

Soil Mechanics

HW #9

Name: Mohammad Al-Swaity

ID: 1181136

Problem ①:

$$\Delta \sigma_z(v) = \frac{2qz^3}{\pi(x^2 + z^2)^2}$$

$$\begin{aligned}\Delta \sigma_z(v_1) &= \frac{2(375)(5)^3}{\pi(5^2 + 5^2)^2} \\ &= 11.943 \text{ kN/m}^2\end{aligned}$$

$$\Delta \sigma_z(v_2) = \frac{2q_2(5^3)}{\pi(12.5^2 + 5^2)^2}$$

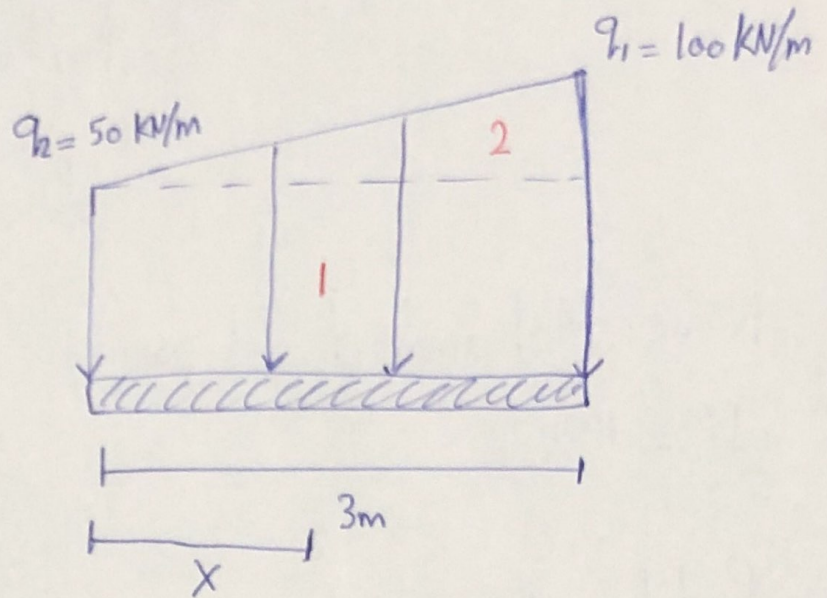
$$= 2.42 \times 10^{-3} q_2$$

$$\Delta \sigma_z = \Delta \sigma_z(v_1) + \Delta \sigma_z(v_2)$$

$$58 = 11.943 + (2.42 \times 10^{-3} \times q_2)$$

$$q_2 = 19031.82 \text{ kN/m}$$

Problem (2):



* The magnitude of the concentrated load is equal to the total load, on the area under the curve

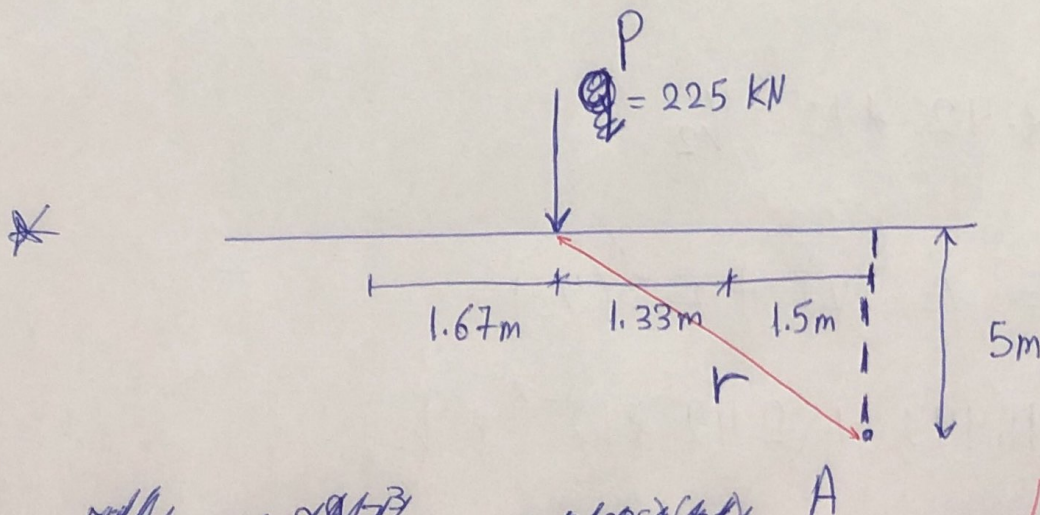
$$P = \left(\frac{q_1 + q_2}{2} \right) \times 3$$

$$= 225 \text{ kN}$$

* Centroid, $\bar{x} = \frac{\sum x_i A_i}{\sum A_i} = \frac{A_1 x_1 + A_2 x_2}{A_1 + A_2}$

$$= \frac{(150)(1.5) + (75)(2)}{150 + 75}$$

$$= 1.67 \text{ m}$$



$$r = \sqrt{25 + (2.83)^2} = 5.745 \text{ m}$$

$$* \Delta \sigma_z = \frac{p}{z^2} \left(\frac{3}{2\pi} \cdot \frac{1}{\left[\left(\frac{r}{z}\right)^2 + 1\right]^{\frac{5}{2}}} \right)$$

$$= \frac{225}{25} \left(\frac{3}{2\pi} \cdot \frac{1}{\left(\left(\frac{5.745}{5}\right)^2 + 1\right)^{\frac{5}{2}}} \right)$$

$$\rightarrow \Delta \sigma_z = 0.524 \text{ kN/m}^2$$

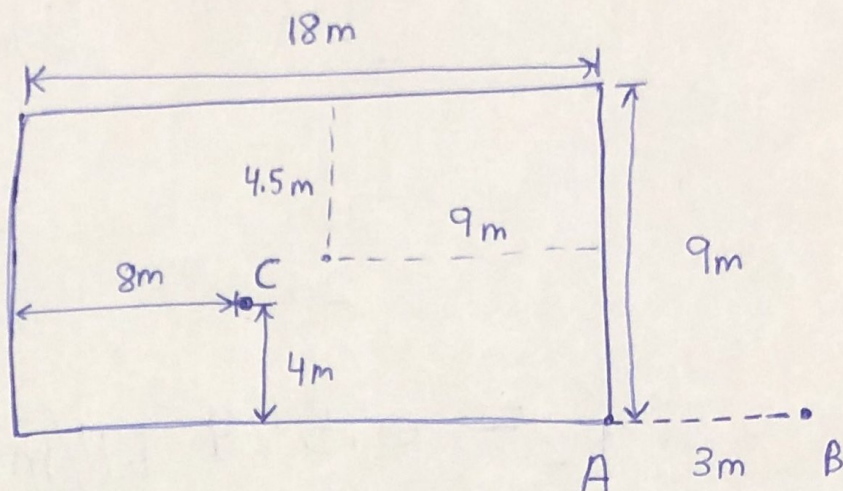
Problem (3)

Problem ③:

$$L = 18\text{ m}, b = 9\text{ m}$$

$$q = 450\text{ kN/m}^2$$

① at $z = 3\text{ m}$:



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$$P = q \cdot A = 450 \cdot 18 \cdot 9 = 72900\text{ kN}$$

for (A): $r = \sqrt{9^2 + 4.5^2} = 10.062\text{ m}$

$$\Delta \sigma_A = \frac{P}{z^2} \left(\frac{3}{2\pi} \cdot \frac{1}{\left[\left(\frac{r}{z} \right)^2 + 1 \right]^{\frac{5}{2}}} \right)$$

$$= \frac{72900}{9} \left(\frac{3}{2\pi} \cdot \frac{1}{\left[\left(\frac{10.062}{3} \right)^2 + 1 \right]^{\frac{5}{2}}} \right)$$

$$\rightarrow \Delta \sigma_A = 7.368\text{ kN/m}^2$$

for (B): ~~r~~ $r = \sqrt{12^2 + 4.5^2} = 12.82\text{ m}$

$$\Delta \sigma_B = \frac{72900}{9} \left(\frac{3}{2\pi} \cdot \frac{1}{\left[\left(\frac{12.82}{3} \right)^2 + 1 \right]^{\frac{5}{2}}} \right) = 2.376\text{ kN/m}^2$$

$$\rightarrow \Delta \sigma_B = 2.376\text{ kN/m}^2$$

at (C): $r = \sqrt{1^2 + 0.5^2} = 1.12 \text{ m}$

$$\Delta \sigma_C = \frac{72900}{9} \left(\frac{3}{2\pi} \cdot \frac{1}{\left[\left(\frac{1.12}{3} \right)^2 + 1 \right]^{\frac{5}{2}}} \right)$$

→ $\Delta \sigma_C = 2792.4 \text{ kN/m}^2$

at $z = 6 \text{ m}$:

at (A): $\Delta \sigma_A = \frac{72900}{36} \left(\frac{3}{2\pi} \cdot \frac{1}{\left[\left(\frac{10.062}{6} \right)^2 + 1 \right]^{\frac{5}{2}}} \right)$

→ $\Delta \sigma_A = 34.089 \text{ kN/m}^2$

at (B): $\Delta \sigma_B = \frac{72900}{36} \left(\frac{3}{2\pi} \cdot \frac{1}{\left[\left(\frac{12.82}{6} \right)^2 + 1 \right]^{\frac{5}{2}}} \right)$

→ $\Delta \sigma_B = 13.24 \text{ kN/m}^2$

at (C): $\Delta \sigma_C = \frac{72900}{36} \left(\frac{3}{2\pi} \cdot \frac{1}{\left[\left(\frac{1.12}{6} \right)^2 + 1 \right]^{\frac{5}{2}}} \right)$

→ $\Delta \sigma_C = 887.97 \text{ kN/m}^2$