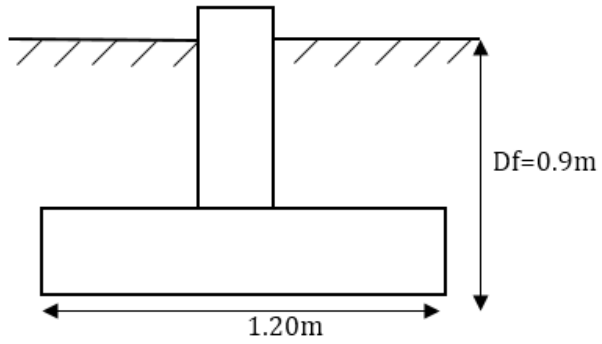
EXAMPLE 1.



A strip foundation is shown in figure. The soil supporting the foundation has a friction angle of 20°and c'=20 kN/m2 . The unit weight of soil, is 17.30 kN/m^3.

Determine the allowable bearing capacity of the foundation with a factor of safety (FS) of 3.

SOLUTION 1.

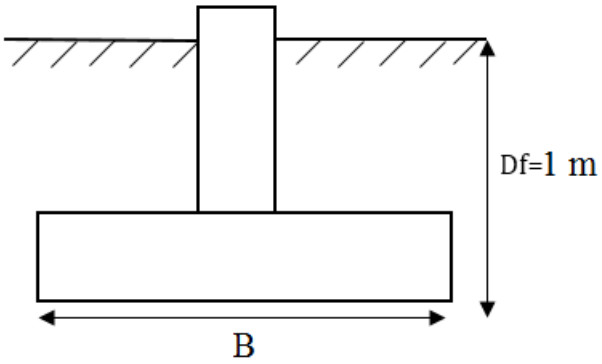
$$\phi = 20° \rightarrow N_c = 17.69,\ N_q = 7.44,\ N_\gamma = 3.64$$

$$q_u = cN_c + D_f \gamma N_q + \frac{1}{2} B\gamma N_\gamma$$

$$q_u = (9.6)(17.69) + (0.9)(17.30)(7.44) + \frac{1}{2}(1.20)(17.30)(3.64)$$

$$q_u = 323.48\ kN/m^2$$

EXAMPLE 2.



For the square foundation shown in the figure , the gross allowable load, Q_{all}, with FS=3 is 294.3 kN. If the supporting sandy soil has a friction angle of 35°and unit weight of 18.15 kN/m^3, determine the size of the footing.

SOLUTION 2.

$$\phi = 35° \rightarrow N_c = 57.75,\ N_q = 41.44,\ N_\gamma = 45.41$$

$$q_{all} = \frac{q_u}{3}$$

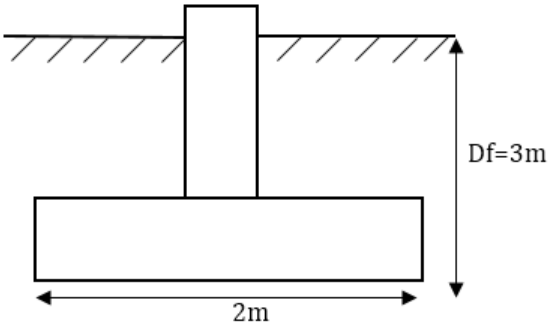
$$q_{all} = \frac{Q_{all}}{BxB} \rightarrow \frac{q_u}{3} = \frac{Q_{all}}{B^2}$$

$$\frac{(1.3)(0)(57.75) + (1)(18.15)B(45.41)}{3} = \frac{294.3}{B^2}$$

$$\frac{294.3}{B^2} = 250.7 + 109.9B$$

$$B = 0.91m$$

EXAMPLE 3.

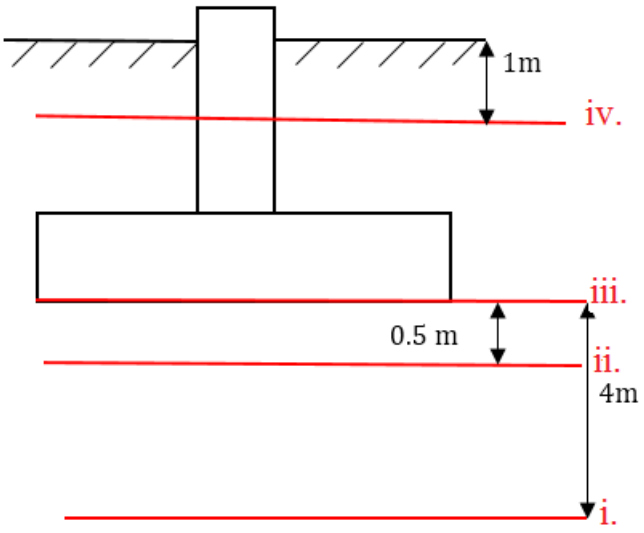


A strip foundation with 2m width is shown in the figure. The soil supporting the foundation has a friction angle of 15°and c=7 t/m^2 . The saturated unit weight of the soil is 2.0 t/m^2 and natural unit weight of the soil, is 1.71 t/m^2.

Determine the ultimate bearing capacity of the strip foundation for the given cases,

i. GWT is located at 4m from base of the foundation.
ii. GWT is located at 0.5m from foundation base.
iii. GWT is located at the foundation base.
iv. GWT is located at 1m from ground surface.

SOLUTION 3.



i.

$d > B \rightarrow 4 > 2$ *No GWT effect*

$q_u = cN_c + D_f \gamma N_q + \frac{1}{2} B \gamma N_\gamma$

$\phi = 15° \rightarrow N_c = 12.86,\ N_q = 4.45,\ N_\gamma = 1.52$ No GWT effect

$q_u = (7)(12.86) + (3)(1.7)(4.45) + \frac{1}{2}(1.7)(2)(1.52)$

$q_u = 115.,3t / m^2$

ii.

$d = 0.5 < B = 2m$

$\bar{\gamma}_2 = \gamma_2 ' + (\frac{d}{B})(\gamma - \gamma_2 ')$

$\gamma_2 ' = \gamma_{sat2} - \gamma_w$

$\gamma_2 ' = 2 - 1 = 1t / m^3$

$\bar{\gamma}_2 = \gamma_2 ' + (\frac{d}{B})(\gamma - \gamma_2 ')$

$\bar{\gamma}_2 = 1 + (\frac{0.5}{2})(1.7 - 1) = 1.175t / m^3$

$q_u = (7)(12.86) + (3)(1.7)(4.45) + \frac{1}{2}(1.175)(2)(1.52)$

$q_u = 114.501t / m^2$

iii.

$q_u = (7)(12.86) + (3)(1.7)(4.45) + \frac{1}{2}(1)(2)(1.52)$

$q_u = 114.24t / m^2$

iv.

$q_u = (7)(12.86) + \left[(1)(1.7) + 2(2-1)\right](4.45) + \frac{1}{2}(2-1)(2)(1.52)$

$q_u = 108t / m^2$

EXAMPLE 4.

A square foundation is 2x2m in plan. The soil supporting the foundation has a friction angle of 25° and c'=20 kN/m^2. The unit weight of soil, is 16.5 kN/m^3

Determine the allowable gross load on the foundation with a factor of safety (FS) of 3. Assume that the depth of the foundation is 1.5 m and that general shear failure occurs in the soil. Use the general bearing capacity equation.

SOLUTION 4.

$$q_u = c' N_c F_{cs} F_{cd} F_{ci} + q N_q F_{qs} F_{qd} F_{qt} + \frac{1}{2}\gamma B N_\gamma F_{\gamma S} F_{\gamma d} F_{\gamma t}$$

$$F_{cs} = 1 + (\frac{B}{L})(\frac{N_q}{N_c}) = 1 + (\frac{2}{2})(\frac{10.66}{20.72}) = 1.514$$

$$F_{qs} = 1 + (\frac{B}{L})\tan\phi' = 1 + (\frac{2}{2})\tan 25 = 1.466$$

$$F_{\gamma S} = 1 - 0.4(\frac{B}{L}) = 1 - 0.4(\frac{2}{2}) = 0.6$$

$$F_{qd} = 1 + 2\tan\phi'(1 - \sin\phi')^2(\frac{D_f}{B})$$

$$F_{qd} = 1 + 2(\tan 25)(1 - \sin 25)^2(\frac{1.5}{2}) = 1.233$$

$$F_{cd} = F_{qd} - \frac{1 - F_{qd}}{Nc\tan\phi'} = 1.233 - \left[\frac{1 - 1.233}{(20.72)(\tan 25)}\right] = 1.257$$

$$F_{\gamma d} = 1$$

$$q_u = (20)(20.72)(1.514)(1.257)(1) + (1.5x16.5)(10.66)(1.466)(1.233)(1) + \frac{1}{2}(16.5)(2)(10.88)(0.6)(1)(1)$$

$$q_u = 1373.2 kN/m^2$$

$$q_{all} = \frac{q_u}{FS} = \frac{1373.2}{3} = 457.7 kN/m^2$$

$$Q = (457.7)(2x2) = 1830.8 kN$$