

Concrete Breakout Strength of Epoxy Anchor in Tension (ACI 318-14 - 17.4.2)

$$h_{ef} := 8.125 \text{ in} \quad (\text{embed depth}) \quad d_o := 0.75 \text{ in}$$

$$\lambda_a := 1 \quad (\text{normal weight concrete})$$

$$h := 12 \text{ in} \quad (\text{concrete thickness}) \quad h_{min} := h_{ef} + 2 \cdot d_o = 9.63 \text{ in}$$

$$c_{a1} := 3.5 \text{ in} \quad (\text{edge distance})$$

$$f'_c := 2500 \text{ psi} \quad (\text{concrete strength})$$

$$k_c := 24 \quad (\text{ESR-4467F - Table 6}) \quad (\text{effectiveness factor}) \quad (\text{uncracked})$$

$$\tau_{k_uncr} := 1334 \text{ psi} \quad (\text{ESR-4467F - Table 7}) \quad (\text{characteristic bond strength}) \quad (\text{uncracked})$$

$$\Psi_{ed_N} := 0.7 + 0.3 \cdot \frac{c_{a1}}{1.5 h_{ef}} = 0.79 \quad (\text{ACI 318-14 - 17.4.2.5b})$$

$$\Psi_{c_N} := 1 \quad (\text{ESR-4467F - 4.1.3})$$

$$\frac{h}{h_{ef}} = 1.48 \quad h_{h_{ef_max}} := 2.4 \quad (\text{ESR-4467F - 4.1.10})$$

$$h_{h_{ef}} := \min\left(\frac{h}{h_{ef}}, h_{h_{ef_max}}\right) = 1.48 \quad (\text{ESR-4467F - 4.1.10})$$

$$c_{ac} := h_{ef} \cdot \left(\frac{\tau_{k_uncr}}{1160 \text{ psi}}\right)^{0.4} \cdot (3.1 - 0.7 \cdot h_{h_{ef}}) = 17.75 \text{ in} \quad (\text{ESR-4467F - 4.1.10})$$

$$\Psi_{cp_N'} := \frac{c_{a1}}{c_{ac}} = 0.20 \quad \Psi_{cp_N_min} := 1.5 \cdot \frac{h_{ef}}{c_{ac}} = 0.69 \quad (\text{ACI 318-14 - 17.4.2.7b})$$

$$\Psi_{cp_N} := \max(\Psi_{cp_N'}, \Psi_{cp_N_min}) = 0.69 \quad (\text{ACI 318-14 - 17.4.2.7b})$$

$$N_b := k_c \cdot \lambda_a \cdot \sqrt{f'_c} \cdot \left(\frac{h_{ef}}{\text{in}}\right)^{1.5} \cdot \text{lb} = 27791.78 \text{ lb} \quad (\text{ACI 318-14 - 17.4.2.2a})$$

$$A_{Nc} := (c_{a1} + 1.5 \cdot h_{ef}) \cdot (2 \cdot 1.5 \cdot h_{ef}) = 382.38 \text{ in}^2 \quad (\text{ACI 318-14 - Fig. R17.4.2.1b})$$

$$A_{Nco} := 9 \cdot h_{ef}^2 = 594.14 \text{ in}^2 \quad (\text{ACI 318-14 - 17.4.2.1c})$$

$$N_{cb} := \frac{A_{Nc}}{A_{Nco}} \cdot \Psi_{ed_N} \cdot \Psi_{c_N} \cdot \Psi_{cp_N} \cdot N_b = 9653.45 \text{ lb} \quad (\text{ACI 318-14 - 17.4.2.1a})$$

$$\phi := 0.65 \quad (\text{ESR-4467F - Table 6})$$

Concrete Breakout Strength in Tension:

$$\phi \cdot N_{cb} = 6274.74 \text{ lb} \quad (\text{ACI 318-14 - 17.3.1.1})$$

Applied Tension (ASD):

$$T_{ASD} := 6454 \text{ lb} \quad (\text{QTR Capacity from Catalog \& Submittal})$$

$$\alpha_{ASD} := \frac{(0.9 D + W)}{(0.6 D + 0.6 W)} = 1.62$$

$$D := 30\% \quad W := 70\% \\ (\text{QE-1 Catalog Page})$$

Adjusted Applied Tension (LRFD):

$$N_{ua} := T_{ASD} \cdot \alpha_{ASD} = 10433.97 \text{ lb}$$

Utilization Ratio:

$$Tension_Check := \frac{N_{ua}}{\phi \cdot N_{cb}} = 1.66$$

$$Design_Check = \text{"FAIL"}$$

$$Excess_Tension_{ASD} := \frac{N_{ua} - \phi \cdot N_{cb}}{\alpha_{ASD}} = 2572.72 \text{ lb}$$

$$Adjusted_Cable_Capacity_{ASD} := T_{ASD} - Excess_Tension_{ASD} = 3881.28 \text{ lb}$$