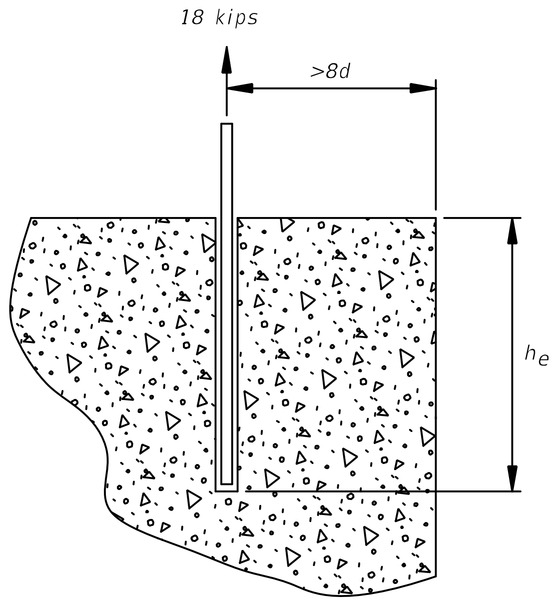
Design Procedure Example 1 **See Figure 1**	**Calculation**
Step 1 - Determine required rod diameter	
Determine the required diameter of the threaded rod by setting the factored tension load equal to the design steel strength.	$\mathbf{N_u = N_s}$
The effective area for the threaded rod may be taken as 75% of the gross area. As with reinforcing bars, the minimum specified yield strength of the rod is used to determine the required diameter.	$\mathbf{N_s = \phi_s A_e f_y}$ Where: $\phi_s = \mathbf{0.9}$; $A_e = \mathbf{0.75}(\pi \mathbf{d}^2/\mathbf{4})$; and $\mathbf{f_y} = \mathbf{100}$ ksi
Substituting and solving for **d**:	$\mathbf{18} = (\mathbf{0.9})[(\pi \mathbf{d}^2/\mathbf{4})](\mathbf{100})$ $\mathbf{d} = \mathbf{0.583}$ in. therefore, use 5/8" threaded rod.
Step 2 - Determine required embedment length to ensure steel failure	
Basic equation for embedment length calculation. Since there are no edge or spacing concerns, Ψ_e and Ψ_{gn} may be taken as unity.	$\mathbf{N_c = \phi_c \Psi_e \Psi_{gn} N_o}$ (for embedment) Where: $\phi_c = \mathbf{0.85}$; $\Psi_e, \Psi_{gn} = \mathbf{1.0}$ (no edge/spacing concern); and $\mathbf{N_o} = \mathbf{T' \pi\, d\, h_e}$
For ductile behavior it is necessary to embed the anchor sufficiently to develop 125% of the yield strength or 100% of the ultimate strength, whichever is less.	$\mathbf{N_c(req'd) = 1.25\, A_e f_y \le A_e f_u}$
Determine the effective area for a 5/8" threaded rod:	$\mathbf{A_e = 0.75\,(\pi 0.625^2/4)}$ $\mathbf{A_e = 0.23\ in^2}$
Determine the required tension force, $\mathbf{N_c(req'd)}$, to ensure ductile behavior.	$\mathbf{N_c(req'd) = 1.25\, A_e f_y \le A_e f_u}$ $\mathbf{N_c(req'd) = 1.25(0.23)(100) \le (0.23)(125)}$ $\mathbf{N_c(req'd) = 28.75\ kips = 28.75\ kips}$ therefore, use $\mathbf{N_c(req'd) = 28.75 kips}$
Substituting and solving for $\mathbf{h_e}$:	$\mathbf{28.75 = 0.85\ (1.0)\ (1.0)\ (1.08)\ \pi\ (.625) h_e}$ $\mathbf{h_e = 16\ in}$

Figure 1 Adhesive Anchors Design Example 1

Design Example 1 - Single Anchor Away from Edges and Other Anchors

Design an adhesive anchor using threaded rod (ASTM A193, Grade B7) for a factored tension load of 18 kips. The anchor is located more than 8 anchor diameters from edges and is isolated from other anchors. The anchor embedment length is to be sufficient to ensure steel failure.

Given:
N_u = 18.0 kips
f_y = 100.0 ksi
f_u = 125.0 ksi
T' = 1.08 ksi

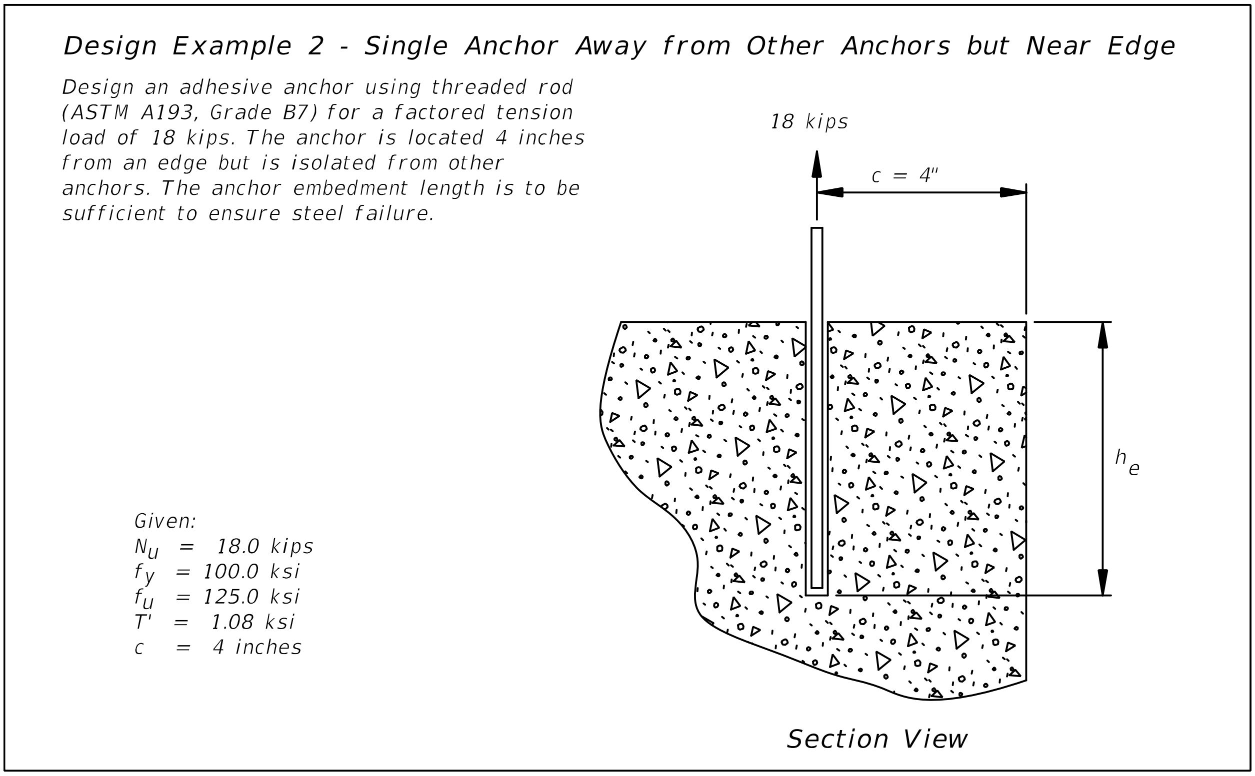


Section View

Design Procedure Example 2 See Figure 2	Calculation
Step 1 - Determine required rod diameter	
Determine the required diameter of the threaded rod by setting the factored tension load equal to the design steel strength.	$N_u = N_s$
The effective area for the threaded rod may be taken as 75% of the gross area. As with reinforcing bars, the minimum specified yield strength of the rod is used to determine the required diameter.	$N_s = \phi_s A_e f_y$ Where: $\phi_s = 0.9$; $A_e = 0.75(\pi d^2/4)$; and $f_y = 100$ ksi
Substituting and solving for **d**:	$18 = (0.9)[0.75(\pi d^2/4)](100)$ $d = 0.583$ in. therefore, use 5/8" threaded rod.
Step 2 - Determine required embedment length to ensure steel failure	
Basic equation for embedment length calculation. Since there are no spacing concerns, Ψ_{gn} may be taken as unity, and, since the edge distance (4 in) is less than **8d** (5 in), the edge effect, Ψ_e, will need to be evaluated.	$N_c = \phi_c \Psi_e \Psi_{gn} N_o$ (for embedment) Where: $\phi_c = 0.85$; $\Psi_{gn} = 1.0$ (no spacing concern); and $N_o = T'\pi d h_e$
For ductile behavior it is necessary to embed the anchor sufficiently to develop 125% of the yield strength or 100% of the ultimate strength, whichever is less.	$N_c(req'd) = 1.25 A_e f_y \le A_e f_u$
Determine the effective area for a 5/8" threaded rod:	$A_e = 0.75(\pi 0.625^2/4)$ $A_e = 0.23 \text{ in}^2$
Determine the required tension force, $N_c(req'd)$, to ensure ductile behavior.	$N_c(req'd) = 1.25 A_e f_y \le A_e f_u$ $N_c(req'd) = 1.25(0.23)(100) \le (0.23)(125)$ $N_c(req'd) = 28.75 \text{ kips} = 28.75 \text{ kips}$ therefore, use $N_c(req'd) = 28.75 \text{kips}$

Design Procedure Example 2 See Figure 2	Calculation
Determine edge effect factor, ψ_e. Note: $C_{cr} = 8d$	$\psi_e = 0.70 + 0.30(c/8d)$ $\psi_e = 0.70 + 0.30[4/(8)(0.625)]$ $\psi_e = 0.94$
Substituting and solving for h_e :	$28.75 = 0.85\ (1.0)\ (0.94)\ (1.08)\ \pi\ (.625) h_e$ $h_e = 16.98$ in

Figure 2 Adhesive Anchors Design Example 2



Design Procedure Example 3 **See Figure 3**	**Calculation**
Step 1 - Determine required rod diameter	
Determine the required diameter of the threaded rod by setting the factored tension load equal to the design steel strength.	$N_u = N_s$
The effective area for the threaded rod may be taken as 75% of the gross area. As with reinforcing bars, the minimum specified yield strength of the rod is used to determine the required diameter.	$N_s = \phi_s A_e f_y$ Where: $\phi_s = 0.9$; $A_e = (2)0.75(\pi d^2/4)$; and $f_y = 100$ ksi
Substituting and solving for **d**:	$18 = (0.9)(2)[0.75(\pi d^2/4)](100)$ $d = 0.412$ in. Although a 1/2" threaded rod is OK, use 5/8" threaded rod to minimize embedment length.
Design steel strength	$N_s = (0.9)(2)[0.75(\pi d^2/4)](100)$ $N_s = 41.4$ kips > 18 kips therefore: OK
Step 2 - Determine required embedment length	
Basic equation for embedment length calculation. Since there are edge or spacing concerns, Ψ_e and Ψ_{gn} will need to be determined.	$N_c = \phi_c \Psi_e \Psi_{gn} N_o$ (for embedment) Where: $\phi_c = 0.85$; Ψ_e and Ψ_{gn} are calculated below; and $N_o = T' \pi d h_e$
Determine edge effect factor, Ψ_e.	$\Psi_e = 0.70 + 0.30(c/8d)$ $\Psi_e = 0.70 + 0.30[4/(8)(0.625)]$ $\Psi_e = 0.94$
Determine group effect factor, Ψ_{gn}.	$\Psi_{gn} = A_n/A_{no}$ $\Psi_{gn} = (4 + 8d)[8 + 2(8d)]/(16d)^2$ $\Psi_{gn} = (4+8(0.625))[8+2(8)(0.625)/16(0.625)^2]$ $\Psi_{gn} = 1.62$

Design Procedure Example 3 **See Figure 3**	**Calculation**
Substituting and solving for $\mathbf{h_e}$:	**18 = 0.85 (1.62) (0.94) (1.08) π (.625)h_e** $h_e = 6.55 in$ **(say 7")** **therefore: OK**
Design adhesive bond strength.	$N_c = (0.85)(1.62)(094)(1.\dot{0}8)\pi(0.625)(7)$ $N_c = 19.21 > 18$ therefore: OK
Step 3 - Final Design Strength	
Strength as controlled by steel.	$N_s = 41.4\,kips > 18\,kips$ therefore: OK
Strength as controlled by adhesive bond.	$N_c = 19.21\,kips > 18\,kips$ therefore: OK
Final Design.	Two 5/8" anchors embedded 7 in.

Figure 3 Adhesive Anchors Design Example 3

Design Example 3 - Two Anchors Spaced at 8 inches, 4 inches from Edge

Design a group of two adhesive anchors using threaded rod (ASTM A193, Grade B7) for a factored tension load of 18 kips. The anchors are located 4 inches from an edge and are spaced 8 inches apart. Steel failure is not required.

Given:

N_u = 18.0 kips
f_y = 100.0 ksi
f_u = 125.0 ksi
T' = 1.08 ksi
c = 4 inches
s = 8 inches