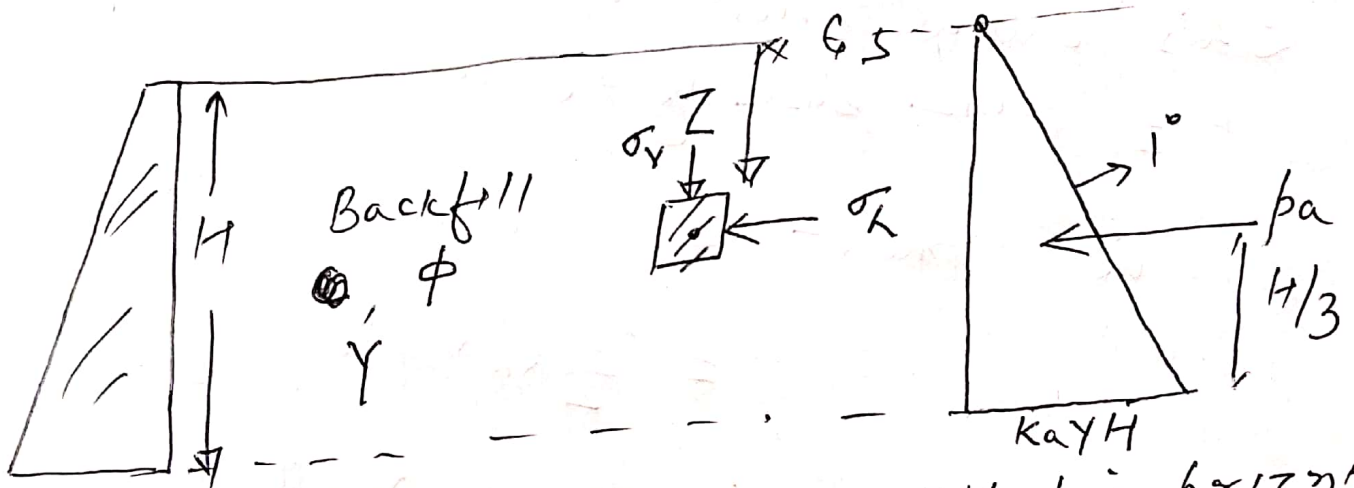


Subject: Soil & Rock Mechanics  
 Topic: Lateral Earth Pressure

Instructor: Prof. RASHID MUSTAFA

Lecture : 02

(2) Active Earth Pressure (AEP): If the movement of wall is away from the soil then pressure acting on the wall due to this backfill is called AEP.



We know that the ratio of Effective horizontal stress to Effective vertical stress is called Earth Pressure coefficient.

$$K = \frac{\sigma_h'}{\sigma_v'} = \frac{\sigma_h}{\sigma_v}$$

$$k_a = \frac{\sigma_h}{\sigma_v} = \frac{\sigma_h}{\gamma Z}$$

$$\sigma_h = k_a \gamma \cdot Z$$

$$\sigma_h = \sigma_a = p_a = k_a \gamma Z$$

When  $z = 0$ ,  $p_a = 0$

When  $z = H$ ,  $p_a = k_a \gamma H$

$$\boxed{\text{Active Earth Pressure } (p_a) = k_a \gamma H \text{ at base of the wall.}}$$

Total Active thrust  $(P_a) = \frac{1}{2} k_a \gamma H \cdot H$

$$\boxed{P_a = \frac{1}{2} k_a \gamma H^2}$$

This lateral thrust acting at a distance of  $H/3$  from base of the wall

Active Moment =  $P_a \times \text{lever Arm}$

$$= \frac{1}{2} k_a \gamma H^2 \times H/3$$

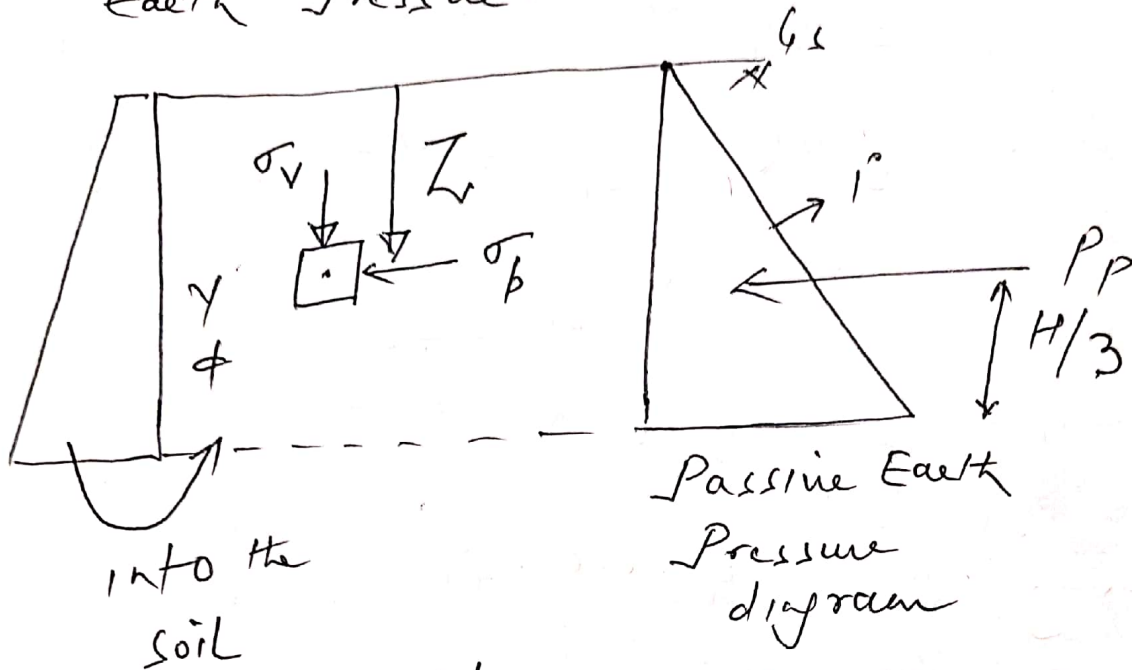
$$= \frac{1}{6} k_a \gamma H^3$$

Where  $k_a =$  Coefficient of Active Earth Pressure

$$k_a = f_n(\phi)$$

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

③ Passive Earth Pressure (PEP): If the movement of wall is into the soil then pressure acting on the wall due to this backfill is called Passive Earth Pressure.



$$k = \frac{\sigma_h'}{\sigma_v'}$$

$$k_p = \frac{\sigma_h'}{\sigma_v'} = \frac{\sigma_p}{\gamma \cdot Z}$$

$$\sigma_p = p_p = k_p \cdot \gamma \cdot Z$$

When  $Z = 0$ ,  $p_p = 0$

When  $Z = H$ ,  $p_p = k_p \gamma H$

Passive Earth Pressure ( $p_p$ ) =  $k_p \gamma H$   
at base of the wall

$$\text{Total Passive thrust } (P_p) = \frac{1}{2} k_p \gamma H \cdot H$$

$$= \frac{1}{2} k_p \gamma H^2$$

OR

$$\begin{aligned}
 \text{Total Passive thrust } (P_p) &= \int_0^H p_p \cdot dz \\
 &= \int_0^H (k_p \gamma z) dz \\
 &= k_p \gamma \int_0^H z dz \\
 &= k_p \gamma \left[ \frac{z^2}{2} \right]_0^H \\
 &= \frac{1}{2} k_p \gamma H^2
 \end{aligned}$$

It is acting at a distance of  $H/3$  from base of the wall.

$$\begin{aligned}
 \text{Total Passive moment} &= P_p \cdot \text{lever arm} \\
 &= \frac{1}{2} k_p \gamma H^2 \times H/3 \\
 &= \frac{1}{6} k_p \gamma H^3
 \end{aligned}$$

Where  $k_p \rightarrow$  Coeff of Passive Earth Pressure

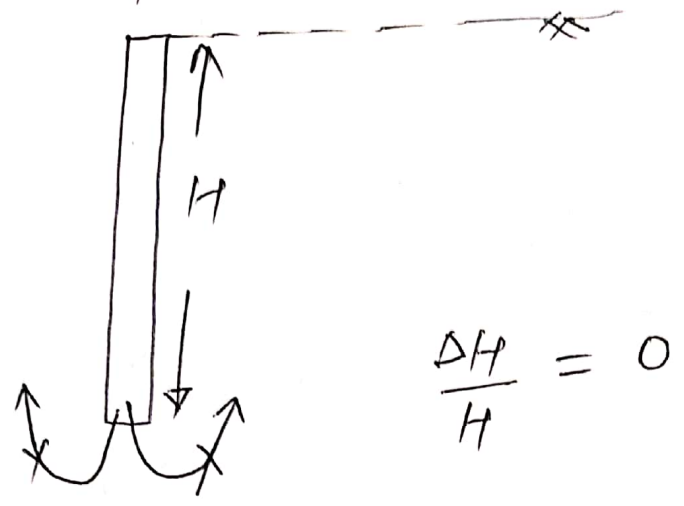
$$k_p = f_a(\phi)$$

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

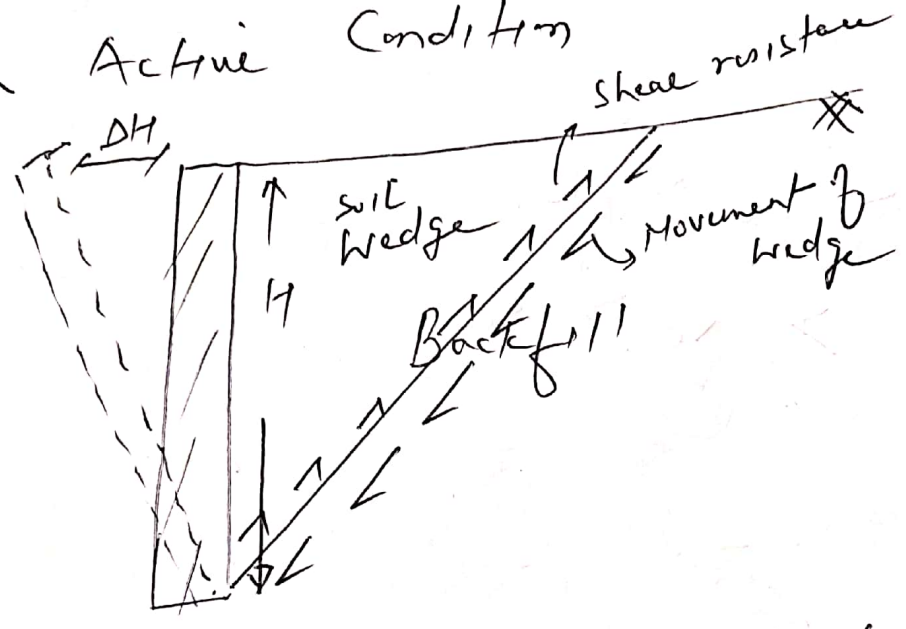
$$\boxed{k_a \cdot k_p = 1}$$

# ⇒ Effect of wall movement.

## At-rest condition

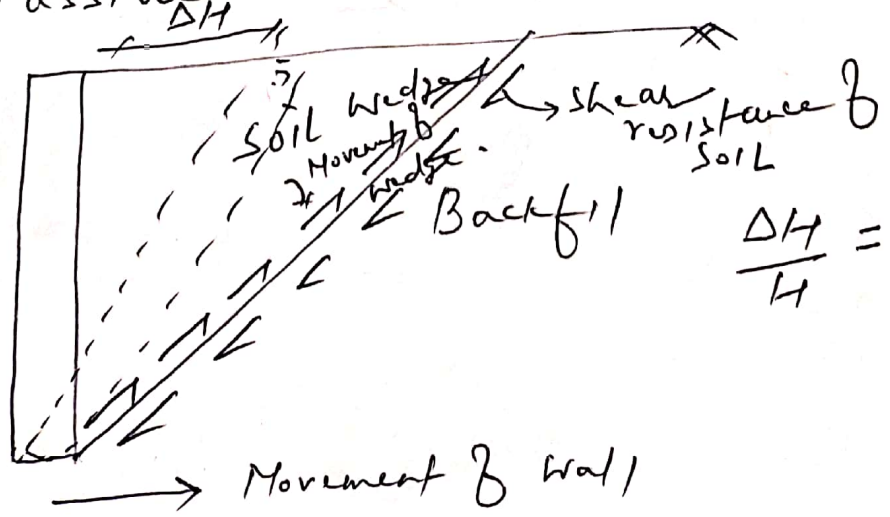


## In Active Condition

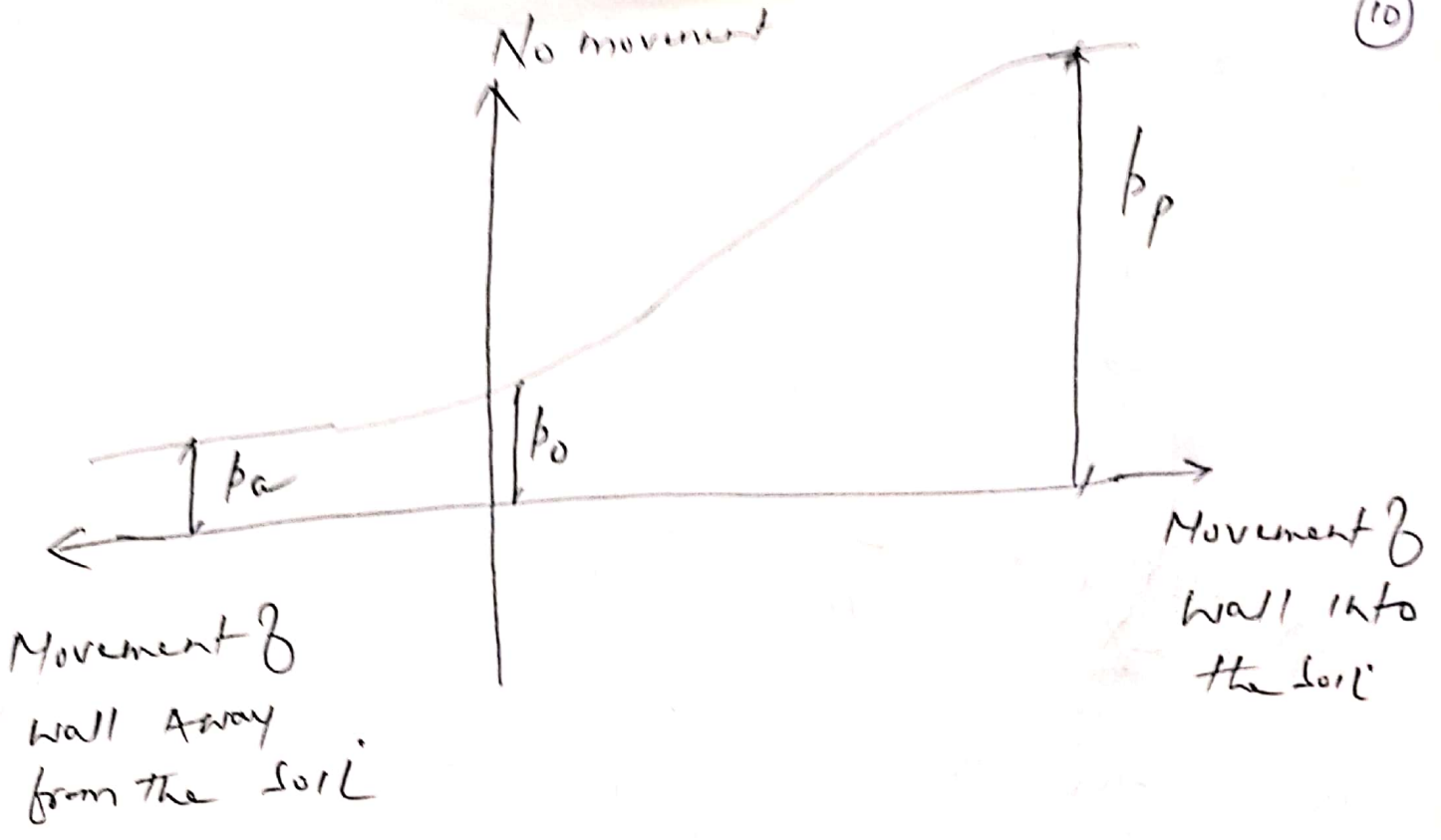


$$\frac{\Delta H}{H} = (0.3 \text{ to } 0.5) \%$$

## In Passive Case



$$\frac{\Delta H}{H} = (3 \text{ to } 15) \%$$



$$p_p > p_o > p_a$$
$$k_p > k_o > k_a$$

Happy Learning