EXPERIMENT 4
SIEVE ANALYSIS

Purpose:

This test is performed to determine the percentage of different grain sizes contained within a soil. The mechanical or sieve analysis is performed to determine the distribution of the coarser, larger-sized particles, the hydrometer method is used to determine the distribution of the finer particles.

The Theoretical Part:

In order to classify a soil for engineering purposes, one needs to know the distribution of the size of grains in a given soil mass. Sieve analysis is a method used to deter mine the grain size distribution of soils. Sieves are made of woven wires with square openings. Note that. as the sieve number increases the size of the openings decreases. Table 4-1 gives a list of the U.S. standard sieve numbers with their corresponding size of openings. For all practical purposes, the No. 200 sieve is the sieve with the smallest opening that should be used for the test. The sieves that are most commonly used for soil tests have a diameter of 8 in. (203 mm). A stack of sieves is shown in Figure. 4.-1. The method of sieve analysis described here is applicable for soils that are *mostly granular with some or no fines.* Sieve analysis does not provide information as to shape of partials.

Sieve No.	Opening (mm)	Sieve No.	Opening (mm)
4	4.75	35	0.500
5	4.00	40	0.425
6	3.35	45	0.355
7	2.80	50	0.300
8	2.36	60	0.250
10	2.00	70	0.212
12	1.70	80	0.180
14	1.40	100	0.150
16	1.18	120	0.125
18	1.00	140	0.106
20	0.85	200	0.075
25	0.71	270	0.053
30	0.60	400	0.038

Table 4-1. U.S. Sieve Sizes

Figure 4-1. A stack of *sieves* with a pan at the bottom and a *cover* on the top.

Equipment And Tools:

1.Sieves, a bottom pan, and a cover

Note: Sieve numbers 4, 10, 20, 40, 60, 140, and 200 are generally used for most standard sieve analysis work.

2.A balance sensitive up to 0.1 g

3.Mortar and rubber~tipped pestle

4.Oven

5. Mechanical sieve shaker

Figure. 3-1 Equipment and tools for sieve analyses test

Procedure:

1. Collect a *representative* oven dry soil sample. Samples having largest particles of the size of No . 4 sieve openings (4.75 rnm) should be about 500 grams. For soils having largest particles of size greater than 4.75 rnm, larger weights are needed.

2. Break the soil sample into individual particles using a mortar and a rubber-tipped

pestle. *(Note:* The idea is to break up the soil into individual particles, not to break the particles themselves.)

3. Determine the mass ofthe sample accurately to 0.1 g *CW).*

4. Prepare a stack of sieves. A sieve with larger openings is placed above a sieve with smaller openings. The sieve at the bottom should be No. 200. A bottom pan should be placed under sieve No. 200. As mentioned before, the sieves that are generally used in a stack are Nos. 4, 10,20,40,60, 140, and 200; however, more sieves can be placed in between.

5. Pour the soil prepared in Step 2 into the stack of sieves from the top.

6. Place the cover on the top of the stack of sieves.

7. Run the stack of sieves through a sieve shaker for about 10 to 15 minutes.

8. Stop the sieve shaker and remove the stack of sieves.

9. Weigh the amount of soil retained on each sieve and the bottom pan.

10. If a *considerable* amount of soil with silty and clayey fractions is retained on the No.
200 sieve, it has to be washed. Washing is done by taking the No. 200 sieve with the soilretained on it and pouring water through the sieve from a tap in the laboratory **(Figure. 4-2)**.

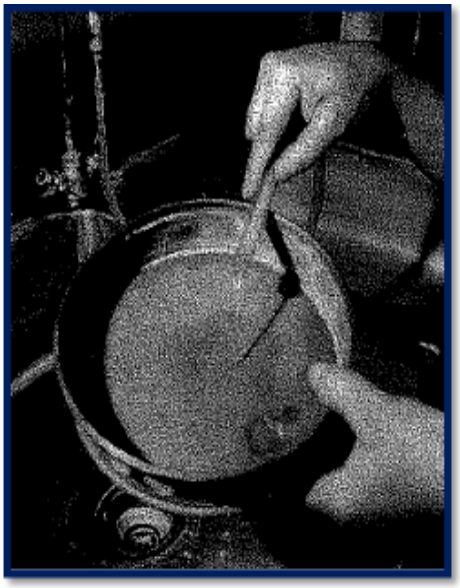

Figure 4-2. Washing of the soil retained on No. 200 sieve.

Calculation:

1. Calculate the percent of soil retained on the *nth* sieve (counting from the top)

$$= \frac{\text{mass retained, } W_n}{\text{total mass, } W \text{ (Step 3)}} \times 100 = R_n$$

2. Calculate the cumulative percent of soil retained on the *nth* sieve

$$= \sum_{i=1}^{i=n} R_n$$

3. Calculate the cumulative percent passing through the *nth* sieve

$$= \text{percent finer} = 100 - \sum_{i=1}^{i=n} R_n$$

Standard Results:

Standard Reference:

ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils

Discussion and Conclusions:

The distribution of different grain sizes affects the engineering properties of soil. Grain size analysis provides the grain size distribution, and it is required in classifying the soil.