Geotechnical Engineering–I

BSc Civil Engineering – 4th Semester

Lecture # 21

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by

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Lecture Handouts: https://groups.google.com/d/forum/geotec-1

CONSOLIDATION – SUMMARY

$\Delta\sigma = \Delta\sigma' + \Delta u$

$$t = \left(\frac{T \cdot H^2}{C_V}\right)$$

$$T = \frac{\pi}{4}\left(\frac{u}{100}\right)^2; \qquad \text{for } u \le 60\%$$

$$T = 1.781 - 0.933 \cdot \log_{10}(100 - u); \qquad \text{for } u > 60\%$$

$$H_S = \frac{W_S}{G_S \cdot \gamma_w \cdot A} \qquad e_0 = \frac{H \cdot (G_S \cdot \gamma_w \cdot A) - W_S}{W_S}$$

$$m_V = \frac{\Delta V / V}{\Delta\sigma} = \frac{\Delta H / H}{\Delta\sigma} \qquad C_C = \frac{\Delta e}{\log p_2 / p_1}$$

$$C_C = 0.009 \cdot (LL - 10) \qquad C_r = 0.1 \cdot C_C$$

Terzaghi & Peck (1948)

$$settlement = S_c = \frac{\Delta e}{1 + e_o} H$$

For NCC

$$S_c = H\left(\frac{C_c}{1+e_o}\right)\left(\log\frac{\sigma_{vo}'+\Delta\sigma'}{\sigma_{vo}'}\right)$$

For OCC

$$S_c = H\left(\frac{C_r}{1+e_o}\right)\left(\log\frac{\sigma_{vo}'+\Delta\sigma'}{\sigma_{vo}'}\right)$$

If OCC is loaded beyond σ_p'

$$S_c = H\left(\frac{C_r}{1+e_o}\right)\left(\log\frac{\sigma_p'}{\sigma_{vo}'}\right) + H\left(\frac{C_c}{1+e_o}\right)\left(\log\frac{\sigma_{vo}'+\Delta\sigma'}{\sigma_p'}\right)$$

Practice Problem #1

A consolidation test was performed on a sample with initial dimensions of $H = 20$ mm and ring diameter = 63 mm. At the end of the test, the sample height was 13.3 mm and the oven dry weight of the soil was 78.3 gms. Assuming $G_s = 2.66$, find:

(i) The initial void ratio, e_o

(ii) Final void ratio, e_f, and

(iii) Total sample strain ε_f.

Practice Problem #2

A clay layer 10' thick has initial void ratio 1.4 and LL= 60%. Find change in thickness of clay layer if pressure is increased from 1 ton/ft² to 1.52 t/ft².

Practice Problem #3

A saturated specimen of clay had undergone consolidation under a pressure of 2 Kg/cm^2 in an oedometer test. The thickness of the specimen was then found to be 21.18 mm and its water content 12%. Subsequently with a further increase in pressure of 1 Kg/cm^2, the thickness of the specimen at the end of 24 hours was reduced by 1.18 mm. From these data, compute the coefficient of volume compressibility and compression index of the soil assuming $G_s = 2.7$.

Practice Problem #4

At a certain depth below the foundation of a building there exists a clay layer of thickness 10 m. Above and below the clay layer there are incompressible permeable soils. In a consolidation test on the clay sample with drainage at top and bottom, a sample with initial thickness 2.54 cm was compressed under a steady pressure. Half of the final settlement took place in 10 minutes after the application of the pressure. Find how long it will take for the settlement of the building to reach 50% of its ultimate value?

If the clay layer had drainage only from top, what would be the settlement time for 50% consolidation?

Practice Problem #5

A clay layer, whose total settlement under a given loading is expected to be 12 cm settles 3 cm at the end of 1 month after the application of load increment. How many months will be required to reach a settlement of 6 cm? How much settlement will occur in 10 months? Assume the layer to have double drainage.

CONCLUDED