HOMEWORK 1

Homework 1 is due on November 14, 2014, Friday at 16:59.

CE363 Homeworks are to be submitted to the "CE363 Homework box" in Soil Mechanics Lab. Soil Mechanics lab door is locked every day at 17:00 and homeworks cannot be submitted under the door.

Homework solutions will be posted to the course website on November 14, Friday at 17:00.

Unless otherwise stated, use $\gamma_{water} = 10\ kN/m^3$

Question 1 (10%)

A container of volume $2.83*10^{-3}$ m^3 weights 9.8 N. Dry sand was poured to fill the container. The container and the sand weights 52.3 N. Calculate (a) the void ratio and (b) the porosity. Assume $G_s = 2.7$.

Question 2 (10%)

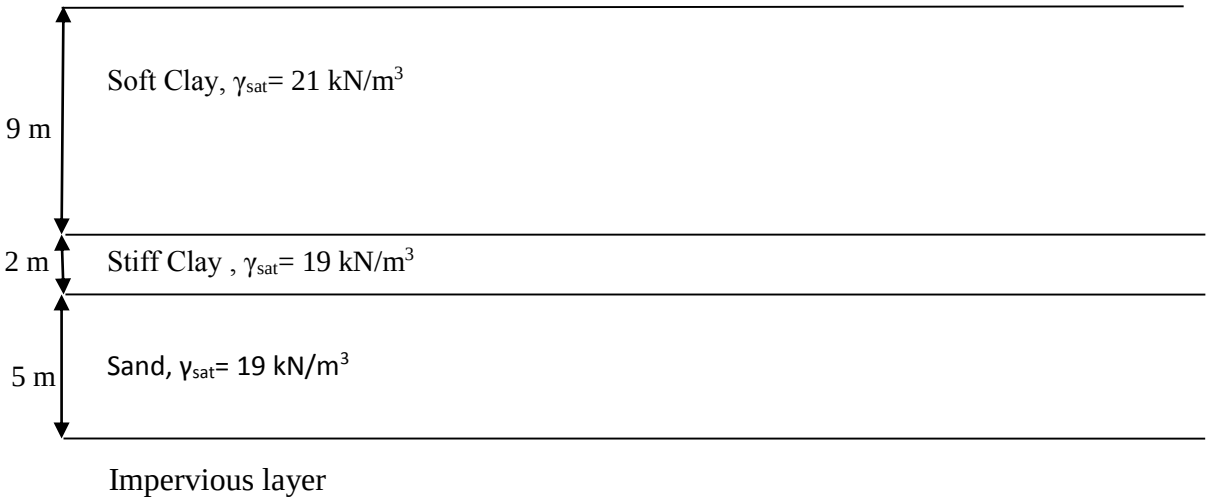
A fine – grained soil has a liquid limit of 300 % and a plastic limit of 55 %. The natural water content of the soil in the field is 80 % and the clay content is 60 %. Determine the plasticity index, the liquidity index, and the activity.

Question 3 (6%)

The bulk density of an undisturbed soil sample was determined to be 1.96 at a water content of 14%. The void ratios in the loosest and densest states were determined to be 0.81 and 0.48, respectively. Determine the relative density of the mass. (G_S=2.7, ρ_w=1kg/m^3)

Question 4 (7%)

The soil profile for the construction site consists of 9 m soft clay followed by 2 m of another stiff clay and 5 m of sand. The ground water level is at the ground surface and the piezometric head for the sand was 3 m above the top of the ground water level. If an excavation of 7 meter is planned, determine the level to which the artesian water should be lowered in order to prevent the heave of the bottom of the excavation.



Question 5 (7%)

Material for an earth fill was available from three different borrow sites. In the compacted state volume of the fill measured as 100,000 m^3 at a void ratio of 0.70. The corresponding in-situ void ratio and cost (material and transportation) of the material for the three sites is as follows:

Borrow Sites	**Void Ratio**	**Total Cost per Cubic Meter**
1	0.8	TL 6.40
2	1.7	TL 6.00
3	1.2	TL 5.15

Determine the most economical sites.

Question 6 (20%)

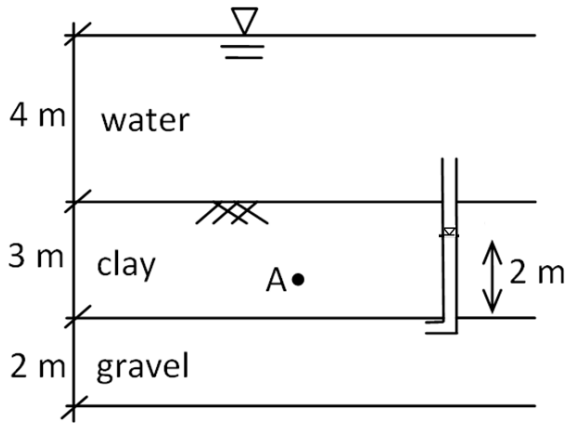
There is a free standing water in a pond. Underneath the pond a 3-m-thick clay layer exists. For the soil profile given below, assume 1D steady state flow is taking place.

a) Calculate hydraulic gradient in clay layer.

b) If the rate of flow through the clay layer is observed to be 0.5 m^3/year for 1 m^2 cross sectional area perpendicular to flow direction, what is the coefficient of permeability of the clay layer, in cm/sec?

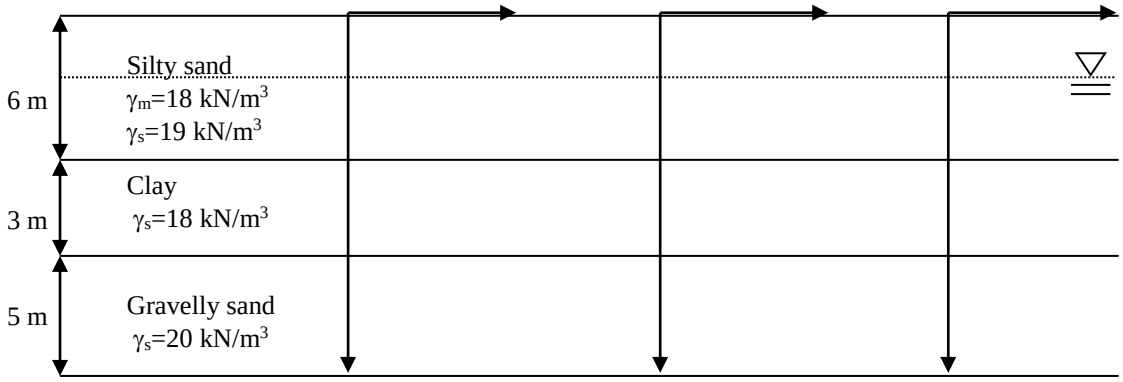
c) Calculate where the water would rise in the tube inserted at the mid-depth of the clay? Indicate on the figure.

d) Calculate effective stress at point A, located 1 m above the boundary between clay and gravel, using two methods i) Total stress and pore pressure method, ii) Buoyant unit weight and seepage force method. Saturated unit weight of clay is 19 kN/m^3.

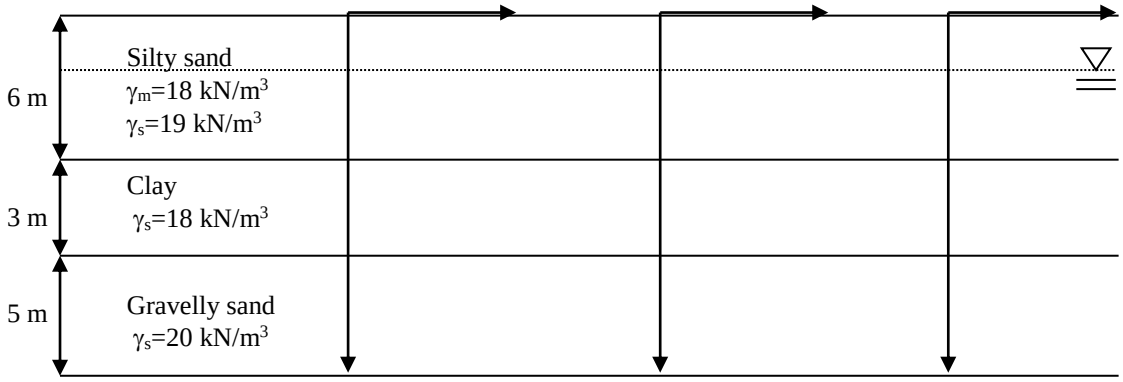


Question 7 (20%)

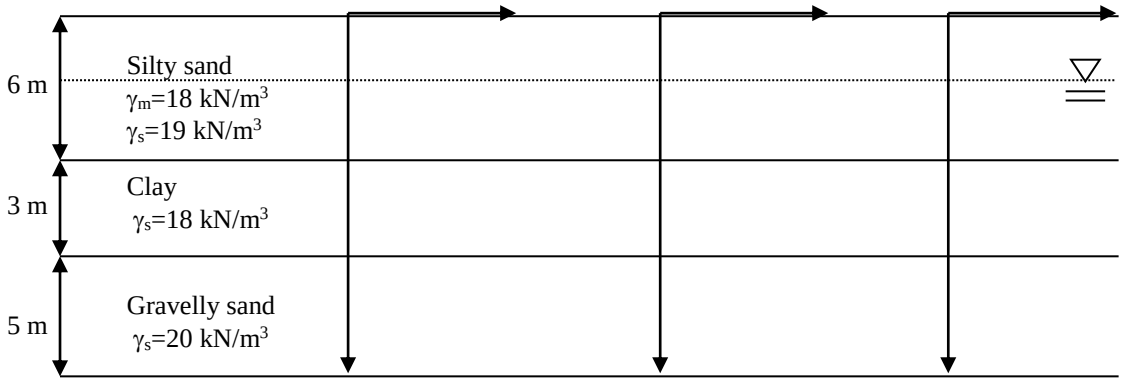
(a) As shown in the figure given below, a 6 m thick layer of silty sand overlies a clay layer of 3 m in thickness. Below this clay layer there lies a 5 m thick gravelly sand layer underlain by bedrock. The ground water table is at 2 m depth below the ground surface. Draw the total stress, pore pressure and effective stress diagrams. (Note: γ_m, γ_s are the moist and saturated unit weights and should be used for the soil layers above and below water table, respectively)



(b)Up to ground water table, 2 meter of the silty sand layer is excavated for future construction purposes. Draw the total stress, pore pressure and effective stress diagrams (i) immediately after and (ii) a long time after the excavation.



(i) Immediately after



(ii) Long time after

Question 8 (20%)

Section of a sheet-pile water retaining structure is shown below (not to scale). The soil, which is silty sand, has a saturated unit weight of γ_{sat} = 21 kN/m^3 (use γ_{water} = 10 kN/m^3).

a) Draw the section to scale using 1 cm: 2 m, and draw a flow net for the two-dimensional seepage problem.
b) Calculate the total amount of water seeping beneath the structure if the coefficient of permeability of the soil is 1.5 * 10^{-4} cm/s and the length of the structure is 40 m.
c) Determine the total head at point A.
d) Determine the pore pressure at point A.
e) Calculate the effective stress at point B using
   i) Total saturated weight and resultant boundary water force approach

   ii) Effective (buoyant) weight and seepage force approach (assume 1D flow at point B).

f) Determine the factor of safety against sand boiling (or quick sand condition) on the downstream side of the sheet-pile structure.