage passing each sieve by starting with 100% and subtracting the percent retained on each sieve as a cumulative procedure.

3.10 Plot the grain-size distribution curve as a semi-logarithmic plot ensure that the information requested at the top of the Figure 1 has been properly filled out. If less than 10% of the total sample passes the #200 sieve this completes the test, if more than 10% passes then continue with a particle size distribution method.

3.11 From the curve grain-size distribution compute the coefficient of uniformity (Cu D_{60}/D_{10}); where D refers to the effective diameter of the soil particles and the subscripts (10 and 60) denote the percent which is smaller. An indication of the spread or range of grain sizes is given by Cu, with a large Cu value indicating that the D_{60} and D_{10} sizes differ appreciably.

4. References

4.1 ASTM D422-33

4.2 Bowles, J.E. 1970. Engineering Properties of Soils and their Measurement, McGraw-Hill, Toronto.

Project _____ Job No. _____

Location of Project _____ Boring No. _____ Sample No. _____

Description of Soil _____ Depth of Sample _____

Tested By _____ Date of Testing _____

(ASTM D1140-54)

Soil Sample Size

Nominal diameter of largest particle	Approximate minimum wt. of sample: g
No. 10 sieve	200
No. 4 sieve	500
¾ in.	1500

Wt. of dry sample + container	
Wt. of container	
Wt. of dry sample	

Sieve analysis and grain shape

Sieve No.	Diam. (mm)	Wt. retained	% retained	% passing
4	4.760			
10	2.000			
20	0.840			
40	0.420			
60	0.250			
100	0.149			
200	0.074			
PAN				

% passing = 100 - Σ % retained

Fig. 13 Grain size analysis mechanical.

Project _____ Job No. _____

Location of Project _____ Boring No. _____ Sample No. _____

Description of Soil _____ Depth of Sample _____

Tested By _____ Date of Testing _____

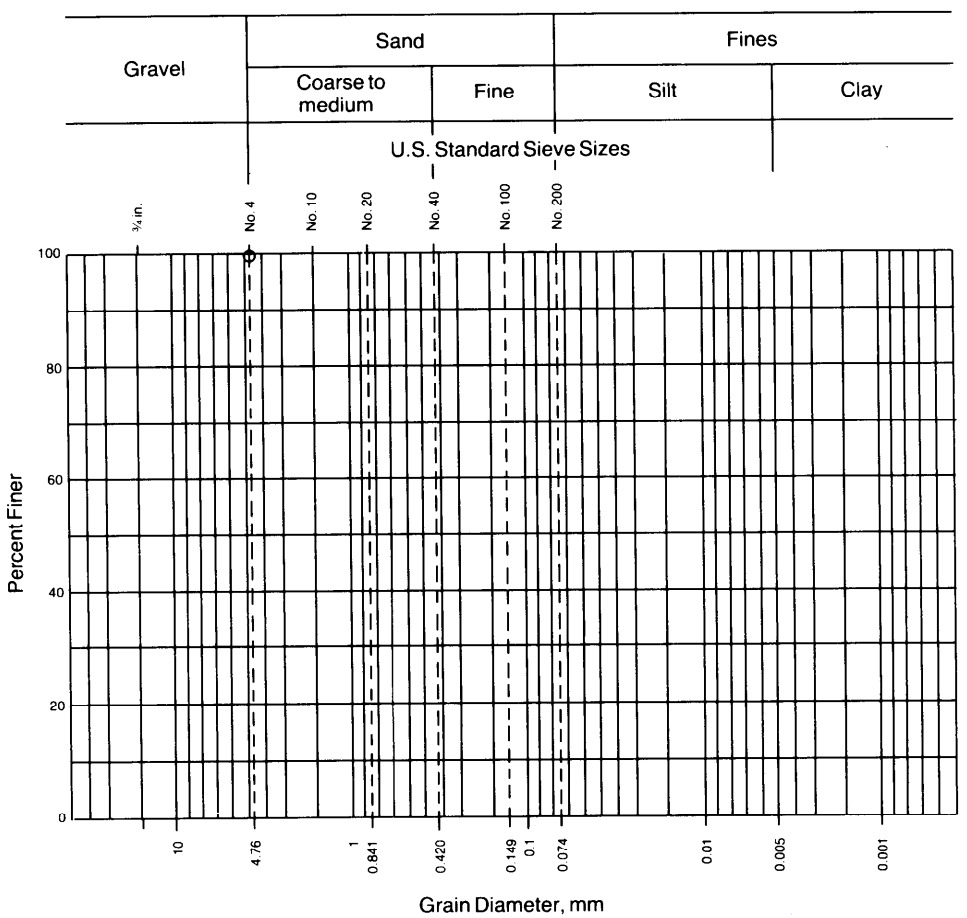

Fig. 14 Grain size distribution