

Name:

Date:

SOIL MECHANICS I

LABORATORY CLASS No 1: WATER CONTENT, CONSISTENCY LIMITS, CLASSIFICATION

I. "FIELD" DESCRIPTION

Describe the soil as in the field: estimate of grading, shape of grains, colour, origin, plasticity, consistency, strength, carbonate and organic content etc. Give an approximate name/classification.

II WATER CONTENT DETERMINATION

The standard method for determining the water content is by drying at the temperature of 110°. In case of organic soils or soils with chemically bonded water (e.g., gypsum) the drying temperature must be lower.

Procedure (not necessarily to standards):

1. Weigh a clean and dry weighing bottle.
 2. Weigh the weighing bottle with at least 30 to 50 g of the soil (bigger amount required for coarse-grained soil).
 3. Put the (opened) weighing bottle into the oven with the controlled temperature of 110°C.
 4. After drying to constant mass (most probably attained after 24 hours) let the weighing bottle with the soil cool down to the room temperature.
 5. Weigh the cooled dry soil with the weighing bottle.
- The water content is computed from the definition $w = M_w / M_d$ and reported using three significant digits (usually as a percentage).

III CONSISTENCY LIMITS (the principle, not following strictly any standard)

Liquid Limit is the water content at which the soil consistency changes from the plastic to the liquid one. It is determined by the fall cone or Casagrande device. **Plastic Limit** is the lowest water content at which the soil is plastic. It is determined by rolling a soil thread by hand pressure, at which a soil thread crumbles. Both the consistency limits are therefore the water contents at a conventional (immediate - undrained) strength, which is defined by the arrangement of the test.

Soil preparation

- Fine-grained soil is disintegrated without crushing the grains, and grains larger than 0.4 mm (or nearest sieve) are removed by wet sieving. Soils may not be allowed to dry at temperatures exceeding 50° C.
- A homogeneous paste is prepared by adding distilled water and thorough mixing.
- The paste is let to homogenise (for 24 hours).

III a Plastic limit

1. The homogenised paste is thoroughly re-mixed.
2. A small amount is worked in the hand until threads of about 3 mm thickness start to crumble, then about 8 mm thick cylindrical lump is formed. Alternatively mold a soil paste in one hand into a ball until small cracks appear on the surface, divide the ball into about 10 g pieces to be tested separately. Roll a thread of about 6 mm in diameter from one of the pieces.
3. A thread is rolled by fingers. Enough pressure should be used to form a 3 mm thread in 10 to 15 movements.
4. The soil has the water content at plastic limit when a 3 mm thick thread crumbles into pieces of the length of about 8-10 mm.
5. The crumbles are immediately placed into a suitable container (weighing bottle) and the water content is determined when a sufficient amount of crumbled soil has been obtained (at least 5 g is recommended).
6. Carry out 3 determinations and compute plastic limit from the closer pair of them (maximum difference up to 2%). The value of w_P is determined to two significant digits and reported as a percentage.

III b Liquid limit – Cone Penetration

1. The homogenised paste is put into a container and the cone tip is in contact with the surface of the soil.
2. The cone is released for 5±1 s. The reading of the penetration depth is recorded. The cone is cleaned and the surface of the soil is levelled (soil of the same water content is added as necessary). The procedure is repeated until two successive measurements do not differ more than by 0.4 mm. A sample for water content determination is taken and the penetration is determined as an average of the two last measurements.
3. The procedure is repeated with the same sample at different water contents. At least four different readings of penetration are required, distributed evenly in the range of penetration of 7-15 mm.
4. The results are plotted on a semilogarithmic plot of (water content) vs (log penetration). Liquid limit is determined by interpolation. For the 60 g and 60° cone w_L corresponds to the penetration of 10 mm.

III b Liquid limit - Casagrande Apparatus

1. The homogenised paste is re-mixed. Water can be added to obtain a suitable consistency for the test.
2. By spatula, sufficient amount of the paste is put into the cup of the apparatus to form a cake with a horizontal surface.
3. The surface is made smooth by the spatula using minimum possible passes. The maximum depth of the soil cake is 8 mm.
4. The cutting knife of specified dimensions is used to cut the soil cake into two halves.
5. The cup is lifted and let fall down by the frequency of 2 Hz. The blows are counted.

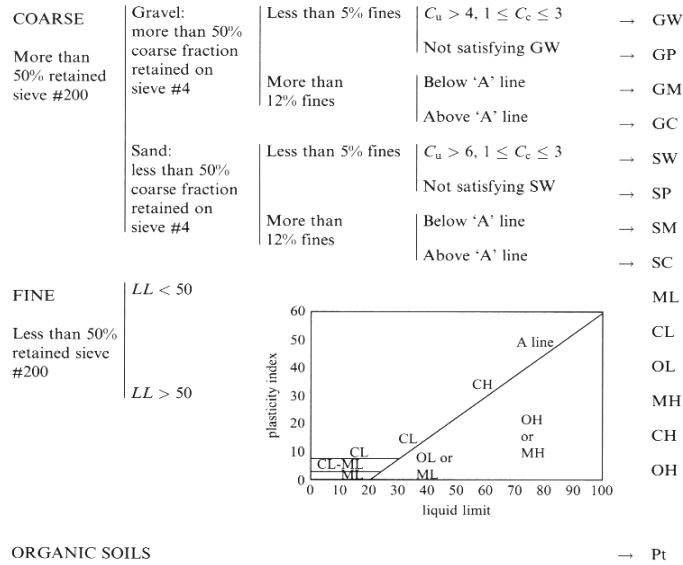
6. When the two halves of the soil cake merge at the length of $12,5 \pm 0,5$ mm under the influence of the blows, the procedure is stopped and the number of blows is registered (the range from 15 to 35 is recommended).
7. From the area where the soil merged a sufficient sample is taken for water content determination (10g).
8. At least four measurements of blow counts are carried out at different water contents. Typically the procedure starts from the lower water content by adding water for the following determination.

Data are put down into the attached tables. The water contents in arithmetic scale are plotted against the blow counts in the logarithmic scale, a regression straight line is plotted, and the water content necessary for 25 blows is determined by *interpolation*. The results are reported as a percentage to two significant digits.

IV GRADING CURVE – is given in a Figure below (the test is not carried out during the lab class)

V SOIL CLASSIFICATION

Classify the tested soil according to USCS:



Note:

Sieve No. 200 has openings of 0.075mm;

Sieve No. 4 has openings of 4.75mm;

O =organic soil; Pt = peat;

LL \equiv w_L (liquid limit)

Fines (F) = clay (C) + silt (M)

Name:

Date:

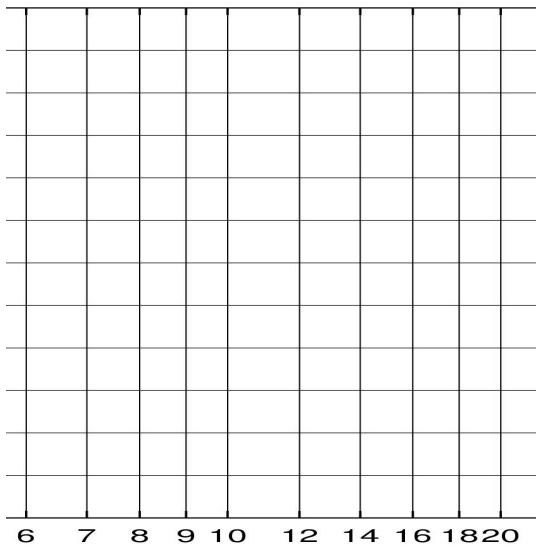
I FIELD DESCRIPTION

II WATER CONTENT

Weighing bottle No				
Mass of weighing bottle [g]				
Mass of wet soil with weighing bottle [g]				
Mass of dry soil with weighing bottle [g]				
Mass of water[g]				
Mass of dry soil [g]				
WATER CONTENT				

III CONSISTENCY LIMITS

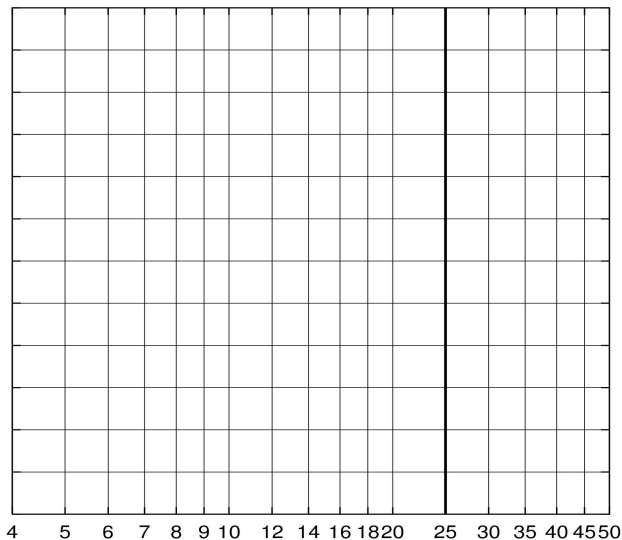
	LIQUID LIMIT								PLASTIC LIMIT			
Weighing bottle No												
Weighing bottle [g]												
Wet soil with weighing bottle [g]												
Dry soil with weighing bottle [g]												
Mass of water[g]												
Mass of dry soil [g]												
WATER CONTENT												
NUMBER OF BLOWS												



LIQUID LIMIT - CONE PENETRATION

horizontal axis: penetration (log scale)

vertical axis: water content (choose an appropriate linear scale)



LIQUID LIMIT - CASAGRANDE METHOD

horizontal axis: number of blows (log scale)

vertical axis: water content (choose an appropriate linear scale)

SUMMARY (consistency limits and soil state)

Soil description:

Liquid Limit w_L

Plastic Limit w_P

Plasticity Index I_P

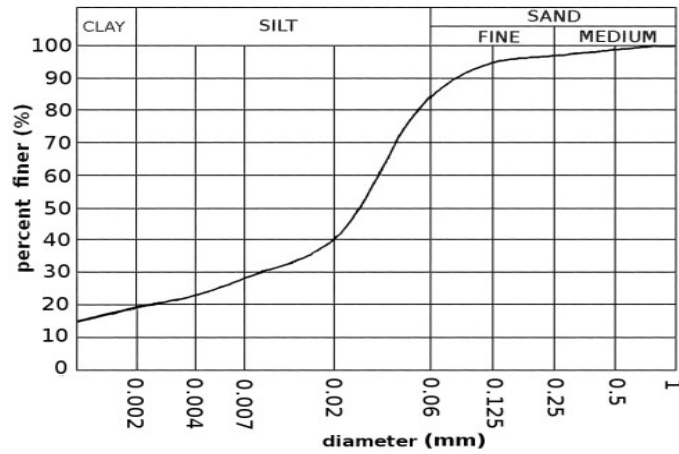
State characteristics:

Natural Water Content w

Consistency Index I_C

Liquidity Index I_L

IV GRADING CURVE



V SOIL CLASSIFICATION

Give the appropriate symbols as well as full names in words

According to USCS: