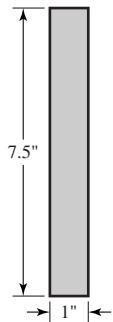


- 9-23** The largest possible weld size is 1/16 in. This is a small weld and thus difficult to accomplish. The bracket's load-carrying capability is not known. There are geometry problems associated with sheet metal folding, load-placement and location of the center of twist. This is not available to us. We will identify the strongest possible weldment.

Use a rectangular, weld-all-around pattern – Table 9-2, category 6:



$$\begin{aligned}A &= 1.414 h(b + d) \\ &= 1.414(1/16)(1 + 7.5) \\ &= 0.751 \text{ in}^2 \\ \bar{x} &= b/2 = 0.5 \text{ in} \\ \bar{y} &= \frac{d}{2} = \frac{7.5}{2} = 3.75 \text{ in}\end{aligned}$$

$$I_u = \frac{d^2}{6}(3b + d) = \frac{7.5^2}{6}[3(1) + 7.5] = 98.4 \text{ in}^3$$

$$I = 0.707hI_u = 0.707(1/16)(98.4) = 4.35 \text{ in}^4$$

$$M = (3.75 + 0.5)W = 4.25W$$

$$\tau' = \frac{V}{A} = \frac{W}{0.751} = 1.332W$$

$$\tau'' = \frac{Mc}{I} = \frac{4.25W(7.5/2)}{4.35} = 3.664W$$

$$\tau_{\max} = \sqrt{\tau'^2 + \tau''^2} = W\sqrt{1.332^2 + 3.664^2} = 3.90W$$

Material properties: The allowable stress given is low. Let's demonstrate that.

For the A36 structural steel member, $S_y = 36$ kpsi and $S_{ut} = 58$ kpsi. For the 1020 CD attachment, use HR properties of $S_y = 30$ kpsi and $S_{ut} = 55$. The E6010 electrode has strengths of $S_y = 50$ and $S_{ut} = 62$ kpsi.

Allowable stresses:

$$\begin{aligned} \text{A36:} \quad \tau_{\text{all}} &= \min[0.3(58), 0.4(36)] \\ &= \min(17.4, 14.4) = 14.4 \text{ kpsi} \end{aligned}$$

$$\begin{aligned} \text{1020:} \quad \tau_{\text{all}} &= \min[0.3(55), 0.4(30)] \\ \tau_{\text{all}} &= \min(16.5, 12) = 12 \text{ kpsi} \end{aligned}$$

$$\begin{aligned} \text{E6010:} \quad \tau_{\text{all}} &= \min[0.3(62), 0.4(50)] \\ &= \min(18.6, 20) = 18.6 \text{ kpsi} \end{aligned}$$

Since Table 9-6 gives 18.0 kpsi as the allowable shear stress, use this lower value.

Therefore, the allowable shear stress is

$$\tau_{\text{all}} = \min(14.4, 12, 18.0) = 12 \text{ kpsi}$$

However, the allowable stress in the problem statement is 0.9 kpsi which is low from the weldment perspective. The load associated with this strength is

$$\tau_{\max} = \tau_{\text{all}} = 3.90W = 900$$

$$W = \frac{900}{3.90} = 231 \text{ lbf}$$

If the welding can be accomplished (1/16 leg size is a small weld), the weld strength is 12 000 psi and the load $W = 3047$ lbf. Can the bracket carry such a load?

There are geometry problems associated with sheet metal folding. Load placement is important and the center of twist has not been identified. Also, the load-carrying capability of the top bend is unknown.

These uncertainties may require the use of a different weld pattern. Our solution provides the best weldment and thus insight for comparing a welded joint to one which employs screw fasteners.