HOMEWORK 2

Homework 2 is due on December 15, 2014, Monday at 16:59.

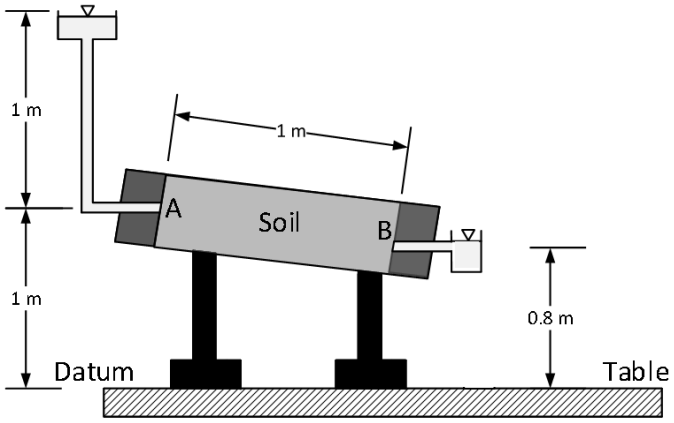
CE363 Homeworks are to be submitted to the "CE363 Homework box" in Soil Mechanics Lab. Soil Mechanics lab door is locked every day at 17:00 and homeworks cannot be submitted under the door.

Homework solutions will be posted to the course website on December 15, Monday at 17:00.

Unless otherwise stated, use γ_{water}= 10 kN/m^3

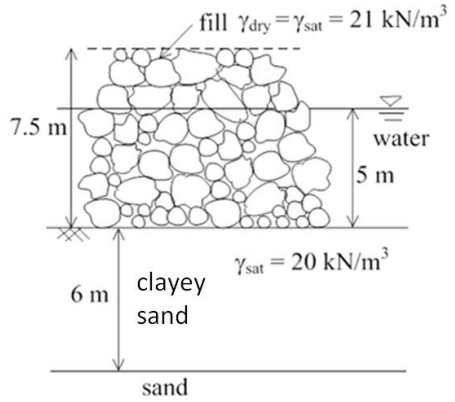
Question 1((a): 6%; (b): 6%; (c): 6%; (d): 6%))

A soil sample 10 cm in diameter is placed in a tube 1 m long. A constant supply of water is allowed to flow into one end of the soil at A, and the outflow at B is collected by a beaker. The average amount of water collected is 1 cm^3 for every 10 seconds. The tube is inclined as shown in Figure. Determine (a) hydraulic gradient, (b) flow rate , (c) average velocity, (d) hydraulic conductivity.

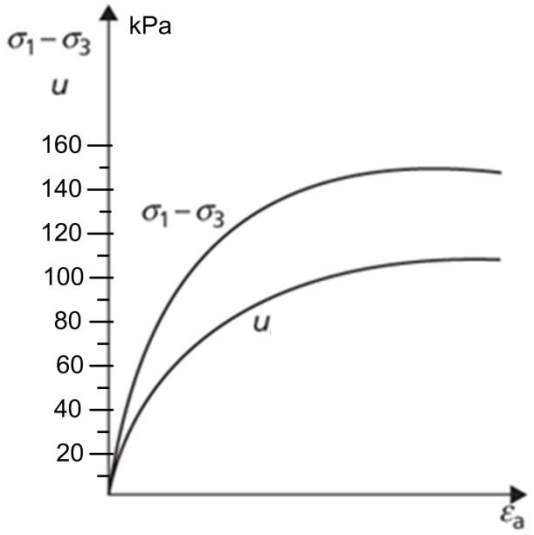


Question 2 ((a): 8%; (b): 8%; (c): 8%))

For the construction of "Palm Island" in the sea, 7.5-m-thick fill made of boulders and gravel is constructed on top of the sea bottom sediments composed of clayey sand. The fill is constructed rapidly and long time after the construction of the fill, someone wanted to check the shear strength of the clay. They took soil samples from 12.5-m depth measured from the top of the fill.



The soil samples are brought to the soil mechanics laboratory for consolidated undrained triaxial testing with pore pressure measurement. The first specimen is consolidated to an equal all around pressure that is equal to its in-situ effective vertical stress. This sample is sheared by increasing the axial stress in undrained conditions, and the following graphs are obtained.



The second specimen is consolidated to a cell pressure of 440 kPa, and when sheared in undrained conditions, the measured principal stress difference at failure was 395 kPa and the pore pressure at failure was 290 kPa.

Find c′ and ϕ′ of this soil

a) Graphically, by drawing Mohr's Circles and using Mohr-Coulomb failure envelope,
b) Graphically, by using Modified Mohr-Coulomb failure envelope,
c) Analytically, by using trigonometry and computations.

Question 3 (10%)

For a sandy soil sample with relative density of 65 %, a 101.6 mm x 101.6 mm square shear box apparatus is intended to be used. Unfortunately, only available dead load is 100 N and the maximum shear load capacity of the apparatus is 50 N. If the shear strength parameters of the sandy soil sample are estimated as c= 1 kPa and ϕ = 33˚, discuss if the sample can be loaded until failure under the constraints of available dead load and equipment capacity.

Question 4 ((a): 6%; (b): 6%))

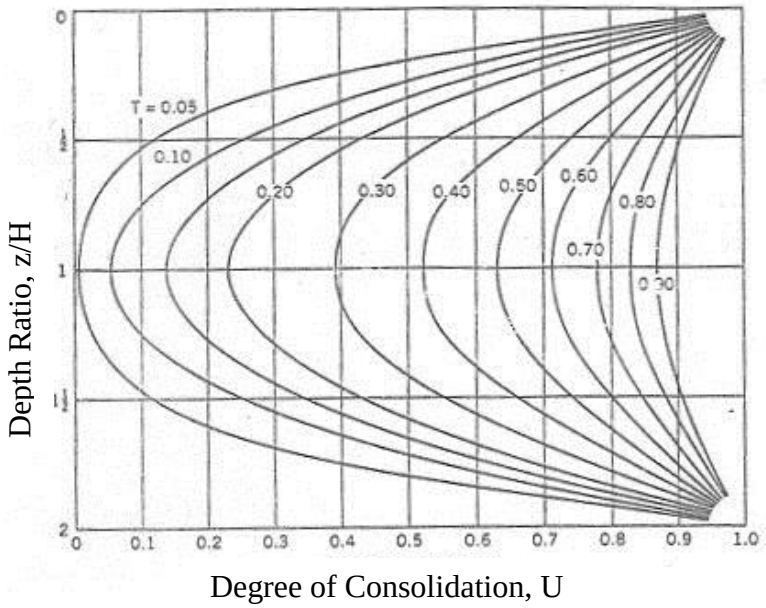
For a 15 m thick, fully-saturated clay layer, which is subjected to 1-D loading and overlain and underlain by permeable silty sand layers, the final consolidation settlement was estimated as 20 cm. Answer the following questions:

a) What is the degree of consolidation at the mid-depth of this clay layer when the amount of settlement reaches to 10 cm?

b) When the degree of consolidation at the mid-depth of this clay layer reaches up to 40 %, what is the average degree of consolidation of the saturated clay layer?

Useful formula: $T_v = \dfrac{C_v \cdot t}{d^2}$

Tv = time factor, t = time, d = drainage distance,
z = depth below the top of the clay layer,
H = one half of the thickness of the clay layer



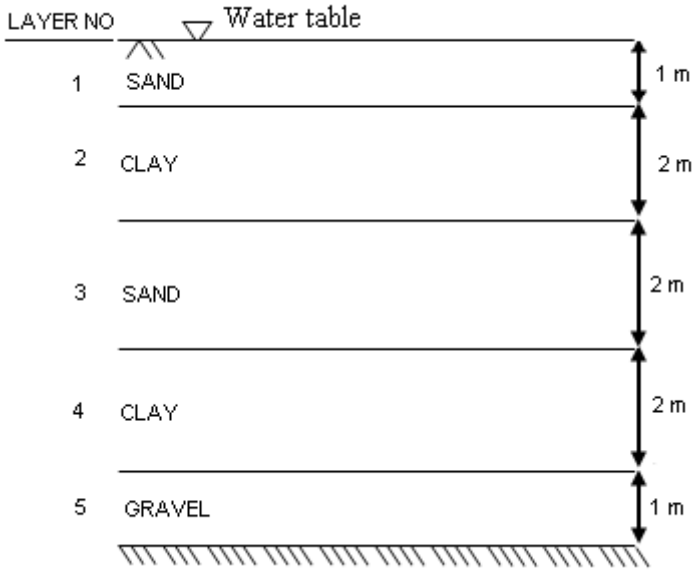
$\bar{U}$ %	T_v
0	0.000
10	0.008
15	0.018
20	0.031
25	0.049
50	0.196
55	0.238
60	0.286
65	0.342
70	0.403
75	0.477

Question 5 (6%)

If the unconfined compressive strength (UCS) of a fully saturated, fissured clayey soil sample is given as 60 kPA, estimate the major (σ_1) and minor (σ_3) total stresses at the time of failure. Discuss how the shear strength value would change if you perform the test under a confining pressure of 50 kPA.

Question 6 (((a): 8%; (b): 8%); (c): 8%))

A 60 kN/m^2 surcharge was applied over a large area on the soil profile given below.



a) Find the total final consolidation settlement for this profile assuming all layers for which consolidation settlement may be observed have the same coefficient of volume compressibility (0.0015 m^2/kN)
b) What is the average degree of consolidation when the total settlement is 5 cm for this soil profile?
c) Determine the coefficient of consolidation if 5 cm settlement was observed 2 years after the load was placed.