Question 11.2

Determine the pressures in each layer:

$$\Delta\sigma_1 = \frac{P}{B_1^2} = \frac{87000}{15^2 \times 144} = 2.69 \text{ psi}$$

$$\Delta\sigma_2 = \frac{P}{B_2^2} = \frac{87000}{41^2 \times 144} = 0.36 \text{ psi}$$

$$\Delta\sigma_3 = \frac{P}{B_3^2} = \frac{87000}{73^2 \times 144} = 0.11 \text{ psi}$$

Now estimate the settlement of each layer using equation 11.14 (and 0.95 for I_f):

$$Se_1 = \frac{\Delta\sigma_1 \times B(1-\mu_1^2) \times I_f}{E_1} = \frac{2.69 \times (5 \times 12)(1-0.4^2) \times 0.95}{2200} = 0.059 \text{ in}$$

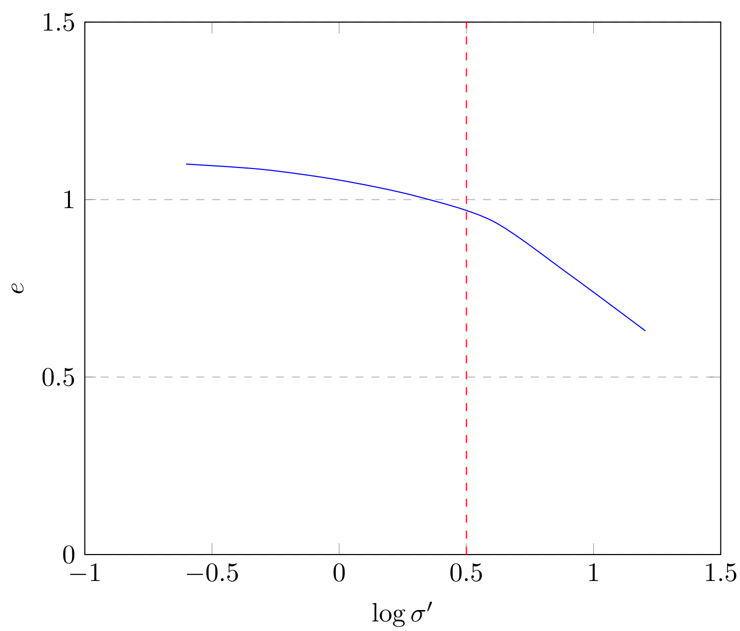
$$Se_2 = \frac{\Delta\sigma_2 \times B(1-\mu_2^2) \times I_f}{E_2} = \frac{0.36 \times (5 \times 12)(1-0.4^2) \times 0.95}{980} = 0.018 \text{ in}$$

$$Se_3 = \frac{\Delta\sigma_3 \times B(1-\mu_3^2) \times I_f}{E_3} = \frac{0.11 \times (5 \times 12)(1-0.4^2) \times 0.95}{9100} = 0.0006 \text{ in}$$

$$Se = Se_1 + Se_2 + Se_3 = \boxed{0.0776 \text{ in}}$$

Question 12.2

The graph is below, after sketching it out, I found the intersection to be at the dashed red line, at which the log is approximately 0.5. This means that the preconsolidation pressure is approximately $\sqrt{10} = \boxed{3.235 \text{ ton/ft}^2}$



$$C_c = \frac{\Delta e}{\log(\sigma_1) - \log(\sigma_2)} = \frac{0.79 - 0.63}{\log(16) - \log(8)} = \boxed{0.53}$$

Question 12.6

$$C_c = 0.009(LL - 10) = 0.009 \times 45 = 0.405$$

$$\gamma_{\text{d sand}} = \frac{G_s \times \gamma_w}{1 + e_s} = \frac{2.65 \times 9.81}{1.64} = 15.85 \text{ kN/m}^3$$

$$\gamma_{\text{sat sand}} = \frac{(G_s + e_s) \times \gamma_w}{1 + e_s} = \frac{(2.65 + 0.64) \times 9.81}{1.64} = 19.68 \text{ kN/m}^3$$

$$\gamma_{\text{sat clay}} = \frac{(G_s + e_c) \times \gamma_w}{1 + e_c} = \frac{(2.75 + 0.9) \times 9.81}{1.9} = 18.85 \text{ kN/m}^3$$

$$\sigma'_o = \gamma_{\text{d sand}} H_1 + (\gamma_{\text{sat sand}} - \gamma_w) H_2 + (\gamma_{\text{sat clay}} - \gamma_w) \frac{H_3}{2}$$

$$\sigma'_o = 15.85 \times 2.5 + (19.68 - 9.81)(2.5) + (18.85 - 9.81)(1.5) = 77.87 \text{ kN/m}^3$$

$$S_c = \frac{C_c H_3}{1 + e_c} \log\left(\frac{\sigma'_o + \Delta\sigma'}{\sigma'_o}\right)$$

$$S_c = \frac{0.405 \times 3}{1.9} \log\left(\frac{77.87 + 100}{77.87}\right) = \boxed{0.229 \text{ m}}$$

Question 12.10

$$T_v = \frac{c_v \times t}{H_{dr}^2}$$

$$t = \frac{T_v \times H_{dr}^2}{c_v}$$

T_v determined to be 0.286 from table. H_{dr} is the maximum drainage path of 3/2.

$$t = \frac{0.286 \times 1.5^2}{2.8 \times 10^{-6}} = 229821 \text{ min} = \boxed{159.6 \text{ days}}$$

Question 12.14

$$a_v = \frac{\Delta e}{4000} = \frac{1.21 - 0.96}{4000} = 6.25 \times 10^{-5}$$

$$e_{av} = \frac{1.21 + 0.96}{2} = 1.085$$

$$m_v = \frac{a_v}{1 + e_{av}} = \frac{6.25 \times 10^{-5}}{1 + 1.085} = 29.98 \times 10^{-6} \text{ ft}^2/\text{lb}$$

$$c_v = \frac{k}{m_v \gamma_w} = \frac{1.8 \times 10^{-4}}{29.98 \times 10^{-6} \times 62.4} = 0.0962 \text{ ft}^2/\text{day}$$

$$T_v = \frac{c_v \times t}{H_{dr}^2}$$

$$t = \frac{T_v \times H_{dr}^2}{c_v}$$

T_v determined to be 0.286 from table. H_{dr} is the maximum drainage path of 9 ft.

$$t = \frac{0.286 \times 9^2}{0.0962} = \boxed{240.8 \text{ days}}$$

Settlement at 60% is calculated as follows:

$$S_c = 0.6 \times \frac{\Delta e \times H_{dr}}{1 + e_o} = 0.6 \times \frac{0.25 \times 9}{1 + 1.21} = \boxed{0.612 \text{ ft}}$$

Question 12.16

$$\frac{t_{\text{lab}}}{H^2_{\text{dr lab}}} = \frac{t_{\text{field}}}{H^2_{\text{dr field}}}$$

$$\frac{225}{0.5 \times 25 \times 10^{-3}} = \frac{t_{\text{field}}}{4}$$

$$t_{\text{field}} = 5760000 \text{ s} = \boxed{66.67 \text{ days}}$$