Soil Mechanics

HW #9

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Problem ①:

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

$$\Delta\sigma_{z(V_1)} = \frac{2(375)(5)^3}{\pi(5^2+5^2)^2}$$

$$= 11.943 \text{ KN/m}^2$$

$$\Delta\sigma_{(V_2)} = \frac{2q_2(5^3)}{\pi(12.5^2+5^2)^2}$$

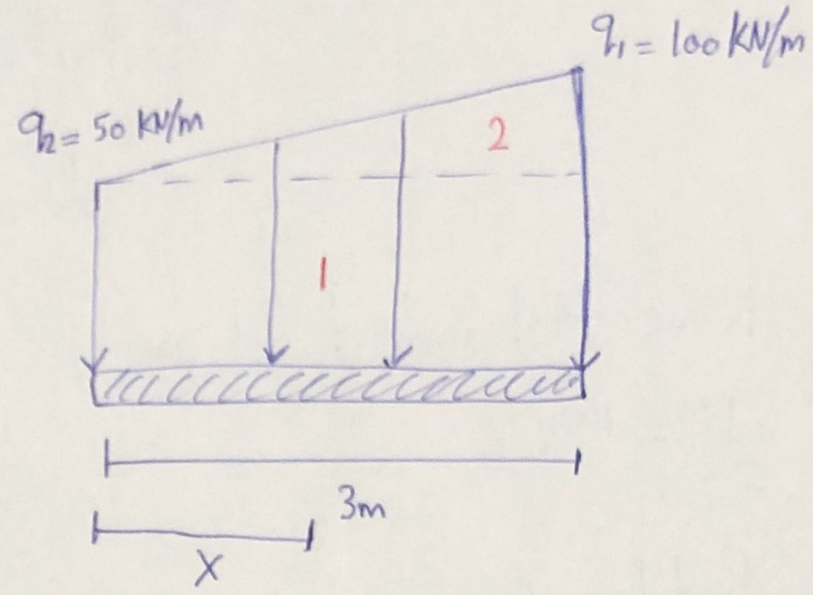
$$= 2.42 * 10^{-3} q_2$$

$$\Delta\sigma_z = \Delta\sigma_{(V_1)} + \Delta\sigma_{(V_2)}$$

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

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

Problem ②:



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

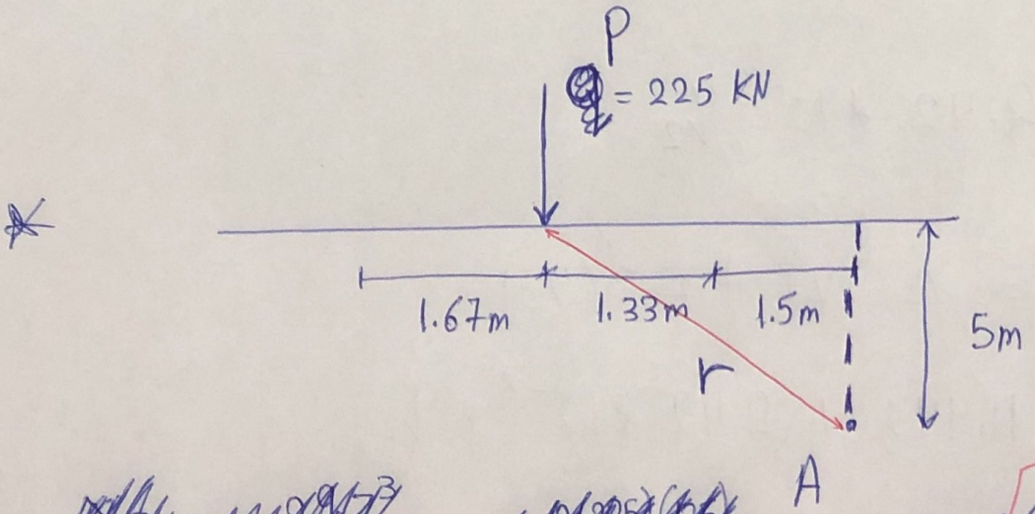
$$P = \left(\frac{q_1 + q_2}{2}\right) * 3$$

$$= 225 \text{ KN}$$

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

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

$$= 1.67 \text{ m}$$



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

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

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

$$\longrightarrow \boxed{\Delta\sigma_z = 0.524 \ KN/m^2}$$

Problem (3)

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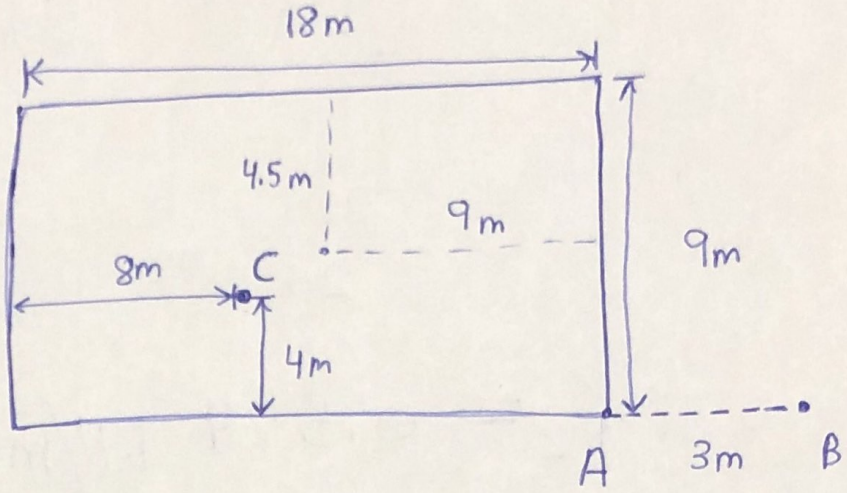
$L = 18\,m$, $b = 9\,m$

$q = 450\ kN/m^2$



(a) at $Z = 3\,m$:

at $Z = 3m$:

$$P = q * A = 450 * 18 * 9 = 72900\ kN$$

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

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

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

$$\longrightarrow \boxed{\Delta\sigma_A = 7.368\ kN/m^2}$$

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

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

$$\longrightarrow \boxed{\Delta\sigma_B = 2.376\ kN/m^2}$$

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

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

$$\longrightarrow \boxed{\Delta\sigma_C = 2792.4\ kN/m^2}$$

at z = 6m:

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

$$\longrightarrow \boxed{\Delta\sigma_A = 34.089\ kN/m^2}$$

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

$$\longrightarrow \boxed{\Delta\sigma_B = 13.24\ kN/m^2}$$

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

$$\longrightarrow \boxed{\Delta\sigma_C = 887.97\ kN/m^2}$$