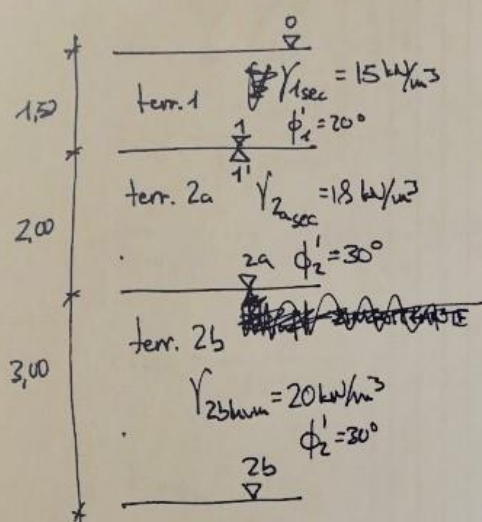


HIPÓTESIS 1



$$K_{01} = 1 - \sin 20^\circ = 0,658$$

$$K_{02} = 1 - \sin 30^\circ = 0,500$$

tensiones verticales

$$\sigma_{v1} = h_1 \cdot \gamma_{1sec} = 1,50m \cdot 15kN/m^3 = 22,50 kN/m^2$$

$$\sigma'_{v1} = \sigma_{v1} = 22,50 kN/m^2 \quad \text{no hay nivel freático (*)}$$

$$\begin{aligned} \sigma_{v2a} &= \sigma_{v1} + h_{2a} \cdot \gamma_{2sec} = 22,50 kN/m^2 + 18kN/m^3 \cdot 2,00 = \\ &= 22,50 + 36,00 = 58,50 kN/m^2 \end{aligned}$$

$$\sigma'_{v2a} = \sigma'_{v2a} = 58,50 kN/m^2 \quad (*)$$

$$\begin{aligned} \sigma_{v2b} &= \sigma_{v1} + \sigma_{v2a} + h_{2b} \cdot \gamma_{2bhum} = \\ &= 58,50 kN/m^2 + 3m \cdot 20kN/m^3 = 118,50 kN/m^2 \end{aligned}$$

$$\sigma'_{v2b} = \sigma'_{v2b} = 118,50 kN/m^2 \quad (*)$$

(*) no es necesario calcular las tensiones efectivas ya que no hay presencia de nivel freático (el agua sólo interviene en el peso específico del terreno)

tensiones horizontales

$$\sigma'_{H1} = \sigma'_{v1} \cdot K_{01} = 22,50 kN/m^2 \cdot 0,658 = 14,81 kN/m^2$$

$$\sigma_{H1} = \sigma'_{H1} = 14,81 kN/m^2$$

$$\sigma'_{H2a} = \sigma'_{v2a} \cdot K_{02} = 58,50 kN/m^2 \cdot 0,50 = 29,25 kN/m^2$$

$$\sigma_{H2a} = \sigma'_{H2a} = 29,25 kN/m^2$$

$$\sigma'_{H2b} = \sigma'_{v2b} \cdot K_{02} = 118,50 kN/m^2 \cdot 0,50 = 59,25 kN/m^2$$

$$\sigma_{H2b} = \sigma'_{H2b} = 59,25 kN/m^2$$

$$\sigma'_{H1'} = \sigma'_{v1} \cdot K_{02} = 22,50 kN/m^2 \cdot 0,5 = 11,25 kN/m^2$$

Es importante tener en cuenta que la tensión horizontal disminuye al cambiar de terreno a uno con menos empuje

empujes activos

$$E_{a1} = \sigma'_{v1} \cdot K_{a1}$$

$$K_{a1} = \frac{1 - \sin \phi'_1}{1 + \sin \phi'_1} = \frac{1 - 0,342}{1 + 0,342} = \cancel{0,745} 0,490$$

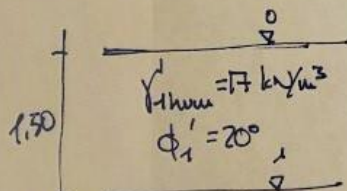
$$E_{a1} = 22,50 \text{ kN/m}^2 \cdot 0,490 = \boxed{11,03 \text{ kN/m}^2}$$

$$K_{a2} = \frac{1 - \sin \phi'_2}{1 + \sin \phi'_2} = \frac{1 - 0,50}{1 + 0,50} = 0,333$$

$$E_{a2a} = \sigma'_{v2a} \cdot K_{a2} = 58,50 \text{ kN/m}^2 \cdot 0,333 = \boxed{19,48 \text{ kN/m}^2}$$

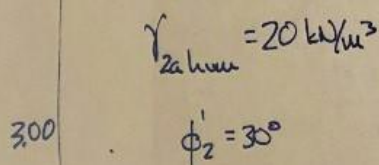
$$E_{a2b} = \sigma'_{v2b} \cdot K_{a2} = 118,50 \text{ kN/m}^2 \cdot 0,333 = \boxed{39,50 \text{ kN/m}^2}$$

$$E_{a1'} = \sigma'_{v1} \cdot K_{a2} = 22,50 \text{ kN/m}^2 \cdot 0,333 = \boxed{7,50 \text{ kN/m}^2}$$

HIPÓTESIS 2tensiones verticales

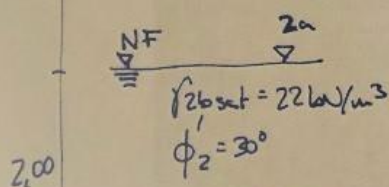
$$\sigma'_{v1} = 17 \text{ kN/m}^3 \cdot 1,50 \text{ m} = 25,50 \text{ kN/m}^2$$

$$\boxed{\sigma'_{v1} = \sigma'_{v1} = 25,50 \text{ kN/m}^2} \quad (\text{no hay agua})$$



$$\sigma'_{v2a} = 25,50 \text{ kN/m}^2 + 3,00 \text{ m} \cdot 20 \text{ kN/m}^3 = 85,50 \text{ kN/m}^2$$

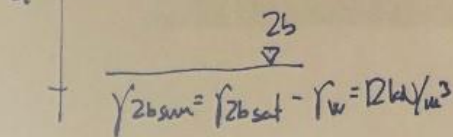
$$\boxed{\sigma'_{v2a} = \sigma'_{v2a} = 85,50 \text{ kN/m}^2} \quad (\text{no hay agua})$$



$$\sigma'_{v2b} = 85,50 \text{ kN/m}^2$$

$$\sigma'_{v2b} = \sigma'_{v2a} + \gamma_{set2b} \cdot h_{2b} = 85,50 \text{ kN/m}^2 + 22 \text{ kN/m}^3 \cdot 2 \text{ m} =$$

$$\boxed{\sigma'_{v2b} = 129,50 \text{ kN/m}^2}$$



$$\sigma'_{v2b} = \sigma'_{v2a} + \gamma_{sum2b} \cdot h_{2b} = 85,50 \text{ kN/m}^2 + 12 \text{ kN/m}^3 \cdot 2 =$$

$$\boxed{\sigma'_{v2b} = 109,50 \text{ kN/m}^2}$$

↓ BAJO NF

tensiones horizontales

$$\star \sigma_{H1}^* = \sigma_{H1}' = \sigma_{V1}' \cdot K_{01} = 25,50 \text{ kN/m}^2 \cdot 0,658 = 16,78 \text{ kN/m}^2$$

$$\boxed{\sigma_{H1} = \sigma_{H1}' = 16,78 \text{ kN}} \quad |$$

$$\sigma_{H1}' = \sigma_{H1}' = \sigma_{V1}' \cdot K_{02} = 25,50 \cdot 0,50 = 12,75 \text{ kN/m}^2 \text{ (capa 2)}$$

$$\star \sigma_{H2a} = \sigma_{H2a}' = \sigma_{V2a}' \cdot K_{02} = 85,50 \cdot 0,50 = 42,75 \text{ kN/m}^2$$

$$\boxed{\sigma_{H2a} = \sigma_{H2a}' = 42,75 \text{ kN}} \quad |$$

$$\star \sigma_{H2b}^* = \sigma_{H2b}' + u \text{ (hay nivel freático)}$$

$$\sigma_{H2b}' = \sigma_{V2b}' \cdot K_{02} = 109,50 \cdot 0,50 = 54,75 \text{ kN/m}^2$$

$$u = \gamma_w \cdot h_{2b} = 10 \text{ kN/m}^3 \cdot 2,00 \text{ m} = 20 \text{ kN/m}^2$$

$$\sigma_{H2b} = 54,75 + 20$$

$$\boxed{\sigma_{H2b} = 74,75 \text{ kN/m}^2} \neq \boxed{\sigma_{H2b}' = 54,75 \text{ kN/m}^2}$$

↑
mayor, ya que hay
presión hidrostática.

empujes activos

④

$$E_{a1} = 25,50 \text{ kN/m}^2 \cdot 0,490 = 12,50 \text{ kN/m}^2$$

$$\boxed{E_{a1} = 12,50 \text{ kN/m}^2}$$

$$\cancel{E_{a1}} \quad E_{a1} = 25,50 \text{ kN/m}^2 \cdot 0,333 = 8,50 \text{ kN/m}^2$$

$$E_{a2a} = 85,50 \cdot 0,333 = 28,50 \text{ kN/m}^2$$

$$\boxed{E_{a2} = 28,50 \text{ kN/m}^2}$$

$$E_{a2b} = \gamma'_{v2b} \cdot K_{a2} = 109,50 \cdot 0,333 = 36,50 \text{ kN/m}^2$$

$$\boxed{E_{a2b} = 36,50 \text{ kN/m}^2}$$

↓ incluyendo presión hidrostática

$$E_{a2b} + u = 36,50 + 2,00 \cdot 10,00 \text{ kN/m}^2 = \boxed{56,50 \text{ kN/m}^2}$$

↓
acción horizontal total