CVG 3109: SOIL MECHANICS 1 – ASSIGNMENT # 4 (Fall 2017)

uOttawa

L'Université canadienne
Canada's university

CONSOLIDATION

Problems:

Q1. Table 1 summarizes the results of a consolidation test:

a. Plot the *e – log σ'* curve

b. Using Casagrande's method, determine the pre-consolidation pressure.

c. Calculate the compression index, C_c from the *e – log σ'* curve.

e	Pressure, σ' (kN/m^2)
1.21	25
1.19	50
1.15	100
1.08	200
1.01	400
0.93	800

Table 1

Q2. A soil profile is shown in Figure 1 on the right. The uniformly distributed load on the ground surface is $\Delta\sigma$= *150 kN/m^2*. In the shown soil profile *H_1 = 1.5 m, H_2 =1.5 m, and H_3 = 2 m.* For sand, γ_{dry} *= 15.6 kN/m^3,* γ_{sat} *= 18.3 kN/m^3* and for clay, γ_{sat} *= 20.3 kN/m^3, LL = 38, e = 0.75.* Estimate the primary settlement of the normally consolidated clay layer.

Hint: $C_c = 0.009(LL - 10)$

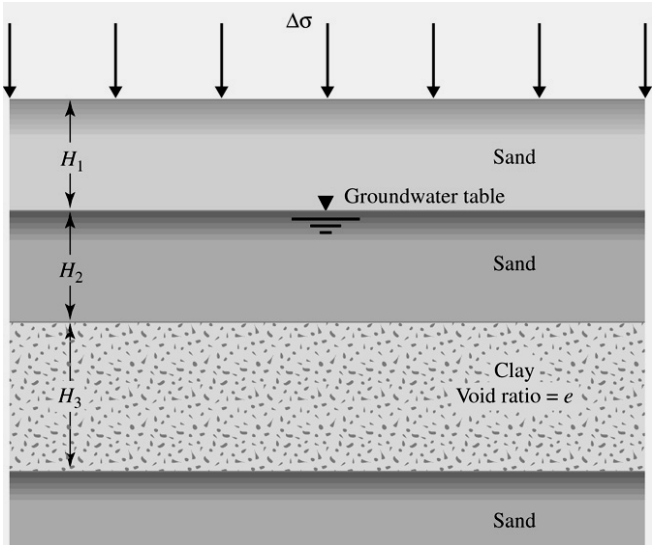


Figure 1

Q3. The coordinates of two points on a virgin compression curve (i.e., results obtained from a consolidation test) are as follows:

e_1 = 0.8, σ'_1 = 150 kN/m^2

e_2 = 0.5, σ'_2 = 400 kN/m^2

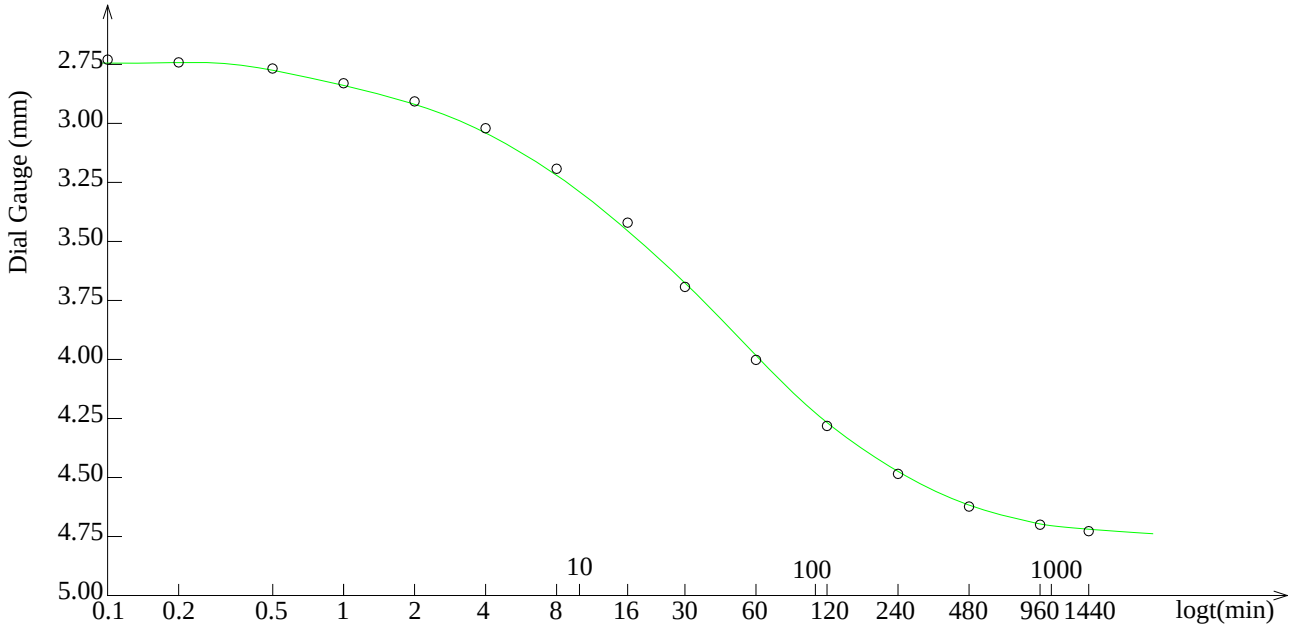
a. Determine the coefficient of volume compressibility, m_v for the pressure range stated above.

b. Given the coefficient of consolidation, c_v = *0.003 cm²/sec*, determine the coefficient of permeability, *k* in cm/sec corresponding to the average void ratio.
c. What would be the effective pressure, σ' *corresponding to e = 0.7?*

Q4. Laboratory tests on a *40-mm-thick* clay specimen drained at the top only shows *50%* consolidation takes place in *26 min*.

- **a.** How long will it take for a similar clay layer in the field, *4 m* thick and drained at the top and bottom, to undergo *50 %* consolidation?
- **b.** Find the time required for the clay layer in the field, as described in part (a), to reach *80 %* consolidation.

Q5. During a laboratory consolidation test, the time and dial gauge readings obtained from an increase in pressure on the specimen from *50 to100 kN/m²* are given in the following figure. Find the time for *50 %* primary consolidation *(t_{50})* using the logarithm-of-time fitting method.



Q6. The following results were obtained from an oedometer test (i.e., consolidation test) on a specimen of saturated clay:

Pressure (kN/m²)	27	54	107	214	429	214	107	54
Void ratio	1.243	1.217	1.144	1.068	0.994	1.001	1.012	1.024

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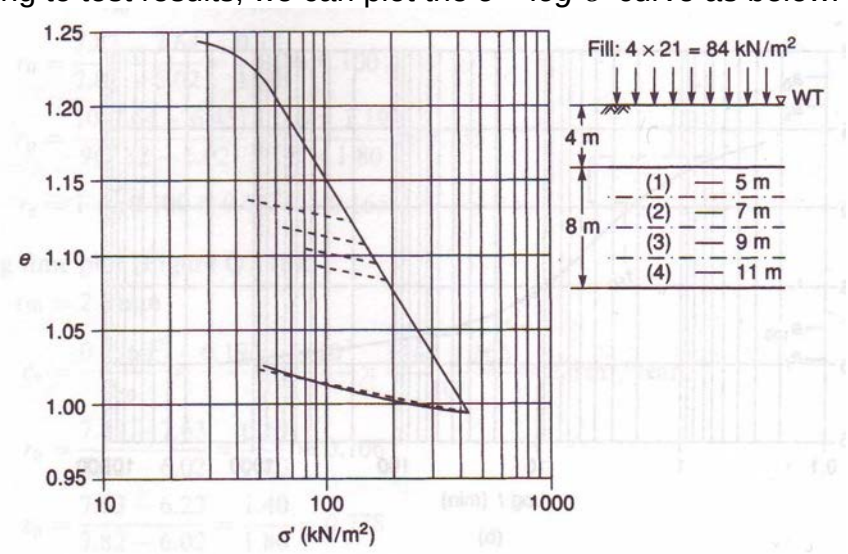
A layer of this clay 8m thick lies below a 4m depth of sand, the water table being at the surface. The saturated unit weight for both soils is 19 kN/m^3. A 4m depth of fill of unit weight 21 kN/m^3 is placed on the sand over an extensive area.

a. Determine settlement due to consolidation of the clay.

b. If the fill was removed some time after the completion of consolidation, calculate the heave or consolidation that would eventually take place due to swelling of the clay?

Hint:

According to test results, we can plot the *e* – *log* σ' curve as below.



The clay is divided into four sublayers. The total settlement is the sum of the settlement of each layer.

Q7. Assuming the fill in Q6 is dumped very rapidly. What would be the value of excess pore water pressure at the center of the clay layer after a period of 3 years? The clay layer is open and the coefficient of consolidation, c_v is 2.4m^2/year.

Q8. A layer of 10 m thick saturated clay is sandwiched by two layers of sand, and is consolidated under an extensive area loading. The final settlement is 60 cm, the coefficient of consolidation of the clay layer, c_v is 0.03 cm^2/min.

a. Determine when the settlement would be half the final settlement.

b. Determine the degree of consolidation and settlement after 1 year.

c. If the layer under the clay layer is impervious, what will be the value in Question a?

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