

Foundation Design

Pile design: Cohesive soil

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Table-11.2

C_u	I_p	N_c^*
24 kPa (500 psf)	50	6.55
48 kPa (1000 psf)	150	8.01
96 kPa (2000 psf)	250	8.69
192 kPa (4000 psf)	350	8.94

$$q_{max} = C_u N_c^* \quad \text{---} \quad 11.7 \quad \text{Reese Page-332}$$

$$\alpha = 0.55 \quad c_u/p_a \leq 1.5 \quad \text{---} \quad 11.6a$$

$$\alpha = 0.55 - 0.1 \left(\frac{c_u}{p_a} - 1.5 \right) \quad \text{for} \quad 1.5 < \frac{c_u}{p_a} \leq 2.5 - 11.6B$$

$p_a = 101.3 \text{ kPa} = \text{atmospheric pressure}$

$$f_s = \alpha C_u$$

$$Q = Q_s + \frac{Q_b}{2}$$

$$Q_s = \int f_s z \, dA$$

$$Q_b = A_b \times q_{max}$$

B-method

$$f_{sz} = \beta \sigma_z' \leq 2.1 \text{ tsf}$$

$$\beta = \frac{N_{60}}{1.5} \left(1.5 - \cancel{0.135 \sqrt{z}} (ft) \right) \text{ or}$$

$$\beta = \frac{N_{60}}{1.5} \left(1.5 - 0.245 \sqrt{z(m)} \right); \quad \underline{0.25 < \beta < 1.20}$$

$$\beta = 1.5 - 0.135 \sqrt{z} \text{ (ft)}$$

$$\text{or } \beta = 1.5 - 0.245 \sqrt{z(m)}$$

For, $\beta = 1.20$

$$1.20 = 1.5 - 0.245 \sqrt{z}$$

$$\Rightarrow \sqrt{z} = \frac{1.5 - 1.20}{0.245} = \frac{0.30}{0.245}$$

$$\Rightarrow z = \left(\frac{1.5 - 1.20}{0.245} \right)^2 = 1.5 \text{ m}$$

For, $\beta = 0.25$,

$$0.25 = 1.5 - 0.245 \sqrt{z}$$

$$\Rightarrow z = \left(\frac{1.5 - 0.25}{0.245} \right)^2 = 26 \text{ m}$$

β will be applicable for depth 1.5 m to 26 m.

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$\sigma_z = \text{effective overburden pressure}$

$$= \sigma_{\text{sub}2}$$

$$q_w = 0.60 \times N_{\text{spt}} \leq 30 + sf \quad \text{if } L \geq 32 \text{ feet} \\ \text{--- (11.28)}$$

$$\text{if } L \leq 32.8 \quad q_w = \frac{L}{32.8} \times 0.60 N_{\text{spt}} \text{ --- (11.29)}$$

consistency	N ₇₀	q _u WTA	q _u psf	q _u psf
Very soft	0-2	< 25	500	250
Soft	3-5	25-50	500-1000	250-500
Medium	6-9	50-100	1000-2000	500-1000
Stiff	10-16	100-200	2000-4000	1000-2000
Very stiff	17-30	200-400	4000-8000	2000-4000
Hard	> 30	> 400	> 8000	> 4000



Skin friction

45 ft for stiff
45 ft for very stiff

45 ft for soft
45 ft for medium

45 ft for stiff
45 ft for very stiff

45 ft for soft
45 ft for medium

45 ft for stiff
45 ft for very stiff

$$f_{11} = 0.85 \times 25 \times 0 = 21.25$$

$$\sigma_2 = (120 - 0.21) = 119.79$$

$$N = \frac{7}{1 - \beta} = \frac{7}{1 - 0.135} = 7.95$$

$$N = 8$$

$$N = 28$$

Depth SS4 - 30 ft

$$\sigma_z = 62.5 \times (120 - 62.5) = 3593.75 \text{ psf}$$

$$B = 1.5 - 0.135 \sqrt{62.5} = 0.43$$

$$f_{s2} = 0.43 \times 3593.75 = 15245.3125 \text{ psf}$$

~~Depth~~

End Bearing

$$q_b = 0.6 \times N_{qPT} = 0.6 \times 28 = 16.8 \text{ tsf} \\ = 33600 \text{ psf}$$

Try 18" dia Cast in situ pile

$$A_{fb} = \frac{\pi}{4} \times 1.5^2 = 1.766 \text{ ft}^2$$

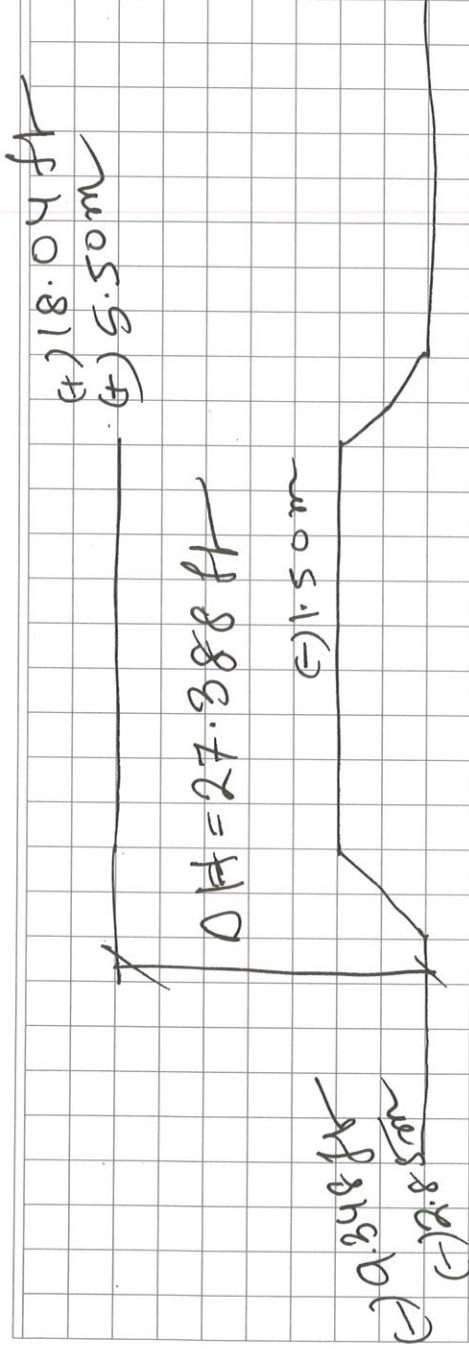
$$A_s = A_{DL} = 4.71 \text{ ft}^2/\text{ft}$$

$$Q_s = f_{c1} A_{s1} + f_{c2} A_{s2} = 1570 \times 4.71 \times 5 + 1545 \times 15 \times 4.71 \\ = 146127 \text{ lb}$$

$$Q_b = f_b \times A_{fb} = 33600 \times 1.766 = 59136 \text{ lb}$$

$$Q_{\text{ult}} = Q_b + Q_s = 205263 \text{ lb}$$

$$Q_{\text{allowable}} = \frac{Q_{\text{ult}}}{2} = 68421 \text{ lb} \approx 68 \text{ wp/pile}$$



$$\text{Soil pressure} = 27.4 \times 120 = 3288 \text{ PSF}$$

$$\text{Pile number required} = \frac{68000}{3288} = 21.14$$

$$\therefore \text{Pile spacing} = \sqrt{21} = 4.58 \text{ ft} \approx 4.5 \text{ ft} \%$$

Pile length = 70 feet ~~45~~