REFERENCES	CALCULATIONS	RESULTS
	Web Plate Shear Yielding	
AISC Sec. J4-2	Allowable Shear Capacity: $$\Omega = 1.5$$	
AISC Eq. J4-3	$$Ra_v = \left(\frac{0.6FyAg_v}{\Omega}\right) = \left(\frac{0.6(38)(0.2)5}{1.5}\right)(2) = 30.4 \text{ kips}$$	30.4 kips
	Design capacity ratio, DCR: $$\text{required shear, } R_v = 4.6 \text{ kips}$$ $$\text{overall capacity, } Ra_v = 30.4 \text{ kips}$$ $$\text{DCR} = \left(\frac{4.6}{30.4}\right) = 0.151$$	Pass
	Web Plate to W10x12 Flange, Weld Strength	
AISC Table J2.5	Strength of Fillet Welds Weld Size, t = 0.2 in $$\Omega = 2.0$$ $$F_{nw} = 0.6\ F_{EXX}$$	
AISC Eq. J2-5	$$F_{nw} = 0.6\ F_{EXX}\ (1.0 + 0.5 \sin^{1.5}\theta)$$ $$\theta = \text{the angle which the load makes with the weld axis}$$ $$= 90, \text{ for transversely loaded welds}$$ $$= 0, \text{ for longitudinally loaded welds}$$	
	Strength per unit size of weld: $$\text{Allowable weld stress, } F_{aw} = \left(\frac{0.6(60)}{2.0}\right) = 18 \text{ ksi}$$ $$\text{transverse length, } l_t = 5 \text{ in}$$ $$\text{longitudinal length, } l_l = 0 \text{ in}$$ $$\text{total effective length, } l = l_t\ (1.5) + l_l\ (1.0) = 7.5 \text{ in}$$ $$\left(\frac{R_a}{t}\right) = 135.0 \text{ kips / in}$$	
AISC Sec. J2.2a	Effective size (throat) of fillet weld, a: 0.707 = the cosine or sine of 45deg $$\text{a} = (0.707)\ \text{t} = 0.141 \text{ in}$$	
AISC Eq. J2-3	$$R_a = \left(\frac{R_a}{t}\right) t = 135\ (0.141)\ (2) = 38.2 \text{ kips}$$	38.2 kips
	Design capacity ratio, DCR: $$\text{required load, R} = 4.6 \text{ kips}$$ $$\text{overall capacity, Ra} = 38.2 \text{ kips}$$ $$\text{DCR} = \left(\frac{4.6}{38.2}\right) = 0.121$$	Pass

Web Plate Shear Rupture

AISC Sec. J4-2

Allowable Shear Capacity:

$$\Omega = 2.0$$

Calculation of net depth:

$$\begin{aligned} \text{total length of bolt hole(s)} &= 0.625(2) \\ &= 1.3 \text{ in} \\ \text{net depth, } d_{net} &= 5 - [0.625(2)] \\ &= 3.8 \text{ in} \end{aligned}$$

AISC Eq. J4-4

$$\begin{aligned} Ra_v &= \left(\frac{0.6FyAn_v}{\Omega} \right) \\ &= \left(\frac{0.6(59)(0.2)3.75}{2.0} \right) \ (2) \\ &= 26.5 \text{ kips} \end{aligned}$$

26.5 kips

Design capacity ratio, DCR:

$$\begin{aligned} \text{required shear, } R_v &= 4.6 \text{ kips} \\ \text{overall capacity, } Ra_v &= 26.5 \text{ kips} \\ \text{DCR} &= \left(\frac{4.6}{26.5} \right) \\ &= 0.173 \end{aligned}$$

Pass

Web Plate to W8x10 Web, Block Shear Rupture Strength

AISC Sec. J4-3

Block Shear Strength:

$$\Omega = 2.0$$

AISC Eq. J4-5

$$\left(\frac{Ra}{\Omega} \right) = \left(\frac{U_{bs} F_u A_{nt}}{\Omega} \right) + \min \left(\frac{0.6F_y A_{gv}, 0.6F_u A_{nv}}{\Omega} \right)$$

Tension Rupture Component: $Ubs = 1.0$ (uniform tension)

$$\begin{aligned} \left(\frac{U_{bs} F_u A_{nt}}{\Omega} \right) &= \left(\frac{(1.0)(59)(3.0625)(0.2)}{2.0} \right) \\ &= 90.35 \text{ kips/in } (0.2) \\ &= 18.1 \text{ kips} \end{aligned}$$

Shear Yielding Component: $0.6F_y A_{gv}$

$$\begin{aligned} \left(\frac{0.6F_y A_{gv}}{\Omega} \right) &= \left(\frac{0.6(38)(4)}{2.0} \right) \ (0.2) \\ &= 45.6 \text{ kips/in } (0.2) \\ &= 9.1 \text{ kips} \end{aligned}$$

Shear Rupture Component: $0.6F_u A_{nv}$

$$\begin{aligned} \left(\frac{0.6F_u A_{nv}}{\Omega} \right) &= \left(\frac{0.6(59)(3.0625)}{2.0} \right) \ (0.2) \\ &= 54.2 \text{ kips/in } (0.2) \\ &= 10.8 \text{ kips} \end{aligned}$$

Total Block Shear Capacity:

$$\begin{aligned} \left(\frac{Ra}{\Omega} \right) &= \left(\frac{U_{bs} F_u A_{nt}}{\Omega} \right) + \min \left(\frac{0.6F_y A_{gv}, 0.6F_u A_{nv}}{\Omega} \right) \\ &= 18.1 \ + \min \left[9.1 \ , 10.8 \right] \\ &= 27.2 \text{ kips} \end{aligned}$$

27.2 kips

Design capacity ratio, DCR:

$$\text{required shear, } R_v = 4.6 \text{ kips}$$
$$\text{overall capacity, } Ra_v = 27.2 \text{ kips}$$
$$\text{DCR} = \left(\frac{4.6}{27.2}\right) = 5.909$$

Pass

Web Plate to undefined Web, Bolt Group Shear and Bearing Check

AISC Sec. J3.1

1. Shear Strength of Bolts

$$\Omega = 2.0$$

$$\text{Bolt Diameter} = 0.515 \text{ in}$$
$$\text{Nominal Shear Strength, } Fn_v = 27 \text{ ksi (AISC Table J3.2)}$$
$$\text{Nominal Shear Strength (per bolt), } Rn_v = 0.6\ Fn_v\ A_b = 0.6\ (27)\ 0.208 \text{ in\^{}2} = 5.6 \text{ kips}$$
$$\left(\frac{Rn_v}{\Omega}\right) = 2.8 \text{ kips}$$

2.8 kips / bolt

AISC Sec. J3.10

2. Bearing Strength of Standard Bolt Holes
(Ignoring bolt hole deformation at service load level)

$$\Omega = 2.0$$

$$\text{edge distance, } l_e = 0.72 \text{ in}$$
$$\text{(clear)distance to adjacent hole, } l_c = 2.44 \text{ in}$$

Since edge distance is less than the adjacent distance to the next bolt hole, edge distance will control.

AISC Eq. J3.6a

$$\left(\frac{Rn_b}{\Omega}\right) = \left(\frac{1.2 l_c t Fu}{\Omega}\right) \leq \left(\frac{2.4 d t Fu}{\Omega}\right)$$

For the outer bolt (tearout), lc = 0.72 in:

$$Rn_b = 1.2\ l_c \text{ t } F_u = 1.2(0.72)\ 0.2\ (59) = 12.7 \text{ kips}$$
$$\left(\frac{Rn_b}{\Omega}\right) = 6.4 \text{ kips}$$

For the inner bolt (tearout), lc = 2.44 in:

$$Rn_b = 1.2\ l_c \text{ t } F_u = 1.2(2.44)\ 0.2\ (59) = 43.1 \text{ kips}$$
$$\left(\frac{Rn_b}{\Omega}\right) = 21.6 \text{ kips}$$

For overall bearing (bolt hole elongation):

$$Rn_b = 2.4 \text{ d t } F_u = 2.4(0.5625)\ 0.2\ (59) = 18.2 \text{ kips}$$
$$\left(\frac{Rn_b}{\Omega}\right) = 9.1 \text{ kips}$$

6.4 kips / bolt

Bolt shear will control over bearing since 2.8 kips $<$ 6.4 kips

3. Capacity of Bolt Group
Considering the minimum among: bolt shear capacity, bearing and tearing in inner and outer bolt holes.

a). Capacity of outer bolt (as established above):

$$\text{(outer bolt) , } Ra_b = 2.8 \text{ kips / bolt}$$

b). Capacity of inner bolt (as established above):

$$\text{(inner bolt) , } Ra_b = 2.8 \text{ kips / bolt}$$

c). Capacity of the bolts as a group: sum of the capacities a). and b).

	$$Ra_b = 2.8 + 1(2.8) = 11.2 \text{ kips}$$	11.2 kips
	Design capacity ratio, DCR: $$\text{required shear, R} = 4.6 \text{ kips}$$ $$\text{overall capacity, } Ra_b = 11.2 \text{ kips}$$ $$\text{DCR} = \left(\frac{4.6}{11.2}\right) = 0.409$$	Pass