

Cautionary Note

Derived from Klingner in ACI SJ 93 1 p.132) (to get the usual confidence of 95% you will need an additional safety factor for anchorages of 2, that is, if you usually for forces amplify by 1.7, for anchors extra amplify multiplying again by 2 to get 3.4. You **need** this load factor to get the proper level of 95% confidence using $\phi_p := 0.65$ pullout strength reduction factor and $\phi_y := 0.9$ steel strength reduction factor .

$f_c := 25 \cdot \text{MPa}$ specified strength cone not curtailed $h_e := 8 \cdot \text{in}$ length of embedment $\phi_p := 0.65$ pull out strength reduction factor
this factor must remain as 0.65 for most applications

STUDS. Concrete Pull-Out (Concrete) Capacity (no Edge Effects included)

$$E := \begin{cases} h_e \cdot \left[1 + \frac{\left(10 - \frac{h_e}{\text{in}} \right)^2}{140} \right] & \text{if } h_e < 10 \cdot \text{in} \\ h_e & \text{otherwise} \end{cases} \quad E = 20.9 \text{ cm} \quad \text{equivalent depth to avoid the use of cones different than } 45^\circ$$

$$SR := \sqrt{\frac{f_c}{\text{psi}}} \cdot \text{psi} \quad K := \begin{cases} 0.21 \cdot f_c & \text{if } f_c < 3 \cdot \text{ksi} \\ 12.57 \cdot SR & \text{otherwise} \end{cases} \quad P_{uC} := \phi_p \cdot K \cdot E^2 \quad \text{a lower bound of anchorage capacity of concrete if embedding concrete is thick enough} \quad t_{\min} := 2 \cdot h_e$$

So the $h_e = 8 \text{ in}$ deep anchor can anchor $P_{uC} = 33312.31 \text{ lbf}$ factored load if the rod is strong enough, load is depth (nut or so) induced and

thickness of concrete is no less than $t_{\min} = 16 \text{ in}$ Calculated by the Stress Cone Method

A corollary of this is that an anchor of given embedment can take the maximum concrete P_{uC} pullout capacity only if distance to edge is at least as big as the embedment. For shallow embedments as this better use $1.5 \cdot h_e$ distance to edge.