Department of Civil Engineering
Kathkar Engineering College, Kathkar

Course: Soil and Rock Mechanics
Topic: Lateral Earth Pressure Theory
Lecture: 06
Instructor: Prof. RASHID MUSTAFA

⇒ Coulomb's Wedge Theory: →

Assumptions:

(I) Soil is homogeneous, isotropic, elastic, semi-infinite, dry & cohesionless.

(II) The face of the wall in contact with backfill is Vertical/Inclined and is rough

(III) The failure wedge acts as a rigid body and stress over it are uniformly distributed

(IV) The failure is essentially two dimensional and rupture surface is planar and passes through the heel of the wall.

(V) The location and direction of resultant thrust b/w wall and soil is known. The point of application is taken at the lower third point of the wall by assuming

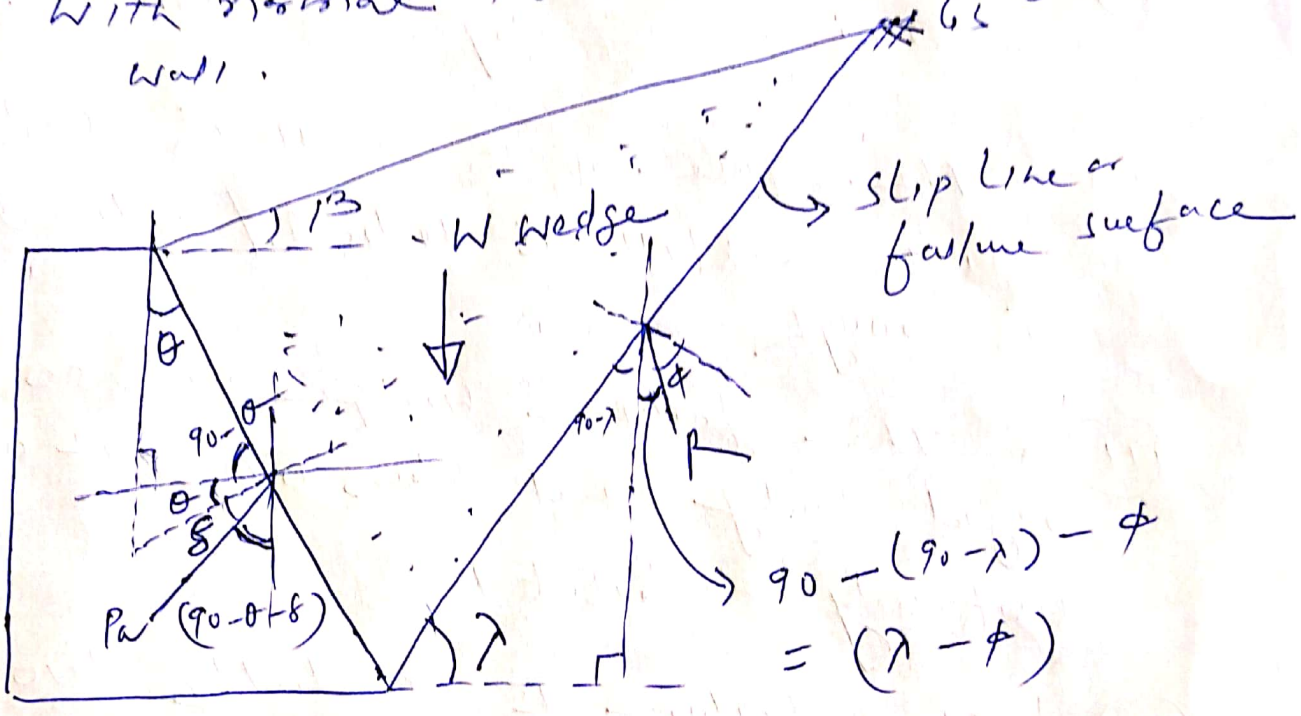
triangular distribution of earth pressure

(vi) Wedge failure is considered which is under equilibrium of three forces

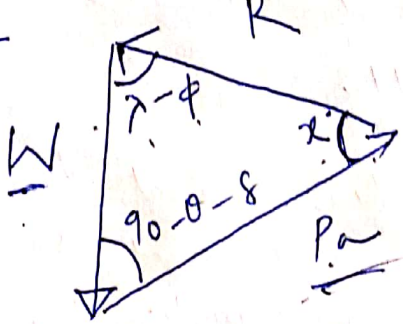
(vii) Self weight of wedge W vertically downward

(viii) The Resultant soil reaction R acts at downward angle of ϕ with normal to slip plane.

(x) Resultant thrust Pa/Pp b/w wall & soil acts downward angle δ with normal to the inclined face of the wall.



Force Triangle



$x = 180 - (\lambda - \phi) - (90 - \theta - \delta)$

Where β → Surcharge angle.

θ → Angle made by vertical with inclined face of the wall.

δ → Angle of friction b/w wall & soil

ϕ → Angle of internal friction.

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

will acts at H/3 from base of the wall.

or A/c to Sine's Law

$$\frac{W}{\sin x^\circ} = \frac{P_a}{\sin(\lambda - \phi)}$$

$$P_a = \frac{\sin(\lambda - \phi) \cdot W}{\sin x}$$

$$K_a = \left[\frac{\sec\theta \cdot \cos(\phi - \theta)}{\sqrt{\cos(\theta - \delta)} + \sqrt{\frac{\sin(\delta + \phi) \cdot \sin(\phi - \beta)}{\cos(\beta - \theta)}}} \right]^2$$

For Smooth wall, $\delta = \frac{\phi}{3}$

For Ordinary wall, $\delta = \frac{2}{3}\phi$

For rough wall, $\delta = \frac{3}{4}\phi$

Special Case :

(1) If $\theta = 0$ (Wall is vertical)

(2) If $\beta = 0$ (Backfill is horizontal)

(3) If $\delta = \phi$

$$K_a = \left[\frac{\cos\phi}{\sqrt{\cos\phi} + \sqrt{\sin 2\phi \cdot \sin\phi}} \right]^2$$

For General Case :

$$K_a = \left[\frac{\sec\theta \cdot \cos(\phi - \theta)}{\sqrt{\cos(\theta - \delta)} + \sqrt{\frac{\sin(\delta + \phi) \cdot \sin(\phi - \beta)}{\cos(\beta - \theta)}}} \right]^2$$

Note: (1) In Columb's theory, failure wedge is assumed to be plane but in actual it is ~~spirat~~ spiral specially in passive case. Hence Coulomb's theory is not performed for Passive earth pressure analysis

(II) In Rankine theory elemental failure is considered whereas in Coulomb's theory wedge failure is considered.

(III) In Rankine theory face of wall is vertical and smooth whereas in Coulomb's theory face of wall may be vertical or inclined and is rough

(iv) Earth Pressure can also be computed using Culmann's or Rebkman's method which are graphical in nature.

(v) Culmann's method is based on Coulomb's theory which is modified version of Rankine theory.

(vi) With the help of friction circle method we can also compute Earth pressure.

<Happy Learning>