

Carleton University
CIVE 3208 (EART 4701): Geotechnical Mechanics

Assignment #1

Tutorial: Oct. 15, AT 302, 11:30-1:00 pm

Due: October 24

1. An undisturbed specimen of clay is taken from a sampling tube, the volume of which is 0.013 m^3 . The mass of the soil specimen is 25.5 kg and the moisture content is 21.1% . Calculate the dry unit weight. If the specific gravity of the particles is 2.68 , find the void ratio and the degree of saturation. (10 marks)

2. Prove that

$$D_r = \frac{\gamma_d - (\gamma_d)_{\min}}{(\gamma_d)_{\max} - (\gamma_d)_{\min}} \left[\frac{(\gamma_d)_{\max}}{\gamma_d} \right] \quad (10 \text{ marks})$$

3. The mass of an oven-dried sample of clay is 11.26 g and its volume is 5.83 cm^3 . If the specific gravity of the soil particles is 2.67 determine the shrinkage limit of the soil. The shrinkage limit is the moisture content the soil would have had if fully saturated at its minimum volume. (10 marks)

4. Table below shows results of sieve analysis on three soil specimens. Classify the material according to the Unified Classification System (20 marks).

| Sieve Size | (mm) | Percentage Passing | | |
|------------|-------|--------------------|---------|-------------|
| | | Soil A | Soil B | Soil C |
| 5/8 | 16.0 | 100 | | |
| 1/2 | 12.7 | 95 | | |
| 3/8 | 9.5 | 90 | | |
| 1/4 | 6.35 | 79 | 100 | |
| No. 4 | 4.75 | 61 | 98 | 100 |
| No. 10 | 2.0 | 32 | 91 | 99 |
| No. 20 | 0.85 | 18 | 86 | 91 |
| No. 40 | 0.425 | 11 | 75 | 56 |
| No. 60 | 0.250 | 5 | 68 | 37 |
| No. 100 | 0.150 | | 55 | 25 |
| No. 200 | 0.075 | | 41 | 14 |
| | | | Plastic | Non-plastic |

5. In a compaction test a bulk unit weight of 16 kN/m^3 was measured at a moisture content of 8%. What would the moisture content have been if the soil had been fully saturated. Assume $G_s = 2.70$ (20 marks).
6. A soil sample with moisture content of 11% and specific gravity of 2.62 was compacted to reach the saturation degree of 97%. What would be the dry unit weight and unit weight of the soil at that saturation level? (10 marks)
7. For the boundary conditions shown below, and for k in the middle layer of $2 \times 10^{-7} \text{ m/s}$ (silt): (20 marks)
- Plot pressure head with depth
 - Plot total head with depth
 - Determine the vertical Darcy velocity for silt layer
 - Calculate the seepage velocity if the void ratio of the silt is 0.66

