

Diseño de Fundaciones

Memoria de cálculo

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Diseño de fundaciones

MURO: F4X

$$\sigma_{suelo_estatico} := 8 \frac{kgf}{cm^2} \quad \sigma_{suelo_sismico} := 10 \frac{kgf}{cm^2}$$

1. Dimensiones elementos

Propiedades y esfuerzos de muro:

$$L_{muro} := 6.76 \text{ m}$$

$$e_{muro} := 25 \text{ cm}$$

Dimensiones zapata:

$$L_{zap} := 90 \text{ cm} + L_{muro} + 90 \text{ cm} = 8.56 \text{ m}$$

$$B_{zap} := 200 \text{ cm}$$

$$H_{zap} := 200 \text{ cm}$$

$$\gamma_H := 2.5 \frac{tonnef}{m^3}$$

$$N_{zap} := \gamma_H \cdot B_{zap} \cdot L_{zap} \cdot H_{zap} = 85.6 \text{ tonnef}$$

2. Esfuerzos de ETABS

$$N_{PP} := -455.244 \text{ tonnef}$$

$$M_{PP} := -112.8124 \text{ tonnef} \cdot m$$

$$V_{PP} := 5.8048 \text{ tonnef}$$

$$N_{SC} := -118.0962 \text{ tonnef}$$

$$M_{SC} := -20.3411 \text{ tonnef} \cdot m$$

$$V_{SC} := -1.0577 \text{ tonnef}$$

$$N_{SX} := 216.7196 \text{ tonnef}$$

$$M_{SX} := 522.4481 \text{ tonnef} \cdot m$$

$$V_{SX} := 27.6026 \text{ tonnef}$$

$$N_{SY} := 157.9424 \text{ tonnef}$$

$$M_{SY} := 59.8586 \text{ tonnef} \cdot m$$

$$V_{SY} := 8.2291 \text{ tonnef}$$

3. Combinaciones

3.1. Combinaciones estáticas

Combinación 1 (PP)

$$N_{est1} := N_{zap} + |N_{PP}| = 540.844 \text{ tonnef}$$

$$V_{est1} := V_{PP} = 5.805 \text{ tonnef}$$

$$M_{est1} := M_{PP} = -112.812 \text{ tonnef} \cdot m$$

$$l := \frac{L_{zap}}{6} = 1.427 \text{ m}$$

$$e := \left| \frac{M_{est1}}{N_{est1}} \right| = 0.209 \text{ m}$$

$$L' := 3 \cdot \left(\frac{L_{zap}}{2} - e \right) = 12.214 \text{ m}$$

$$\sigma_{est1} := \begin{cases} \text{if } e < l \\ \left\| \max \left(\frac{N_{est1}}{B_{zap} \cdot L_{zap}} + \frac{6 \cdot M_{est1}}{B_{zap} \cdot L_{zap}^2}, \frac{N_{est1}}{B_{zap} \cdot L_{zap}} - \frac{6 \cdot M_{est1}}{B_{zap} \cdot L_{zap}^2} \right) \right\| \\ \text{else if } e = l \\ \left\| \frac{2 N_{est1}}{B_{zap} \cdot L_{zap}} \right\| \\ \text{else} \\ \left\| \frac{2 N_{est1}}{B_{zap} \cdot L'} \right\| \end{cases} = 3.621 \frac{kgf}{cm^2}$$

Factores de seguridad

$$\mu := 0.4$$

$$F_D := V_{est1} = 5.805 \text{ tonnef}$$

$$F_R := N_{est1} \cdot \mu = 216.338 \text{ tonnef}$$

$$FS_D := \frac{|F_R|}{|F_D|} = 37.269$$

$$M_V := |M_{est1}| + |V_{est1} \cdot H_{zap}| = 124.422 \text{ tonnef} \cdot m$$

$$M_R := \left| N_{est1} \cdot \frac{L_{zap}}{2} \right| + |M_{est1}| = 2427.625 \text{ tonnef} \cdot m$$

$$FS_V := \frac{|M_R|}{|M_V|} = 19.511$$

chequeo (FS_D) = "CUMPLE"

chequeo (FS_V) = "CUMPLE"

Combinación 2 (PP+SC)

$$N_{est2} := N_{zap} + |N_{PP}| + |N_{SC}| = 658.94 \text{ tonnef}$$

$$V_{est2} := V_{PP} + V_{SC} = 4.747 \text{ tonnef}$$

$$M_{est2} := M_{PP} + M_{SC} = -133.154 \text{ tonnef} \cdot m$$

$$l := \frac{L_{zap}}{6} = 1.427 \text{ m}$$

$$e := \left| \frac{M_{est2}}{N_{est2}} \right| = 0.202 \text{ m}$$

$$L' := 3 \cdot \left(\frac{L_{zap}}{2} - e \right) = 12.234 \text{ m}$$

$$\sigma_{est2} := \begin{cases} \text{if } e < l \\ \left\| \max \left(\frac{N_{est2}}{B_{zap} \cdot L_{zap}} + \frac{6 \cdot M_{est2}}{B_{zap} \cdot L_{zap}^2}, \frac{N_{est2}}{B_{zap} \cdot L_{zap}} - \frac{6 \cdot M_{est2}}{B_{zap} \cdot L_{zap}^2} \right) \right\| \\ \text{else if } e = l \\ \left\| \frac{2 N_{est2}}{B_{zap} \cdot L_{zap}} \right\| \\ \text{else} \\ \left\| \frac{2 N_{est2}}{B_{zap} \cdot L'} \right\| \end{cases} = 4.394 \frac{\text{kgf}}{\text{cm}^2}$$

$$\sigma_{est} := \max(\sigma_{est1}, \sigma_{est2}) = 4.394 \frac{\text{kgf}}{\text{cm}^2}$$

resistencia ($\sigma_{suelo_estatico}, \sigma_{est}$) = "CUMPLE"

Factores de seguridad

$$\mu := 0.4$$

$$F_D := V_{est2} = 4.747 \text{ tonnef}$$

$$F_R := N_{est2} \cdot \mu = 263.576 \text{ tonnef}$$

$$FS_D := \frac{|F_R|}{|F_D|} = 55.524$$

$$M_V := |M_{est2}| + |V_{est2} \cdot H_{zap}| = 142.648 \text{ tonnef} \cdot m$$

$$M_R := \left| N_{est2} \cdot \frac{L_{zap}}{2} \right| + |M_{est2}| = 2953.418 \text{ tonnef} \cdot m$$

$$FS_V := \frac{|M_R|}{|M_V|} = 20.704$$

chequeo (FS_D) = "CUMPLE"

chequeo (FS_V) = "CUMPLE"

3.2. Combinaciones

sísmicas

Combinación 3.1 (PP+SX)

$$N_{sis} := N_{zap} + |N_{PP}| + N_{SX} = 757.564 \text{ tonnef} \quad V_{sis} := V_{PP} + V_{SX} = 33.407 \text{ tonnef}$$

$$M_{sis} := M_{PP} + M_{SX} = 409.636 \text{ tonnef} \cdot m$$

$$l := \frac{L_{zap}}{6} = 1.427 \text{ m} \quad e := \left| \frac{M_{sis}}{N_{sis}} \right| = 0.541 \text{ m} \quad L' := 3 \cdot \left(\frac{L_{zap}}{2} - e \right) = 11.218 \text{ m}$$

$$\sigma_{sis31} := \begin{cases} \text{if } e < l \\ \left\| \max \left(\frac{N_{sis}}{B_{zap} \cdot L_{zap}} + \frac{6 \cdot M_{sis}}{B_{zap} \cdot L_{zap}^2}, \frac{N_{sis}}{B_{zap} \cdot L_{zap}} - \frac{6 \cdot M_{sis}}{B_{zap} \cdot L_{zap}^2} \right) \right\| \\ \text{else if } e = l \\ \left\| \frac{2 N_{sis}}{B_{zap} \cdot L_{zap}} \right\| \\ \text{else} \\ \left\| \frac{2 N_{sis}}{B_{zap} \cdot L'} \right\| \end{cases} = 6.102 \frac{\text{kgf}}{\text{cm}^2}$$

Factores de seguridad

$$\mu := 0.4$$

$$F_D := V_{sis} = 33.407 \text{ tonnef} \quad F_R := N_{sis} \cdot \mu = 303.025 \text{ tonnef}$$

$$FS_D := \frac{|F_R|}{|F_D|} = 9.071$$

$$M_V := |M_{sis}| + |V_{sis} \cdot H_{zap}| = 476.451 \text{ tonnef} \cdot m$$

$$M_R := \left| N_{sis} \cdot \frac{L_{zap}}{2} \right| + |M_{sis}| = 3652.008 \text{ tonnef} \cdot m$$

$$FS_V := \frac{|M_R|}{|M_V|} = 7.665$$

chequeo (FS_D) = "CUMPLE"

chequeo (FS_V) = "CUMPLE"

Combinación 3.2 (PP-SX)

$$N_{sis} := N_{zap} + |N_{PP}| - N_{SX} = 324.124 \text{ tonnef}$$

$$V_{sis} := V_{PP} - V_{SX} = -21.798 \text{ tonnef}$$

$$M_{sis} := M_{PP} - M_{SX} = -635.261 \text{ tonnef} \cdot m$$

$$l := \frac{L_{zap}}{6} = 1.427 \text{ m}$$

$$e := \left| \frac{M_{sis}}{N_{sis}} \right| = 1.96 \text{ m}$$

$$L' := 3 \cdot \left(\frac{L_{zap}}{2} - e \right) = 6.96 \text{ m}$$

$$\sigma_{sis32} := \begin{cases} \text{if } e < l \\ \left\| \max \left(\frac{N_{sis}}{B_{zap} \cdot L_{zap}} + \frac{6 \cdot M_{sis}}{B_{zap} \cdot L_{zap}^2}, \frac{N_{sis}}{B_{zap} \cdot L_{zap}} - \frac{6 \cdot M_{sis}}{B_{zap} \cdot L_{zap}^2} \right) \right\| \\ \text{else if } e = l \\ \left\| \frac{2 N_{sis}}{B_{zap} \cdot L_{zap}} \right\| \\ \text{else} \\ \left\| \frac{2 N_{sis}}{B_{zap} \cdot L'} \right\| \end{cases} = 4.657 \frac{\text{kgf}}{\text{cm}^2}$$

Factores de seguridad

$$\mu := 0.4$$

$$F_D := V_{sis} = -21.798 \text{ tonnef}$$

$$F_R := N_{sis} \cdot \mu = 129.65 \text{ tonnef}$$

$$FS_D := \frac{|F_R|}{|F_D|} = 5.948$$

$$M_V := |M_{sis}| + |V_{sis} \cdot H_{zap}| = 678.856 \text{ tonnef} \cdot m$$

$$M_R := \left| N_{sis} \cdot \frac{L_{zap}}{2} \right| + |M_{sis}| = 2022.513 \text{ tonnef} \cdot m$$

$$FS_V := \frac{|M_R|}{|M_V|} = 2.979$$

chequeo (FS_D) = "CUMPLE"

chequeo (FS_V) = "CUMPLE"

Combinación 4.1 (PP+SC+S)

$$N_{sis} := N_{zap} + |N_{PP}| + |N_{SC}| + N_{SX} = 875.66 \text{ tonnef}$$

$$M_{sis} := M_{PP} + M_{SC} + M_{SX} = 389.295 \text{ tonnef} \cdot m$$

$$V_{sis} := V_{PP} + V_{SC} + V_{SX} = 32.35 \text{ tonnef}$$

$$l := \frac{L_{zap}}{6} = 1.427 \text{ m} \quad e := \left| \frac{M_{sis}}{N_{sis}} \right| = 0.445 \text{ m} \quad L' := 3 \cdot \left(\frac{L_{zap}}{2} - e \right) = 11.506 \text{ m}$$

$$\sigma_{sis41} := \begin{cases} \text{if } e < l \\ \left\| \max \left(\frac{N_{sis}}{B_{zap} \cdot L_{zap}} + \frac{6 \cdot M_{sis}}{B_{zap} \cdot L_{zap}^2}, \frac{N_{sis}}{B_{zap} \cdot L_{zap}} - \frac{6 \cdot M_{sis}}{B_{zap} \cdot L_{zap}^2} \right) \right\| \\ \text{else if } e = l \\ \left\| \frac{2 N_{sis}}{B_{zap} \cdot L_{zap}} \right\| \\ \text{else} \\ \left\| \frac{2 N_{sis}}{B_{zap} \cdot L'} \right\| \end{cases} = 6.709 \frac{\text{kgf}}{\text{cm}^2}$$

Factores de seguridad

$$\mu := 0.4$$

$$F_D := V_{sis} = 32.35 \text{ tonnef} \quad F_R := N_{sis} \cdot \mu = 350.264 \text{ tonnef}$$

$$FS_D := \frac{|F_R|}{|F_D|} = 10.827$$

$$M_V := |M_{sis}| + |V_{sis} \cdot H_{zap}| = 453.994 \text{ tonnef} \cdot m$$

$$M_R := \left| N_{sis} \cdot \frac{L_{zap}}{2} \right| + |M_{sis}| = 4137.119 \text{ tonnef} \cdot m$$

$$FS_V := \frac{|M_R|}{|M_V|} = 9.113$$

chequeo (FS_D) = "CUMPLE"

chequeo (FS_V) = "CUMPLE"

Combinación 4.2 (PP+SC-S)

$$N_{sis} := N_{zap} + |N_{PP}| + |N_{SC}| - N_{SX} = 442.221 \text{ tonnef}$$

$$M_{sis} := M_{PP} + M_{SC} - M_{SX} = -655.602 \text{ tonnef} \cdot m$$

$$V_{sis} := V_{PP} + V_{SC} - V_{SX} = -22.856 \text{ tonnef}$$

$$l := \frac{L_{zap}}{6} = 1.427 \text{ m} \quad e := \left| \frac{M_{sis}}{N_{sis}} \right| = 1.483 \text{ m} \quad L' := 3 \cdot \left(\frac{L_{zap}}{2} - e \right) = 8.392 \text{ m}$$

$$\sigma_{sis42} := \begin{cases} \text{if } e < l \\ \left\| \max \left(\frac{N_{sis}}{B_{zap} \cdot L_{zap}} + \frac{6 \cdot M_{sis}}{B_{zap} \cdot L_{zap}^2}, \frac{N_{sis}}{B_{zap} \cdot L_{zap}} - \frac{6 \cdot M_{sis}}{B_{zap} \cdot L_{zap}^2} \right) \right\| \\ \text{else if } e = l \\ \left\| \frac{2 N_{sis}}{B_{zap} \cdot L_{zap}} \right\| \\ \text{else} \\ \left\| \frac{2 N_{sis}}{B_{zap} \cdot L'} \right\| \end{cases} = 5.269 \frac{\text{kgf}}{\text{cm}^2}$$

Factores de seguridad

$$\mu := 0.4$$

$$F_D := V_{sis} = -22.856 \text{ tonnef} \quad F_R := N_{sis} \cdot \mu = 176.888 \text{ tonnef}$$

$$FS_D := \frac{|F_R|}{|F_D|} = 7.739$$

$$M_V := |M_{sis}| + |V_{sis} \cdot H_{zap}| = 701.313 \text{ tonnef} \cdot m$$

$$M_R := \left| N_{sis} \cdot \frac{L_{zap}}{2} \right| + |M_{sis}| = 2548.306 \text{ tonnef} \cdot m$$

$$FS_V := \frac{|M_R|}{|M_V|} = 3.634$$

chequeo (FS_D) = "CUMPLE"

chequeo (FS_V) = "CUMPLE"

$$\sigma_{sis} := \max(\sigma_{sis31}, \sigma_{sis32}, \sigma_{sis41}, \sigma_{sis42}) = 6.709 \frac{\text{kgf}}{\text{cm}^2}$$

resistencia ($\sigma_{suelo_estatico}, \sigma_{est}$) = "CUMPLE"

4. Chequeo parrilla

Momento lado corto

$$M1 := \frac{\sigma_{sis} \cdot \left(\frac{B_{zap}}{2} \right)^2 \cdot 1 \text{ m}}{2} = 33.544 \text{ tonnef} \cdot \text{m}$$

Propiedad de la Sección de Zapata

$$W := \frac{1}{6} \cdot 1 \text{ m} \cdot H_{zap}^2 = 0.667 \text{ m}^3$$

Momento Lado Largo

$$M2 := \frac{\sigma_{sis} \cdot \left(\frac{L_{zap} - L_{muro}}{2} \right)^2 \cdot 1 \text{ m}}{2} = 27.17 \text{ tonnef} \cdot \text{m}$$

Propiedad de la Sección de Zapata

$$W := \frac{1}{6} \cdot 1 \text{ m} \cdot H_{zap}^2 = 0.667 \text{ m}^3$$

$$\frac{M1}{W} = 5.032 \frac{\text{kgf}}{\text{cm}^2}$$

if $\frac{M1}{W} < 7 \frac{\text{kgf}}{\text{cm}^2}$ | = “No necesita parrilla”
|| “No necesita parrilla”
else
|| “Necesita Parrilla”

$$\frac{M2}{W} = 4.076 \frac{\text{kgf}}{\text{cm}^2}$$

if $\frac{M2}{W} < 7 \frac{\text{kgf}}{\text{cm}^2}$ | = “No necesita parrilla”
|| “No necesita parrilla”
else
|| “Necesita Parrilla”