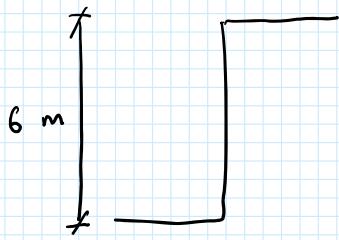


Question 1

$$\gamma = 19 \text{ kN/m}^3$$

$$\phi = 32^\circ$$

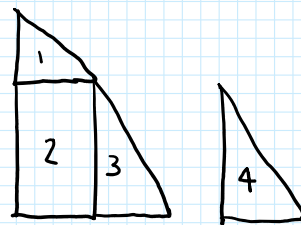
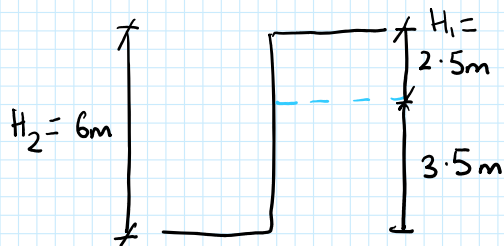
a. Active Earth Pressure Coefficient ( $k_a$ )

$$\begin{aligned} k_a &= \frac{1 - \sin \phi}{1 + \sin \phi} = \frac{1 - \sin 32}{1 + \sin 32} \\ &= \frac{1 - 0.53}{1 + 0.53} \\ &= \frac{0.47}{1.53} = \underline{\underline{0.31}} \end{aligned}$$

b. Active Earth Pressure ( $p_a$ )

$$\begin{aligned} p_a &= k_a \gamma z = 0.31 \times 19 \times 6 \\ &= \underline{\underline{35.3 \text{ kN/m}^2}} \end{aligned}$$

c. Total Thrust ( $P_a$ )



$$\gamma_{\text{sat}} = 21 \text{ kN/m}^3$$

Section 1 - Dry

$$\begin{aligned} P_a &= \frac{1}{2} k_a \gamma H_1^2 = \frac{1}{2} \times 0.31 \times 19 \times 2.5^2 \\ &= 18.21111 \end{aligned}$$

$$P_a = \frac{1}{2} k_a \gamma H_1 = \frac{1}{2} \times 0.31 \times 19 \times 2.5$$

$$= \underline{\underline{18.41 \text{ kN/m}}}$$

Section 2 - Submerged

The weight of the soil above the water table adds extra pressure to the submerged soil.

$$P_a = k_a \gamma H_1 (H_2 - H_1) = 0.31 \times 19 \times 2.5 \times (6.0 - 2.5)$$

$$= 0.31 \times 19 \times 2.5 \times 3.5$$

$$= \underline{\underline{53.20 \text{ kN/m}}}$$

Section 3 - Submerged

$$P_a = \frac{1}{2} k_a \gamma' (H_2 - H_1)^2$$

$$\gamma' = \gamma_{\text{sat}} - \gamma_w = 21 - 9.81 = 11.19 \text{ kN/m}^3$$

$$P_a = \frac{1}{2} \times 0.31 \times 11.19 \times (6 - 2.5)^2$$

$$= \frac{1}{2} \times 0.31 \times 11.19 \times 3.5^2$$

$$= \frac{1}{2} \times 0.31 \times 11.19 \times 12.25$$

$$= \underline{\underline{21.24 \text{ kN/m}}}$$

Section 4 - Hydrostatic

$$P_a = \frac{1}{2} \gamma_w (H_2 - H_1)^2 = \frac{1}{2} \times 9.81 \times (6 - 2.5)^2$$

$$= \frac{1}{2} \times 9.81 \times 3.5^2$$

$$= \frac{1}{2} \times 9.81 \times 12.25$$

$$= \underline{\underline{60.09 \text{ kN/m}}}$$

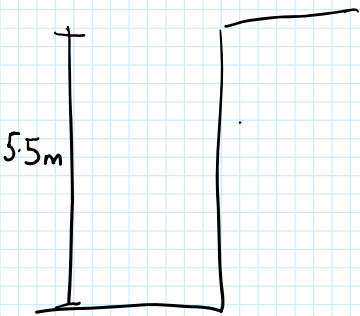
Total

$$P_{a_{\text{TOT}}} = P_{a1} + P_{a2} + P_{a3} + P_{a4}$$

$$= 18.41 + 53.20 + 21.24 + 60.09$$

$$= \underline{\underline{152.94 \text{ kN/m}}}$$

## Question 2



$$\gamma = 18.8 \text{ kN/m}^3$$

$$\phi = 31^\circ$$

a. Active Earth Pressure Coefficient

$$k_a = \frac{1 - \sin \phi}{1 + \sin \phi} = \frac{1 - \sin 31}{1 + \sin 31} =$$

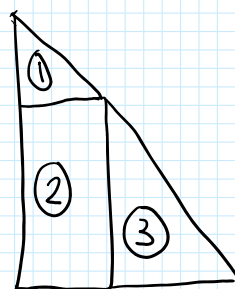
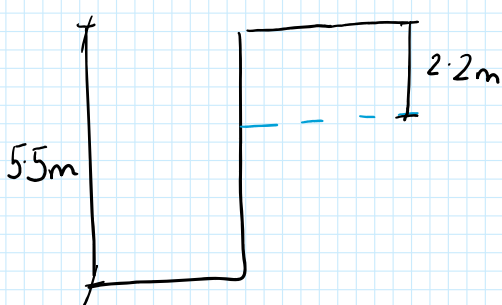
$$= \frac{0.48}{1.52} = \underline{\underline{0.32}}$$

b. Active Earth Pressure

$$p_a = k_a \gamma z = 0.32 \times 18.8 \times 5.5$$

$$= 33.00 \text{ kN/m}^2$$

c. Total Thrust



$$\gamma_{sat} = 20.5 \text{ kN/m}^3$$



Section 1

$$P_a = \frac{1}{2} k_a \gamma H_1^2 = \frac{1}{2} \times 0.32 \times 18.8 \times 2.2^2$$

$$= \underline{\underline{13.94 \text{ kN/m}}}$$

Section 2

$$P_a = k_a \gamma H_1 (H_2 - H_1) = 0.32 \times 18.8 \times 2.2 \times (5.5 - 2.2)$$

$$= 0.32 \times 18.8 \times 2.2 \times 3.3$$

$$= \underline{\underline{43.68 \text{ kN/m}}}$$

Section 3

$$P_a = \frac{1}{2} k_a \gamma' (H_2 - H_1)^2$$

$$\gamma' = \gamma_{\text{sat}} - \gamma_w = 20.5 - 9.81 = 10.69$$

$$P_a = \frac{1}{2} \times 0.32 \times 10.69 \times (5.5 - 2.2)^2$$

$$= \frac{1}{2} \times 0.32 \times 10.69 \times 3.3^2$$

$$= \frac{1}{2} \times 0.32 \times 10.69 \times 10.89$$

$$= \underline{\underline{18.63 \text{ kN/m}}}$$

Section 4

$$P_a = \frac{1}{2} \gamma_w (H_2 - H_1)^2 = \frac{1}{2} \times 9.81 \times (5.5 - 2.2)^2$$

$$= \frac{1}{2} \times 9.81 \times 3.3^2$$

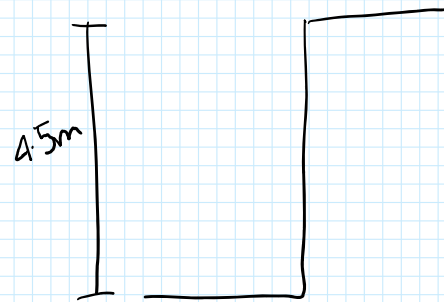
$$= \underline{\underline{53.42 \text{ kN/m}}}$$

Total

$$P_{\text{atof}} = 13.94 + 43.68 + 18.63 + 53.42$$

$$= \underline{\underline{129.67 \text{ kN/m}}}$$

### Question 3



$$\gamma = 17.5 \text{ kN/m}^3$$

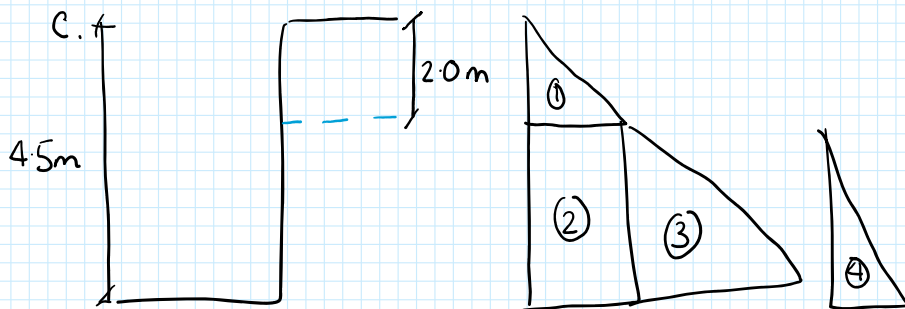
$$\phi = 28^\circ$$

$$a. K_a = \frac{1 - \sin \phi}{1 + \sin \phi} = \frac{1 - \sin 28}{1 + \sin 28}$$

$$= \frac{0.53}{1.47} = \underline{\underline{0.36}}$$

$$b. p_a = K_a \gamma z = 0.36 \times 17.5 \times 4.5$$

$$= \underline{\underline{28.35 \text{ kN/m}^2}}$$



$$\gamma_{\text{sat}} = 19.5 \text{ kN/m}^3$$

### Section 1

$$D = 1, \quad 1.2 = 1 \times 0.2 \times 17.5 \times 2.0^2$$

$$P_a = \frac{1}{2} k_a \gamma H_1^2 = \frac{1}{2} \times 0.36 \times 17.5 \times 2.0^2$$

$$= \underline{\underline{12.60 \text{ kN/m}}}$$

Section 2

$$P_a = k_a \gamma H_1 (H_2 - H_1) = 0.36 \times 17.5 \times 2.0 \times (4.5 - 2.0)$$

$$= 0.36 \times 17.5 \times 2.0 \times 2.5$$

$$= \underline{\underline{31.50 \text{ kN/m}}}$$

Section 3

$$P_a = \frac{1}{2} k_a \gamma' (H_2 - H_1)^2$$

$$\gamma' = \gamma_{\text{sat}} - \gamma_w = 19.5 - 9.81 = 9.69$$

$$P_a = \frac{1}{2} \times 0.36 \times 9.69 \times (4.5 - 2.0)^2$$

$$= \frac{1}{2} \times 0.36 \times 9.69 \times 2.5^2$$

$$= \frac{1}{2} \times 0.36 \times 9.69 \times 6.25$$

$$= \underline{\underline{10.90 \text{ kN/m}}}$$

Section 4

$$P_a = \frac{1}{2} \gamma_w (H_2 - H_1)^2 = \frac{1}{2} \times 9.81 \times (4.5 - 2.0)^2$$

$$= \frac{1}{2} \times 9.81 \times 2.5^2$$

$$= \frac{1}{2} \times 9.81 \times 6.25$$

$$= \frac{61.33}{2}$$
$$= \underline{\underline{30.66 \text{ kN/m}}}$$

Total

$$P_{a\text{TOT}} = 12.60 + 31.50 + 10.90 + 30.66$$
$$= \underline{\underline{85.66 \text{ kN/m}}}$$