Solution 200 Kip Pile

- Structural Capacity of Uncased Length

$$P_{c-allowable} = 0.4\, f'_{c-grout}\, A_{grout} + 0.47\, F_{y-bar}\, A_{bar}$$

$$A_{bar} = \frac{\pi}{4}(D_{bar})^2 = \frac{\pi}{4}(2.5\,in.)^2 = 4.9\,in.^2$$

$$A_{grout} = \frac{\pi}{4}(D_{drillhole})^2 - A_{bar} = \frac{\pi}{4}(4.5\,in.)^2 - 4.9\,in.^2 = 11\,in.^2$$

$$F_{y-bar} = \min\left(F_{y-bar},\ grout\ \ crushing\ \ strength\right)$$

$$grout\ \ crushing\ \ strength = 29{,}000\ ksi \times 0.003 = 87\ ksi$$

$$F_{y-bar} = \min\left(150\ ksi,\ 87\ ksi\right) = 87\ ksi$$

$$\therefore P_{c-allowable} = 0.4\,(4\ ksi)\,(11\,in.^2) + 0.47\,(87\ ksi)\,(4.9\,in.^2) = 218\ kips$$

$$218\ kips > 200\ kips \quad OK$$

Solution 200 Kip Pile

- **Structural Capacity of Cased Length**

$$P_{c-allowable} = \left[0.4\, f'_{c-grout} \times A_{grout} + 0.47\, F_{y-casing}\, A_{casing}\right]$$

$$A_{casing} = \frac{\pi}{4}(OD^2 - ID^2)$$

$$ID = OD - 2t_w = 5.5in. - 2(0.415in.) = 4.67in$$

$$A_{casing} = \frac{\pi}{4}(5.5in.^2 - 4.67in.^2) = 6.63in.^2$$

$$A_{grout} = \frac{\pi}{4}(D_{drillhole})^2 - A_{casing} = \frac{\pi}{4}(5.5in.)^2 - 6.63in.^2 = 17.13in.^2$$

$$F_{y-casing} = \min\left(F_{y-casing},\ grout\ \ crushing\ \ strength\right)$$

$$F_{y-casing} = \min\left(80\ ksi,\ 87\ ksi\right) = 80\ ksi$$

$$\therefore P_{c-allowable} = 0.4\,(4\ ksi)\,(17.13\,in.^2) + 0.47\,(80\ ksi)\,(6.63\,in.^2) = 276\ kips$$

$$276\ kips > 200\ kips \quad OK$$

Solution

- Adequacy of proposed bond length
  - Proposed bond length is 12.5 ft
  - Back calculate ultimate bond value and compare to values for granite in Table 5-3.

$$\alpha_{bond} = \frac{P_{G-allowable} \times FS}{\pi \times D_{drillhole} \times L_b}$$

$$\alpha_{bond} = \frac{200\,kips \times 2.0}{\pi \times (4.5in./12in/ft) \times 12.5\,ft} = 27\,ksf\ (=188\,psi)$$

  - Minimum α_{bond} for granite from Table 5-3 is 200 psi (> 188 psi), therefore bond length is reasonable
  - Also, 10% of q_u = 500 psi (can be used to estimate α_{bond} for rock/grout)