REFERENCES	CALCULATIONS	RESULTS
	Web Plate Shear Yielding (HP8x36)	
AISC Sec. J4-2	Allowable Shear Capacity:	
	$\Omega=1.5$	
AISC Eq. J4-3	$egin{aligned} Ra_v &= \left(rac{0.6FyAg_v}{\Omega} ight) \ &= \left(rac{0.6(38)(0.4)5}{\Omega} ight) \end{aligned}$	
	$= \left(\frac{30.4 \text{ kips}}{1.5}\right)$ $= 30.4 \text{ kips}$	
	D : DCD	$30.4 \mathrm{\ kips}$
	Design capacity ratio, DCR:	
	$ ext{overall capacity}, Ra_v = 30.4  ext{ kips} \  ext{DCR} = \left(rac{10.0}{30.4} ight)$	
	=0.329	Pass
	Web Plate to HP8x36 Flange, Weld Strength	
	Strength of Fillet Welds	
AISC Table J2.5	Weld Size, $t=0.2$ in $\Omega=2.0$	
	$F_{nw}=0.6~F_{EXX}$	
AISC Eq. J2-5	$F_{nw} = 0.6~F_{EXX}~(1.0 + 0.5 \sin^{-1.5} heta)$	
	heta= the angle which the load makes with the weld axis $=90,$ for transversely loaded welds $=0,$ for longitudinally loaded welds	
	Strength per unit size of weld:	
	Allowable weld stress, $F_{aw} = \left( rac{0.6(60)}{2.0}  ight)$	
	$=18~ m ksi$ transverse length, $l_t=5~ m in$	
	$egin{aligned}  ext{longitudinal length, } l_l &= 0  ext{ in} \  ext{total effective length, } l &= l_t \ (1.5) + \ l_l \ (1.0) \ &= 7.5  ext{ in} \end{aligned}$	
	/R	
	$\left(rac{R_a}{t} ight)=135.0~\mathrm{kips}/~\mathrm{in}$	
AISC Sec. J2.2a	Effective size (throat) of fillet weld, a: $0.707 = \text{the cosine or sine of } 45 \text{deg}$	
	$a=(0.707)~{ m t}$ $=0.141~{ m in}$	
	— 0.141 III	
AISC Eq. J2-3	$R_a = \left(rac{R_a}{t} ight)  t$	
	= 135 (0.141) $= 19.1  kips$	
	Design capacity ratio, DCR:	19.1 kips
	Design capacity ratio, DCR: $ \begin{array}{c} \text{required load, } R=10.0 \text{ kips} \\ \text{overall capacity, } Ra=19.1 \text{ kips} \end{array} $	
	$ ext{DCR} = \left(rac{10.0}{19.1} ight)$	
	=0.524	Pass

	Web Plate Shear Rupture (HP8x36)	
AISC Sec. J4-2	Allowable Shear Capacity:	
11150 500. 54-2	$\Omega=2.0$	
	Calculation of net depth: ${\rm total\ length\ of\ bolt\ hole}(s) = 0.625(2)$	
	$=1.3  ext{ in}$	
	$egin{aligned}  ext{net depth,}  d_{net} &= 5 - [0.625(2)] \ &= 3.8  ext{ in} \end{aligned}$	
AISC Eq. J4-4	$Ra_v = \left(rac{0.6 Fy An_v}{\Omega} ight)$	
	$=\left(\begin{array}{c} 0.6(59)(0.4)3.75 \end{array}\right)$	
	$igg( 2.0 igg) \ = 26.5  ext{ kips}$	
		26.5 kips
	Design capacity ratio, DCR: required shear, $R_v = 10.0  ext{ kips}$	
	$ m over all\ capacity, \it Ra_v=26.5\ kips$	
	$ ext{DCR} = \left(rac{10.0}{26.5} ight)$	
	=0.377	Pass
	Web Plate to HP8x36 Web, Block Shear Rupture Strength	
AISC Sec. J4-3	Block Shear Strength: $\Omega=2.0$	
AISC Eq. J4-5		
	$\left(rac{Ra}{\Omega} ight) = \left(rac{U_{bs}F_uA_{nt}}{\Omega} ight)  + \min  \left(rac{0.6F_yA_{gv}, 0.6F_uA_{nv}}{\Omega} ight)$	
	$egin{aligned}  ext{Tension Rupture Component: } Ubs = 1.0  ext{ (uniform tension)} \end{aligned}$	
	$\left(rac{U_{bs}F_{u}A_{nt}}{\Omega} ight)=\left(rac{(1.0)(59)(3.0625)(0.4)}{2.0} ight)$	
	$=90.35~\mathrm{kips/in}~(0.4) \ =36.1~\mathrm{kips}$	
	Shear Yielding Component: $0.6F_yA_{gv}$	
	$\left(\frac{0.6F_yA_{gv}}{\Omega}\right)=\left(\frac{0.6(38)(4)}{2.0}\right)\;(0.4)$	
	$\left(\frac{\Omega}{\Omega}\right) - \left(\frac{1}{2.0}\right)^{-1} (0.4)$ $= 45.6 \text{ kips/in } (0.4)$	
	$=18.2~\mathrm{kips}$	
	Shear Rupture Component: $0.6F_uA_{nv}$	
	$\left(rac{0.6F_uA_{nv}}{\Omega} ight) = \left(rac{0.6(59)(3.0625)}{2.0} ight) \; (0.4)$	
	$= 54.2  ext{ kips/in } (0.4)$ = $21.7  ext{ kips}$	
	Total Block Shear Capacity:	
	$\left(rac{Ra}{\Omega} ight) = \left(rac{U_{bs}F_uA_{nt}}{\Omega} ight)  + \min  \left(rac{0.6F_yA_{gv}, 0.6F_uA_{nv}}{\Omega} ight)$	
	$= 36.1\ + \min\ [\ 18.2\ , 21.7\ ]$	
	$=54.4~\mathrm{kips}$	54.4 kips
	Design capacity ratio, DCR:	
I		1

	$ m required shear, \; \it R_v = 10.0 \; kips \  m overall \; capacity, \it Ra_v = 54.4 \; kips \  m$	
	$DCR = \left(\frac{10.0}{54.4}\right)$	
	=0.184	Pass
	Web Plate to HP8x36 Web, Bolt Group Shear and Bearing Check	
AISC Sec. J3.1	1. Shear Strength of Bolts	
	$\Omega=2.0$	
	$\operatorname{Bolt} \operatorname{Diameter} = 0.515 \operatorname{in}$	
	Nominal Shear Strength, $Fn_v=27~{ m ksi}~({ m AISC~Table~J3.2})$ Nominal Shear Strength (per bolt), $Rn_v=0.6~Fn_v~A_b$	
	$= 0.6 (27) 0.208  ext{ in}^2$ $= 5.6  ext{ kips}$	
	$\left(rac{Rn_v}{\Omega} ight)=2.8~\mathrm{kips}$	2.8 kips / bolt
AISC Sec. J3.10	2. Bearing Strength of Standard Bolt Holes	2.0 kips / boil
71150 500. 30.10	(Ignoring bolt hole deformation at service load level) $\Omega=2.0$	
	edge distance, $l_e=0.72$ in $({ m clear})$ distance to adjacent hole, $l_c=2.44$ in	
	Since edge distance is less than the adjacent distance to the next bolt hole, edge distance will control.	
AISC Eq. J3.6a	$\left(rac{Rn_b}{\Omega} ight) = \left(rac{1.2l_ctFu}{\Omega} ight) \ \le \ \left(rac{2.4dtFu}{\Omega} ight)$	
	For the outer bolt (tearout), $lc = 0.72$ in:	
	$Rn_b = 1.2\ l_c\ { m t}\ F_u \ = 1.2 (0.72)\ 0.4\ (59)$	
	$=25.4~{ m kips} \ \left(rac{Rn_b}{\Omega} ight)=12.7~{ m kips}$	
	For the inner bolt (tearout), lc = 2.44 in: $Rn_b = 1.2 \ l_c \ {\rm t} \ F_u$	
	$= 1.2(2.44) \ 0.4 \ (59)$ $= 86.3 \ \text{kips}$	
	$\left(rac{Rn_b}{\Omega} ight)=43.1~\mathrm{kips}$	
	For overall bearing (bolt hole elongation):	
	$Rn_b = 2.4  ext{ d t } F_u \ = 2.4 (0.5625) \ 0.4 \ (59) \ = 36.5  ext{ kips}$	
	$\left(rac{Rn_b}{\Omega} ight)=18.2~\mathrm{kips}$	
	Bolt shear will control over bearing since $2.8~{ m kips} < 12.7~{ m kips}$	$12.7~{ m kips}~/~{ m bolt}$
	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):	
	$( ext{outer bolt})$ , $Ra_b=2.8~ ext{kips}$ / bolt	
	b). Capacity of inner bolt (as established above): $ ({\rm inner\ bolt}) \ , Ra_b = 2.8 \ {\rm kips\ /\ bolt} $	
	c). Capacity of the bolts as a group: sum of the capacities a). and b).	

	$Ra_b = 2.8 + 1(2.8) \ = 11.2  ext{ kips}$	11.2 kips
	Design capacity ratio, DCR: $\begin{array}{c} \text{required shear, } R=10.0 \text{ kips} \\ \text{overall capacity, } Ra_b=11.2 \text{ kips} \\ \text{DCR}=\left(\frac{10.0}{11.2}\right) \end{array}$	11.2 KIPS
	= 0.889	Pass
	Web Element Shear Rupture (HP8x36)	
AISC Sec. J4-2	Allowable Shear Capacity: $\Omega = 2.0$	
	Calculation of net depth: $ \begin{array}{c} \text{total length of bolt hole(s)} = 0.625(2) \\ = 1.3 \text{ in} \\ \text{net depth, } d_{net} = 8.02 - [0.625(2)] \\ = 6.8 \text{ in} \end{array} $	
AISC Eq. J4-4	$Ra_v = \left(rac{0.6FyAn_v}{\Omega} ight) \ = \left(rac{0.6(59)(0.445)6.77}{2.0} ight) \ = 53.3  ext{ kips}$	$53.3 \mathrm{\ kips}$
	Design capacity ratio, DCR: $ \begin{array}{c} \text{required shear, } R_v = 10.0 \text{ kips} \\ \text{overall capacity, } Ra_v = 53.3 \text{ kips} \\ \text{DCR} = \left(\frac{10.0}{53.3}\right) \\ = 0.188 \end{array} $	oo.o mps
		Pass
AISC Sec. J3.1	Web Element, Bolt Group Shear and Bearing Check $ \Omega = 2.0 $	
	$ ext{Bolt Diameter} = 0.515  ext{ in} \  ext{Nominal Shear Strength}, Fn_v = 27  ext{ ksi (AISC Table J3.2)} \  ext{Nominal Shear Strength (per bolt)}, Rn_v = 0.6 Fn_v A_b \ = 0.6 (27) 0.208  ext{ in}^2 \ = 5.6  ext{ kips} \ \left( rac{Rn_v}{\Omega}  ight) = 2.8  ext{ kips} \  ext{}$	2.8 kips / bolt
AISC Sec. J3.10	2. Bearing Strength of Standard Bolt Holes (Ignoring bolt hole deformation at service load level) $\Omega = 2.0$	
	edge distance, $l_e=0.72$ in (clear)distance to adjacent hole, $l_c=2.44$ in Since edge distance is less than the adjacent distance to the next bolt hole, edge distance will control.	
AISC Eq. J3.6a	$\left(rac{Rn_b}{\Omega} ight) = \left(rac{1.2l_ctFu}{\Omega} ight) \; \leq \; \left(rac{2.4dtFu}{\Omega} ight)$	



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

$$egin{aligned} Rn_b &= 1.2 \ l_c \ {
m t} \ F_u \ &= 1.2 (0.72) \ 0.445 \ (59) \ &= 28.3 \ {
m kips} \ \left(rac{Rn_b}{\Omega}
ight) = 14.2 \ {
m kips} \end{aligned}$$

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

$$Rn_b = 1.2 \ l_c \ {
m t} \ F_u \ = 1.2 (2.44) \ 0.445 \ (59) \ = 96.0 \ {
m kips} \ \left(rac{Rn_b}{\Omega}
ight) = 48.0 \ {
m kips}$$

For overall bearing (bolt hole elongation):

$$egin{aligned} Rn_b &= 2.4 ext{ d t } F_u \ &= 2.4 (0.5625) \ 0.445 \ (59) \ &= 40.6 ext{ kips} \ \left(rac{Rn_b}{\Omega}
ight) = 20.3 ext{ kips} \end{aligned}$$

Bolt shear will control over bearing since  $2.8~{\rm kips} < 14.2~{\rm kips}$ 

 $14.2 \mathrm{\ kips} / \mathrm{\ bolt}$ 

## 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):

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

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

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

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

$$Ra_b = 2.8 + 1(2.8)$$
  
= 11.2 kips

 $11.2 \mathrm{\ kips}$ 

Design capacity ratio, DCR:

required shear, R = 10.0 kips overall capacity, 
$$Ra_b = 11.2$$
 kips 
$$DCR = \left(\frac{10.0}{11.2}\right)$$
$$= 0.889$$

Pass