DETERMINATION OF PARTICLE SIZE DISTRIBUTION BY SIEVING (GRAIN SIZE ANALYSIS)

Aim: To determine the particle size distribution by sieving (Grain size analysis) and to determine the fineness modulus, effective size and uniformity coefficient.

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 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.

Specifications:

This test is specified in IS: 2720 (Part 4) – 1985 (Reaffirmed-May 2015) – Method of test for soil (Part 4- Grain size analysis). (Note: Depends of standart)

Equipments Required:

a) Sieves of sizes: 4.75 mm, 2.0 mm, 1.0 mm, 600 μ, 300 μ, 150 μ and 75 μ. That is, I.S 460-1962 is used. The sieves for soil tests: 4.75 mm to 75 microns. (Depends of standart)
b) Thermostatically controlled oven.
c) Trays, sieve brushes, mortar with a rubber covered pestle, etc.
d) Mechanical sieve shaker etc.

Theory:

The grain size analysis is widely used in classification of soils. The data obtained from grain size distribution curves is used in the design of filters for earth dams and to determine suitability of soil for road construction, air field etc. Information obtained from grain size analysis can be used to predict soil water movement although permeability tests are generally used. The method is applicable to dry soil passing through 4.75 mm size sieve less than 10 % passing through 75-micron sieve.

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Percentage retained on any sieve = (weight of soil retained / total weight) x 100
Cumulative percentage retained = sum of percentages retained on any sieve on all coarser sieves

Percentage finer than any sieve = 100 percent minus cumulative Size, N Percentage retained.

Precautions:

- Clean the sieves set so that no soil particles were struck in them
- While weighing put the sieve with soil sample on the balance in a concentric position.
- Check the electric connection of the sieve shaker before conducting the test.
- No particle of soil sample shall be pushed through the sieves.

Procedures:

a) Take a representative sample of soil received from the field and dry it in the oven.
b) Use a known mass of dried soil with all the grains properly separated out. The maximum mass of soil taken for analysis may not exceed 500 g.
c) Prepare a stack of sieves. Set the sieves one over the other with an ascending order (sieves having larger opening sizes i.e., lower numbers are placed above the one with smaller opening sizes i.e., smaller numbers). The very last sieve is #200 (75 μ sieve). A pan is attached to the lowest 75 μ sieve to collect the portions passing #200 sieves and fit the nest to a mechanical shaker.
d) Make sure sieves are clean. If many soil particles are stuck in the openings try to poke them out using brush.
e) The whole nest of sieves is given a horizontal shaking for 10 min in sieve shaker till the soil retained on each reaches a constant value.
f) Determine mass of soil retained on each sieve including that collected in the pan below.

The test results obtained from a sample of soil are given below. Mass of soil taken for analysis W =_____gm

Sieve Analysis data sheet

No	Sieves (mm)	Mass Retained (gm)	Mass Retained (%)	Cumulative Mass Retained (%)	Finer (%)
1	4.75				
2	2.00				
3	1.00				
4	0.600				
5	0.300				
6	0.150				
7	0.075				
8	pan				

Cumulative mass retained W'= ---------- gm

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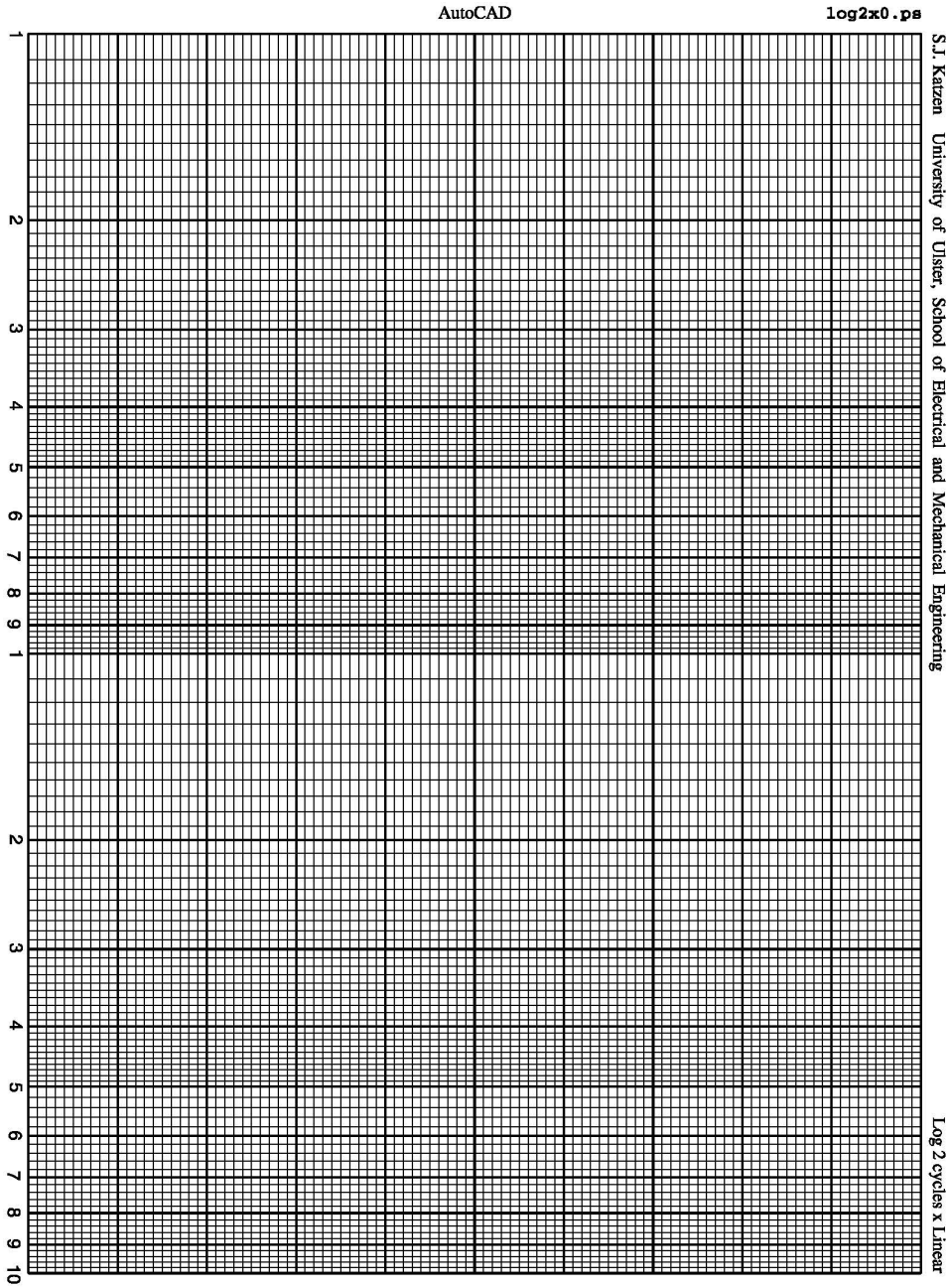
Graph (Grain Size in mm vs. Percentage Finer in %):



Important Note: This semi logarithmic paper is representative!!! You can find scaled one on the course web page.

Draw graph of log sieve size vs. % finer. The graph is known as grading curve. Corresponding to 10%, 30% and 60% finer, obtain diameters from graph these are D10, D30, D60, using these obtain Cc and Cu which further represent how well the soil is graded i.e. whether the soil is well-graded, gap-graded or poorly graded.

Questions:

1) Define the grain size analysis and what is the silt size?
2) What is uniformity coefficient? What is the significance on computing the same?
3) How to compute D_{10}, D_{30} and D_{60} of soil using sieve analysis?
4) How to compute C_c and C_u?
5) What is poorly graded, gap graded and well graded soil? How well the soil is graded?

Results:

Uniformity coefficient, C_u =

Coefficient of curvature, C_c =