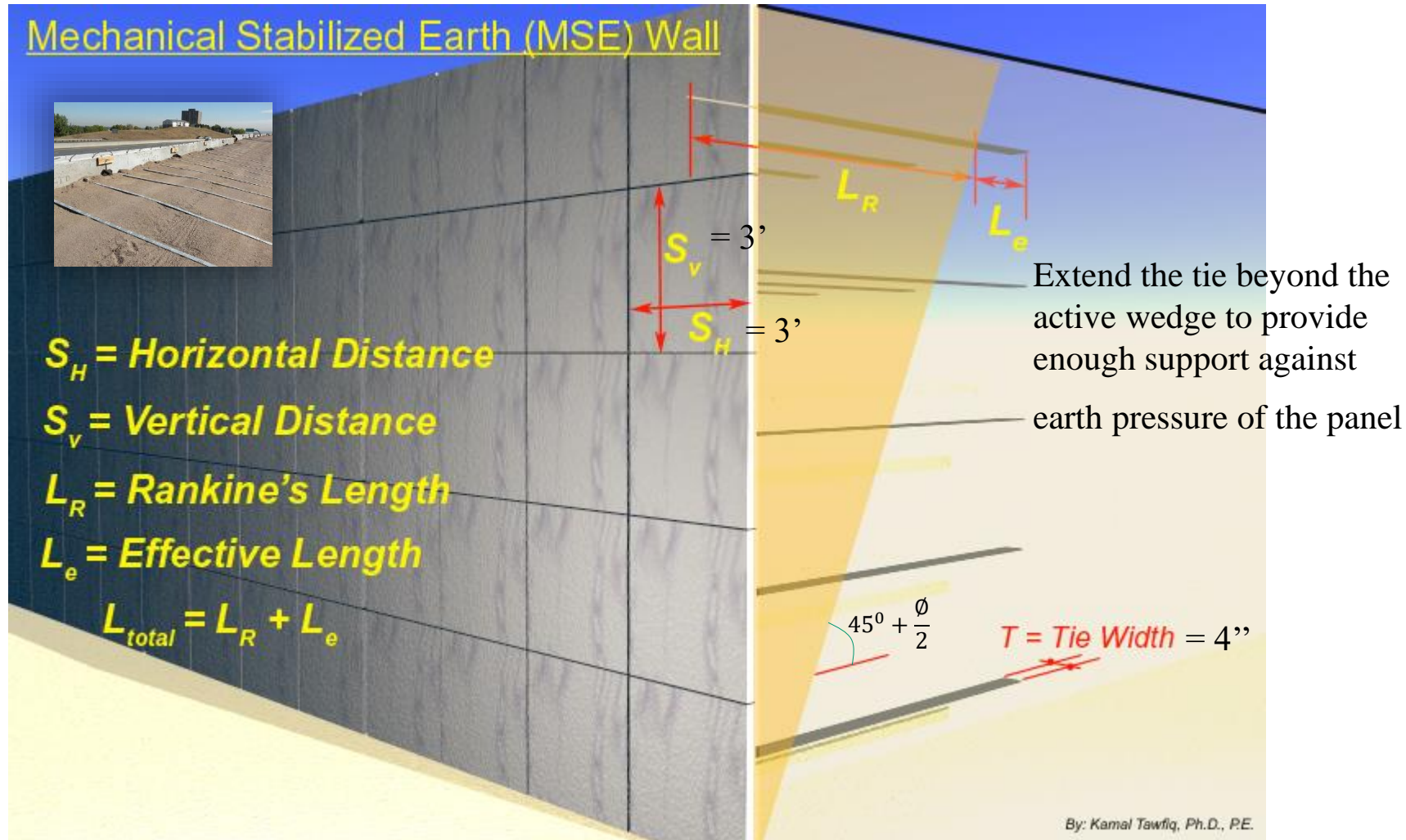


Design Concept



Homework Problem:

A reinforced earth retaining wall is to be **20 ft high**. The properties of the backfill material are $\gamma = 110 \text{ lb/ft}^3$ and $\phi = 30^\circ$. Galvanized steel ties are to be used for the construction of the wall. Design the Reinforcements with $FS_{(B)} = 3$, $FS_{(p)} = 3$, $f_y = 29,000 \text{ psi}$ and $\phi_{tie} = 20^\circ$.

Mechanically Stabilized Earth (MSE) Wall

- $L_{total} = L_R + L_e$
- $L_R = \text{Rankine's Length}$
- $L_e = \text{Effective Length}$
- $S_H = \text{Horizontal Distance}$
- $S_V = \text{Vertical Distance}$

Yield Strength of Steel H

$t = \text{thickness of tie}$

Tie Force = $F = \sigma_a * S_v * S_H$

$w t f_y$

$FS_{(tie\ Breaking)} = \frac{w t f_y}{\sigma_a * S_v * S_H} = 2.5 \text{ to } 3$

Friction angle between steel and soil (given)

$FS_{(tie\ pullout)} = \frac{2 L_e w \sigma_v \tan \phi_H}{\sigma_a * S_v * S_H} = 2.5 \text{ to } 3$

Skin Panel

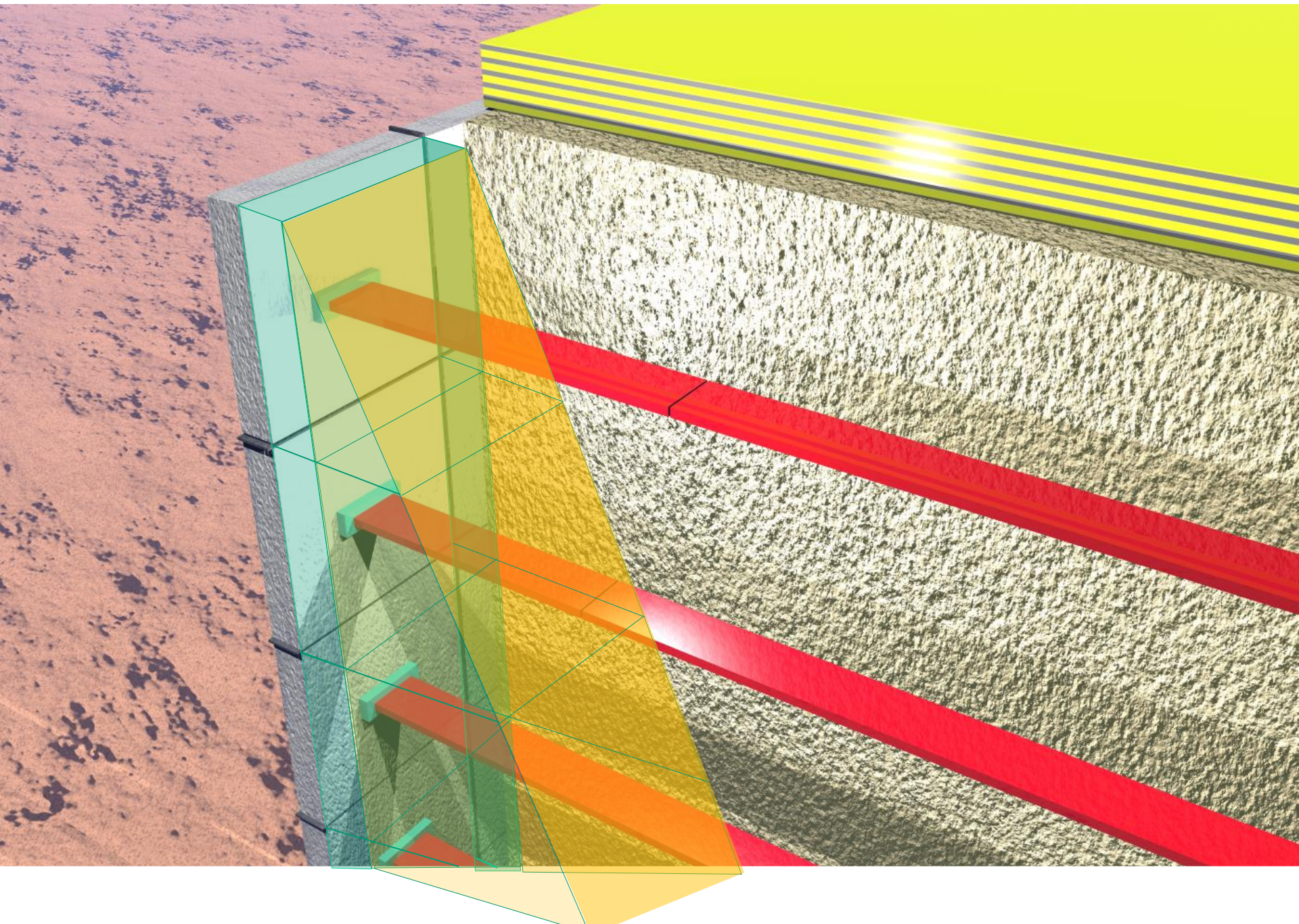
Steel Tie

$w = \text{Tie Width}$

$\gamma H k_a$

Rankine's Earth Pressure

$45 + \phi/2$



Example:

A reinforced earth retaining wall is to be **30 ft high**. The properties of the backfill material are $\gamma = 110 \text{ lb/ft}^3$ and $\phi = 30^\circ$. Galvanized steel ties are to be used for the construction of the wall. Find the lengths (L_{total}) and thicknesses (t) of the steel ties with $FS_{(B)} = 3$, $FS_{(p)} = 3$, $f_y = 60000 \text{ psi}$, width of ties (w) = 4in, and $\delta_{\text{tie}} = 20^\circ$

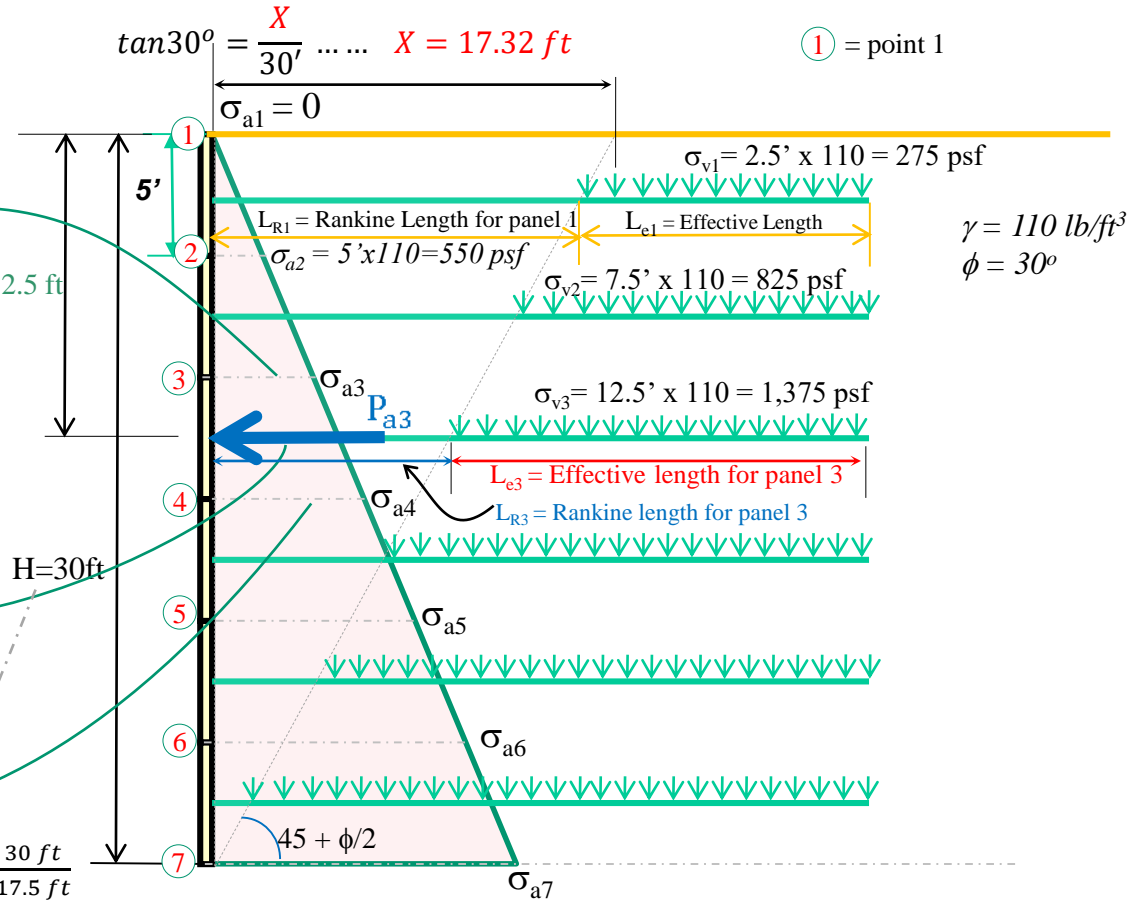
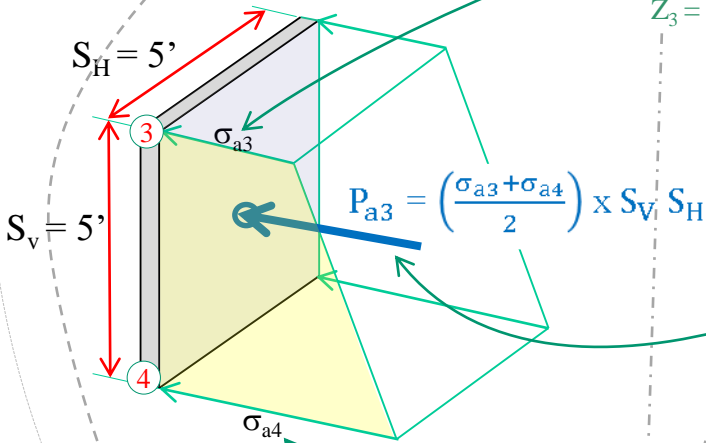
This equation came from $\rightarrow\rightarrow\rightarrow$ Factor of Safety against Pull Out Failure = $3 = \frac{\text{Resisting Force}}{\text{Driving Force}} = \frac{\text{Frictional Force}}{\text{Active Force } P_a} = \frac{2 \cdot w \cdot L_{e3} \cdot \sigma_{v3} \cdot \tan \delta}{\sigma_{h3} \cdot S_v \cdot S_H} = 3$

$$L_{\text{total } 3} = L_{R3} + L_{e3}$$

$$L_{e3} = \frac{3 (\sigma_{h3} \cdot S_v \cdot S_H)}{2 \cdot w \cdot \sigma_{v3} \cdot \tan \delta}$$

Driving Force P_a

Resisting Force



① = point 1

$$\tan 30^\circ = \frac{X}{30'} \dots \dots X = 17.32 \text{ ft}$$

$\gamma = 110 \text{ lb/ft}^3$
 $\phi = 30^\circ$

To determine

$$L_{R3} = \text{Rankine Length for panel 3} = \frac{X}{L_{R3}} = \frac{17.32}{L_{R3}} = \frac{H}{Z_3} = \frac{30 \text{ ft}}{17.5 \text{ ft}}$$

$$L_{R3} = \frac{17.32 \times 17.5}{30} = 10.10 \text{ ft}$$

5' + 5' + 2.5'

