MECÁNICA DE SUELOS

Clase práctica - 06-07-2021

4.1 Calcule la capacidad de carga de una zapata cuadrada de 1.20 m de lado para profundidades de fundación: 0.0, 1.0 y 2.0m, para los siguientes suelos:

- Granular, γ = 20kN/m3, ϕ' = 35º y c' = 0.0 kPa
- Cohesivo, γ = 20kN/m3, su = 50kPa, ϕ' = 28º y c'= 5kPa
- Nivel freático: no detectado.

Establezca conclusiones respecto de la capacidad de carga en corto plazo para ambos suelos.

CASO 1: MATERIAL GRANULAR - COMPORTAMIENTO DRENADO - PROF. 0

Parámetros de entrada

$prof := 0m \quad \phi := 35° \quad c := 0kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := 0kPa$

Cálculos

$N_q := e^{\pi\cdot\tan(\phi)}\cdot\left(\tan\left(\frac{\pi}{4}+\frac{\phi}{2}\right)\right)^2 = 33.296$

$N_c := \cot(\phi)\cdot\left(N_q - 1\right) = 46.124$

$N_\gamma := 1.5\cdot\left(N_q - 1\right)\cdot\tan(\phi) = 33.921$

$d_c := 1 + 0.4\cdot\operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$

$d_q := 1 + 2\tan(\phi)\cdot(1-\sin(\phi))^2\cdot\operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$

$d_\gamma := 1$

$s_c := 1 + \frac{N_q}{N_c} = 1.722$

$s_\gamma := 0.6$

$s_q := 1 + \sin(\phi) = 1.574$

$q_{ult} := \frac{1}{2}\cdot\gamma\cdot Beq\cdot N_\gamma\cdot s_\gamma\cdot d_\gamma + \sigma_0\cdot N_q\cdot s_q\cdot d_q + c\cdot N_c\cdot s_c\cdot d_c = 244.231\cdot kPa$

CASO 2: MATERIAL GRANULAR - COMPORTAMIENTO DRENADO - PROF. 1

Parámetros de entrada

$prof := 1m \quad \phi := 35° \quad c := 0kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := \gamma \cdot prof = 20 \cdot kPa$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 33.296$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 46.124$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 33.921$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.278$$

$$d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.177$$

$$d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} = 1.722$$

$$s_\gamma := 0.6$$

$$s_q := 1 + \sin(\phi) = 1.574$$

$$q_{ult} := \frac{1}{2} \cdot \gamma \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 1.477 \times 10^3 \cdot kPa$$

CASO 3: MATERIAL GRANULAR - COMPORTAMIENTO DRENADO - PROF. 2

Parámetros iniciales

$prof := 2m \quad \phi := 35° \quad c := 0kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := \gamma \cdot prof = 40 \cdot kPa$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2} \right) \right)^2 = 33.296$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1 \right) = 46.124$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1 \right) \cdot \tan(\phi) = 33.921$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq} \right) = 1.412$$

$$d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq} \right) = 1.262$$

$$d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} = 1.722$$

$$s_\gamma := 0.6$$

$$s_q := 1 + \sin(\phi) = 1.574$$

$$q_{ult} := \frac{1}{2} \cdot \gamma \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 2.89 \times 10^3 \cdot kPa$$

CASO 4: MATERIAL COHESIVO - COMPORTAMIENTO DRENADO - PROF. 0

Parámetros iniciales

$prof := 0m \quad \phi := 28° \quad c := 5kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := \gamma \cdot prof = 0 \cdot kPa$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 14.72$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 25.803$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 10.942$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$$

$$d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$$

$$d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} = 1.57$$

$$s_\gamma := 0.6$$

$$s_q := 1 + \sin(\phi) = 1.469$$

$$q_{ult} := \frac{1}{2} \cdot \gamma \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 281.402 \cdot kPa$$

CASO 5: MATERIAL COHESIVO - COMPORTAMIENTO DRENADO - PROF. 1

Parámetros

$prof := 1m \quad \phi := 28° \quad c := 5kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := \gamma \cdot prof = 20 \cdot kPa$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 14.72$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 25.803$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 10.942$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.278$$

$$d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.208$$

$$d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} = 1.57$$

$$s_\gamma := 0.6$$

$$s_c := 1 + \sin(\phi) = 1.469$$

$$q_{ult} := \frac{1}{2} \cdot \gamma \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 843.624 \cdot kPa$$

CASO 5: MATERIAL COHESIVO - COMPORTAMIENTO DRENADO - PROF. 2

Parámetros iniciales

$prof := 2m \quad \phi := 28° \quad c := 5kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := \gamma \cdot prof = 40 \cdot kPa$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 14.72$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 25.803$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 10.942$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.412$$

$$d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.308$$

$$d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} = 1.57$$

$$s_\gamma := 0.6$$

$$s_q := 1 + \sin(\phi) = 1.469$$

$$q_{ult} := \frac{1}{2} \cdot \gamma \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 1.497 \times 10^3 \cdot kPa$$

CASO 6: MATERIAL COHESIVO - COMPORTAMIENTO NO DRENADO - PROF. 0

Parámetros iniciales

$prof := 0m \quad \phi := 0.0001° \quad c := 50kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := \gamma \cdot prof = 0 \cdot kPa$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 1$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 5.142$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 2.349 \times 10^{-11}$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$$

$$d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$$

$$d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} = 1.194$$

$$s_\gamma := 0.6$$

$$s_q := 1 + \sin(\phi) = 1$$

$$q_{ult} := \frac{1}{2} \cdot \gamma \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 307.081 \cdot kPa$$

CASO 7: MATERIAL COHESIVO - COMPORTAMIENTO NO DRENADO - PROF. 1

Parámetros iniciales

$prof := 1m \quad \phi := 0.0001° \quad c := 50kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := \gamma \cdot prof = 20 \cdot kPa$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 1$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 5.142$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 2.349 \times 10^{-11}$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.278$$

$$d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$$

$$d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} = 1.194$$

$$s_\gamma := 0.6$$

$$s_q := 1 + \sin(\phi) = 1$$

$$q_{ult} := \frac{1}{2} \cdot \gamma \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 412.418 \cdot kPa$$

CASO 8: MATERIAL COHESIVO - COMPORTAMIENTO NO DRENADO - PROF. 2

Parámetros iniciales

$prof := 2m \quad \phi := 0.0001° \quad c := 50kPa \quad \gamma := 20\frac{kN}{m^3} \quad Beq := 1.2m \quad \sigma_0 := \gamma \cdot prof = 40 \cdot kPa$

Cálculos

$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 1$

$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 5.142$

$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 2.349 \times 10^{-11}$

$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.412$

$d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$

$d_\gamma := 1$

$s_c := 1 + \frac{N_q}{N_c} = 1.194$

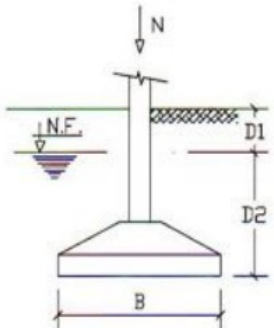
$s_\gamma := 0.6$

$s_q := 1 + \sin(\phi) = 1$

$q_{ult} := \frac{1}{2} \cdot \gamma \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 473.646 \cdot kPa$

4.2 Diseñe una zapata rectangular de relación de lados 1.2 que sea capaz de trasmitir al terreno una carga en servicio de 2500kN. Verifique para condición de corto y largo plazo. Los parámetros del terreno son:

- γ = 19kN/m3, su = 80kPa, ϕ' = 28º y c'= 3kPa.
- En el esquema, D1 = 1.0m y D2 = 1.5m.



EJERCICIO 4.2 - COMPORTAMIENTO DRENADO - ANCHO B

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 28°$ $c := 3kPa$ $\gamma_w := 10\frac{kN}{m^3}$ $D1 := 1m$ $D2 := 1.5m$

$prof := D1 + D2 = 2.5\,m$ $Beq := 2.45m$ $Leq := Beq \cdot 1.2$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 14.72$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 25.803$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 10.942$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.318 \qquad d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.238 \qquad d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} \cdot \frac{Beq}{Leq} = 1.475 \qquad s_\gamma := 1 - 0.4 \cdot \frac{Beq}{Leq} = 0.667 \qquad s_q := 1 + \sin(\phi) \cdot \frac{Beq}{Leq} = 1.391$$

$$\sigma_0 := \gamma \cdot D1 + \left(\gamma - \gamma_w\right) \cdot D2 = 32.5 \cdot kPa \qquad \gamma_{sum} := \gamma - 10\frac{kN}{m^3}$$

$$q_{ultB} := \frac{1}{2} \cdot \gamma_{sum} \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 1.055 \cdot MPa$$

EJERCICIO 4.2 - COMPORTAMIENTO DRENADO - ANCHO L

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 28°$ $c := 3kPa$ $\gamma_w := 10\frac{kN}{m^3}$ $D1 := 1m$ $D2 := 1.5m$

$prof := D1 + D2 = 2.5\,m$

Cálculos

$N_q := e^{\pi\cdot\tan(\phi)}\cdot\left(\tan\left(\frac{\pi}{4}+\frac{\phi}{2}\right)\right)^2 = 14.72$

$N_c := \cot(\phi)\cdot\left(N_q - 1\right) = 25.803$

$N_\gamma := 1.5\cdot\left(N_q - 1\right)\cdot\tan(\phi) = 10.942$

$d_c := 1 + 0.4\cdot\operatorname{atan}\left(\frac{prof}{Leq}\right) = 1.282$ $d_q := 1 + 2\tan(\phi)\cdot(1-\sin(\phi))^2\cdot\operatorname{atan}\left(\frac{prof}{Leq}\right) = 1.211$ $d_\gamma := 1$

$s_c := 1 + \frac{N_q}{N_c}\cdot\frac{Leq}{Beq} = 1.685$ $s_\gamma := \max\left(1 - 0.4\cdot\frac{Leq}{Beq}, 0.6\right) = 0.6$ $s_q := 1 + \sin(\phi)\cdot\frac{Leq}{Beq} = 1.563$

$\sigma_0 := \gamma\cdot D1 + \left(\gamma - \gamma_w\right)\cdot D2 = 32.5\cdot kPa$ $\gamma_{sum} := \gamma - 10\frac{kN}{m^3}$

$q_{ultL} := \frac{1}{2}\cdot\gamma_{sum}\cdot Leq\cdot N_\gamma\cdot s_\gamma\cdot d_\gamma + \sigma_0\cdot N_q\cdot s_q\cdot d_q + c\cdot N_c\cdot s_c\cdot d_c = 1.16\cdot MPa$

$q_{ult} := \min\left(q_{ultL}, q_{ultB}\right) = 1.055\cdot MPa$

$P_{ult} := q_{ult}\cdot Beq\cdot Leq = 7.599\times 10^3\cdot kN$

$P_{adm} := \frac{P_{ult}}{3} = 2.533\times 10^3\cdot kN$

EJERCICIO 4.2 - COMPORTAMIENTO NO DRENADO - ANCHO B

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 0.000001°$ $c := 80kPa$ $\gamma_w := 10\frac{kN}{m^3}$ $D1 := 1m$ $D2 := 1.5m$

$prof := D1 + D2 = 2.5\,m$ $Beq := 3.15m$ $Leq := Beq \cdot 1.2$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 1$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 5.142$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 2.349 \times 10^{-15}$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.268 \qquad d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1 \qquad d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} \cdot \frac{Beq}{Leq} = 1.162 \qquad s_\gamma := \max\left(1 - 0.4 \cdot \frac{Beq}{Leq}, 0.6\right) = 0.667 \qquad s_q := 1 + \sin(\phi) \cdot \frac{Beq}{Leq} = 1$$

$$\sigma_0 := \gamma \cdot D1 + \left(\gamma - \gamma_w\right) \cdot D2 = 32.5 \cdot kPa \qquad \gamma_{sum} := \gamma - 10\frac{kN}{m^3}$$

$$q_{ultB} := \frac{1}{2} \cdot \gamma_{sum} \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 0.639 \cdot MPa$$

EJERCICIO 4.2 - COMPORTAMIENTO NO DRENADO - ANCHO L

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 0.000001°$ $c := 80kPa$ $\gamma_w := 10\frac{kN}{m^3}$ $D1 := 1m$ $D2 := 1.5m$

$prof := D1 + D2 = 2.5\,m$

Cálculos

$N_q := e^{\pi\cdot\tan(\phi)}\cdot\left(\tan\left(\frac{\pi}{4}+\frac{\phi}{2}\right)\right)^2 = 1$

$N_c := \cot(\phi)\cdot\left(N_q - 1\right) = 5.142$

$N_\gamma := 1.5\cdot\left(N_q - 1\right)\cdot\tan(\phi) = 2.349\times 10^{-15}$

$d_c := 1 + 0.4\cdot\operatorname{atan}\left(\frac{prof}{Leq}\right) = 1.234$ $d_q := 1 + 2\tan(\phi)\cdot(1-\sin(\phi))^2\cdot\operatorname{atan}\left(\frac{prof}{Leq}\right) = 1$ $d_\gamma := 1$

$s_c := 1 + \frac{N_q}{N_c}\cdot\frac{Leq}{Beq} = 1.233$ $s_\gamma := \max\left(1 - 0.4\cdot\frac{Leq}{Beq}, 0.6\right) = 0.6$ $s_q := 1 + \sin(\phi)\cdot\frac{Leq}{Beq} = 1$

$\sigma_0 := \gamma\cdot D1 + \left(\gamma - \gamma_w\right)\cdot D2 = 32.5\cdot kPa$ $\gamma_{sum} := \gamma - 10\frac{kN}{m^3}$

$q_{ultL} := \frac{1}{2}\cdot\gamma_{sum}\cdot Beq\cdot N_\gamma\cdot s_\gamma\cdot d_\gamma + \sigma_0\cdot N_q\cdot s_q\cdot d_q + c\cdot N_c\cdot s_c\cdot d_c = 0.658\cdot MPa$

$q_{ult} := \min\left(q_{ultL}, q_{ultB}\right) = 0.639\cdot MPa$

$P_{ult} := q_{ult}\cdot Beq\cdot Leq = 7.606\times 10^3\cdot kN$

$P_{adm} := \frac{P_{ult}}{3} = 2.535\times 10^3\cdot kN$

4.3 Repita el ejercicio 4.2 para la condición de largo plazo considerando una excentricidad de 0.60m de la carga normal aplicada respecto del lado menor de la fundación.

EJERCICIO 4.3 - COMPORTAMIENTO DRENADO - ANCHO B

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 28°$ $c := 3kPa$ $e_x := 0.60m$

$Beq := 3m$ $Leq := Beq \cdot 1.2 - 2 \cdot e_x$ $\gamma_w := 10\frac{kN}{m^3}$

$D1 := 1m$ $D2 := 1.5m$ $prof := D1 + D2 = 2.5\,m$

Cálculos

$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 14.72$

$N_c := \cot(\phi) \cdot (N_q - 1) = 25.803$

$N_\gamma := 1.5 \cdot (N_q - 1) \cdot \tan(\phi) = 10.942$

$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.278$ $d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.208$ $d_\gamma := 1$

$s_c := 1 + \frac{N_q}{N_c} \cdot \frac{Beq}{Leq} = 1.713$ $s_\gamma := \max\left(1 - 0.4 \cdot \frac{Beq}{Leq}, 0.6\right) = 0.6$ $s_q := 1 + \sin(\phi) \cdot \frac{Beq}{Leq} = 1.587$

$\sigma_0 := \gamma \cdot D1 + (\gamma - \gamma_w) \cdot D2 = 32.5 \cdot kPa$

$q_{ultB} := \frac{1}{2} \cdot \gamma_{sum} \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 1.175 \cdot MPa$

EJERCICIO 4.3 - COMPORTAMIENTO DRENADO - ANCHO L

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 28°$ $c := 3kPa$ $e_x := 0.60m$

$\gamma_w := 10\frac{kN}{m^3}$

$D1 := 1m$ $D2 := 1.5m$ $prof := D1 + D2 = 2.5\,m$

Cálculos

$N_q := e^{\pi\cdot\tan(\phi)}\cdot\left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 14.72$

$N_c := \cot(\phi)\cdot\left(N_q - 1\right) = 25.803$

$N_\gamma := 1.5\cdot\left(N_q - 1\right)\cdot\tan(\phi) = 10.942$

$d_c := 1 + 0.4\cdot\operatorname{atan}\left(\frac{prof}{Leq}\right) = 1.322$ $d_q := 1 + 2\tan(\phi)\cdot(1 - \sin(\phi))^2\cdot\operatorname{atan}\left(\frac{prof}{Leq}\right) = 1.241$ $d_\gamma := 1$

$s_c := 1 + \frac{N_q}{N_c}\cdot\frac{Leq}{Beq} = 1.456$ $s_\gamma := \max\left(1 - 0.4\cdot\frac{Leq}{Beq}, 0.6\right) = 0.68$ $s_q := 1 + \sin(\phi)\cdot\frac{Leq}{Beq} = 1.376$

$\sigma_0 := \gamma\cdot D1 + \left(\gamma - \gamma_w\right)\cdot D2 = 32.5\cdot kPa$

$q_{ultL} := \frac{1}{2}\cdot\gamma_{sum}\cdot Leq\cdot N_\gamma\cdot s_\gamma\cdot d_\gamma + \sigma_0\cdot N_q\cdot s_q\cdot d_q + c\cdot N_c\cdot s_c\cdot d_c = 1.046\cdot MPa$

$q_{ult} := \min\left(q_{ultB}, q_{ultL}\right) = 1.046\times 10^3\cdot kPa$

$P_{ult} := q_{ult}\cdot Beq\cdot Leq = 7.533\times 10^3\cdot kN$

$P_{adm} := \frac{P_{ult}}{3} = 2.511\times 10^3\cdot kN$

EJERCICIO 4.3 - COMPORTAMIENTO NO DRENADO - ANCHO B

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 0.000001°$ $c := 80kPa$ $e_x := 0.60m$

$Beq := 3m$ $Leq := Beq \cdot 1.2 - 2 \cdot e_x$ $\gamma_w := 10\frac{kN}{m^3}$

$D1 := 1m$ $D2 := 1.5m$ $prof := D1 + D2 = 2.5\,m$

Cálculos

$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 1$

$N_c := \cot(\phi) \cdot (N_q - 1) = 5.142$

$N_\gamma := 1.5 \cdot (N_q - 1) \cdot \tan(\phi) = 2.349 \times 10^{-15}$

$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.278$ $d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1$ $d_\gamma := 1$

$s_c := 1 + \frac{N_q}{N_c} \cdot \frac{Beq}{Leq} = 1.243$ $s_\gamma := \max\left(1 - 0.4 \cdot \frac{Beq}{Leq}, 0.6\right) = 0.6$ $s_q := 1 + \sin(\phi) \cdot \frac{Beq}{Leq} = 1$

$\sigma_0 := \gamma \cdot D1 + (\gamma - \gamma_w) \cdot D2 = 32.5 \cdot kPa$

$q_{ultB} := \frac{1}{2} \cdot \gamma_{sum} \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 0.686 \cdot MPa$

EJERCICIO 4.3 - COMPORTAMIENTO NO DRENADO - ANCHO L

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 0.000001°$ $c := 80kPa$ $e_x := 0.60m$

$\gamma_w := 10\frac{kN}{m^3}$

$D1 := 1m$ $D2 := 1.5m$ $prof := D1 + D2 = 2.5\,m$

Cálculos

$N_q := e^{\pi\cdot\tan(\phi)}\cdot\left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 1$

$N_c := \cot(\phi)\cdot\left(N_q - 1\right) = 5.142$

$N_\gamma := 1.5\cdot\left(N_q - 1\right)\cdot\tan(\phi) = 2.349\times 10^{-15}$

$d_c := 1 + 0.4\cdot\operatorname{atan}\left(\frac{prof}{Leq}\right) = 1.322$ $d_q := 1 + 2\tan(\phi)\cdot(1 - \sin(\phi))^2\cdot\operatorname{atan}\left(\frac{prof}{Leq}\right) = 1$ $d_\gamma := 1$

$s_c := 1 + \frac{N_q}{N_c}\cdot\frac{Leq}{Beq} = 1.156$ $s_\gamma := \max\left(1 - 0.4\cdot\frac{Leq}{Beq}, 0.6\right) = 0.68$ $s_q := 1 + \sin(\phi)\cdot\frac{Leq}{Beq} = 1$

$\sigma_0 := \gamma\cdot D1 + \left(\gamma - \gamma_w\right)\cdot D2 = 32.5\cdot kPa$

$q_{ultL} := \frac{1}{2}\cdot\gamma_{sum}\cdot Leq\cdot N_\gamma\cdot s_\gamma\cdot d_\gamma + \sigma_0\cdot N_q\cdot s_q\cdot d_q + c\cdot N_c\cdot s_c\cdot d_c = 0.661\cdot MPa$

$q_{ult} := \min\left(q_{ultB}, q_{ultL}\right) = 661.036\cdot kPa$

$P_{ult} := q_{ult}\cdot Beq\cdot Leq = 4.759\times 10^3\cdot kN$

$P_{adm} := \frac{P_{ult}}{3} = 1.586\times 10^3\cdot kN$

4.5 Para el mismo perfil estratigráfico y nivel de fundación indicado en el ejercicio 4.2, diseñar para condición de largo plazo la fundación de un tabique portante (L>>B) que transmite al terreno una carga q=600kN/m.

EJERCICIO 4.4 - COMPORTAMIENTO DRENADO

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 28°$ $c := 3kPa$

$Beq := 2.25m$ $Leq := Beq \cdot 100000000$ $\gamma_w := 10\frac{kN}{m^3}$

$D1 := 1m$ $D2 := 1.5m$ $prof := D1 + D2 = 2.5\,m$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 14.72$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 25.803$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 10.942$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.335 \qquad d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.251 \qquad d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} \cdot \frac{Beq}{Leq} = 1 \qquad s_\gamma := \max\left(1 - 0.4 \cdot \frac{Beq}{Leq}, 0.6\right) = 1 \qquad s_q := 1 + \sin(\phi) \cdot \frac{Beq}{Leq} = 1$$

$$\sigma_0 := \gamma \cdot D1 + \left(\gamma - \gamma_w\right) \cdot D2 = 32.5 \cdot kPa$$

$$q_{ult} := \frac{1}{2} \cdot \gamma_{sum} \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 0.813 \cdot MPa$$

$$P_{ult} := q_{ult} \cdot Beq = 1.828 \times 10^3 \frac{1}{m} \cdot kN$$

$$P_{adm} := \frac{P_{ult}}{3} = 609.402 \cdot \frac{kN}{m}$$

EJERCICIO 4.4 - COMPORTAMIENTO NO DRENADO

Parámetros iniciales

$\gamma := 19\frac{kN}{m^3}$ $P := 2500kN$ $s_u := 80kPa$ $\phi := 0.000001°$ $c := 80kPa$

$Beq := 3.30m$ $Leq := Beq \cdot 1000000000$ $\gamma_w := 10\frac{kN}{m^3}$

$D1 := 1m$ $D2 := 1.5m$ $prof := D1 + D2 = 2.5\,m$

Cálculos

$$N_q := e^{\pi \cdot \tan(\phi)} \cdot \left(\tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)\right)^2 = 1$$

$$N_c := \cot(\phi) \cdot \left(N_q - 1\right) = 5.142$$

$$N_\gamma := 1.5 \cdot \left(N_q - 1\right) \cdot \tan(\phi) = 2.349 \times 10^{-15}$$

$$d_c := 1 + 0.4 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1.259 \qquad d_q := 1 + 2\tan(\phi) \cdot (1 - \sin(\phi))^2 \cdot \operatorname{atan}\left(\frac{prof}{Beq}\right) = 1 \qquad d_\gamma := 1$$

$$s_c := 1 + \frac{N_q}{N_c} \cdot \frac{Beq}{Leq} = 1 \qquad s_\gamma := \max\left(1 - 0.4 \cdot \frac{Beq}{Leq}, 0.6\right) = 1 \qquad s_q := 1 + \sin(\phi) \cdot \frac{Beq}{Leq} = 1$$

$$\sigma_0 := \gamma \cdot D1 + \left(\gamma - \gamma_w\right) \cdot D2 = 32.5 \cdot kPa$$

$$q_{ult} := \frac{1}{2} \cdot \gamma_{sum} \cdot Beq \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma + \sigma_0 \cdot N_q \cdot s_q \cdot d_q + c \cdot N_c \cdot s_c \cdot d_c = 0.55 \cdot MPa$$

$$P_{ult} := q_{ult} \cdot Beq = 1.817 \times 10^3 \frac{1}{m} \cdot kN$$

$$P_{adm} := \frac{P_{ult}}{3} = 605.548 \cdot \frac{kN}{m}$$