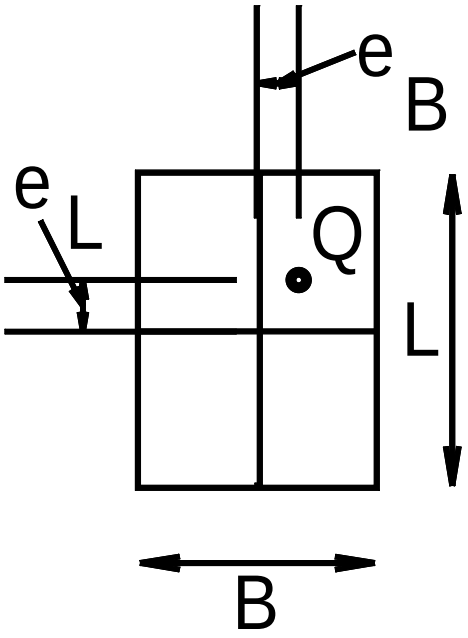
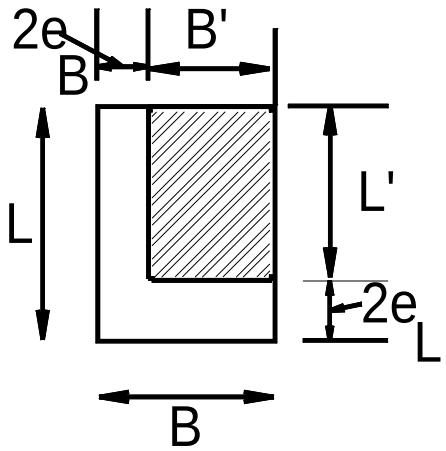
Equivalent loading (1API method)



$$e_B = \frac{M_B}{Q}$$

$$e_L = \frac{M_L}{Q}$$

Design size



Rectangular footings:
L' = L - 2 e_L

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[1] *American Petroleum Institute Method*

$B' = B - 2\, e_B$

Soil pressure assumed uniform on footing area $L' \times B'$.

- Use L' and B' for shape factors and $F_{\gamma s} \geq 0.6$
- Use actual L and B for inclination and depth factors
- Use B' for footing width in N_γ term

Example 1

B = 1.5 m, L = 1.5 m; e_L = 0.3 m and e_B = 0.15. D_f = 0.7 m, ϕ = 30, c = 0, γ = 18 kN/m^3

Determine Q_{ult}.

Solution

B' = 1.5 - 2x0.3 = 0.9 m

L' = 1.5 - 2x0.15 = 1.2 m

For shape factors, B = B′

$$F_{qs} = 1 + \frac{B'}{L'}\tan\phi = 1 + \frac{0.9}{1.2}\tan 30 = 1.433$$

$$F_{\gamma s} = 1 - 0.4\left(\frac{B'}{L'}\right) = 1 - 0.4\left(\frac{0.9}{1.2}\right) = 0.7 \geq 0.6, \text{ OK}$$

For depth factors, B = B

$D_f/B = 0.7/1.5 < 1$

$q = 18 \times 0.7 = 12.6$ kPa

$$F_{qd} = 1 + 2\tan 30(1 - \sin 30)^2 \frac{0.7}{1.5} = 1.135$$

$F_{\gamma d} = 1$

For ϕ = 30, Nq = 18.4 and Nγ = 22.4

$q_{ult} = qN_qF_{qs}F_{qd}F_{qi} + 0.5\,\gamma BN_\gamma F_{\gamma s}F_{\gamma d}F_{\gamma i}$

$q_{ult} = 12.6 \times 18.4 \times 1.433 \times 1.135 + 0.5 \times 18 \times 0.9 \times 22.4 \times 0.7 \times 1$

q_{ult} = 504.1 kPa

$Q_{ult} = q_{ult} \times B' \times L' = 0.9 \times 1.2 \times 504.1 =$ **542 kN**

Other method 605.95 kN, difference about 11%