Determine the forces at the gusset/beam interface

Based on these loads as shown in Figure 3–13, the shear force at the interface of the gusset with the beam flange is,

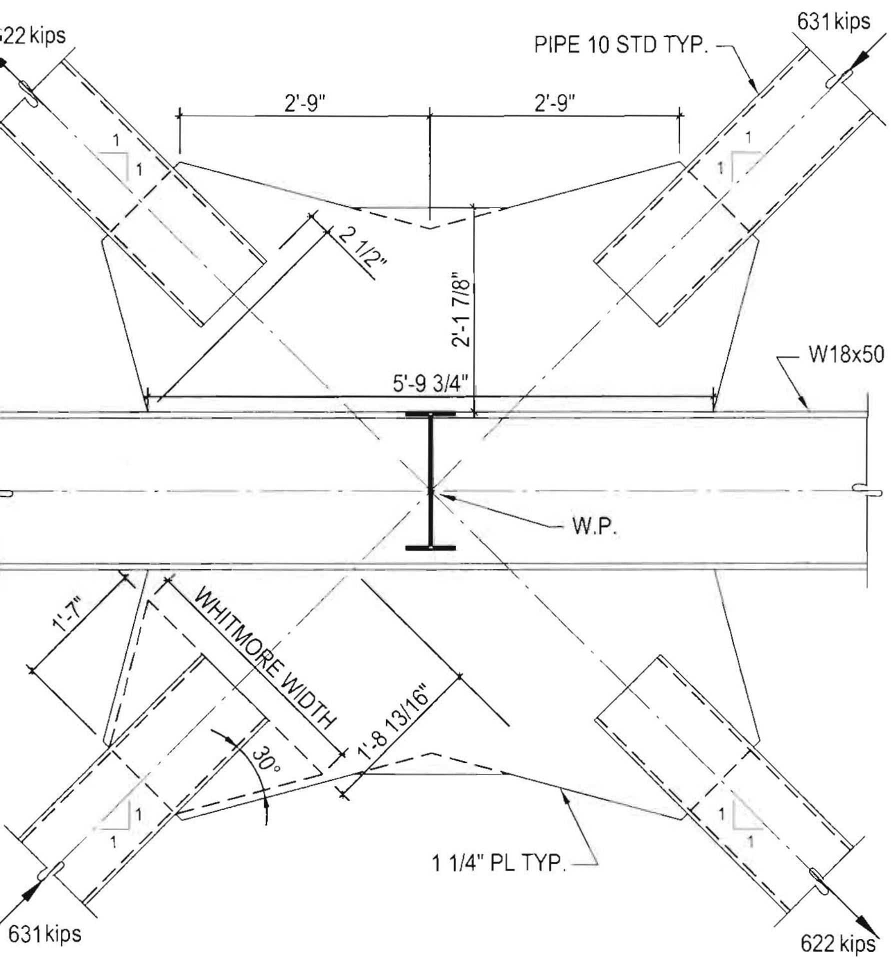
$$V = \left(622 \text{ kips} + 631 \text{ kips}\right)\frac{1}{\sqrt{2}} = 886 \text{ kips}$$

the tension force is,

$$T = \left(622 \text{ kips} - 631 \text{ kips}\right)\frac{1}{\sqrt{2}} = -6.36 \text{ kips}$$

and the moment is,

$$M = V\left(\frac{d_b}{2}\right) = 886 \text{ kips}\left(\frac{18.0 \text{ in.}}{2}\right) = 7{,}970 \text{ kip-in.}$$



Design the weld at the gusset/beam interface

From Figure 3–13, the length of the gusset plate is 5 ft $9^3/_4$ in. Treating the welds as lines,

$$S_w = \frac{l^2}{6} = \frac{\left(69.75 \text{ in.}\right)^2}{6} = 811 \text{ in.}^3/\text{in.}$$

$$f_v = \frac{V}{l} = \frac{886 \text{ kips}}{69.75 \text{ in.}} = 12.7 \text{ kips/in.}$$

$$f_a = \frac{T}{l} = \frac{6.36 \text{ kips}}{69.75 \text{ in.}} = 0.0912 \text{ kips/in.}$$

$$f_b = \frac{M}{S_w} = \frac{7{,}970 \text{ kips-in.}}{811 \text{ in.}^2} = 9.83 \text{ kips/in.}$$

$$f_{peak} = \sqrt{f_v^2 + \left(f_a + f_b\right)^2}$$
$$= \sqrt{\left(12.7 \text{ kips/in.}\right)^2 + \left(0.0912 \text{ kips/in.} + 9.83 \text{ kips/in.}\right)^2}$$
$$= 16.1 \text{ kips/in.}$$

$$f_{avg} = \frac{1}{2}\left[\sqrt{\left(f_a - f_b\right)^2 + f_v^{\,2}} + \sqrt{\left(f_a + f_b\right)^2 + f_v^{\,2}}\right]$$
$$= \frac{1}{2}\left[\begin{array}{l}\sqrt{\left(0.0912 \text{ kips/in.} - 9.83 \text{ kips/in.}\right)^2 + \left(12.7 \text{ kips/in.}\right)^2} \\ + \sqrt{\left(0.0912 \text{ kips/in.} + 9.83 \text{ kips/in.}\right)^2 + \left(12.7 \text{ kips/in.}\right)^2}\end{array}\right]$$
$$= 16.1 \text{ kips/in.}$$

$$\frac{f_{peak}}{f_{avg}} = \frac{16.1}{16.1} = 1.00 < 1.25$$

Therefore, $f_r = 1.25 f_{avg} = 1.25(16.1 \text{ kips/in.}) = 20.1$ kips/in.

The minimum double-sided fillet weld size is,

$$D \geq \frac{20.1 \text{ kips/in.}}{2\left(1.392 \text{ kips/in.}\right)} = 7.22 \text{ sixteenths}$$