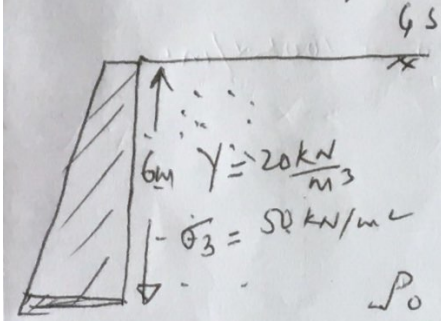
Class Test-I (Soil & Rock Mechanics)

B.Tech 6th Semester (Civil Engineering)

Instructor : RASHID MUSTAFA

Q-1 $\left(120 \frac{kN}{m}\right)$



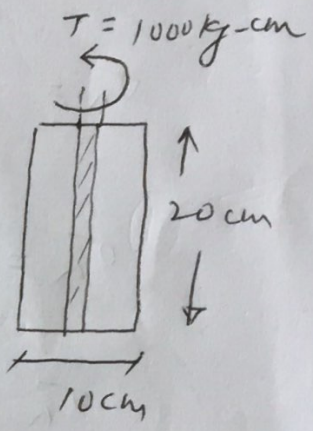
$$\nu = \frac{\sigma_3}{\sigma_1 + \sigma_3} = \frac{50}{200} = \frac{1}{4} = 0.25$$

$$K_0 = \frac{\nu}{1-\nu} = \frac{0.25}{0.75} = \frac{1}{3}$$

$$P_0 = \frac{1}{2} K_0 \gamma H^2 = \frac{1}{2} \times \frac{1}{3} \times 20 \times 36$$

$$\boxed{P_0 = 120 \text{ kN/m}}$$

Q-2 $\left[\frac{1}{\pi}\left(\frac{6}{7}\right)\right]$



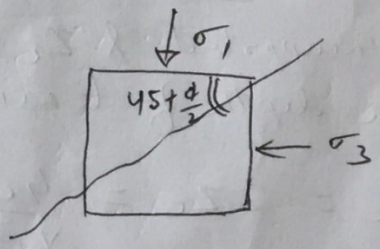
$$S = \frac{T}{\pi D^2 \left(\frac{H}{2} + \frac{D}{6}\right)}$$

$$= \frac{1000}{\pi \times 100 \left(\frac{20}{2} + \frac{10}{6}\right)}$$

$$= \frac{10}{\pi\left(10 + \frac{5}{3}\right)} = \frac{10 \times 3}{\pi\left(\frac{35}{2}\right)}$$

$$S = \frac{6}{7\pi} = \boxed{\frac{1}{\pi}\left(\frac{6}{7}\right)} \text{ kg/cm}^2$$

Q-3 (40°)

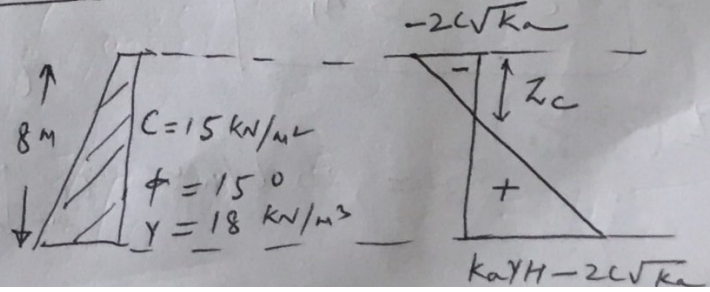


$$\alpha = 45 - \frac{\phi}{2}$$

$$\alpha = 45 - \frac{10}{2} = \boxed{40^\circ}$$

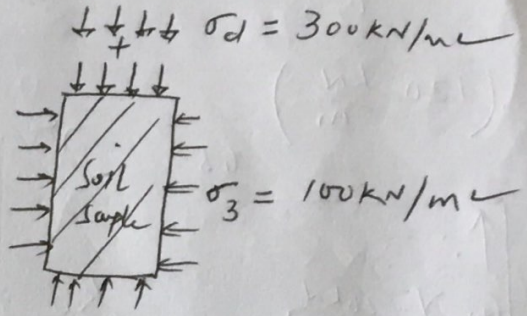
Q-4 $\left(-13.81 \frac{kN}{m^2}\right)$

Active Pressure at top $= -2c\sqrt{k_a}$



$$P_{a\,/\,at\ top} = -2\times 15\times\sqrt{\frac{1-\sin 15}{1+\sin 15}} = \boxed{-13.81\ \frac{kN}{m^2}}$$

Q-5 $\left(250\ \frac{kN}{m^2}\right)$



$\sigma_3 = 100\ kN/m^2$

$\sigma_1 = \sigma_3 + \sigma_d$

$= 400\ kN/m^2$

Max^m shear stress occur at 45°

$$\sigma_n = \sigma_1 \cos^2\theta + \sigma_3 \sin^2\theta + 2\tau_{xy} \sin\theta\cos\theta$$

OR

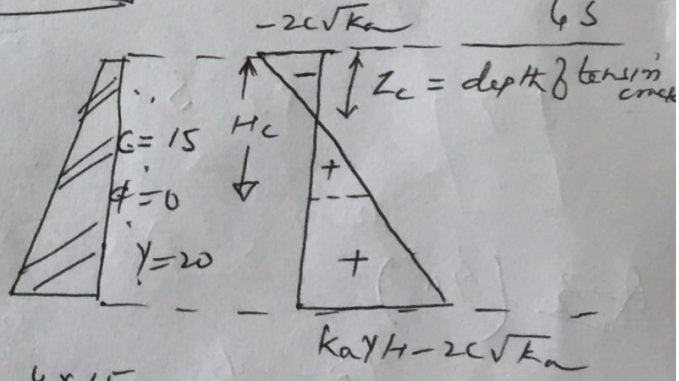
$$\sigma_n = \left(\frac{\sigma_1+\sigma_3}{2}\right) + \left(\frac{\sigma_1-\sigma_3}{2}\right)\cos 2\theta$$

$$\sigma_n = \left(\frac{400+100}{2}\right) + \left(\frac{400-100}{2}\right)\cos 90^\circ$$

$$\boxed{\sigma_n = 250\ kN/m^2}$$

Q-6 (3 m)

Let H_c be the height of Unsupported & Z_c be the depth of tension crack

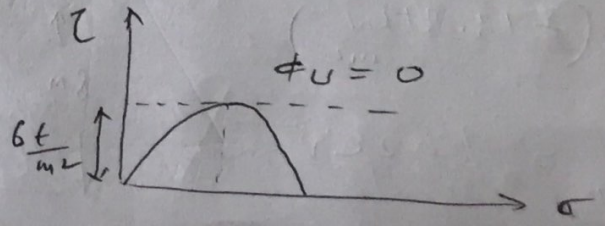


$$H_c = 2Z_c = \frac{4c}{\gamma\sqrt{k_a}} = \frac{4\times 15}{20\sqrt{1}}$$

$$\boxed{H_c = 3\ m}$$

Q-7 $\left(32\ \frac{t}{m^2}\right)$

$\sigma_3 = 20\ t/m^2$

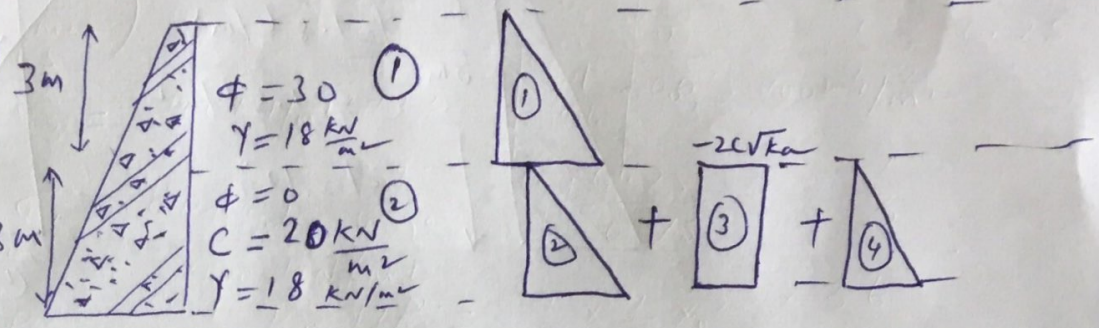


$$\sigma_1 = \sigma_3 \tan^2\left(45+\frac{\phi}{2}\right) + 2c \tan\left(45+\frac{\phi}{2}\right)$$

$$\sigma_1 = 20 \tan^2(45) + 2 \times 6 \times \tan(45)$$

$$\sigma_1 = 20 \times 1 + 12 \times 1 = 32 \text{ t/m}^2$$

Q-8 $\left(150 \frac{kN}{m}\right)$



For Layer ①, $K_{a_1} = \frac{1-\sin 30}{1+\sin 30} = 1/3$

For Layer ② $K_{a_2} = \frac{1-\sin 0}{1+\sin 0} = 1$

$$P_a = P_{a1} + P_{a2} + P_{a3} + P_{a4}$$

$$= \frac{1}{2} \times \frac{1}{3} \times 18 \times 9 + \frac{1}{2} \times 1 \times 18 \times 9 - 2 \times 20 \times \sqrt{1} \times 3 + 1 \times (18 \times 3) \times 3$$

$$= 27 + 81 - 120 + 162 = 150 \text{ kN/m}$$

Q-9 (0.467)

$$B = \frac{\Delta U}{\Delta \sigma_3} = \frac{70}{300-150} = \frac{70}{150}$$

$$B = 0.467$$

Q-10 (119.2 kPa)

$c' = 20 \text{ kPa}$

$\phi' = 22^\circ$

$\sigma_3 = 150 \text{ kPa}$, $U = 100 \text{ kPa}$

$\sigma_3' = 150 - 100 = 50 \text{ kPa}$

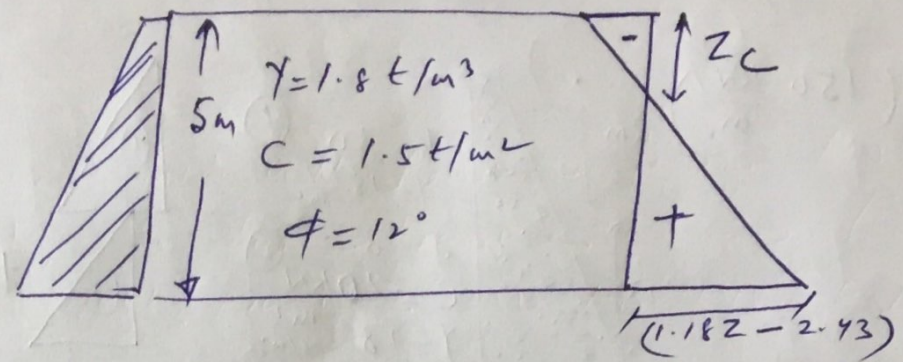
$$\sigma_1' = \sigma_3' \tan^2\left(45+\frac{\phi}{2}\right) + 2c' \tan\left(45+\frac{\phi'}{2}\right)$$

$$\sigma_1' = 50 \tan^2(45+11) + 40 \tan(56)$$

$\sigma_1' = 169.20 \text{ kN/m}^2$

$\sigma_d = 169.2 - 50 = 119.2 \text{ kN/m}^2$

Q-11 (5.1 t/m)



$$z_c = \frac{2c}{\gamma\sqrt{k_a}} = \frac{2 \times 1.5}{1.8 \times \sqrt{\frac{1-\sin 12}{1+\sin 12}}}$$

$$= 2.058 \text{ m}$$

$$k_a = \frac{1-\sin 12}{1+\sin 12} = 0.656$$

$$p_a = k_a \gamma z - 2c\sqrt{k_a}$$

$$= 0.656 \times 1.8z - 2 \times 1.5\sqrt{0.656}$$

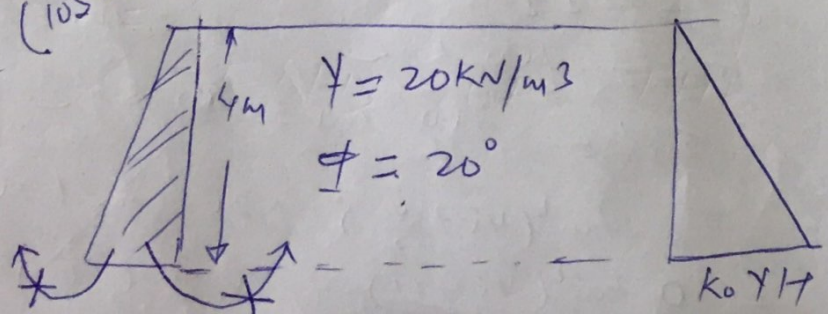
$$p_a = (1.18z - 2.43)$$

$$P_a = \int_{z_c}^{H} (p_a)\, dz$$

$$= \int_{2.058}^{5} (1.18z - 2.43)\, dz$$

$$= 5.10 \text{ t/m}$$

Q-13 (105.28)



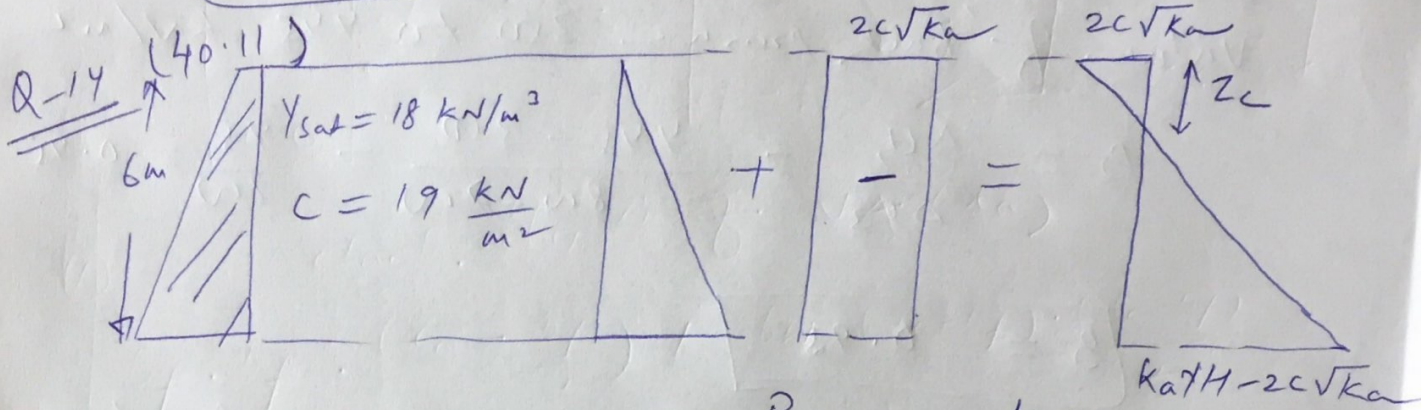
At rest thrust $(P_0) = \frac{1}{2} k_0 \gamma H^2$

$k_0 = 1 - \sin\phi = 1 - \sin 20^\circ = 0.658$

$P_0 = \frac{1}{2} \times 0.658 \times 20 \times 16 = 105.28 \text{ kN/m}$

$P_0 = 105.28 \text{ kN/m}$

Q-14 (40.11)



Pressure diagram

depth of tension Crack $(z_c) = \frac{2c}{\gamma\sqrt{k_a}} = \frac{2\times 19}{18\sqrt{1}}$

$= 2.11 \text{ m}$

Pressure at depth (z)

$P_a = k_a\gamma z - 2c\sqrt{k_a}$

$= 1 \times 18 \times z - 38\sqrt{1}$

$= (18z - 38)$

Total active thrust before tension Crack (P_a)

$P_a = \int_0^H (k_a\gamma z - 2c\sqrt{k_a})\, dz = \int_0^6 (18z - 38)\, dz$

$P_a = 96 \text{ kN/m}$

Total active thrust after tension Crack (P_a)

$P_a = \int_{z_c}^H (k_a\gamma z - 2c\sqrt{k_a})\, dz = \int_{@2.11}^6 (18z - 38)\, dz$

$P_a = 136.11 \text{ kN/m}^2$

Difference $= (136.11 - 96) = 40.11 \text{ kN/m}^2$

Q-15 (0.357, 0.95)

$\sigma_3 = 700 \text{ kN/m}^2$

For an increase in Cell Pressure from 700 to 800 kN/m², the Pore Pressure increases from the value of back pressure 350 to 445 kN/m²

$$B = \frac{\Delta U_1}{\Delta \sigma_3} = \frac{445 - 350}{800 - 700} = \frac{95}{100} = 0.95$$

$$\boxed{B = 0.95}$$

An increase in total major Principal stress from 800 kN/m² to (800 + 575) kN/m² produced a corresponding increase in PWP from 445 to 640 kN/m²

$$A' = \frac{\Delta U_2}{\Delta \sigma_1 - \Delta \sigma_3} = \frac{640 - 445}{575}$$

$$= \frac{195}{575} = 0.339$$

$$A' = AB$$

$$A = \frac{A'}{B} = \frac{0.339}{0.95} = 0.357$$

$$\boxed{A = 0.357}$$

END OF THE SOLUTION