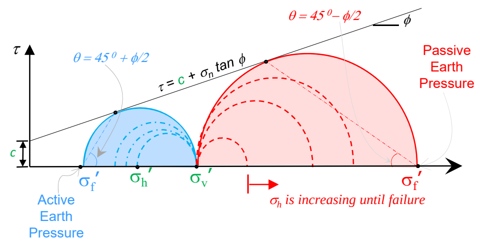
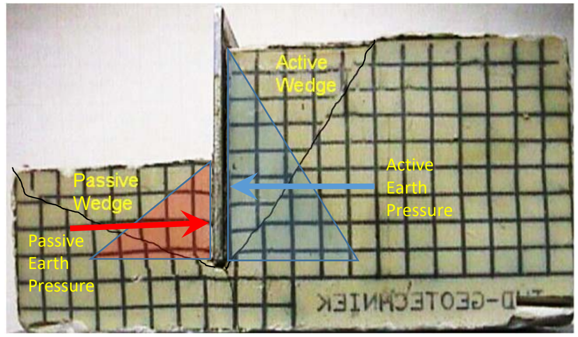
Session Started 9/30/2020 at 5:00 PM

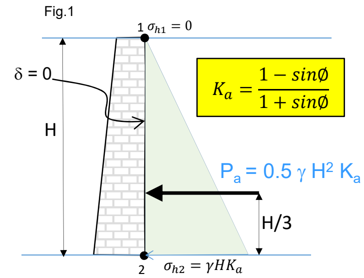
Rankine's Earth Pressure Method for (c- ϕ) Soil

Rankine's Active and Passive Earth Pressure in (c- f) Soil



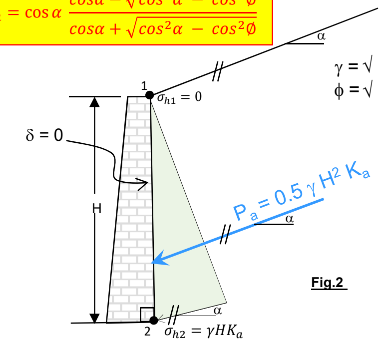


Rankine's Active Earth Pressure in (ϕ) Soil



Rankine's Active Earth Pressure in (ϕ) Soil with inclined backfill

$$k_a = \cos\alpha \, \frac{\cos\alpha - \sqrt{\cos^2\alpha - \cos^2\emptyset}}{\cos\alpha + \sqrt{\cos^2\alpha - \cos^2\emptyset}}$$



Active Earth Pressure

$$\sigma_f' = \sigma_V' \tan^2\left(45^o - \frac{\emptyset}{2}\right) + 2\,c\,\tan\left(45^o - \frac{\emptyset}{2}\right)$$

Or

$$\sigma_f' = \sigma_V' K_a - 2\,c\sqrt{K_a}$$

$$K_a = \tan^2\left(45^o - \frac{\emptyset}{2}\right) = \frac{1-\sin\emptyset}{1+\sin\emptyset}$$

Coefficient of active earth pressure

Passive Earth Pressure

$$\sigma_f' = \sigma_V' \tan^2\left(45^o + \frac{\emptyset}{2}\right) + 2\,c\,\tan\left(45^o + \frac{\emptyset}{2}\right)$$

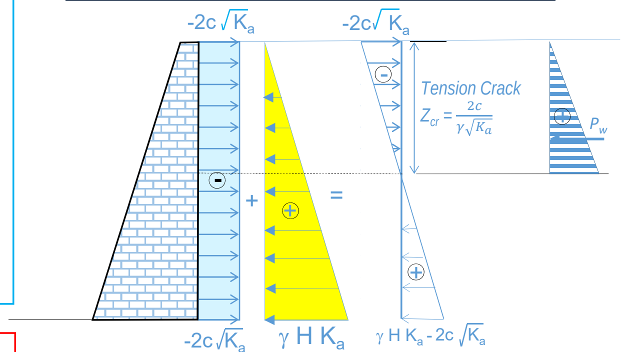
Or

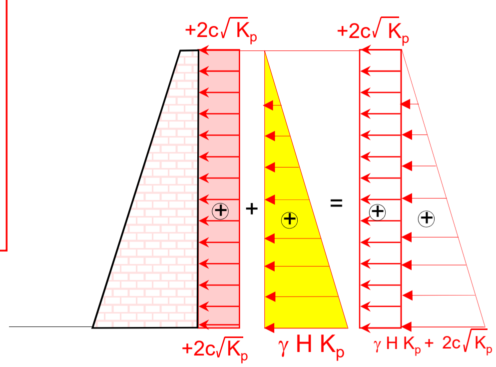
$$\sigma_f' = \sigma_V' K_p + 2\,c\sqrt{K_p}$$

$$K_p = \tan^2\left(45^o + \frac{\emptyset}{2}\right) = \frac{1+\sin\emptyset}{1-\sin\emptyset}$$

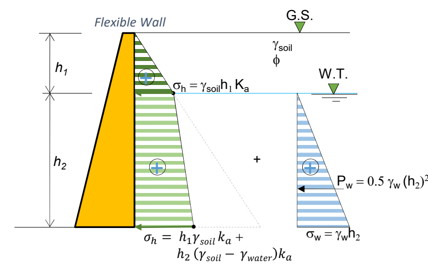
Coefficient of passive earth pressure

Effect of Cohesion of the Rankine's Active and Passive Earth Pressure

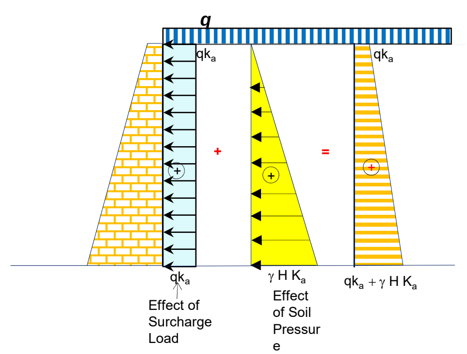




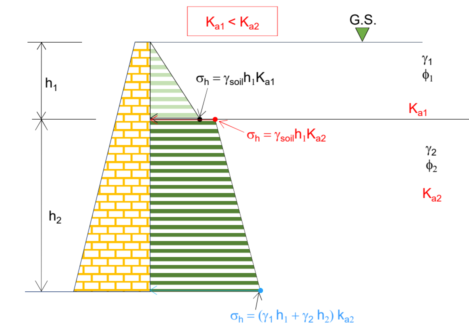
Rankine's Active Earth Pressure in f - Soil & Water Table

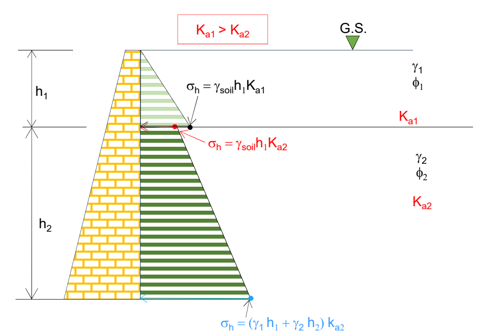


Effect of Surcharge (q) Load on Active Earth Pressure



Effect of Two Soil Layers on Active Earth Pressure

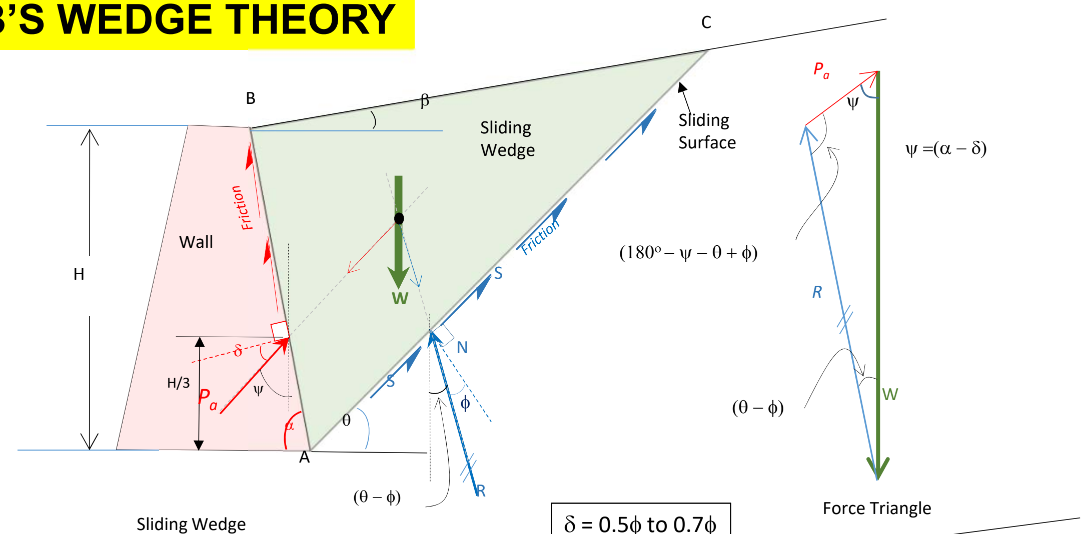




COULOMB'S WEDGE THEORY

W = weight of the soil wedge
R = resultant of the shear and normal forces on the failure surface BC
$\mathbf{P_a}$ = the active force per unit length of the wall. The direction of Pa is inclined at an angle δ to the normal drawn and the face of the wall that supports the soil

δ = the angle of friction between the soil and the wall



W = g (area of wedge *ABC*)

From the triangles of forces,

$$\frac{P_a}{\sin(\theta - \emptyset)} = \frac{W}{\sin(180^o - \psi - \theta + \phi)}$$

$$P_a = \frac{W \sin(\theta - \emptyset)}{\sin(180^o - \psi - \theta + \phi)}$$

Substituting for *W*,

$$P_a = \frac{1}{2} \cdot \frac{\gamma H^2}{sin^2\,\alpha} \cdot \frac{\sin(\theta - \emptyset)}{\sin(180^o - \psi - \theta + \phi)} \cdot \frac{\sin(\theta + \alpha).\sin(\alpha + \beta)}{\sin(\theta - \beta)}$$

The maximum value of *Pa* is obtained by equating the first derivative of *Pa* with respect to θ to zero; or

$(\partial P_a)/\partial\theta = 0$, and substituting the corresponding value of θ.

The value of P_a so obtained is written as

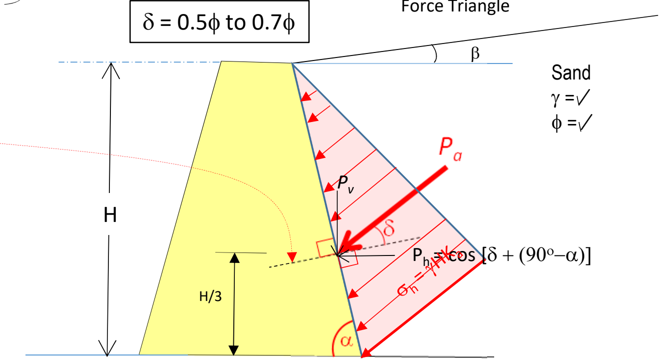
$$P_a = \frac{1}{2} . \gamma H^2 . \frac{sin^2(\alpha + \phi)}{sin^2\alpha \ sin(\alpha - \delta)\left[1 + \sqrt{\frac{\sin(\emptyset + \delta)\sin(\emptyset - \beta)}{\sin(\alpha - \delta)\sin(\alpha + \beta)}}\right]^2}$$

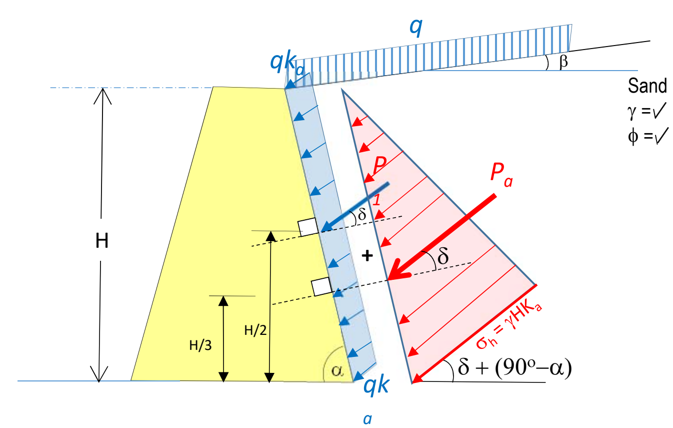
This is usually written as

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

δ = 0.5φ to 0.7φ

- Draw this perpendicular line first
- Then draw P_a with an angle = α

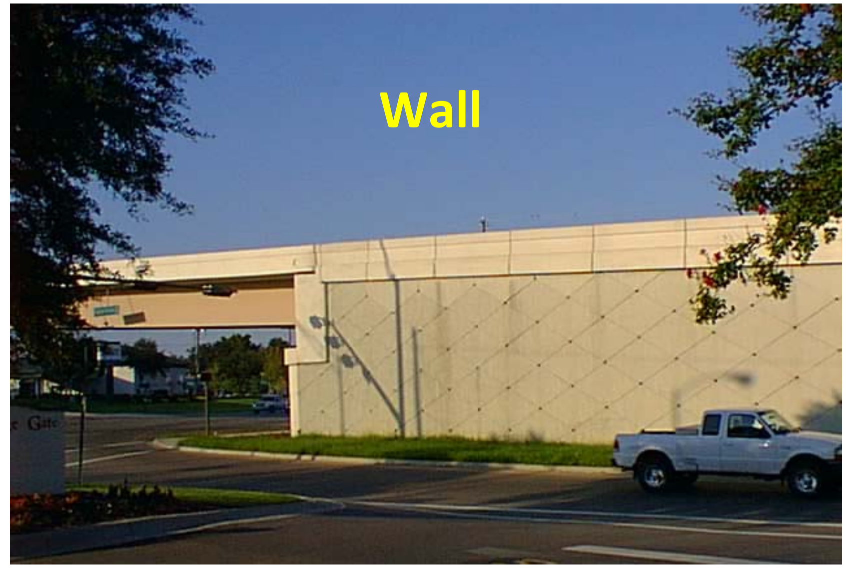




Where K_a being the coefficient of active earth pressur $= \dfrac{sin^2(\alpha + \phi)}{sin^2\alpha \ sin(\alpha - \delta)\left[1 + \sqrt{\frac{\sin(\emptyset + \delta)\sin(\emptyset - \beta)}{\sin(\alpha - \delta)\sin(\alpha + \beta)}}\right]^2}$

Kamal Tawfiq

Earth Retaining Walls

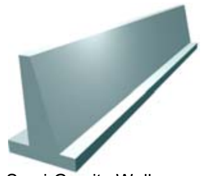


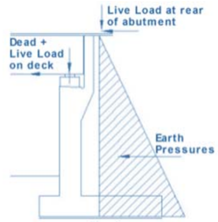
Design of Retaining Wall

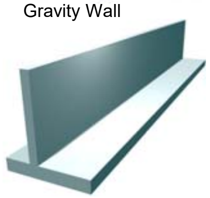
Types of Earth Retaining Walls

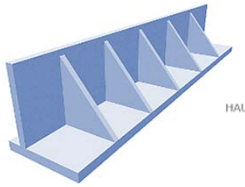
I- Permanent Walls

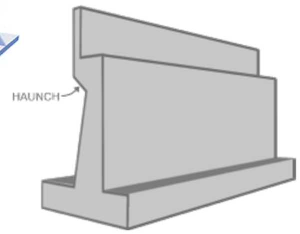

Gravity Wall

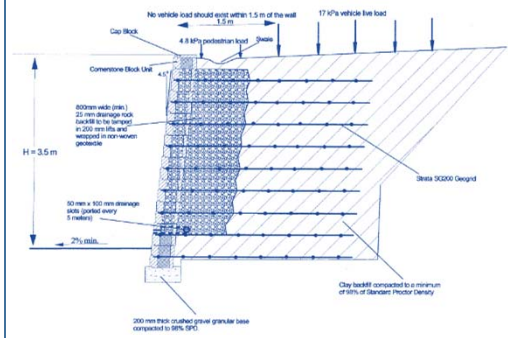

Semi-Gravity Wall




Cantilever Wall

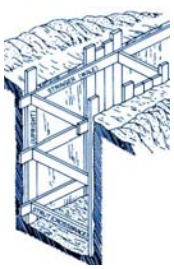

Counterfort wall




Segmental Walls


MSE Walls

II- Temporary Walls


Braced cuts


Sheet pile wall

Design of Retaining Wall

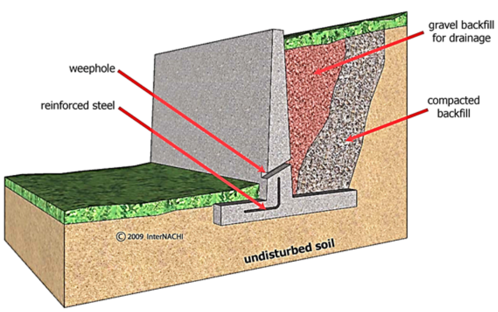
By Kamal Tawfiq, Ph.D., P.E

1- External Stability
2- Internal Stability

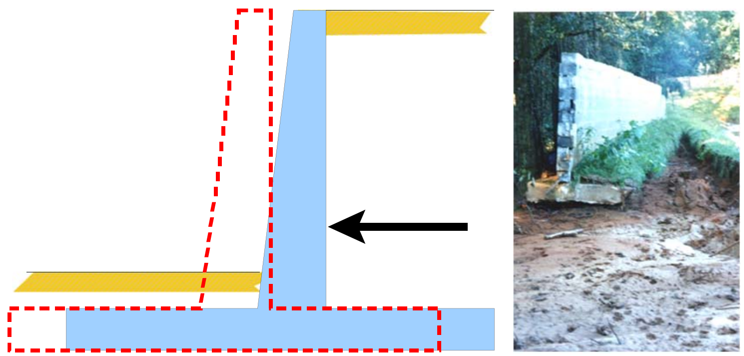
1. External Stability

1- Sliding
2- Overturning
3- Settlement
4- Overall Failure

Cantilevered Concrete Retaining Wall



1



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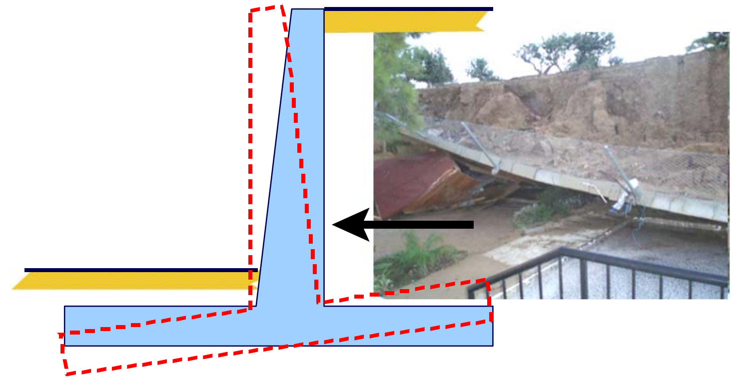

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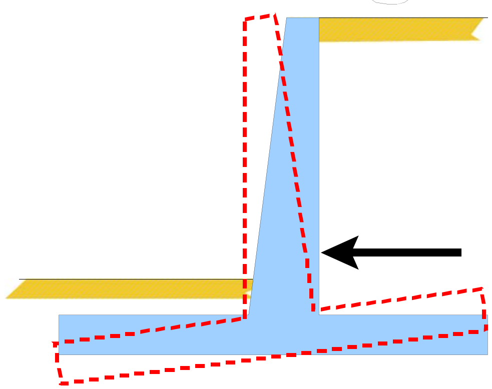

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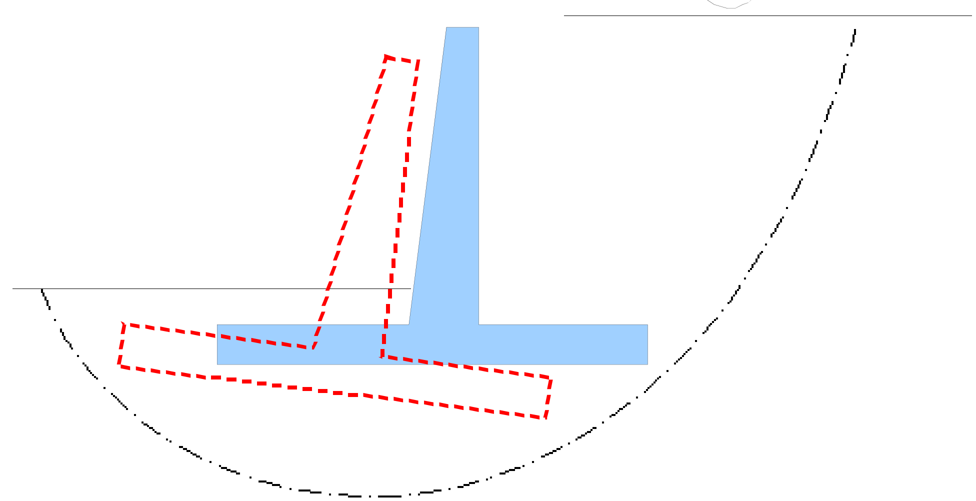
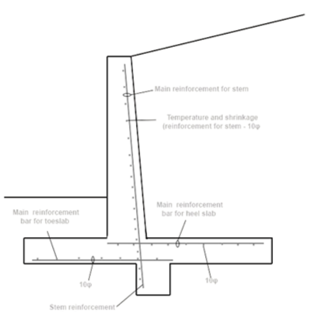
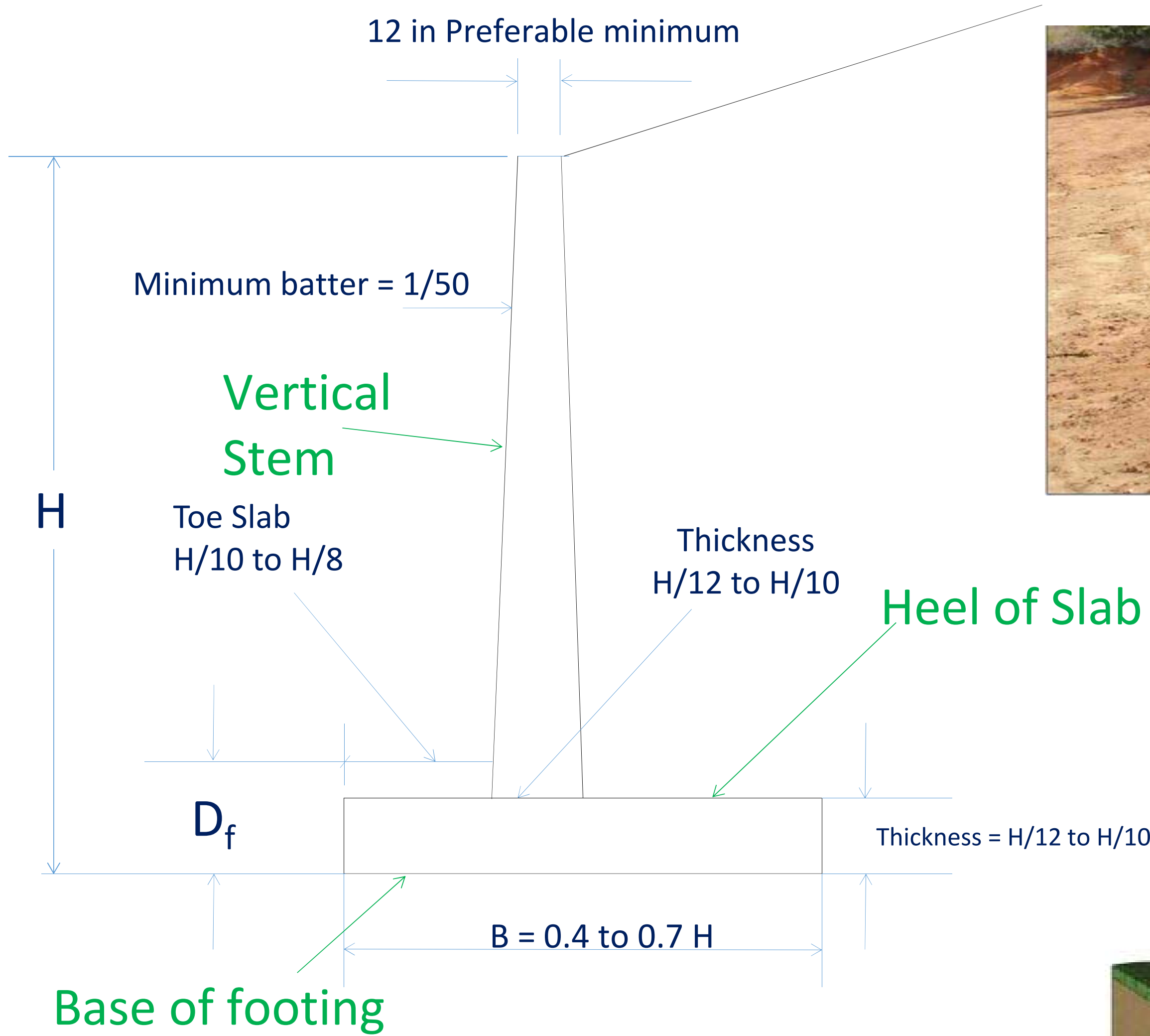


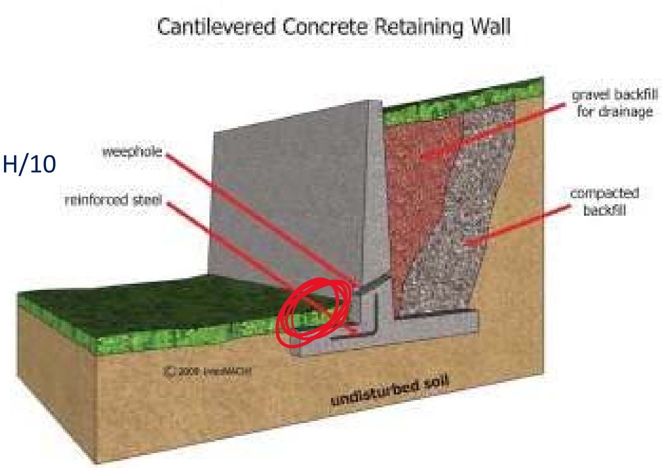


Internal Stability

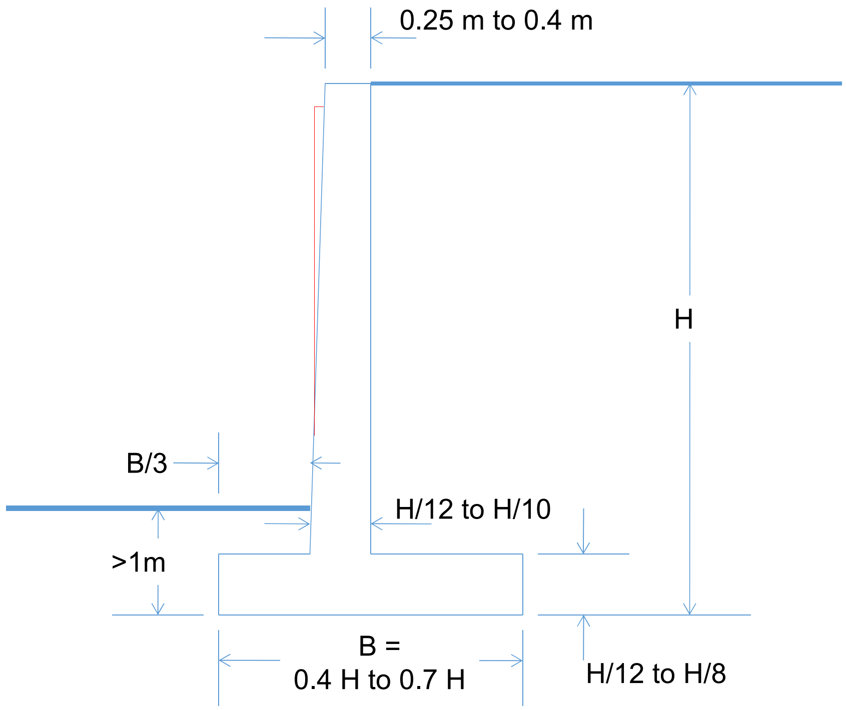
Steel Reinforcement and Thicknesses

Common Proportions of Cantilever Wall

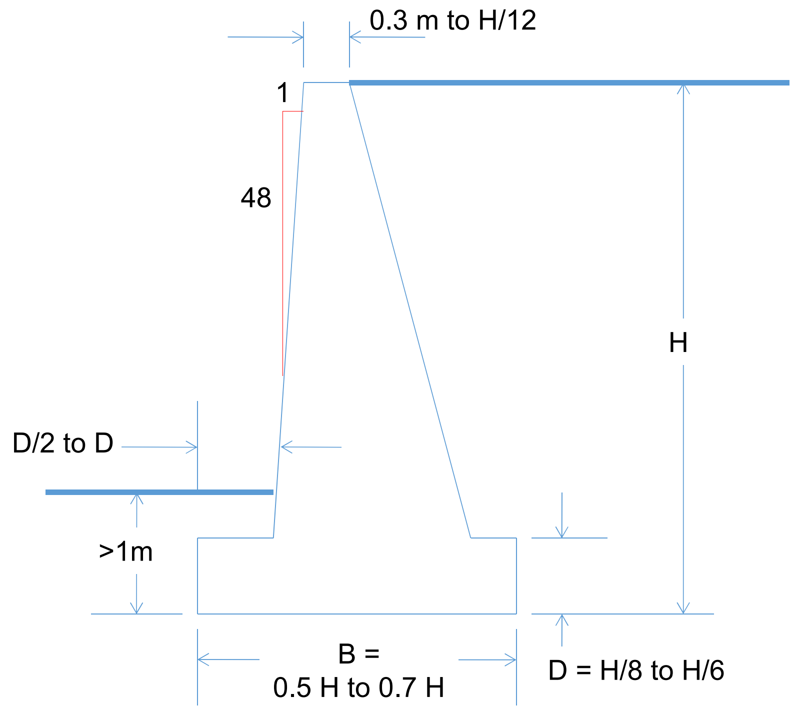




Approximate Dimensions



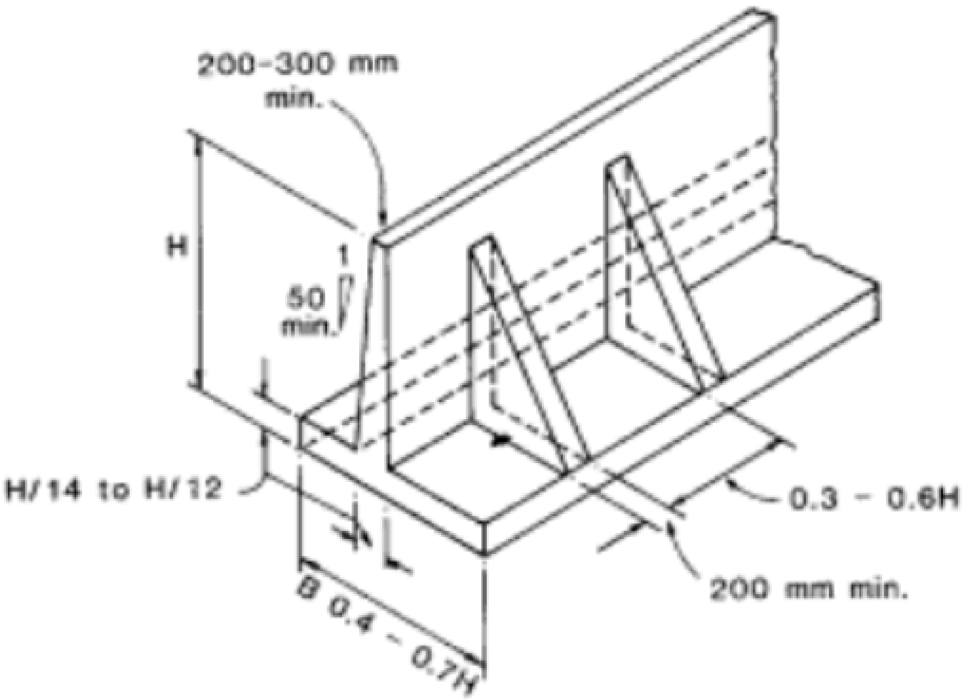
Cantilever Retaining Wall



Gravity Retaining Wall

Kamal Tawfiq, 2011

Counterfort Retaining Wall

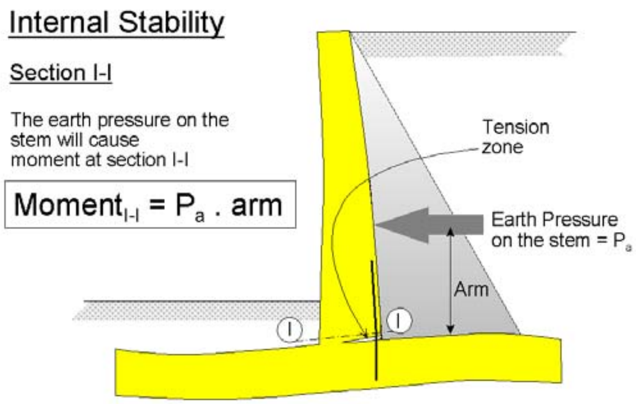


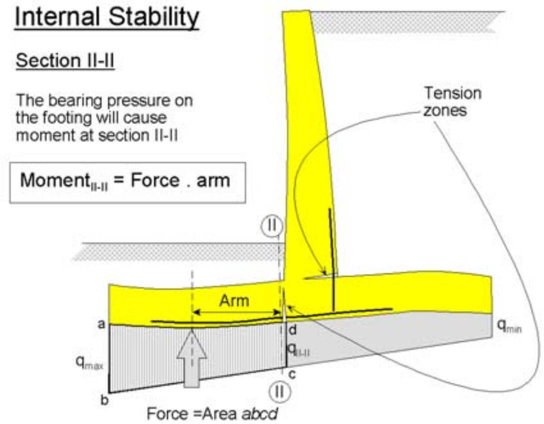
Internal Stability

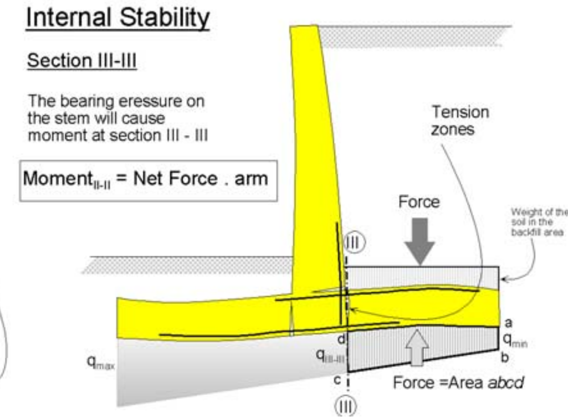
Structural Design

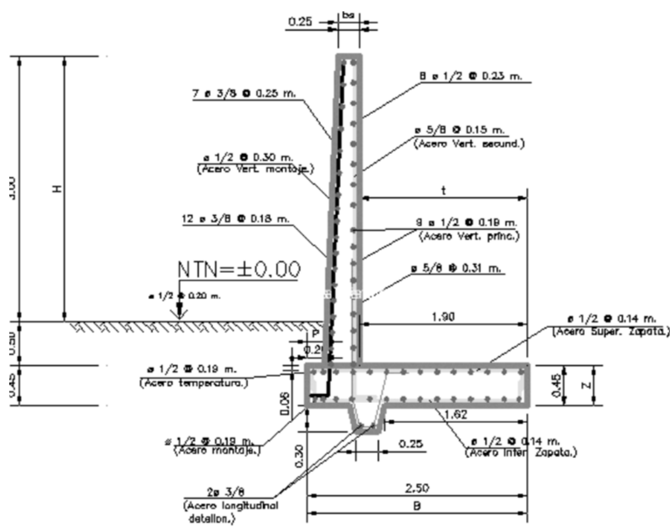
Steel Reinforcement and Thicknesses } Structural Design

2-

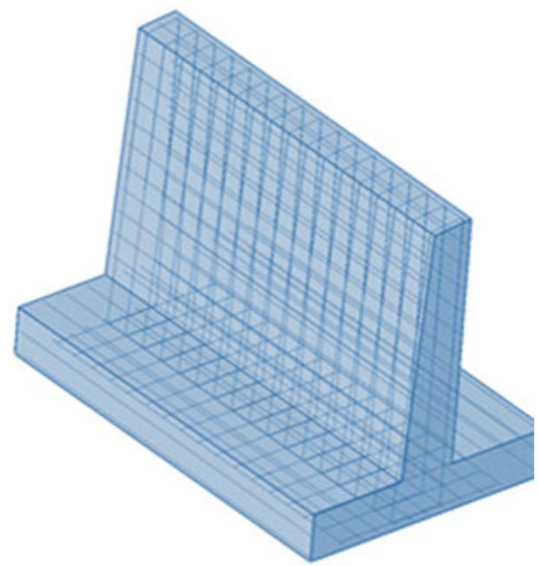








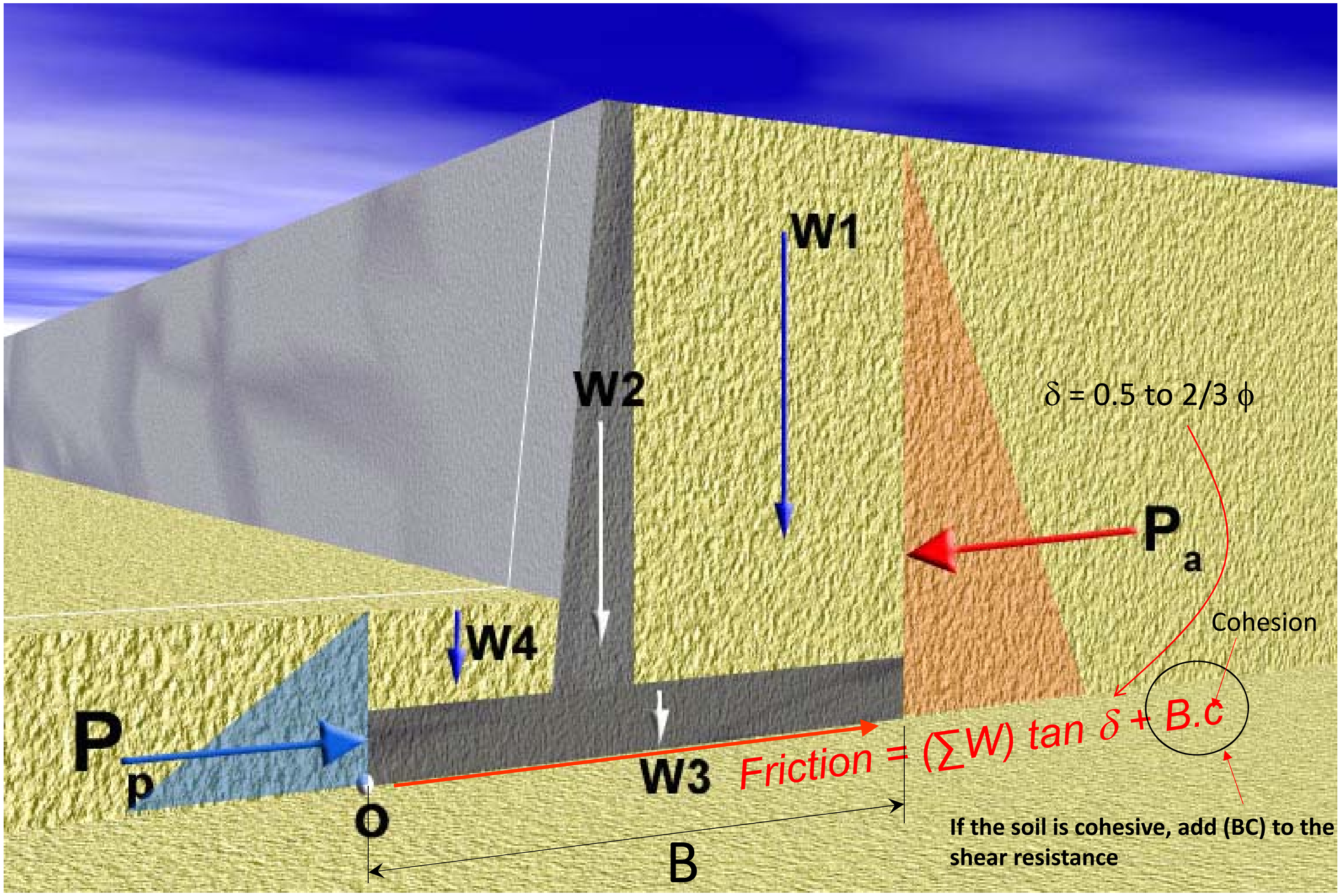
DETALLES DE MURO DE CONTENCION



I. External Stability

1- Sliding

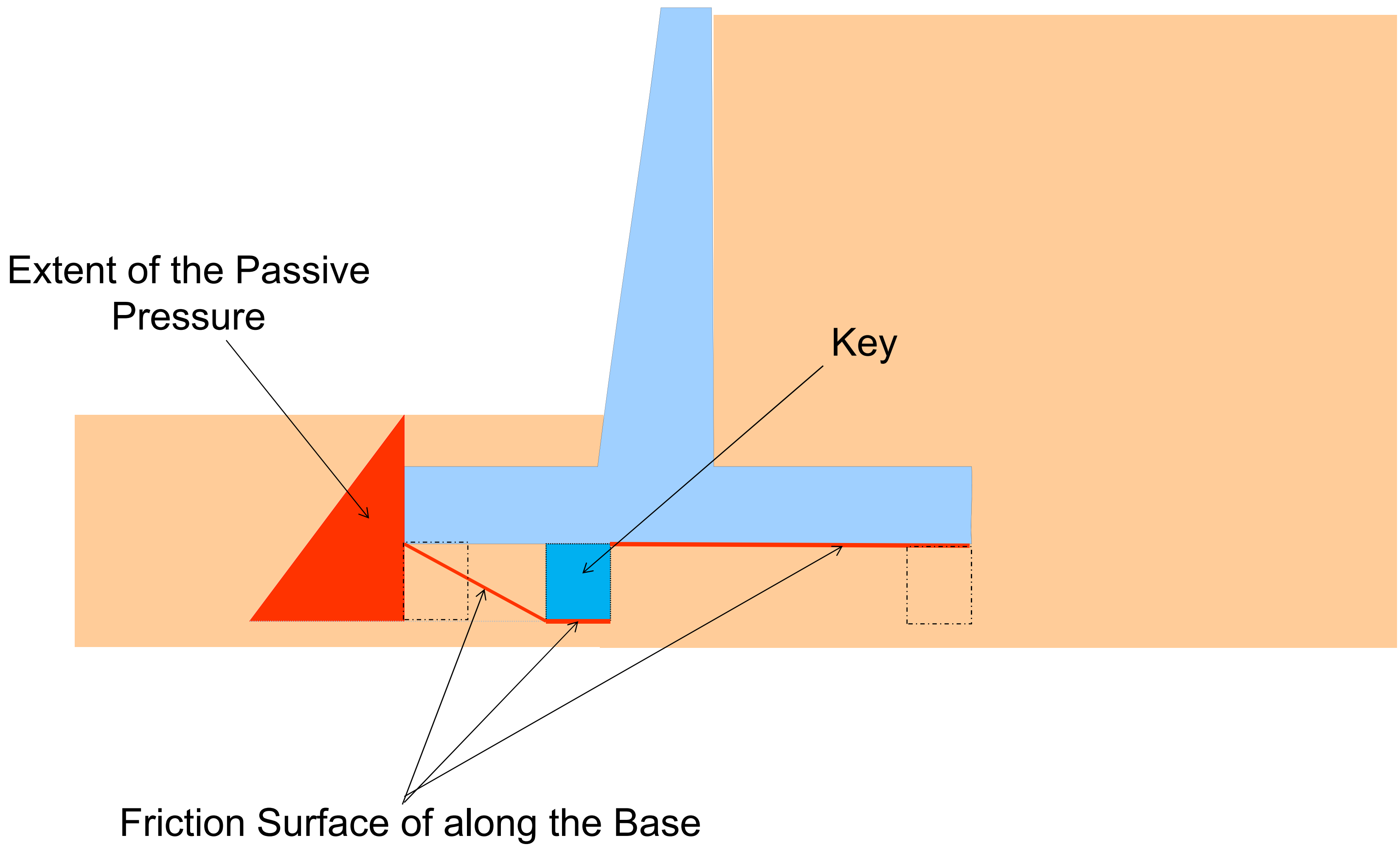
Factor of Safety Against Sliding = $\dfrac{\text{Resisting Force}}{\text{Driving Force}} = \dfrac{F_R}{F_D}$



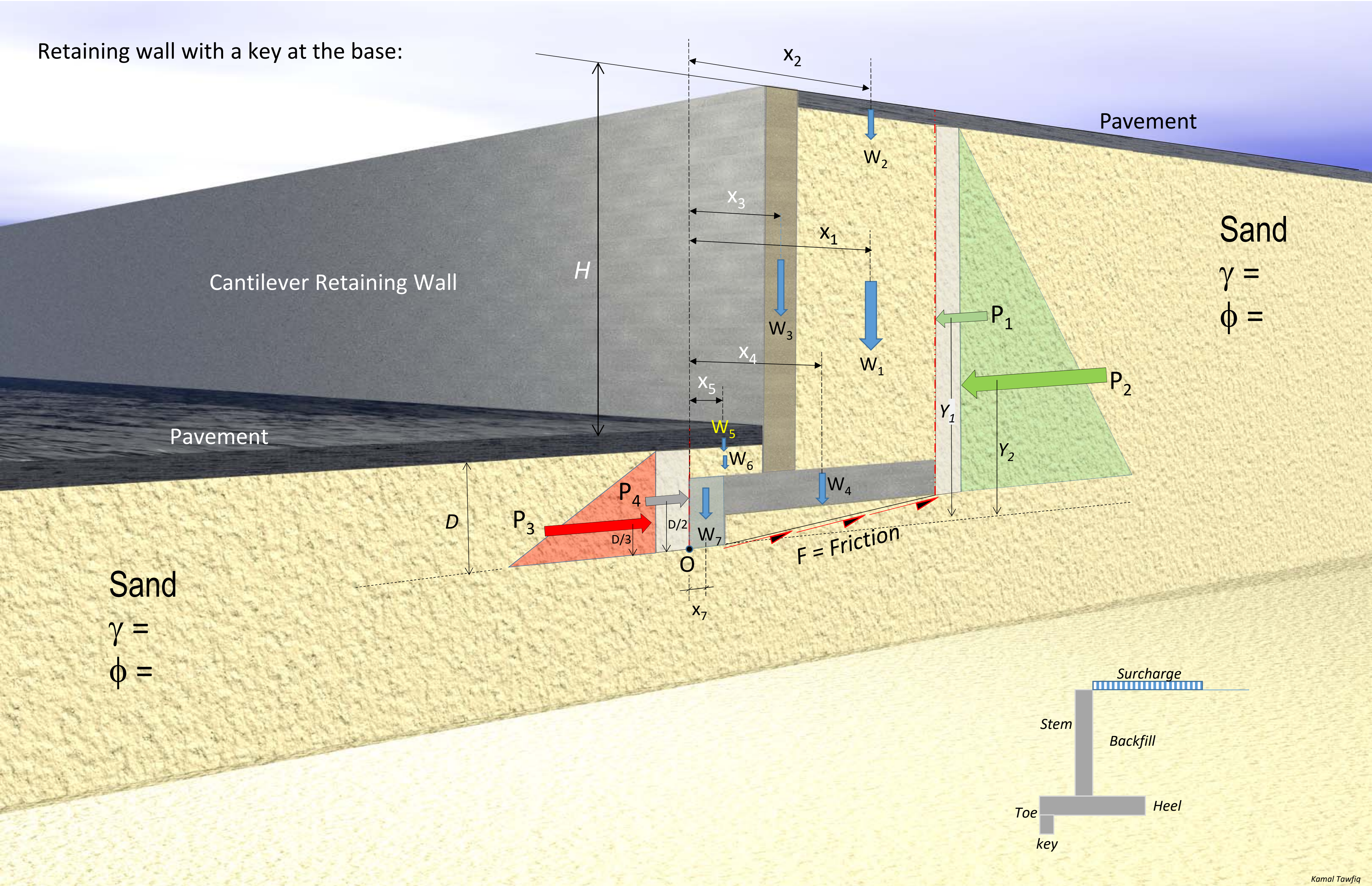
$F_D = P_a$ $\qquad$ $F_R = P_p + \text{Friction}$

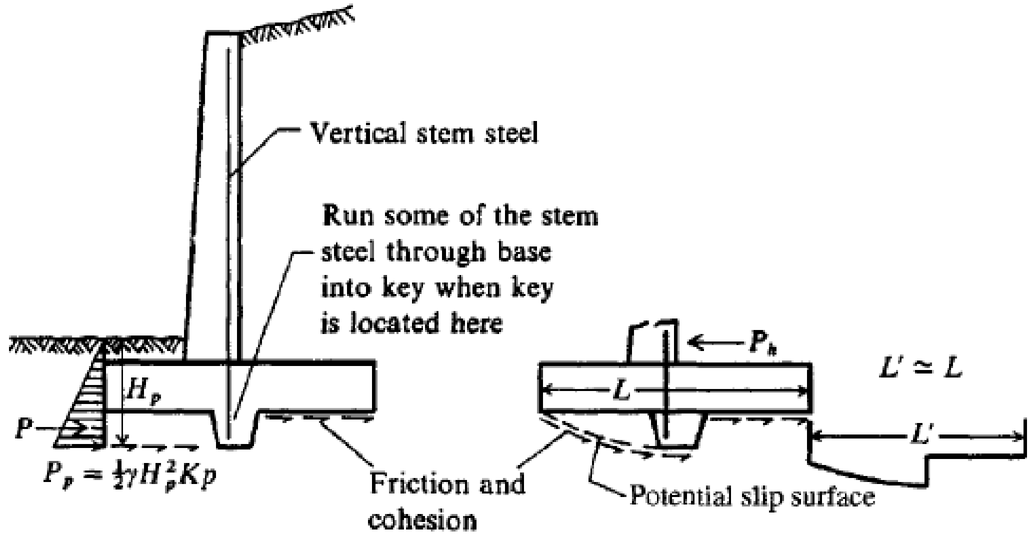
By: Kamal Tawfiq

<u>Using Key at the Base to Improve Sliding Resistance</u>



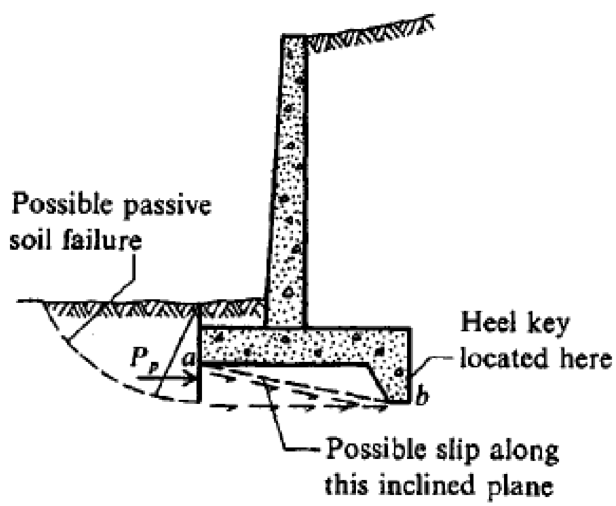
Retaining wall with a key at the base:





(*a*) Base key near stem so that stem steel may be extended into the key without additional splicing or using anchor bends.

(*b*) Potential sliding surface using the key location of *a*. There may be little increase in sliding resistance from this key, if the slip surface develops as shown.



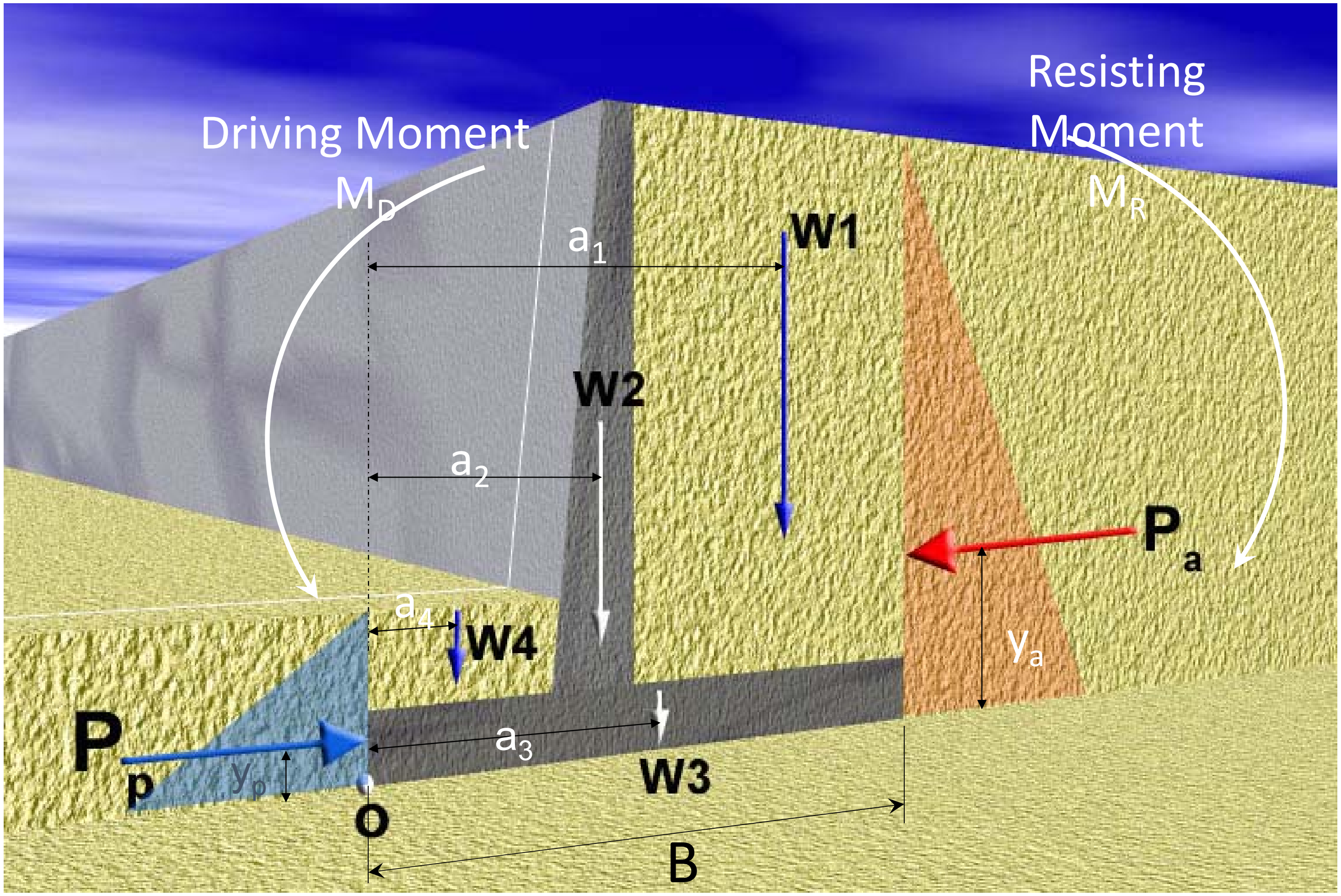
(*c*) Possible sliding modes when using a heel key.

Figure 12-14 Stability against sliding by using a base key.

I. External Stability

2- Overturning

Factor of Safety Against Sliding = $\dfrac{\text{Resisting Moment}}{\text{Driving Moment}} = \dfrac{M_R}{M_D}$

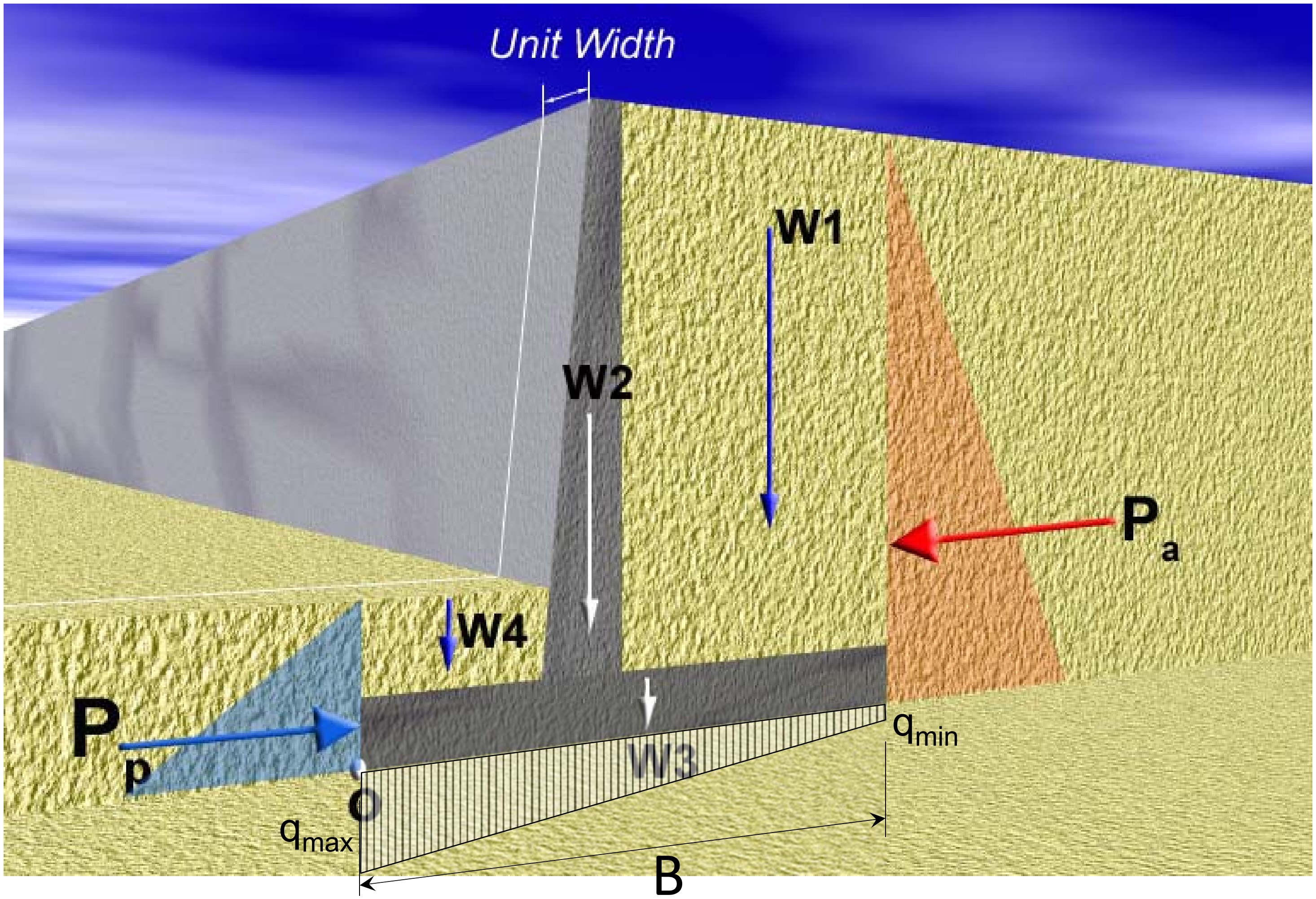


Moment About o $M_D = P_a \cdot y_a$ $M_R = P_p . y_p + W_1\, a_1 + W_2\, a_2 + W_3\, a_3 + W_4\, a_4$

By: Kamal Tawfiq

I. External Stability

3- Bearing Capacity Failure



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