Example calculation for a grouping of adhesive anchors using ASD:

Design a connection comprised of four ¾" diameter all-thread rods installed in f'_c = 2,000 psi concrete using SET adhesive as shown. The anchor grouping is subject to an applied tension load of 3,000 lb. and an applied shear load of 1,000 lb. acting simultaneously.

ADDITIONAL DATA:

- All-thread rod material: ASTM A307.
- All-thread rod embedment depth: 6¾"
- All-thread rod spacing: S1=S3=8", S2=11.3" (use 11") ($S_{critical}$ = 27" > S_{actual}, therefore reduced efficiency.)
- All-thread rod edge distance: C1=C2=3" ($C_{critical}$ = 10⅛" > C_{actual}, therefore reduced efficiency.)

SOLUTION:

Unadjusted allowable tension loads:

Based on adhesive bond strength = T_{bond} = 10,525 lbs.

Based on steel strength = T_{steel} = 8,460 lbs.

Unadjusted allowable shear loads:

Based on concrete strength = V_{conc} = 6,310 lbs.

Based on steel strength = V_{steel} = 4,360 lbs.

Calculate reduced efficiency factors for all-thread rod installed at an edge distance of 3" using tables on pages 48–49:

Tension: C1=C2=3", f_c = 0.56 from f_c - Tension Table

Shear: C1=C2=3", f_c = 0.29 from f_c - Shear Table

Calculate reduced efficiency factors for all-thread rod installed at a spacing of 8" using tables on pages 50–51:

Tension: S1=S3=8", f_s = 0.91 from f_s - Tension Table
S2=11", f_s = 0.925 from f_s - Tension Table

Shear: S1=S3=8", f_s = 0.95 from f_s - Shear Table
S2=11", f_s = 1.00 from f_s - Shear Table

Reduce allowable tension value based on bond strength. The reduction factors are cumulative due to the influence of two reduced edge distance conditions and three reduced spacing conditions:

$(T_{bond})net = (f_c)(f_s)(T_{bond})$
= (0.56 x 0.56)(0.91 x 0.91 x 0.925)(10,525 lbs.)
= 2,528 lbs.

Allowable tension value is the lesser of:

Tension based on net bond strength = **2,528 lbs.** (governs) or

Tension based on steel strength = 8,460 lbs.

For a group of 4 anchors the combined allowable tension value is:

= (4 anchors)(2,528 lbs./anchor) = **10,112 lbs. > 3,000 lbs. (design tension) O.K.**

(Note: If high in-service temperature is expected, the allowable based on bond/concrete should be multiplied by a strength reduction factor found in the adhesive's temperature sensitivity table.)

Reduce allowable shear value based on concrete strength. The reduction factors are cumulative due to the influence of two reduced edge-distance conditions and three reduced spacing conditions:

$(V_{conc})net = (f_c)(f_s)(V_{conc})$
= (0.29 x 0.29)(.95 x .95 x 1.00)(6,310 lbs.)
= 478 lbs.

Allowable shear value is the lesser of:

Shear based on net concrete strength = **478 lbs.** (governs) or

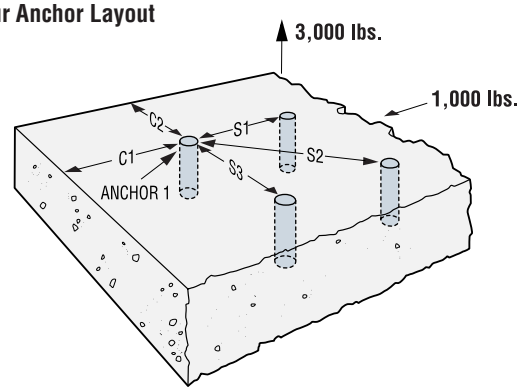
Shear based on steel strength = 4,360 lbs.

For a group of 4 anchors the combined allowable shear value is:

= (4 anchors)(478 lbs./anchor) = **1,912 lbs. > 1,000 lbs. (design shear) O.K.**

(Note: If high in-service temperature is expected, the allowable shear based on bond/concrete should be multiplied by a strength reduction factor found in the adhesive's temperature sensitivity table.)

Four Anchor Layout



The allowable tension (or shear) value for a group of anchors is equal to the lowest (minimum) tension (or shear) value for a single anchor within the group multiplied by the number of anchors within the group.

CHECK COMBINED TENSION AND SHEAR INTERACTION:

For adhesive anchors, use the straight-line method (n=1.0, see Figure 1) when calculating the interaction of both tension and shear upon the anchor per the following equation:

$(\text{Design shear/allowable shear})^n + (\text{Design tension/allowable tension})^n \leq 1.0$, n=1.0

Design shear (V) = 1,000 lbs.

Allowable shear (V_{all}) = 1,912 lbs.

Design tension (T) = 3,000 lbs.

Allowable tension (T_{all}) = 10,112 lbs.

$(1{,}000/1{,}912)^{1.0} + (3{,}000/10{,}112)^{1.0} = 0.82 \leq 1.0$ **O.K.**

Figure 1