#1) Given: Square column foundation $q_{all} = \frac{Q_{all}}{B^2} = \frac{1805}{B^2}$

$D_f = 1.5\,m$ $\gamma = 15.9\,KN/m^3$ $\phi = 34°$ $c' = 0$ $FS = 3$

Find: Use Terzaghi's eqn. to determine the size of the foundation.

Solution:

$$q_u = 1.3c'N_c + qN_q + 0.4\gamma BN_\gamma$$

for $\phi = 34°$; $N_c = 52.64$; $N_q = 36.5$; $N_\gamma = 38.04$

$$\frac{1805}{B^2} = [1.3(0)(52.64)] + [23.85(36.5)] + [0.4(15.9\,KN/m^3)B(38.04)]$$

$$q = \gamma D_f = 15.9\,KN/m^3\,(1.5\,m) = 23.85\,KN/m^2$$

$$\frac{1805}{B^2} = 870\,KN/m^2 + 241.9\,KN/m^3\,(B)$$

$$\boxed{B = 2.0\,m \quad \text{(each side)}}$$

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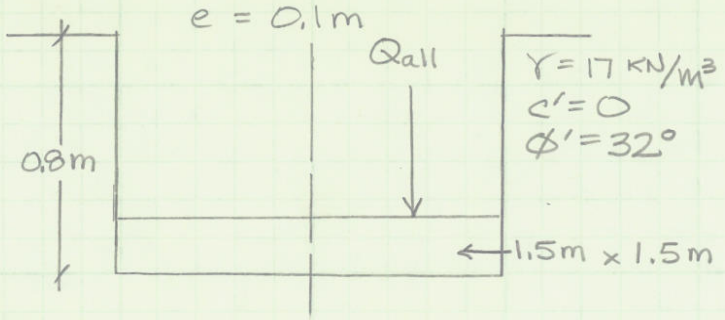
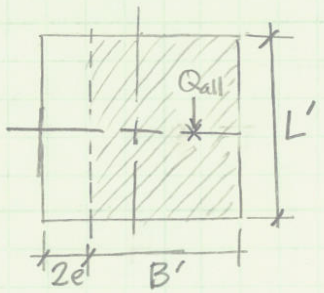
#2) Given: One-way Eccentrically loaded foundation.



Find: Q_{all}

Solution:



$B' = B - 2e = 1.5 - 2(0.1) = 1.3\,m$ $\quad \frac{D_f}{B'} = \frac{0.8}{1.3} = 0.62$

$L = 1.5\,m = L'$

$q_u' = c' N_c F_{cs} F_{cd} F_{ci} + q N_q F_{qs} F_{qd} F_{qi} + \frac{1}{2}\gamma B N_\gamma F_{\gamma s} F_{\gamma d} F_{\gamma i}$ ($c' = 0$; $q = \gamma D_f$)

Table 3.3 for $\phi = 32°$ $N_c = 35.49$ $N_q = 23.18$ $N_\gamma = 30.22$

Since load is vertical $F_{ci} = F_{qi} = F_{\gamma i} = 1$

From Table 3.4

$F_{cs} = 1 + \frac{B'}{L'}\left(\frac{N_q}{N_c}\right) = 1 + \frac{1.3}{1.5}\left(\frac{23.18}{35.49}\right) = 1.653$

$F_{qs} = 1 + \frac{B'}{L'}\tan\phi' = 1 + \frac{1.5}{1.5}\tan 32 = 1.625$

$F_{\gamma s} = 1 - 0.4\left(\frac{B'}{L'}\right) = 1 - 0.4\left(\frac{1.3}{1.5}\right) = 0.653$

$F_{qd} = 1 + 2\tan\phi'(1 - \sin\phi')^2\left(\frac{D_f}{B'}\right) = 1 + 2\tan 32(1 - \sin 32)^2\left(\frac{0.8}{1.5}\right) = 1.15$

$F_{cd} = F_{qd} - \frac{1 - F_{qd}}{N_c \tan\phi'} = 1.17 - \frac{1 - 1.17}{35.49 \tan 32} = 1.178$

$F_{\gamma d} = 1$

$q_u' = 0.8(23.18)(1.542)(1.17)(1) + \frac{1}{2}\left(17\frac{kN}{m^2}\right)(1.3)(30.22)(0.653)(1)(1)$

$q_u' = \cancel{818.77\,kN}$ 774.91 kN/m^2 (4/5)

$Q_{ult} = q_u' B' L = 818.77\,kN\,(1.3)(1.5) = 1596.5\,kN$

$Q_{all} = \frac{Q_{ult}}{FS} = \frac{1596.5}{4} = 399\,kN$

$\boxed{Q_{all} = \cancel{399}\,kN}$

377.8