5.14 From Eq. (5.36) the equivalent diameter is

$$B_e = \sqrt{\frac{4BL}{\pi}} = \sqrt{\frac{(4)(8)(2.5)}{\pi}} = 5.05 \text{ ft}$$

$$q_o = 3000 \text{ lb/ft}^2$$

$$\beta = \frac{E_o}{kB_e} = \frac{1250}{(30)(5.05)} = 8.25$$

$$\frac{H}{B_e} = \frac{8}{5.05} = 1.58$$

From Figure 5.19, for $\beta = 8.25$ and $H/B_e = 1.58$, the value of $I_G \approx 0.72$

Eq. (5.40):

$$I_F = \frac{\pi}{4} + \frac{1}{4.6 + 10\left(\frac{E_f}{E_o + \frac{B_e}{2}k}\right)\left(\frac{2t}{B_e}\right)^3}$$

$$= \frac{\pi}{4} + \frac{1}{4.6 + 10\left[\frac{2 \times 10^6}{1250 + \left(\frac{5.05}{2}\right)(30)}\right]\left[\frac{(2)(1)}{5.05}\right]^3} = 0.786$$

Eq. (5.41):

$$I_E = 1 - \frac{1}{3.5\exp(1.22\mu_s - 0.4)\left(\frac{B_e}{D_f} + 1.6\right)}$$

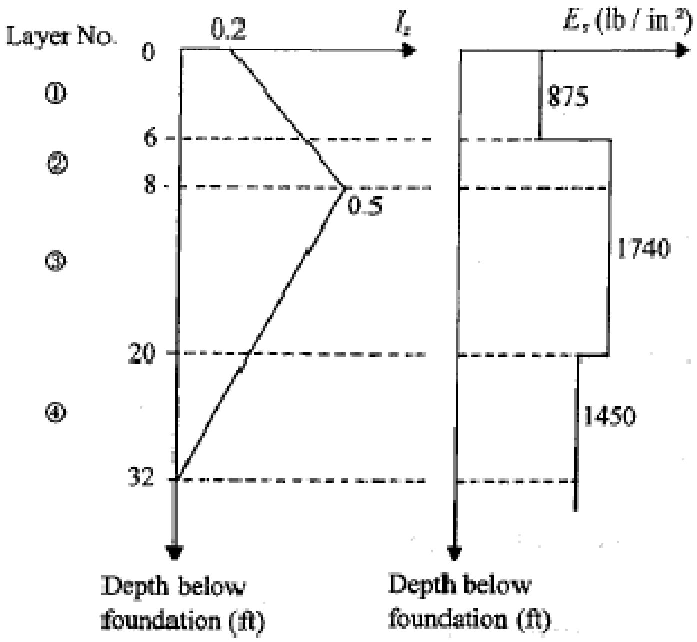
$$= 1 - \frac{1}{3.5\exp[(1.22)(0.4) - 0.4]\left(\frac{5.05}{2.5} + 1.6\right)} = 0.928$$

Eq. (5.39):

$$S_e = \frac{q_o B_e I_G I_F I_E}{E_o}(1 - \mu_s^2) = \frac{(3000)(5.05)(0.72)(0.786)(0.928)}{(1250 \times 144)}(1 - 0.4^2)$$

$= 0.037$ ft $\approx$ **0.446 in.**

5.18 See the figure below for strain influence factor diagram.



Depth (ft)	Δz (in.)	E_s (lb / in.^{2})	I_z	$\frac{I_z}{E_s}(\Delta z)$
0–6	72	875	0.313	0.0258
6–8	24	1740	0.463	0.0064
8–20	144	1740	0.375	0.0301
20–32	144	1450	0.125	0.0124
				$\sum 0.0756$

$q = \gamma D_f = (115)(5) = 575$ lb / in.^{2}

$$C_1 = 1 - 0.5\left(\frac{q}{\bar{q} - q}\right) = 1 - 0.5\left(\frac{575}{4000 - 575}\right) = 0.916; \quad C_2 = 1 + 0.2\log\left(\frac{10}{0.1}\right) = 1.4$$

$$S_e = C_1 C_2 (\bar{q} - q)\Sigma \frac{I_z}{E_s}\Delta z = (0.916)(1.4)(\frac{4000 - 575}{144})(0.0756) = \mathbf{2.31\ in.}$$

5.6 The plan of the foundation can be divided into 4 areas, each measuring 2.5 ft × 2.5 ft.

$H_1 = 3$ ft; $H_2 = 13$ ft; $B = 2.5$ ft; $L = 2.5$ ft

$$m_2 = \frac{B}{H_1} = \frac{2.5}{3} = 0.833; \quad n_2 = \frac{L}{H_1} = \frac{2.5}{3} = 0.833$$

Figure 5.7: $I_{a(H_1)} = 0.212$

$$m_2 = \frac{B}{H_2} = \frac{2.5}{3} = 0.833; \quad n_2 = \frac{L}{H_2} = \frac{2.5}{13} = 0.192$$

Figure 5.7: $I_{a(H_2)} = 0.13$

$$\Delta\sigma_{av(H_1/H_2)} = \left[\frac{H_2 I_{a(H_2)} - H_1 I_{a(H_1)}}{H_2 - H_1}\right] = (q_o)(4)$$

$$= \left[\frac{(13)(0.13) - (3)(0.212)}{13 - 3}\right]\left(\frac{50 \times 2000}{5 \times 5}\right)(4) = \mathbf{1686\ lb/ft^2}$$

5.23 $$\sigma'_o = (4.5)(100) + (3)(122 - 62.4) + \frac{10}{2}(120 - 62.4)$$

$$= 450 + 178.8 + 288 = 916.8 \text{ lb/ft}^2$$

$$\sigma'_o + \Delta\sigma'_{av} = 916.8 + 1686 = 2602.8 \text{ lb/ft}^2$$

$$S_{c(p)} = \frac{C_s H_c}{1 + e_o}\log\frac{\sigma'_c}{\sigma'_o} + \frac{C_c H_c}{1 + e_o}\log\frac{\sigma'_o + \Delta\sigma'_{av}}{\sigma'_c}$$

$$= \frac{(0.06)(10 \times 12)}{1 + 0.7}\log\left(\frac{2000}{916.8}\right) + \frac{(0.25)(10 \times 12)}{1 + 0.7}\log\left(\frac{2602.8}{2000}\right) = \mathbf{3.45\ in.}$$