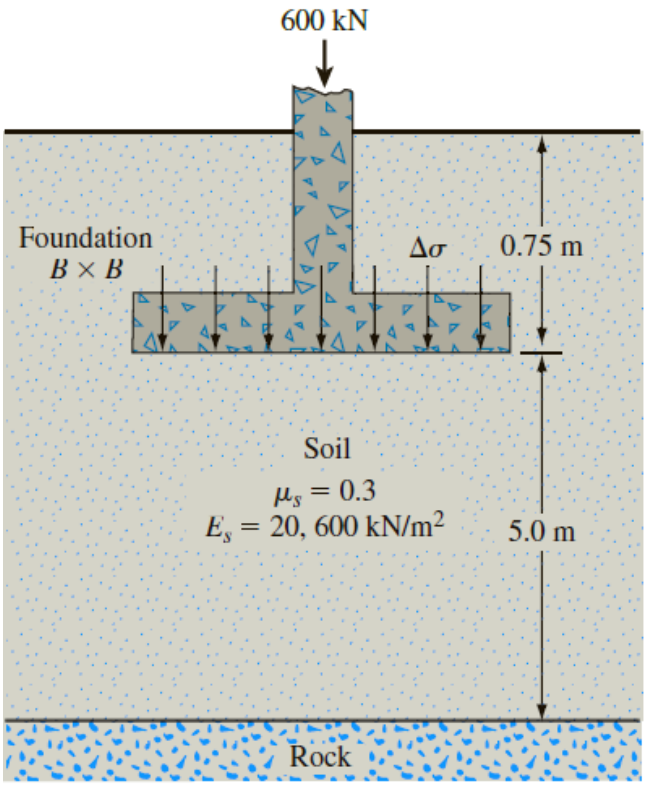
Birzeit University
Faculty of Engineering
Department of Civil and Environmental Engineering

ENCE 331, Soil Mechanics

Homework assignment #10
Due on Tuesday, Jan 21th, 2021 @ 12:00 AM.

Problem 1:

A vertical column load, P = 600 kN, is applied to a rigid square concrete foundation. The foundation rests at a depth D_f = 0.75 m on a uniform dense sand with the following properties: average modulus of elasticity, E_s = 20,600 kN/m^2, and Poisson's ratio, μ_s = 0.3. Calculate the required foundation dimensions if the allowable settlement under the center of the foundation is 25mm.



Problem 2:

The following are the results of a consolidation test on a sample of a clayey soil.

- Plot the e-log σ curve.
- Determine the pre-consolidation pressure.
- Calculate the compression index, C_c and the ratio of C_s /C_c.

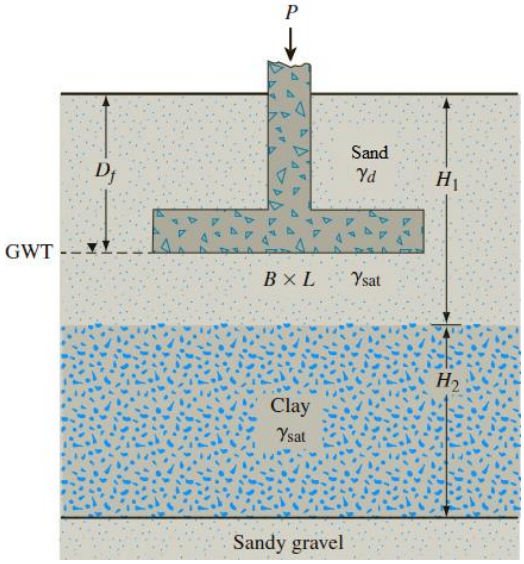
e	Pressure, σ' (kN/m^2)
1.113	25
1.106	50
1.066	100
0.982	200
0.855	400
0.735	800
0.63	1600
0.66	800
0.675	400
0.685	200

Problem 3:

A foundation with dimensions BxL supporting a column load, P. The foundation rests on a sandy soil underlain by a clay layer (consolidation test result in Problem 2).

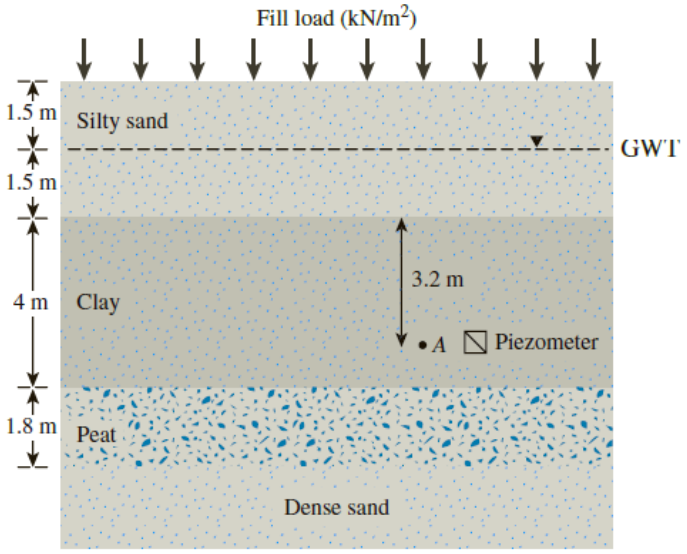
- Estimate the primary consolidation settlement of the clay due to the foundation load.
- What is the void ratio at the end of primary consolidation?
- Calculate the secondary Consolidation settlement after 6 years knowing that the primary consolidation settlement took 2.5 years.

Given:
P = 350 kN, B = L = 2.5 m, D_f = 2 m, H_1= 3 m, and H_2 =4.5 m.
The soil properties are as follows:
Sand: γ_d = 16.4 kN/m^3; γ_{sat} = 18.8 kN/m^3
Clay: γ_{sat} = 17.6 kN/m^3; e_0 = 0.82, C_α=0.02



Problem 4:

The figure shows a soil profile with a silty sand (γ = 17 kN/m^3; γ_{sat} = 19.2 kN/m3) underlain by high plasticity clay (γ_{sat} =18.8 kN/m^3) and a peat layer (γ_{sat} =15 kN/m^3), followed by dense sand. To expedite consolidation and minimize future settlement, an additional 1.75-m thick fill material, compacted to a unit weight of 20.1 kN/m^3, will be placed on top of the silty sand layer. The fill load will be left in place for 18 months, after which construction will begin over the compacted fill.



Undisturbed samples collected from the clay and organic Peat layers had the following properties:

Layer	C_c	C_α	c_v (cm²/sec)	e_0
Clay	0.31	0.048	0.006	1.08
Peat	7.2	0.273	0.029	6.4

- Are the layers singly or doubly drained? Explain.
- Estimate the time for 99% primary consolidation in each layer.
- Estimate the **total** consolidation settlement under the action of the fill load. Consider both the clay and peat layers to be normally consolidated.
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