

## **GRAIN SIZE ANALYSIS BY DRY SIEVING**

### **AIM OF THE EXPERIMENT:-**

To determine the percentage of various size particles in a soil sample, and to classify the coarse grained soil.

### **APPARATUS REQUIRED:-**

- i. 1<sup>st</sup> set of sieves of size 300 mm, 80 mm, 40 mm, 20 mm, 10 mm, and 4.75 mm.
- ii. 2<sup>nd</sup> set of sieves of sizes 2mm, 850 micron, 425 micron, 150 micron, and 75 micron.
- iii. Balances of 0.1 g sensitivity, along with weights and weight box.
- iv. Brush.

### **THEORY:-**

Soils having particle larger than 0.075mm size are termed as coarse grained soils. In these soils more than 50% of the total material by mass is larger 75 micron. Coarse grained soil may have boulder, cobble, gravel and sand.

The following particle classification names are given depending on the size of the particle:

- i. BOULDER: particle size is more than 300mm.
- ii. COBBLE: particle size in range 80mm to 300mm.
- iii. GRAVE (G): particle size in range 4.75mm to 80mm.
  - a. Coarse Gravel: 20 to 80mm.
  - b. Fine Gravel: 4.75mm to 20mm.
- iv. SAND (S): particle size in range 0.075mm to 4.75mm.
  - a. Coarse sand: 2.0mm to 4.75mm
  - b. Medium Sand: 0.075mm to 0.425mm.
  - c. Fine Sand: 0.075mm to o.425mm.

Name of the soil is given depending on the maximum percentage of the above components.

Soils having less than 5% particle of size smaller than 0.075mm are designated by the symbols, Example:

GP: Poorly Graded Gravel.

GW: Well Graded Gravel.

SW: Well Graded Sand.

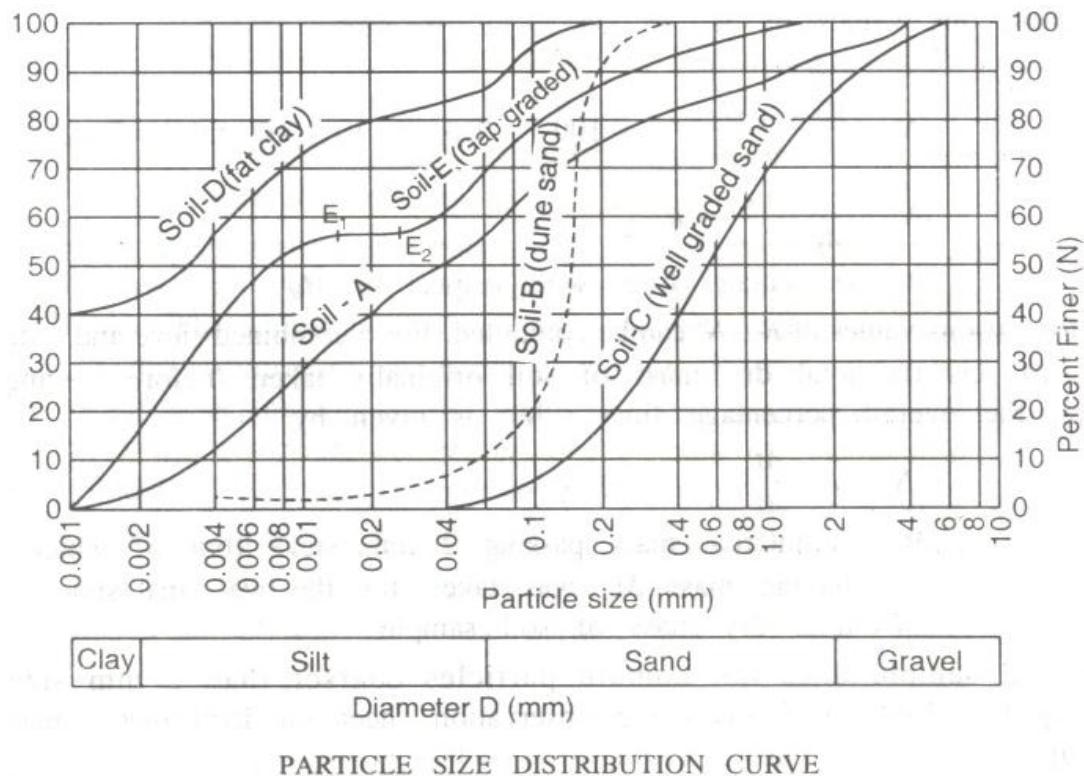
SP: Poorly Graded Sand.

Soils having greater than 12% of particle of size smaller than 0.075mm are designated by the following symbols:

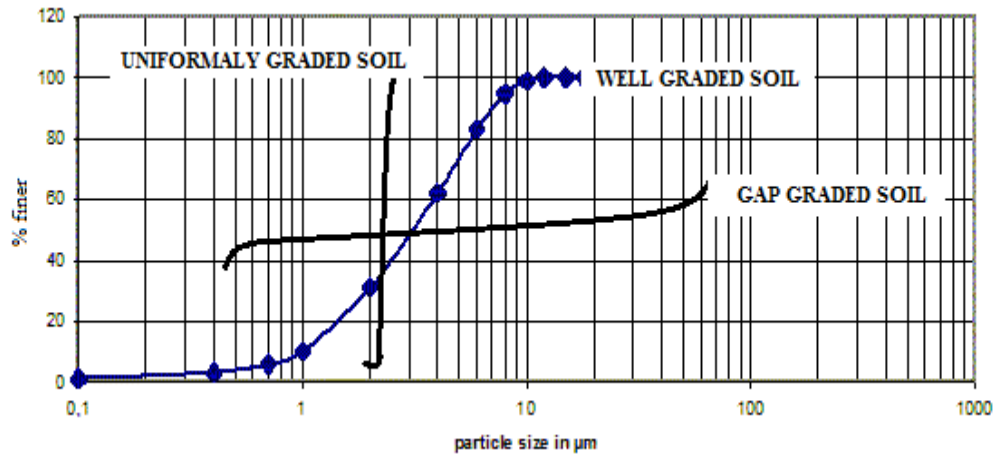
Dual symbols are used for the soils having 75 micron passing between 5 to 12%.

Dry sieve is performed for cohesion less soils if fines are less than 5%. Wet sieve analysis is carried out if fines are more than 5% and of cohesive nature.

We can analysis from foiling,



In simpler way we can show the above particle size distribution curve for course grain soil as fallows,



Gravels and sands may be either poorly graded (Uniformly graded) or well graded depending on the value of coefficient of curvature and uniformity coefficient.

Coefficient of curvature ( $C_c$ ) may be estimated as:

$$C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$$

Coefficient of curvature ( $C_c$ ) should lie between 1 and 3 for well grade gravel and sand.

Uniformity coefficient ( $C_u$ ) is given by:

$$C_u = \frac{D_{60}}{D_{10}}$$

Its value should be more than 4 for well graded gravel and more than 6 for well graded sand.

Where,  $D_{60}$  = particle size at 60% finer.

$D_{30}$  = particle size at 30% finer.

$D_{10}$  = particle size at 10% finer.

APPLICATION:

The percentage of different size of soil particles coarser than 75 micron is determined. Coarse soils are mainly classified by sieve analysis. The grain size distribution curve gives an idea regarding the gradation of the soil, that is, it is possible to identify whether the soil is well graded or poorly graded. In mechanical soil stabilization, the main principle is to mix a few selected soils in such a proportion that a desired grain size distribution is obtained for the design mix. Hence for proportioning the selected soils, the grain size distribution of each soil is to be first known.

#### PROCEDURE:

- i. Weight accurately about 200gms of oven dried soil sample. If the soil has a large fraction greater than 4.75mm size, then greater quantity of soil, that is, about 5.0 Kg should be taken. For soil containing some particle greater than 4.75 mm size, the weight of the soil sample for grain size analysis should be taken as 0.5 Kg to 1.0 Kg.
- ii. Clean the sieves and pan with brush and weigh them upto 0.1 gm accuracy. Arrange the sieves in the order as shown in Table. The first set shall consist of sieves of size 300 mm, 80mm, 40mm, 20mm, 10mm, and 4.75 mm. While the second set shall consist of sieves of sizes 2mm, 850 micron, 425 micron, 150 micron, and 75 micron.
- iii. Keep the required quantity of soil sample on the top sieve and shake it with mechanical sieve shaker for about 5 to 10 minutes. Care should be taken to tightly fit the lid cover on the top sieve.
- iv. After shaking the soil on the sieve shaker, weigh the soil retained on each sieve. The sum of the retained soil must tally with the original weight of soil taken.

#### PRECAUTIONS:

- i. During shaking the lid on the topmost sieve should be kept tight to prevent escape of soils.
- ii. While drying the soil, the temperature of the oven should not be more than 105 °C because higher temperature may cause some permanent change in the 75 fraction.

#### OBSERVATION AND CALCULATION TABLE:

Mass of soil Sample taken for Analysis =     M

Sieve size (mm)	Mass of soil Retained (gms)	% of soil retained (%) = (x/M)	Cumulative % of soil retained (%)	% finer = (100 - p)
80	x1	y1	p1=y1	n1=100-p1
40	x2	y2	p2=y1+y2	n2=100-p2
20	x3	y3	p3=y1+y2+y3+....	n3=100-p3
10				
4.75				
2.0				
0.850				
0.425				
0.150				
0.075				
pan				

Coefficient of curvature ( $C_c$ ) may be estimated as:

$$C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$$

Uniformity coefficient ( $C_u$ ) is given by:

$$C_u = \frac{D_{60}}{D_{10}}$$

#### QUESTIONNAIRE:

- What do you understand by well graded, poorly graded and uniformly graded soils?
- What do you understand by dry sieve and wet sieve analysis? Which once did you perform and why?
- What is the grain size distribution curve? Why do you use a semi-log graph paper for plotting it?
- What do you understand by GW,GP,GM,GC,SW,SP,SM,SC,SW-SM,GP-SC?

#### TEST PROCEDURE:

- i. Select the type of soil (dry sand or dry gravel) and mass of soil.
- ii. Mass of soil is appear on screen at 'TOTAL MASS OF SOIL'
- iii. Click arrow that is for sieving the soil mass, the total sieve have appear ob be like vibrating.
- iv. The table is filling by calculation.
- v. Click next arrow, the graph is display on semi log paper for % finer Vs size of practical.
- vi. Then at bottom portion the result is appear as, Coefficient of curvature ( $C_c$ ) and Uniformity coefficient ( $C_u$ ) and type of soil.