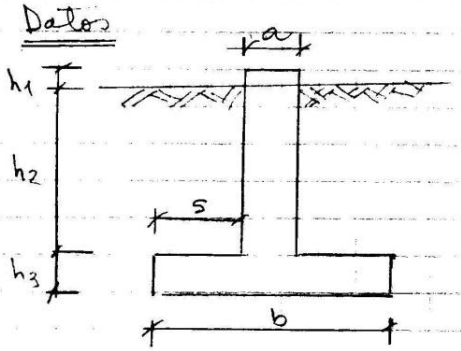
Ejemplo

Verificación de fundación directa por fuerza cortante horizontal

Datos



$a = 1.80\,m$
$b = 2.80\,m$
$s = 0.50\,m$
$h_1 = 0.20$
$h_2 = 3.10$
$h_3 = 0.90$

$\sigma_{adm} = 1.50\,kg/cm^2$
$\gamma_{suelo} = 1955\,kg/m^3$
$\phi = 19°$
$c = 4200\,kg/m^2$

solicitaciones, (condiciones)

$C = 44330\,kg \downarrow$
$T = 40689.84\,kg \uparrow$

Corte en compresión, $F_x = 3664.86\,kg$
Corte en compresión, $F_z = 3595.5\,kg$
$F = \sqrt{F_x^2 + F_z^2} = 5134.86\,kg$

solución:

Peso del volumen de concreto

$$V_c = b^2 h_3 + a^2 (h_1 + h_2)$$
$$V_c = 2.80^2 \times 0.4 + 1.80^2 (0.2 + 3.10) = 13.828\,m^3$$
$$P_c = \gamma V_c = 2400 \times 13.828 = 33187.20\,kg$$

Peso del volumen de tierra

$$P_s = \left[\left(b^2 h_2 + 2 b \operatorname{tg}\phi\, h_2^2 + \frac{\pi}{3} \operatorname{tg}^2\theta\, h_2^3 \right) - (a^2 h_2) \right] \gamma_s$$

$$P_s = \left[2.80 \times 3.1 + 2 \times 2.80 \operatorname{tg} 19° \times 3.10^2 + \frac{\pi}{3} \operatorname{tg}^2 19° \times 3.10^3 \right) - 1.80^2 \times 3.10 \Big)\Big] 1995 = 36.49 \times 1995 = 72796\,kg$$

Por compresión

$$\sigma_{comp} = \frac{c + P_c}{b^2} \pm \frac{0.9 F_x \cdot 6 (h_1 + h_2)}{b^3}$$

$$\sigma_{comp} = \frac{44330 + 33187.20}{2.80^2} \pm \frac{0.9 \times 51348.86 (6) 3.30}{2.80^3}$$

$\sigma_{comp} = 0.593 \pm 0.4168 = 1.01;\ 0.176$, ambos $< \sigma_{adm}$

Por tracción

$$\sigma_{trac.} = \frac{T - P_c}{b^2 - a^2} \pm \frac{0.9F(6)(h_2+h_3)}{b^3}$$

$$\sigma_{trac} = \frac{40689.84 - 33187.20}{280^2 - 180^2} \pm \frac{0.9 \times 5134.86 \times 6 \times 330}{280^3}$$

$\sigma_{trac} = 0.163 \pm 0.417 = 0.58;\ -0.254$ kgf/cm²

Existe tracción en la zapata; debe evaluarse si es despreciable o no.

Factor de seguridad contra la tracción o anclaje

Considerando un cono de anclamiento

$$P_s = \gamma\left[\left(b^2 h_2 + 2b\,tg\phi\, h_2^2 + \frac{\pi}{3} tg^2\theta\, h_2^3\right) - (a^2 h_2)\right]$$

$P_s = 72796$ kgf

$$F_s = \frac{P_s + P_c}{T} = \frac{72796 + 33187.20}{40689.84} = 2.60 > 2.0 \text{ verifica}$$

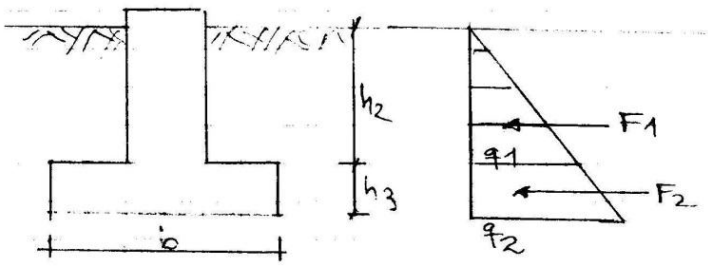
Deslizamiento

Criterio del roce

$$F_s = \frac{(P_s + P_c)\mu}{F}, \text{ con } \mu = 0.4$$

$$F_s = \frac{(72796 + 33187.20)\,0.40}{5134.86} = 8.26$$

Criterio de Rankine (simplificado)



$q = h\gamma \frac{1-\operatorname{sen}\phi}{1+\operatorname{sen}\phi}$ $\quad \phi = 19° \quad \operatorname{sen} 19° = 0.3256$

$q_1 = q = 3.10 \times 1955 \frac{1-\operatorname{sen}19°}{1+\operatorname{sen}19°} = 4571.89 \approx 4572 \text{ kf/m}^2$

$F_1 = (q_1 h_2)\frac{b}{2} = (4572 \times 3)\frac{2.80}{2} = 19842.48 \text{ kf}$

$q_2 = q_1 \frac{(h_2+h_3)}{h_2} = 4572 \frac{3.50}{3.10} = 5161.935 \text{ kf/m}^2$

$F_2 = q_1 h_3 b + (q_2 - q_1) h_3 \frac{b}{2}$

$F_2 = 4572 \times 0.4 \times 2.80 + (5161.935 - 4572) 0.4 \frac{2.80}{2}$

$F_2 = 5451.0 \text{ kf}$

$F_t = F_1 + F_2 = 25293.48 \text{ kf} > F = 5134.80 \text{ kf}$

Verifica