Department of Civil Engineering
Kathlal Engineering College, Kathlal

Subject: Soil & Rock Mechanics
Topic: Earth Pressure Theory
Lecture: 05
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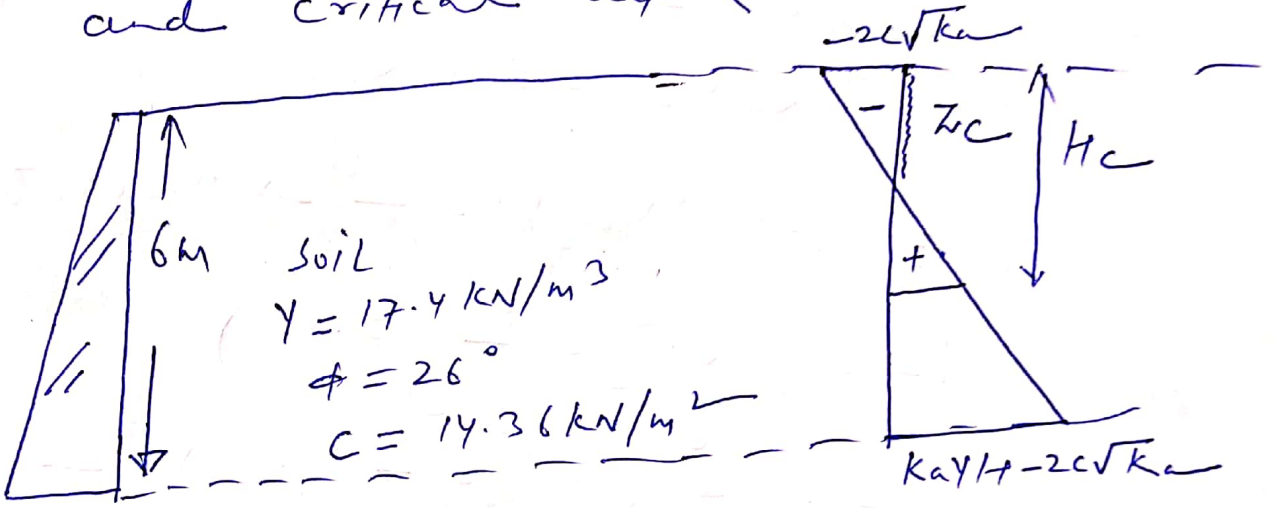
P-1. A 6.0 m high retaining wall is to support a soil with unit weight $\gamma = 17.4\ kN/m^3$ $\phi = 26^\circ$ and $c' = 14.36\ kN/m^2$. Determine the Rankine active force per unit length of wall before and after tensile crack. Also compute the depth of tension crack and critical depth.



Active Earth Pressure coefficient $(K_a) = \dfrac{1-\sin\phi}{1+\sin\phi}$

$= \dfrac{1-\sin 26}{1+\sin 26} = 0.39$

Depth of tension crack $(Z_c) = \dfrac{2c}{\gamma\sqrt{K_a}}$

$$Z_c = \frac{2 \times 14.36}{17.4 \times \sqrt{0.39}}$$

$$Z_c = 2.64 \text{ m}$$

$$\text{Critical height } (H_c) = 2 \times Z_c = \frac{4c}{\gamma \sqrt{k_a}}$$

$$= 2 \times 2.64$$

$$= 5.28 \text{ m}.$$

Active Earth force before the tension Crack $(P_a) = \int_0^H (p_a)\, dz$

At any depth z

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

$$= (0.39) \times 17.4 \times z - 2 \times 14.36 \times \sqrt{0.39}$$

$$= (6.79z - 17.94)$$

$$P_a = \int_0^6 (6.79z - 17.94)\, dz$$

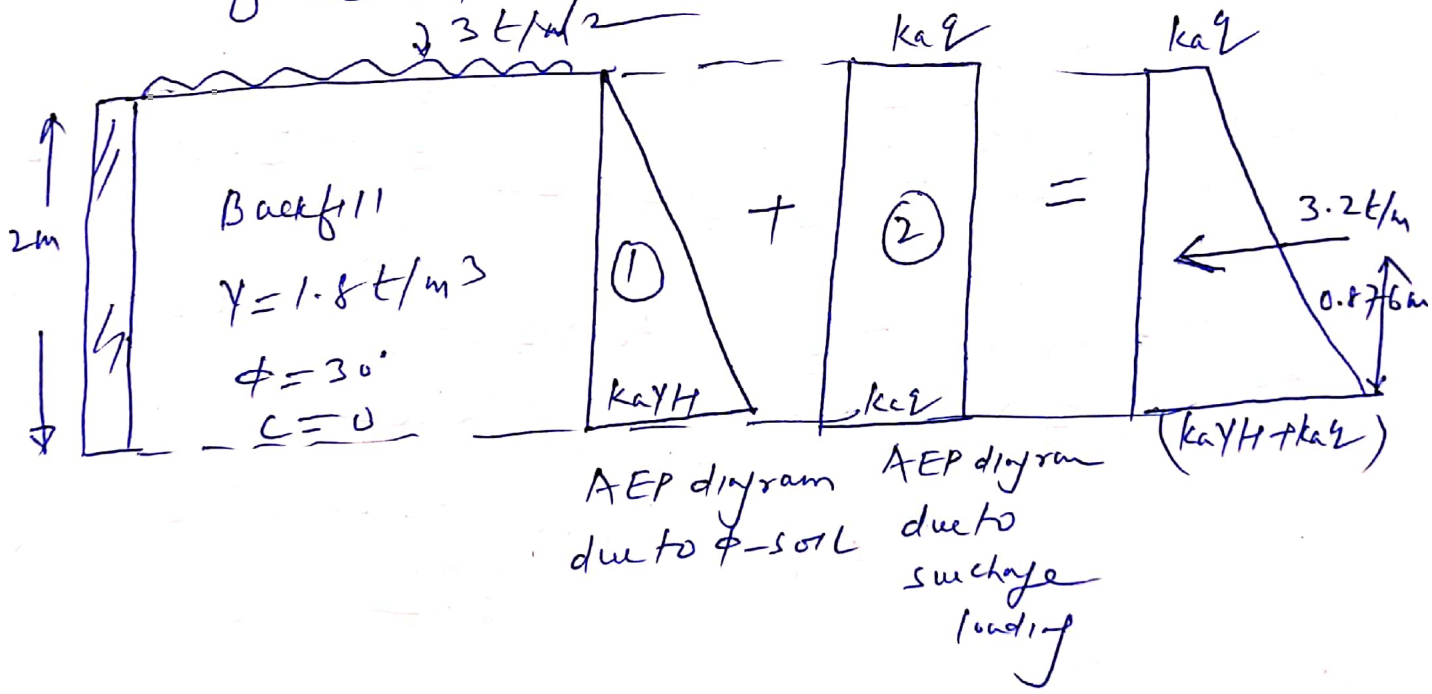
$$P_a = 14.58 \text{ kN/m}$$

Active Earth force after the tension Crack $(P_a) = \int_{z_c}^{H} (p_a)\, dz$

$$= \int_{2.64}^{6} (6.79z - 17.94)\, dz$$

$$\boxed{P_a = 38.28 \text{ kN/m}}$$

P-2. A retaining wall 2m in height has a smooth vertical surface. The backfill has a horizontal levelled surface with the top of retaining wall. The density of the backfill is 1.8 t/m³, $\phi = 30°$, $C = 0$. A uniform surcharge load of 3 t/m² intensity is acting on the backfill. Compute magnitude and point of application of Active Earth pressure per metre by the retaining wall.



$$K_a = \frac{1-\sin\phi}{1+\sin\phi} = 1/3$$

Active Earth Pressure due to ϕ-soil $(p_{a_1}) = K_a \gamma H$

$= \frac{1}{3} \times 1.8 \times 2 = 1.2 \text{ t/m}^2$

Active thrust due to ϕ-soil $(P_{a_1}) = \frac{1}{2} \times 1.2 \times 2$ acts at $\frac{2}{3}$ rd from base.

$= 1.2$ t/m — acts 0.67 m from base.

Active Pressure due to ~~C~~ surcharge q $(p_{a_2}) = k_a q$

$= \frac{1}{3} \times 3$

$= 1$ t/m^2

Active thrust due to surcharge loading q $(P_{a_2}) = (1 \times 2)$ acts at $\frac{2}{2}$ from base of the wall

$= 2$ t/m acts at 1 m from base of the wall

Total Active force $(P_a) = P_{a_1} + P_{a_2}$

$= 1.2 + 2 = 3.2$ t/m

Line of Action $(\bar{z}) = \dfrac{P_{a_1} \times z_1 + P_{a_2} \times z_2}{P_a}$

$= \dfrac{1.2 \times 0.67 + 2 \times 1}{3.2}$

$= 0.876$ m

<Happy Learning>