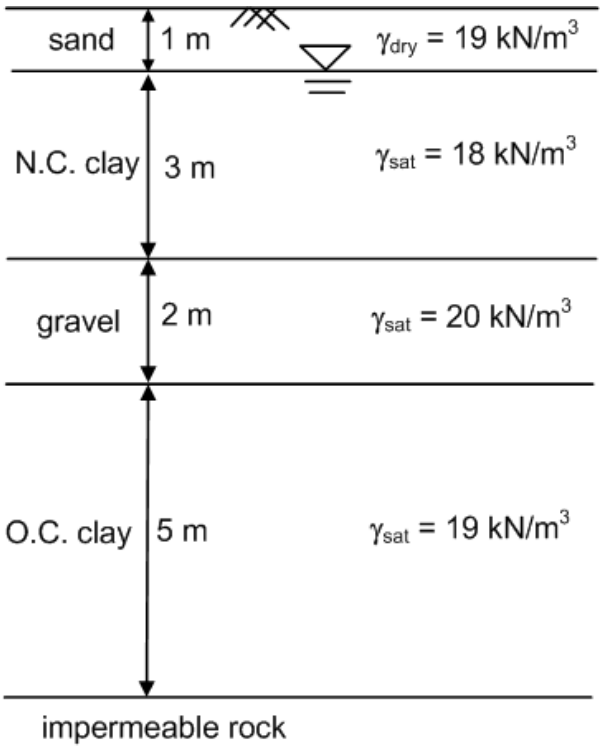
METU Civil Engineering Department
CE363 Soil Mechanics
2011-2012 Fall Semester

HOMEWORK 4

Due on: Dec 8 Thursday, 17:00

1) Soil profile given below is composed of sand, normally consolidated (N.C) clay, gravel and over consolidated (O.C.) clay. A 4-m-thick fill (γ=21 kN/m^3) will be placed rapidly at the ground surface.



a) Calculate the total and effective vertical stresses and the pore water pressure, only at the mid-depth of each clay layer, before the fill is placed, immediately after the fill is placed, and after the clays have consolidated under the vertical stress increment due to the fill.

b) A laboratory oedometer (consolidation) test is carried out on a sample taken from the N.C. clay. Using the lab data given below, plot the void ratio versus effective stress (e - σ') graph and calculate m_v of the N.C. clay layer. You can see from your plot that m_v changes with effective stress. Consider the initial (σ'_o) and final effective stresses (σ'_1) at the mid-depth of N.C. clay layer, and use values (e_o , σ'_o) and (e_1 , σ'_1) obtained from your plot to calculate m_v .

σ' (kPa)	e
25	1.021
50	0.975
100	0.902
150	0.851
200	0.814
300	0.753

c) A laboratory oedometer test is carried out on a sample taken from the O.C. clay. Using the lab data given below, plot the void ratio versus log effective stress (e - log σ') graph and calculate recompression index (C_r) and compression index (C_c).

σ' (kPa)	e
25	0.981
50	0.972
100	0.960
200	0.865
400	0.773

d) Calculate final consolidation settlement of each clay layer due to the stress increase caused by 4-m-high fill (assume the preconsolidation pressure, σ'_p, of the overconsolidated clay layer as 100 kPa).

e) How much ground surface settlement will be observed at 8 months after the placement of the fill. Coefficient of consolidation, c_v, for the N.C. and O.C. clay is 2.4 and 6.0 m^2/year, respectively.

U (%)	T_v
0	0
5	0.002
10	0.008
15	0.018
20	0.031
25	0.049
30	0.071

U (%)	T_v
35	0.096
40	0.126
45	0.159
50	0.195
55	0.239
60	0.286
65	0.340

U (%)	T_v
70	0.403
75	0.477
80	0.567
85	0.684
90	0.848
95	1.129

f) How long time is required after the placement of the fill for the N.C. clay layer to settle 40 mm?

g) 1-year after the placement of the fill, a piezometric tube is inserted at 10 m depth from ground surface to measure the pore water pressure at that point. Where the water would rise in this tube. (Hint: Use the graph given below and find the degree of consolidation ($U_z = \frac{u_{ie} - u_e}{u_{ie}}$) at that depth, at that time).