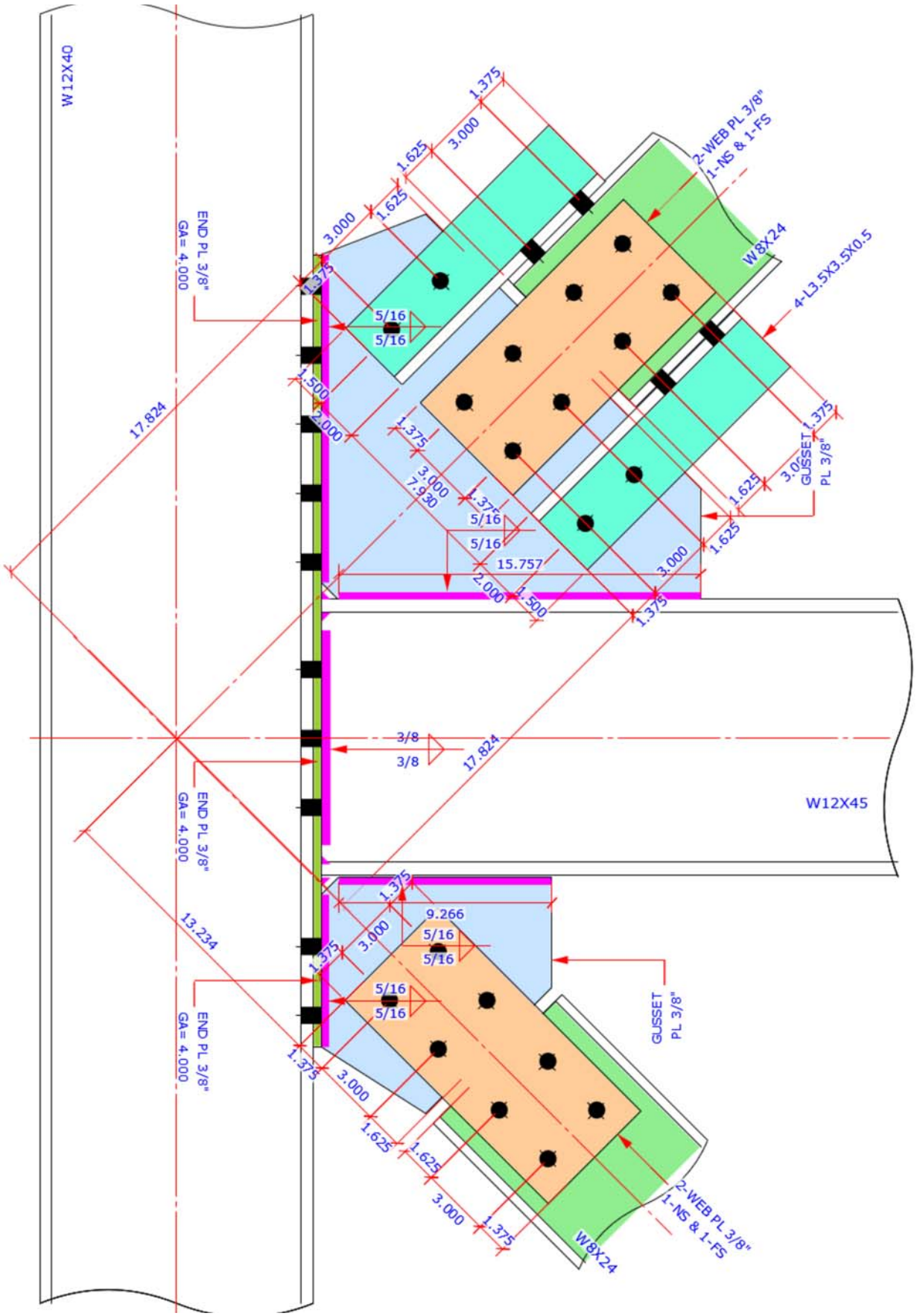
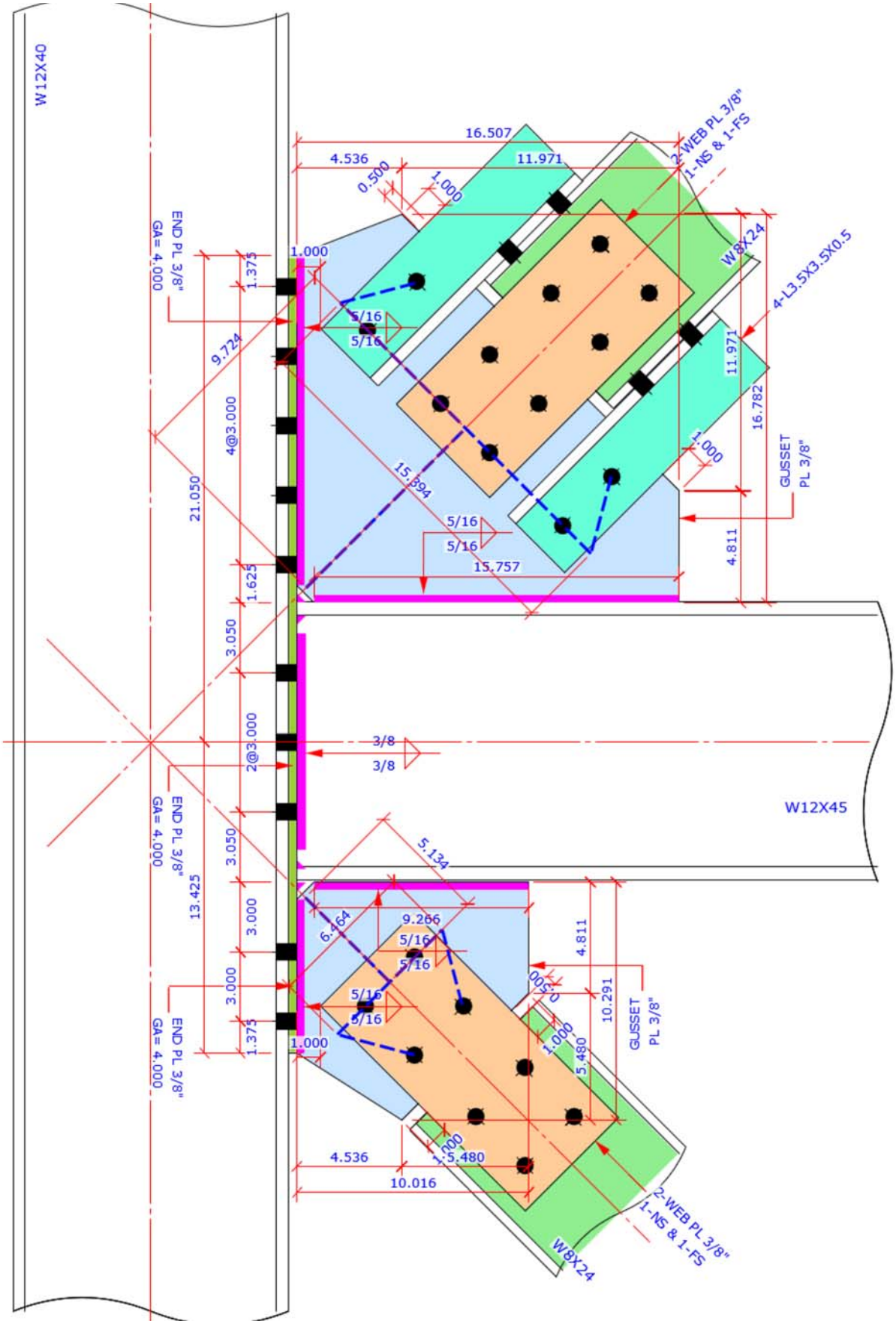
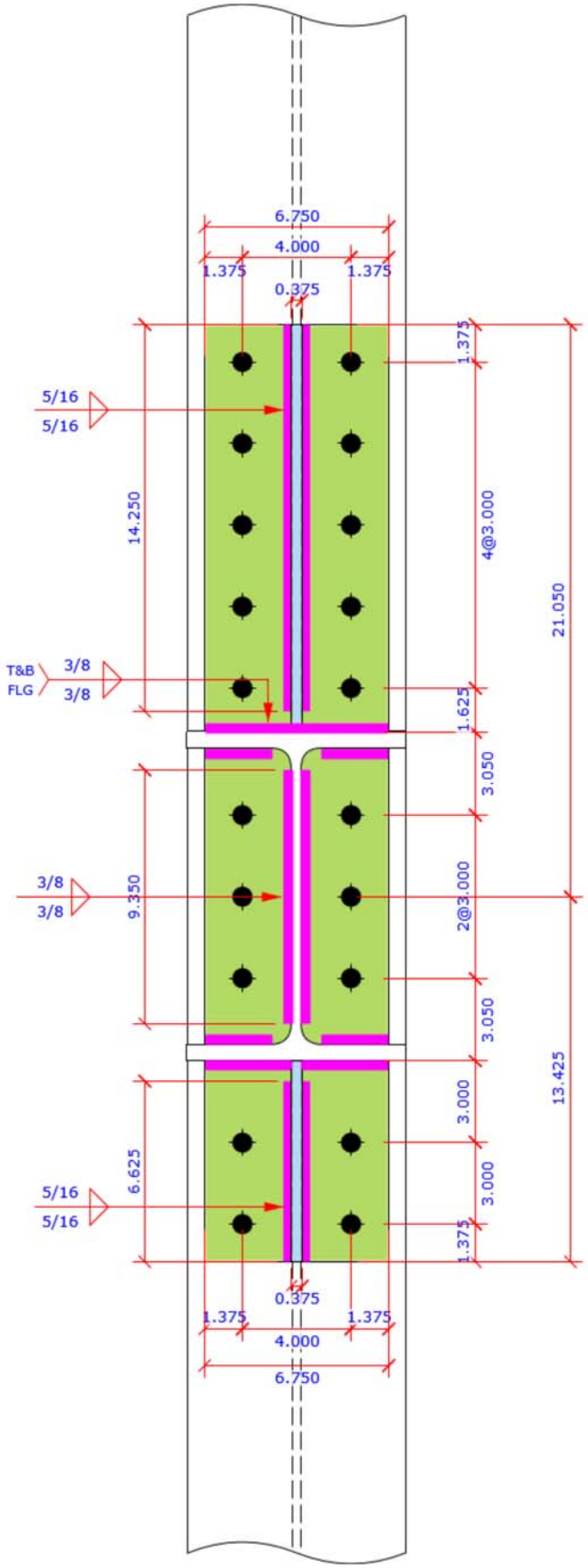
Result Summary - Overall Vertical Brace Connection Code=AISC 360-10 LRFD

Result Summary - Overall	geometries & weld limitations = **PASS**	limit states max ratio = **0.84**	**PASS**
Top Brace - Brace to Gusset	geometries & weld limitations = **PASS**	limit states max ratio = **0.53**	**PASS**
Top Brace - Gusset to Column	geometries & weld limitations = **PASS**	limit states max ratio = **0.42**	**PASS**
Top Brace - Gusset to Beam	geometries & weld limitations = **PASS**	limit states max ratio = **0.44**	**PASS**
Bottom Brace - Brace to Gusset	geometries & weld limitations = **PASS**	limit states max ratio = **0.69**	**PASS**
Bottom Brace - Gusset to Column	geometries & weld limitations = **PASS**	limit states max ratio = **0.71**	**PASS**
Bottom Brace - Gusset to Beam	geometries & weld limitations = **PASS**	limit states max ratio = **0.48**	**PASS**
Beam to Column	geometries & weld limitations = **PASS**	limit states max ratio = **0.84**	**PASS**

Sketch Vertical Brace Connection Code=AISC 360-10 LRFD


W12X40
END PL 3/8"
GA= 4.000
17.824
1.375
3.000
1.625
2-WEB PL 3/8"
1-NS & 1-FS
W8X24
4-L3.5X3.5X0.5
5/16
1.500
2.000
7.930
GUSSET
PL 3/8"
15.757
3/8
W12X45
9.266
13.234
GUSSET
PL 3/8"
2-WEB PL 3/8"
1-NS & 1-FS
W8X24

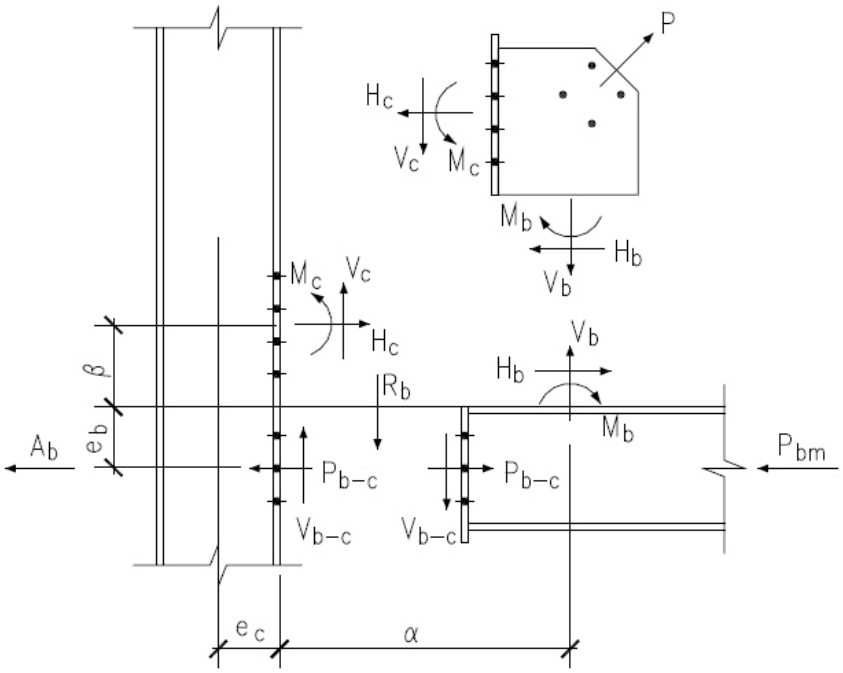

W12X40
W12X45
W8X24
W8X24
END PL 3/8"
GA=4.000
END PL 3/8"
GA=4.000
END PL 3/8"
GA=4.000
GUSSET
PL 3/8"
GUSSET
PL 3/8"
2-WEB PL 3/8"
1-NS & 1-FS
2-WEB PL 3/8"
1-NS & 1-FS
4-L3.5X3.5X0.5
16.507
4.536
0.500
1.000
11.971
1.000
1.375
5/16
5/16
9.724
4@3.000
21.050
15.394
11.971
16.782
1.000
5/16
5/16
15.757
4.811
1.625
3.050
2@3.000
3/8
3/8
3.050
13.425
3.000
3.000
1.375
5.134
6.464
9.266
5/16
5/16
5/16
5/16
4.811
0.500
10.291
1.000
5.480
1.000
5.480
4.536
10.016


6.750
4.000
1.375
0.375
1.375
1.375
5/16
5/16
14.250
4@3.000
21.050
T&B
FLG
3/8
3/8
1.625
3.050
3/8
3/8
9.350
2@3.000
3.050
13.425
3.000
6.625
3.000
5/16
5/16
1.375
0.375
1.375
4.000
6.750

Members & Components Summary

Member	Brace Connection				Code=AISC 360-10 LRFD
Beam Section					
W12X45	d = 12.100	[in]	b_f = 8.050	[in]	
	t_f = 0.575	[in]	t_w = 0.335	[in]	
	k_{des} = 1.080	[in]	k_{det} = 1.375	[in]	
	k_1 = 0.938	[in]	A = 13.100	[in^2]	
	S_x = 57.70	[in^3]	Z_x = 64.20	[in^3]	
Steel Grade A992	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]	
Column Section					
W12X40	d = 11.900	[in]	b_f = 8.010	[in]	
	t_f = 0.515	[in]	t_w = 0.295	[in]	
	k_{des} = 1.020	[in]	k_{det} = 1.375	[in]	
	k_1 = 0.875	[in]	A = 11.700	[in^2]	
	S_x = 51.50	[in^3]	Z_x = 57.00	[in^3]	
Steel Grade A992	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]	

Gusset Plate Interface Forces Calculation



Brace Axial Force Load Case 1

Top and bottom brace force	Top P_{top} = -100.00 [kips] (T)		Bot P_{bot} = 50.00	[kips] (C)
Beam end shear & transfer force	Shear R_b = 25.00 [kips]		Transfer A_b = 15.00	[kips]

Top Brace Interface Forces

Refer to AISC 14th Page 13-4 and Fig. 13-2 for all charts and definitions of variables and symbols shown in calculation below

e_b = 6.050 [in] e_c = 5.950 [in]

α = 9.004 [in] β = 7.625 [in]

θ = 45.0 [°]

$K = e_b \tan\theta - e_c$	= 0.100	[in]	AISC 14th Eq. 13-16
$D = \tan^2\theta + (\frac{\alpha}{\beta})^2$	= 2.394		AISC 14th Eq. 13-24
$K' = \alpha (\tan\theta + \frac{\alpha}{\beta})$	= 19.635		AISC 14th Eq. 13-23
$\bar{\alpha} = [K' \tan\theta + K (\frac{\alpha}{\beta})^2] / D$	= 7.725	[in]	AISC 14th Eq. 13-21
$\bar{\beta} = (K' - K \tan\theta) / D$	= 7.625	[in]	AISC 14th Eq. 13-22
$r = [(e_b + \bar{\beta})^2 + (e_c + \bar{\alpha})^2]^{0.5}$	= 19.339	[in]	AISC 14th Eq. 13-6

Brace axial force	P_u = from user input	= -100.00	[kips]	in tension
Gusset to Column Interface Forces				
Shear force	$V_c = (\bar{\beta} / r) P_u$	= **-39.43**	[kips]	AISC 14th Eq. 13-2
Axial force	$H_c = (e_c / r) P_u$	= **-30.77**	[kips]	AISC 14th Eq. 13-3
Moment	$M_c = H_c (\beta - \bar{\beta})$	= **0.00**	[kip-ft]	AISC 14th Eq. 13-19
Gusset to Beam Interface Forces				
Shear force	$H_b = (\bar{\alpha} / r) P_u$	= **-39.94**	[kips]	AISC 14th Eq. 13-5

Top Brace - Brace to Gusset Sect=W8X24 P_{LC1} =-100.00 kips (T) P_{LC2} =100.00 kips (C) Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.53**	**PASS**

Geometry Restriction Checks - Flange Angle to Gusset — PASS

Min Bolt Edge Distance - Flange Angle to Gusset

Bolt diameter	d_b =	= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in Flange Angle to Gusset	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - Flange Angle to Gusset

Bolt diameter	d_b =	= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in Flange Angle to Gusset	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Geometry Restriction Checks - Flange Angle to Brace Flange — PASS

Min Bolt Edge Distance - Flange Angle to Brace Flange

Bolt diameter	d_b =	= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in Flange Angle to Brace Flange	L_e =	= **1.063**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - Flange Angle to Brace Flange

Bolt diameter	d_b =	= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in Flange Angle to Brace Flange	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Geometry Restriction Checks - Web Plate to Gusset — PASS

Min Bolt Edge Distance - Web Plate to Gusset

Bolt diameter	d_b =	= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in Web Plate to Gusset	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - Web Plate to Gusset

Bolt diameter	d_b =	= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in Web Plate to Gusset	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Geometry Restriction Checks - Web Plate to Brace Web					**PASS**
Min Bolt Edge Distance - Web Plate to Brace Web					
Bolt diameter	d_b =		= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =		= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in Web Plate to Brace Web	L_e =		= **1.375**	[in]	
			> $L_{e\text{-}min}$	OK	
Min Bolt Spacing - Web Plate to Brace Web					
Bolt diameter	d_b =		= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b		= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in Web Plate to Brace Web	L_s =		= **3.000**	[in]	
			> $L_{s\text{-}min}$	OK	

Brace Force Load Case 1 Sect=W8X24 P =-100.00 kips (T) ratio = **0.53** **PASS**

Brace Axial Force Distribution					
W shape section	b_f = 6.500	[in]	t_f = 0.400	[in]	
	A = 7.080	[in^2]			
Brace axial force	P =		= 100.00	[kips]	in compression
Force carried by w shape flange	$P_f = P (b_f t_f / A)$		= **36.72**	[kips]	
Force carried by w shape web	$P_w = P - 2 P_{tf}$		= **26.55**	[kips]	

W Shape Brace - Tensile Yield		ratio = 100.00 / 318.60	= **0.31**	**PASS**
Gross area subject to tension	A_g =	= 7.080	[in^2]	
Steel yield strength	F_y =	= 50.0	[ksi]	
Tensile force required	P_u =	= **100.00**	[kips]	
Tensile yielding strength	$R_n = F_y A_g$	= 354.00	[kips]	AISC 14th Eq D2-1
Resistance factor-LRFD	ϕ = 0.90			AISC 14th D2 (a)
	ϕR_n =	= **318.60**	[kips]	AISC 14th Eq D2-1
	ratio = **0.31**	> P_u	OK	

W Shape Brace - Tensile Rupture		ratio = 100.00 / 256.00	= **0.39**	**PASS**
Section gross area	A_g =	= 7.080	[in^2]	
Tensile net area	A_n =	= 5.251	[in^2]	
Shear lag factor	U =	= 1.000		AISC 14th Table D3.1
Tensile force required	P_u =	= **100.00**	[kips]	
Tensile effective net area	$A_e = A_n U$	= 5.251	[in^2]	
Plate tensile strength	F_u =	= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$	= 341.33	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75			AISC 14th D2 (b)
	ϕR_n =	= **256.00**	[kips]	AISC 14th Eq D2-2
	ratio = **0.39**	> P_u	OK	

Flange Angle - Tensile Yield			ratio = 36.72 / 292.50	= **0.13**	**PASS**
Gross area subject to tension	A_g =		= 6.500	[in^2]	
Steel yield strength	F_y =		= 50.0	[ksi]	
Tensile force required	P_u =		= **36.72**	[kips]	
Tensile yielding strength	$R_n = F_y A_g$		= 325.00	[kips]	AISC 14th Eq D2-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th D2 (a)
	ϕR_n =		= **292.50**	[kips]	AISC 14th Eq D2-1
	ratio = **0.13**		> P_u	OK	

Flange Angle - Tensile Rupture			ratio = 36.72 / 178.24	= **0.21**	**PASS**
Section gross area	A_g = 2 L3-1/2X3-1/2X1/2		= 6.500	[in^2]	
Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$		[in]	AISC 14th B4.3b
Number of bolt row	n_v = 1	angle leg t = 0.500		[in]	
Tensile net area	$A_n = A_g - n_v d_h t \times 2$		= 5.625	[in^2]	
No of bolt column	n_h = 2	bolt space s_h = 3.000		[in]	
Length of connection	$L = (n_h - 1) s_h$		= 3.000	[in]	
Eccentricity of connection	$\bar{x}$ = from sect L3$^1/_2$ x 3$^1/_2$ x $^1/_2$		= 1.050	[in]	
Shear lag factor	$U = 1 - \bar{x} / L$		= 0.650		AISC 14th Table D3.1
Tensile force required	P_u =		= **36.72**	[kips]	
Tensile effective net area	$A_e = A_n U$		= 3.656	[in^2]	
Plate tensile strength	F_u =		= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$		= 237.66	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th D2 (b)
	ϕR_n =		= **178.24**	[kips]	AISC 14th Eq D2-2
	ratio = **0.21**		> P_u	OK	

Flange Angle - Brace Side - Bolt Shear			ratio = 36.72 / 71.57	= **0.51**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750 [in]	bolt area A_b = 0.442		[in^2]	
Number of bolt carried shear	n_s = 4.0	shear plane m = 1			
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **36.72**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 95.43	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Brace Side - Bolt Bearing on Angle			ratio = 36.72 / 71.57	= **0.51**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.500	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 106.64 ≤ 73.13		= 73.13	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 47.23 ≤ 73.13		= 47.23	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Brace Side - Bolt Bearing on Brace Flange					ratio = 36.72 / 71.57	= **0.51**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]			bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$				= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]			bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]			edge distance L_e = 1.625	[in]	
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.400	[in]					
Interior Bolt							
Bolt hole edge clear distance	$L_c = L_s - d_h$				= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$						AISC 14th Eq J3-6b
	= 85.31 ≤ 58.50				= 58.50	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$				= 23.86	[kips]	
Edge Bolt							
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$				= 1.219	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$						AISC 14th Eq J3-6b
	= 47.53 ≤ 58.50				= 47.53	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$				= 23.86	[kips]	
Number of bolt	interior n_{in} = 2				edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$				= 95.43	[kips]	
Required shear strength	V_u =				= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕ R_n =				= **71.57**	[kips]	
	ratio = **0.51**				> V_u	OK	

Flange Angle - Block Shear - 1-Side Strip ratio = 18.36 / 70.69 = **0.26** **PASS**

Plate Block Shear - Side Strip

Bolt hole diameter	bolt dia d_b = 3/4 [in]	bolt hole dia d_h = 7/8	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.500 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 1	n_h = 2			
Bolt spacing in hor dir	s_h = 3.000 [in]				
Bolt edge dist in ver & hor dir	e_v = 1.500 [in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$	= 2.188	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$	= 1.531	[in^2]		
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$	= 0.531	[in^2]		
Block shear strength required	V_u =	= **18.36**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 94.25	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **70.69**	[kips]		
	ratio = **0.26**	> V_u	OK		

Brace Flange - Block Shear - 1-Side Strip ratio = 18.36 / 50.95 = **0.36** **PASS**

Plate Block Shear - Side Strip

Bolt hole diameter	bolt dia d_b = 3/4 [in]	bolt hole dia d_h = 7/8	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.400 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 1	n_h = 2			
Bolt spacing in hor dir	s_h = 3.000 [in]				
Bolt edge dist in ver & hor dir	e_v = 1.063 [in]	e_h = 1.625	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$	= 1.850	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$	= 1.325	[in^2]		
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$	= 0.250	[in^2]		
Block shear strength required	V_u =	= **18.36**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 67.94	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **50.95**	[kips]		
	ratio = **0.36**	> V_u	OK		

Flange Angle - Gusset PL Side - Bolt Shear			ratio = 36.72 / 71.57	= **0.51**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 2.0		shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **36.72**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 95.43	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Gusset PL Side - Bolt Bearing on Angle			ratio = 18.36 / 35.78	= **0.51**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.500	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5 L_c t F_u \le 3.0 d_b t F_u$				AISC 14th Eq J3-6b
	= 106.64 ≤ 73.13		= 73.13	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5 L_c t F_u \le 3.0 d_b t F_u$				AISC 14th Eq J3-6b
	= 47.23 ≤ 73.13		= 47.23	[kips]	
Bolt strength at edge	$R_{n\text{-}ed}$ = min ($R_{n\text{-}t\&b\text{-}ed}$, $R_{n\text{-}bolt}$)		= 23.86	[kips]	
Number of bolt	interior n_{in} = 1		edge n_{ed} = 1		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 47.71	[kips]	
Required shear strength	V_u =		= **18.36**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **35.78**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Gusset PL Side - Bolt Bearing on Gusset Plate	ratio = 36.72 / 69.21	= **0.53**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.625	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 47.71	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 1.219	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 44.56 ≤ 54.84	= 44.56	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 44.56	[kips]	

Number of bolt	interior n_{in} = 1		edge n_{ed} = 1		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 92.27	[kips]	
Required shear strength	V_u =		= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **69.21**	[kips]	
	ratio = **0.53**		> V_u	OK	

Web Plate - Tensile Yield	ratio = 13.28 / 97.03	= **0.14**	**PASS**

Plate Tensile Yielding Check

Plate size	width b_p = 5.750	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 2.156	[in^2]	
Tensile force required	P_u =		= **13.28**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 107.81	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕ R_n =		= **97.03**	[kips]	
	ratio = **0.14**		> P_u	OK	

Web Plate - Tensile Rupture			ratio = 13.28 / 73.13	= **0.18**	**PASS**
Plate Tensile Rupture Check					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th B4.3b
Number of bolt	n = 2				
Plate size	width b_p = 5.750	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	A_{nt} = (b_p - n d_h) t_p		= 1.500	[in^2]	
Tensile force required	P_u =		= **13.28**	[kips]	
Plate tensile rupture strength	R_n = $F_u A_{nt}$		= 97.50	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕ R_n =		= **73.13**	[kips]	AISC 14th Eq J4-2
	ratio = **0.18**		> P_u	OK	

Web Plate - Brace Side - Bolt Shear			ratio = 26.55 / 143.14	= **0.19**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **26.55**	[kips]	
Bolt shear strength	R_n = $F_{nv} A_b n_s$ m C_{ec}		= 190.85	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕ R_n =		= **143.14**	[kips]	
	ratio = **0.19**		> V_u	OK	

Web Plate - Brace Side - Bolt Bearing on Web Plate	ratio = 13.28 / 71.57	= **0.19**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84	= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Number of bolt	interior n_{in} = 2	edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$	= 95.43	[kips]	
Required shear strength	V_u =	= **13.28**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75			AISC 14th J3-10
	ϕ R_n =	= **71.57**	[kips]	
	ratio = **0.19**	> V_u	OK	

Web Plate - Brace Side - Bolt Bearing on Brace Web				ratio = 26.55 / 97.42	= **0.27**	**PASS**
Single Bolt Shear Strength						
Bolt shear stress	bolt grade = A325-N			F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$			= 47.71	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate						
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]		edge distance L_e = 1.625	[in]	
Plate tensile strength	F_u = 65.0	[ksi]				
Plate thickness	t = 0.245	[in]				
Interior Bolt						
Bolt hole edge clear distance	$L_c = L_s - d_h$			= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$					AISC 14th Eq J3-6b
	= 52.25 ≤ 35.83			= 35.83	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$			= 35.83	[kips]	
Edge Bolt						
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$			= 1.219	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$					AISC 14th Eq J3-6b
	= 29.11 ≤ 35.83			= 29.11	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$			= 29.11	[kips]	
Number of bolt	interior n_{in} = 2			edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$			= 129.89	[kips]	
Required shear strength	V_u =			= **26.55**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th J3-10
	ϕR_n =			= **97.42**	[kips]	
	ratio = **0.27**			> V_u	OK	

Web Plate - Block Shear - Center Strip ratio = 13.28 / 106.03 = **0.13** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.375	[in]				
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 2		n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000	[in]	s_h = 3.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2		= 3.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2		= 2.297	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 0.797	[in^2]		
Block shear strength required	V_u =		= **13.28**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 141.38	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **106.03**	[kips]		
	ratio = **0.13**		> V_u	OK		

Web Plate - Block Shear - 1-Side Strip ratio = 13.28 / 89.58 = **0.15** **PASS**

Plate Block Shear - Side Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.375	[in]				
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 2		n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000	[in]	s_h = 3.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 1.641	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 1.148	[in^2]		
Net area subject to tension when sheared out by side strip	$A_{nt} = [(n_v - 1)s_v + e_v - ((n_v - 1) + 0.5)d_h] t_p$		= 1.148	[in^2]		
Block shear strength required	V_u =		= **13.28**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 119.44	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **89.58**	[kips]		
	ratio = **0.15**		> V_u	OK		

Web Plate - Block Shear - 2-Side Strip ratio = 13.28 / 101.46 = **0.13** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = 3/4 [in]	bolt hole dia d_h = 7/8 [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 3.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 2.297	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$	= 0.703	[in^2]		
Block shear strength required	V_u =	= **13.28**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 135.28	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **101.46**	[kips]		
	ratio = **0.13**	> V_u	OK		

Brace Web - Block Shear - Center Strip ratio = 26.55 / 72.86 = **0.36** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = 3/4 [in]	bolt hole dia d_h = 7/8 [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.245 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 2.465 [in]	e_h = 1.625 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 2.266	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 1.623	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 0.521	[in^2]		
Block shear strength required	V_u =	= **26.55**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 97.14	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **72.86**	[kips]		
	ratio = **0.36**	> V_u	OK		

Web Plate - Gusset PL Side - Bolt Shear			ratio = 26.55 / 143.14	= **0.19**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **26.55**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 190.85	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕ R_n =		= **143.14**	[kips]	
	ratio = **0.19**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Bearing on Web Plate			ratio = 13.28 / 71.57	= **0.19**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5 L_c t F_u \le 3.0 d_b t F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5 L_c t F_u \le 3.0 d_b t F_u$				AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84		= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed}$ = min ($R_{n\text{-}t\&b\text{-}ed}$, $R_{n\text{-}bolt}$)		= 23.86	[kips]	
Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **13.28**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.19**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Bearing on Gusset Plate	ratio = 26.55 / 138.41	= **0.19**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.625	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 47.71	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 1.219	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 44.56 ≤ 54.84	= 44.56	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 44.56	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 184.55	[kips]	
Required shear strength	V_u =		= **26.55**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **138.41**	[kips]	
	ratio = **0.19**		> V_u	OK	

Gusset Plate at Web Plate - Block Shear - Center Strip ratio = 26.55 / 111.52 = **0.24** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 2.465 [in]	e_h = 1.625 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 3.469	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 2.484	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 0.797	[in^2]		
Block shear strength required	V_u =	= **26.55**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 148.69	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **111.52**	[kips]		
	ratio = **0.24**	> V_u	OK		

Gusset Plate Overall - Block Shear - Center Strip ratio = 100.00 / 242.78 = **0.41** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 4.0	n_h = 2			
Bolt spacing in hor dir	s_h = 3.000 [in]	edge dist e_h = 1.625 [in]			
Width of block shear strip	W_{bs} = 11.930 [in]				
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 3.469	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 2.484	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = [W_{bs} - (n_v - 1) d_h] t_p$	= 3.489	[in^2]		
Block shear strength required	V_u =	= **100.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 323.70	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **242.78**	[kips]		
	ratio = **0.41**	> V_u	OK		

Gusset Plate - Tensile Yield (Whitmore)			ratio = 100.00 / 259.77	= **0.38**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 15.394	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 5.773	[in^2]	
Tensile force required	P_u =		= **100.00**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 288.64	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **259.77**	[kips]	
	ratio = **0.38**		> P_u	OK	

Gusset Plate - Tensile Rupture (Whitmore)			ratio = 100.00 / 217.44	= **0.46**	**PASS**
Plate Tensile Rupture Check					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 7/8	[in]	AISC 14th B4.3b
Number of bolt	n = 4				
Plate size	width b_p = 15.394	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	$A_{nt} = (b_p - n d_h) t_p$		= 4.460	[in^2]	
Tensile force required	P_u =		= **100.00**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 289.92	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕR_n =		= **217.44**	[kips]	AISC 14th Eq J4-2
	ratio = **0.46**		> P_u	OK	

Brace Force Load Case 2 Sect=W8X24 P =100.00 kips (C) ratio = **0.51** **PASS**

Brace Axial Force Distribution					
W shape section	b_f = 6.500	[in]	t_f = 0.400	[in]	
	A = 7.080	[in^2]			
Brace axial force	P =		= 100.00	[kips]	in compression
Force carried by w shape flange	$P_f = P (b_f t_f / A)$		= **36.72**	[kips]	
Force carried by w shape web	$P_w = P - 2 P_{tf}$		= **26.55**	[kips]	

Flange Angle - Brace Side - Bolt Shear			ratio = 36.72 / 71.57	= **0.51**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 1		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **36.72**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 95.43	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Brace Side - Bolt Bearing on Angle				ratio = 36.72 / 71.57	= **0.51**	**PASS**
Single Bolt Shear Strength						
Bolt shear stress	bolt grade = A325-N			F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$			= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate						
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]				
Plate tensile strength	F_u = 65.0	[ksi]				
Plate thickness	t = 0.500	[in]				
Interior Bolt						
Bolt hole edge clear distance	$L_c = L_s - d_h$			= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, m\, F_u$					AISC 14th Eq J3-6b
	= 106.64 ≤ 73.13			= 73.13	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$			= 23.86	[kips]	
Number of bolt	interior n_{in} = 4					
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$			= 95.43	[kips]	
Required shear strength	V_u =			= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th J3-10
	ϕR_n =			= **71.57**	[kips]	
	ratio = **0.51**			> V_u	OK	

Flange Angle - Brace Side - Bolt Bearing on Brace Flange				ratio = 36.72 / 71.57	= **0.51**	**PASS**
Single Bolt Shear Strength						
Bolt shear stress	bolt grade = A325-N			F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$			= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate						
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]				
Plate tensile strength	F_u = 65.0	[ksi]				
Plate thickness	t = 0.400	[in]				
Interior Bolt						
Bolt hole edge clear distance	$L_c = L_s - d_h$			= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$					AISC 14th Eq J3-6b
	= 85.31 ≤ 58.50			= 58.50	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)			= 23.86	[kips]	
Number of bolt	interior n_{in} = 4					
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$			= 95.43	[kips]	
Required shear strength	V_u =			= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th J3-10
	ϕ R_n =			= **71.57**	[kips]	
	ratio = **0.51**			> V_u	OK	

Flange Angle - Gusset PL Side - Bolt Shear				ratio = 36.72 / 71.57	= **0.51**	**PASS**
Bolt shear stress	bolt grade = A325-N			F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 2.0			shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =			= 1.000		
Required shear strength	V_u =			= **36.72**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$			= 95.43	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq J3-1
	ϕ R_n =			= **71.57**	[kips]	
	ratio = **0.51**			> V_u	OK	

Flange Angle - Gusset PL Side - Bolt Bearing on Angle ratio = 18.36 / 35.78 = **0.51** **PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.500	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$				AISC 14th Eq J3-6b
	= 106.64 ≤ 73.13		= 73.13	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)		= 23.86	[kips]	
Number of bolt	interior n_{in} = 2				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 47.71	[kips]	
Required shear strength	V_u =		= **18.36**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **35.78**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Gusset PL Side - Bolt Bearing on Gusset Plate			ratio = 36.72 / 71.57	= **0.51**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, m\, F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 47.71	[kips]	
Number of bolt	interior n_{in} = 2				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 95.43	[kips]	
Required shear strength	V_u =		= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.51**		> V_u	OK	

Web Plate - Brace Side - Bolt Shear			ratio = 26.55 / 143.14	= **0.19**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **26.55**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 190.85	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕ R_n =		= **143.14**	[kips]	
	ratio = **0.19**		> V_u	OK	

Web Plate - Brace Side - Bolt Bearing on Web Plate	ratio = 13.28 / 71.57	= **0.19**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ F_u$			AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ F_u$			AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84	= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **13.28**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.19**		> V_u	OK	

Web Plate - Brace Side - Bolt Bearing on Brace Web			ratio = 26.55 / 107.49	= **0.25**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.245	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$				AISC 14th Eq J3-6b
	= 52.25 ≤ 35.83		= 35.83	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 35.83	[kips]	
Number of bolt	interior n_{in} = 4				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 143.33	[kips]	
Required shear strength	V_u =		= **26.55**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **107.49**	[kips]	
	ratio = **0.25**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Shear			ratio = 26.55 / 143.14	= **0.19**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **26.55**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 190.85	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕ R_n =		= **143.14**	[kips]	
	ratio = **0.19**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Bearing on Web Plate	ratio = 13.28 / 71.57	= **0.19**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)		= 23.86	[kips]	
Number of bolt	interior n_{in} = 4				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 95.43	[kips]	
Required shear strength	V_u =		= **13.28**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.19**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Bearing on Gusset Plate ratio = 26.55 / 143.14 = **0.19** **PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$			AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)	= 47.71	[kips]	
Number of bolt	interior n_{in} = 4			
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$	= 190.85	[kips]	
Required shear strength	V_u =	= **26.55**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75			AISC 14th J3-10
	ϕ R_n =	= **143.14**	[kips]	
	ratio = **0.19**	> V_u	OK	

Web Plate - Compression Buckling ratio = 13.28 / 73.02 = **0.18** **PASS**

Plate Compression Check

Plate size	width b_p = 5.750 [in]	thickness t_p = 0.375	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 2.156	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$	= 0.108	[in]	
Plate effective length factor	K =	= 1.00		
Plate unbraced length	L_u =	= 6.750	[in]	
Plate slenderness	$KL/r = 1.00 \times L_u / r$	= 62.35		
	when $\frac{KL}{r} > 25$, use Chapter E			AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$	= 73.62	[ksi]	AISC 14th Eq E3-4
	when $\frac{KL}{r} \le 4.71 \left(\frac{E}{F_y}\right)^{0.5} = 113.43$			AISC 14th E3 (a)
Critical stress	$F_{cr} = 0.658^{(F_y/F_e)} F_y$	= 37.63	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =	= **13.28**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$	= 81.13	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th E1
	ϕR_n =	= **73.02**	[kips]	
	ratio = **0.18**	> P_u	OK	

Gusset Plate - Compression (Whitmore) ratio = 100.00 / 224.15 = **0.45** **PASS**

Plate Compression Check

Plate size	width b_p = 15.394 [in]	thickness t_p = 0.375	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 5.773	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$	= 0.108	[in]	
Plate effective length factor	K =	= 0.50		
Plate unbraced length	L_u =	= 9.724	[in]	
Plate slenderness	$KL/r = 0.50 \times L_u / r$	= 44.91		
	when $\frac{KL}{r} > 25$, use Chapter E			AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$	= 141.89	[ksi]	AISC 14th Eq E3-4
	when $\frac{KL}{r} \le 4.71 \left(\frac{E}{F_y}\right)^{0.5} = 113.43$			AISC 14th E3 (a)
Critical stress	$F_{cr} = 0.658^{(F_y/F_e)} F_y$	= 43.14	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =	= **100.00**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$	= 249.06	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th E1
	ϕR_n =	= **224.15**	[kips]	
	ratio = **0.45**	> P_u	OK	

Top Brace - Gusset to Column | End Plate Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.42**	**PASS**

Geometry Restriction Checks - End Plate to Column Flange — PASS

Min Bolt Edge Distance - End Plate to Column Flange

Bolt diameter	d_b =	= 0.750	[in]		
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th	Table J3.4
Min edge distance in End Plate to Column Flange	L_e =	= **1.375**	[in]		
		> $L_{e\text{-}min}$	OK		

Min Bolt Spacing - End Plate to Column Flange

Bolt diameter	d_b =	= 0.750	[in]		
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th	J3.3
Min Bolt spacing in End Plate to Column Flange	L_s =	= **3.000**	[in]		
		> $L_{s\text{-}min}$	OK		

Geometry Restriction Checks - End Plate - Bolt Gage Clearance — PASS

Bolt Gage Entering Clearance Check - Plate Welded to End Plate

Bolt diameter	d_b = 0.750 [in]	gage g = 4.000	[in]		
Bolt entering clearance	c_3 = from AISC manual Table 7-15	= **0.750**	[in]	AISC 14th	Table 7-15
Plate thickness	t = 0.375 [in]	dbl fillet w = 0.313	[in]		
Bolt center clearance distance to fillet toe	c = (g - t - 2 w) / 2	= **1.500**	[in]		
		> c_3	OK	AISC 14th	Table 7-15

Geometry Restriction Checks - Col Flange - Bolt Gage Clearance — PASS

Bolt Gage Entering Clearance Check - Bolt on W Shape Flange

Bolt diameter	d_b = 0.750 [in]	gage g = 4.000	[in]		
Bolt entering clearance	c_3 = from AISC manual Table 7-15	= **0.750**	[in]	AISC 14th	Table 7-15
W section	t_w = 0.295 [in]	k_1 = 0.875	[in]		
Bolt center clearance distance to fillet toe	c = (g - 2 k_1) / 2	= **1.125**	[in]		
		> c_3	OK	AISC 14th	Table 7-15

Weld Limitation Checks - Gusset Plate to End Plate					**PASS**
Min Fillet Weld Size					
Thinner part joined thickness	t =		= 0.375	[in]	
Min fillet weld size allowed	w_{min} =		= **0.188**	[in]	AISC 14th Table J2.4
Fillet weld size provided	w =		= **0.313**	[in]	
			> w_{min}	OK	
Min Fillet Weld Length					
Fillet weld size provided	w =		= 0.313	[in]	
Min fillet weld length allowed	L_{min} = 4 x w		= **1.250**	[in]	AISC 14th J2.2b
Min fillet weld length	L =		= **14.250**	[in]	
			> L_{min}	OK	

Brace Force Load Case 1 Gusset plate t=0.375 P =-100.00 kips (T) ratio = **0.42** **PASS**

Gusset Plate - Shear Yielding					ratio = 39.43 / 160.31 = **0.25**	**PASS**
Plate Shear Yielding Check						
Plate size	width b_p = 14.250	[in]	thickness t_p = 0.375	[in]		
Plate yield strength	F_y = 50.0	[ksi]				
Plate gross area in shear	$A_{gv} = b_p t_p$		= 5.344	[in^2]		
Shear force required	V_u =		= **39.43**	[kips]		
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 160.31	[kips]	AISC 14th Eq J4-3	
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3	
	ϕR_n =		= **160.31**	[kips]		
	ratio = **0.25**		> V_u	OK		

Gusset Plate - Shear Rupture					ratio = 39.43 / 156.30 = **0.25**	**PASS**
Plate Shear Rupture Check						
Plate size	width b_p = 14.250	[in]	thickness t_p = 0.375	[in]		
Plate tensile strength	F_u = 65.0	[ksi]				
Plate net area in shear	$A_{nv} = b_p t_p$		= 5.344	[in^2]		
Shear force in demand	V_u =		= **39.43**	[kips]		
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 208.41	[kips]	AISC 14th Eq J4-4	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4	
	ϕR_n =		= **156.30**	[kips]		
	ratio = **0.25**		> V_u	OK		

Gusset Plate - Axial Yield			ratio = 30.77 / 240.47	= **0.13**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 14.250 [in]		thickness t_p = 0.375 [in]		
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_g = b_p t_p$		= 5.344 [in^2]		
Tensile force required	P_u =		= **30.77** [kips]		
Plate tensile yielding strength	$R_n = F_y A_g$		= 267.19 [kips]	AISC 14th Eq J4-1	
Resistance factor-LRFD	ϕ = 0.90			AISC 14th Eq J4-1	
	ϕR_n =		= **240.47** [kips]		
	ratio = **0.13**		> P_u	OK	

Gusset Plate - Axial Tensile Rupture			ratio = 30.77 / 260.51	= **0.12**	**PASS**
Tensile force required	P_u =		= **30.77** [kips]		
Tensile effective net area	$A_e = A_n U$		= 5.344 [in^2]		
Plate tensile strength	F_u =		= 65.0 [ksi]		
Tensile rupture strength	$R_n = F_u A_e$		= 347.34 [kips]	AISC 14th Eq D2-2	
Resistance factor-LRFD	ϕ = 0.75			AISC 14th D2 (b)	
	ϕR_n =		= **260.51** [kips]	AISC 14th Eq D2-2	
	ratio = **0.12**		> P_u	OK	

End Plate - Shear Yield			ratio = 19.72 / 165.94	= **0.12**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 14.750 [in]		thickness t_p = 0.375 [in]		
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_{gv} = b_p t_p$		= 5.531 [in^2]		
Shear force required	V_u =		= **19.72** [kips]		
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 165.94 [kips]	AISC 14th Eq J4-3	
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3	
	ϕR_n =		= **165.94** [kips]		
	ratio = **0.12**		> V_u	OK	

End Plate - Shear Rupture			ratio = 19.72 / 113.80	= **0.17**	**PASS**
Plate Shear Rupture Check					
Bolt hole diameter	bolt dia d_b = 3/4 [in]		bolt hole dia d_h = 7/8 [in]	AISC 14th B4.3b	
Number of bolt	n = 5				
Plate size	width b_p = 14.750 [in]		thickness t_p = 0.375 [in]		
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$		= 3.891 [in^2]		
Shear force required	V_u =		= **19.72** [kips]		
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 151.73 [kips]	AISC 14th Eq J4-4	
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4	
	ϕR_n =		= **113.80** [kips]		
	ratio = **0.17**		> V_u	OK	

End Plate - Block Shear - Center Strip ratio = 39.43 / 264.16 = **0.15** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 5			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 10.031	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 7.078	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 1.172	[in^2]		
Block shear strength required	V_u =	= **39.43**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 352.22	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **264.16**	[kips]		
	ratio = **0.15**	> V_u	OK		

End Plate - Block Shear - 2-Side Strip ratio = 39.43 / 241.31 = **0.16** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 5			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 10.031	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 7.078	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$	= 0.703	[in^2]		
Block shear strength required	V_u =	= **39.43**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 321.75	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **241.31**	[kips]		
	ratio = **0.16**	> V_u	OK		

End Plate - Bolt Bearing on End Plate			ratio = 39.43 / 178.92	= **0.22**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84		= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Number of bolt	interior n_{in} = 8		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 238.56	[kips]	
Required shear strength	V_u =		= **39.43**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **178.92**	[kips]	
	ratio = **0.22**		> V_u	OK	

End Plate / Column - Bolt Shear			ratio = 39.43 / 178.92	= **0.22**	**PASS**
Bolt group forces	shear V = 39.43	[kips]	axial P = 30.77	[kips]	
Bolt shear stress	grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 10.0		shear plane m = 1		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **39.43**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 238.56	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕ R_n =		= **178.92**	[kips]	
	ratio = **0.22**		> V_u	OK	

End Plate / Column - Bolt Bearing on Column					ratio = 39.43 / 178.92	= **0.22**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442		[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$				= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16		[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]					
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.515	[in]					
Interior Bolt							
Bolt hole edge clear distance	$L_c = L_s - d_h$				= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$						AISC 14th Eq J3-6b
	= 109.84 ≤ 75.32				= 75.32	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$				= 23.86	[kips]	
Number of bolt	interior n_{in} = 10						
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$				= 238.56	[kips]	
Required shear strength	V_u =				= **39.43**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕR_n =				= **178.92**	[kips]	
	ratio = **0.22**				> V_u	OK	

Bolt Tensile Prying Action on End Plate			ratio = 3.08 / 7.28	= **0.42**	**PASS**
Bolt group forces	shear V = 39.43	[kips]	axial P = -30.77	[kips]	
Single Bolt Tensile Capacity Without Considering Prying					
Bolt grade	grade = A325-N				
Nominal tensile/shear stress	F_{nt} = 90.0	[ksi]	F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Bolt group shear force	shear V = 39.43	[kips]	no of bolt n = 10		
Shear stress required	$f_{rv} = V / (n A_b)$		= 8.93	[ksi]	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$		= **90.00**	[ksi]	AISC 14th Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$		= 39.76	[kips]	AISC 14th Eq J3-1
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.6
Single bolt tensile capacity	ϕr_n =		= **29.82**	[kips]	
Single Bolt Tensile Capacity After Considering Prying					
End plate	width w = 6.750	[in]	bolt gage g = 4.000	[in]	
	web t_w = 0.375	[in]			
Dist from bolt center to plate edge	a = 0.5 (w - g)		= 1.375	[in]	
	$a' = a + 0.5 d_b \le (1.25 b + 0.5 d_b)$		= 1.750	[in]	AISC 14th Eq 9-27
Bolt hole diameter	bolt dia d_b = 0.750	[in]	bolt hole dia d_h = 0.813	[in]	AISC 14th B4.3b
Dist from bolt center to face of web	$b = 0.5(g - t_w)$		= 1.813	[in]	
	$b' = b - 0.5 d_b$		= 1.438	[in]	AISC 14th Eq 9-21
Bolt pitch spacing	s_v = 3.000				
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$		= 2.950	[in]	AISC 14th Page 9-11
	$\rho = b' / a'$		= 0.821		AISC 14th Eq 9-26
	$\delta = 1 - d_h / p$		= 0.725		AISC 14th Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section		= 29.82	[kips]	
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Page 9-10
End plate thickness	t = 0.375	[in]	tensile F_u = 65.0	[ksi]	
Plate thickness req'd to develop bolt tensile capacity without prying	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$		= 0.997	[in]	AISC 14th Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$		= 4.596		AISC 14th Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$		= 0.244		AISC 14th Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below		= **3.08**	[kips]	
Tensile strength per bolt after considering prying	ϕr_n = B x Q		= **7.28**	[kips]	AISC 14th Eq 9-31
	ratio = **0.42**		> T	OK	
Calculate Max Single Bolt Tensile Load					
Bolt group force	axial P = 30.77	[kips]			
Bolt number	Bolt Row n_h = 2		Bolt Col n_v = 5		
Bolt tensile force per bolt	$T = P / (n_v n_h)$		= **3.08**	[kips]	

Bolt Tensile Prying Action on Column Flange			ratio = 3.08 / 13.62	= **0.23**	**PASS**
Bolt group forces	shear V = 39.43	[kips]	axial P = -30.77	[kips]	
Single Bolt Tensile Capacity Without Considering Prying					
Bolt grade	grade = A325-N				
Nominal tensile/shear stress	F_{nt} = 90.0	[ksi]	F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Bolt group shear force	shear V = 39.43	[kips]	no of bolt n = 10		
Shear stress required	$f_{rv} = V / (n A_b)$		= 8.93	[ksi]	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$		= **90.00**	[ksi]	AISC 14th Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$		= 39.76	[kips]	AISC 14th Eq J3-1
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.6
Single bolt tensile capacity	ϕr_n =		= **29.82**	[kips]	
Single Bolt Tensile Capacity After Considering Prying					
Column flange as tee	b_f = 8.010	[in]	bolt gage g = 4.000	[in]	
	web t_w = 0.295	[in]			
Dist from bolt center to flange edge	$a_{cf} = 0.5 (b_f - g)$		= 2.005	[in]	
End plate	width w = 6.750	[in]	bolt gage g = 4.000	[in]	
Dist from bolt center to plate edge	$a_{pl} = 0.5 (w - g)$		= 1.375	[in]	
Dist from bolt center to plate edge	$a = \min (a_{cf}, a_{pl})$		= 1.375	[in]	
	$a' = a + 0.5 d_b \le (1.25 b + 0.5 d_b)$		= 1.750	[in]	AISC 14th Eq 9-27
Bolt hole diameter	bolt dia d_b = 0.750	[in]	bolt hole dia d_h = 0.813	[in]	AISC 14th B4.3b
Dist from bolt center to face of web	$b = 0.5(g - t_w)$		= 1.853	[in]	
	$b' = b - 0.5 d_b$		= 1.478	[in]	AISC 14th Eq 9-21
Bolt pitch spacing	s_v = 3.000				
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$		= 3.000	[in]	AISC 14th Page 9-11
	$\rho = b' / a'$		= 0.844		AISC 14th Eq 9-26
	$\delta = 1 - d_h / p$		= 0.729		AISC 14th Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section		= 29.82	[kips]	
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Page 9-10
Column flange thickness	t = 0.515	[in]	tensile F_u = 65.0	[ksi]	
Plate thickness req'd to develop bolt tensile capacity without prying	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$		= 1.002	[in]	AISC 14th Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$		= 2.072		AISC 14th Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$		= 0.457		AISC 14th Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below		= **3.08**	[kips]	
Tensile strength per bolt after considering prying	ϕr_n = B x Q		= **13.62**	[kips]	AISC 14th Eq 9-31
	ratio = **0.23**		> T	OK	
Calculate Max Single Bolt Tensile Load					
Bolt group force	axial P = 30.77	[kips]			

Gusset Plate to End Plate Weld Strength ratio = 3.51 / 10.97 = **0.32** **PASS**

Weld Group Forces

shear V = 39.43 [kips] axial P = -30.77 [kips] in tension

Gusset-end plate fillet weld length	L = weld length tributary to bolt group	= **14.250**	[in]		
Combined Weld Stress					
Weld stress from axial force	$f_a = P / L$	= -2.159	[kip/in]	in tension	
Weld stress from shear force	$f_v = V / L$	= 2.767	[kip/in]		
Weld stress combined - max	$f_{max} = (f_a^2 + f_v^2)^{0.5}$	= **3.510**	[kip/in]	AISC 14th	Eq 8-11
Weld stress load angle	$\theta = \tan^{-1} (f_a / f_v)$	= 38.0	[°]		
Fillet Weld Strength Calc					
Fillet weld leg size	$w = 5/16$ [in]	load angle θ = 38.0	[°]		
Electrode strength	F_{EXX} = 70.0 [ksi]	strength coeff C_1 = 1.00		AISC 14th	Table 8-3
Number of weld line	n = 2 for double fillet				
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$	= 1.24		AISC 14th	Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$	= 23.036	[kip/in]	AISC 14th	Eq 8-1
Base metal - gusset plate	thickness t = 0.375 [in]	tensile F_u = 65.0	[ksi]		
Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked				AISC 14th	J2.4
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	= 14.625	[kip/in]	AISC 14th	Eq J4-4
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	= **14.625**	[kip/in]	AISC 14th	Eq 9-2
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq 8-1
	ϕ R_n =	= **10.969**	[kip/in]		
	ratio = **0.32**	> f_{max}	OK		

Column Web Local Yielding ratio = 30.77 / 292.79 = **0.11** **PASS**

Concentrated force from gusset	P_u =	= **30.77**	[kips]		
Column section	d = 11.900 [in]	t_f = 0.515	[in]		
	t_w = 0.295 [in]	k = 1.020	[in]		
	yield F_y = 50.0 [ksi]				
Length of bearing	l_b = end plate length	= 14.750	[in]		
Column web local yielding strength	$R_n = F_y t_w (5 k + l_b)$	= 292.79	[kips]	AISC 14th	Eq J10-2
Resistance factor-LRFD	ϕ = 1.00				
	ϕ R_n =	= **292.79**	[kips]		
	ratio = **0.11**	> P_u	OK		

Column Flange Local Bending			ratio = 30.77 / 74.59	= **0.41**	**PASS**
Concentrated force from gusset	P_u =		= **30.77**	[kips]	
Column w section	t_f = 0.515	[in]	yield F_y = 50.0	[ksi]	
Column flange local bending strength	$R_n = 6.25\ F_y t_f^2$		= 82.88	[kips]	AISC 14th Eq J10-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th J10.1
	ϕR_n =		= **74.59**	[kips]	
	ratio = **0.41**		> P_u	OK	

Brace Force Load Case 2 Gusset plate t=0.375 P =100.00 kips (C) ratio = **0.25** **PASS**

Gusset Plate - Shear Yielding			ratio = 39.43 / 160.31	= **0.25**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 14.250	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 5.344	[in^2]	
Shear force required	V_u =		= **39.43**	[kips]	
Plate shear yielding strength	$R_n = 0.6\ F_y A_{gv}$		= 160.31	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **160.31**	[kips]	
	ratio = **0.25**		> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 39.43 / 156.30	= **0.25**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 14.250	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 5.344	[in^2]	
Shear force in demand	V_u =		= **39.43**	[kips]	
Plate shear rupture strength	$R_n = 0.6\ F_u A_{nv}$		= 208.41	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **156.30**	[kips]	
	ratio = **0.25**		> V_u	OK	

End Plate - Shear Yield			ratio = 19.72 / 165.94	= **0.12**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 14.750	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 5.531	[in^2]	
Shear force required	V_u =		= **19.72**	[kips]	
Plate shear yielding strength	$R_n = 0.6\ F_y A_{gv}$		= 165.94	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **165.94**	[kips]	
	ratio = **0.12**		> V_u	OK	

End Plate - Shear Rupture			ratio = 19.72 / 113.80	= **0.17**	**PASS**
Plate Shear Rupture Check					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th B4.3b
Number of bolt	n = 5				
Plate size	width b_p = 14.750	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	A_{nv} = (b_p - n d_h) t_p		= 3.891	[in^2]	
Shear force required	V_u =		= **19.72**	[kips]	
Plate shear rupture strength	R_n = 0.6 F_u A_{nv}		= 151.73	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **113.80**	[kips]	
	ratio = **0.17**		> V_u	OK	

End Plate - Block Shear - Center Strip			ratio = 39.43 / 264.16	= **0.15**	**PASS**
Plate Block Shear - Center Strip					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th B4.3b
Plate thickness	t_p = 0.375	[in]			
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]	
Bolt no in ver & hor dir	n_v = 2		n_h = 5		
Bolt spacing in ver & hor dir	s_v = 4.000	[in]	s_h = 3.000	[in]	
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]	
Gross area subject to shear	A_{gv} = [(n_h - 1) s_h + e_h] t_p x 2		= 10.031	[in^2]	
Net area subject to shear	A_{nv} = A_{gv} - [(n_h - 1)+ 0.5] d_h t_p x2		= 7.078	[in^2]	
Net area subject to tension when sheared out by center strip	A_{nt} = (n_v - 1) (s_v - d_h) t_p		= 1.172	[in^2]	
Block shear strength required	V_u =		= **39.43**	[kips]	
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th Fig C-J4.2
Bolt shear resistance provided	R_n = min (0.6F_u A_{nv} , 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}		= 352.22	[kips]	AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5
	ϕ R_n =		= **264.16**	[kips]	
	ratio = **0.15**		> V_u	OK	

End Plate - Block Shear - 2-Side Strip ratio = 39.43 / 241.31 = **0.16** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 5			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 10.031	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 7.078	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$	= 0.703	[in^2]		
Block shear strength required	V_u =	= **39.43**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 321.75	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **241.31**	[kips]		
	ratio = **0.16**	> V_u	OK		

End Plate - Bolt Bearing on End Plate			ratio = 39.43 / 178.92	= **0.22**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84		= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Number of bolt	interior n_{in} = 8		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 238.56	[kips]	
Required shear strength	V_u =		= **39.43**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **178.92**	[kips]	
	ratio = **0.22**		> V_u	OK	

End Plate / Column - Bolt Shear			ratio = 39.43 / 178.92	= **0.22**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 10.0		shear plane m = 1		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **39.43**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 238.56	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕR_n =		= **178.92**	[kips]	
	ratio = **0.22**		> V_u	OK	

End Plate / Column - Bolt Bearing on Column					ratio = 39.43 / 178.92	= **0.22**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442		[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$				= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16		[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]					
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.515	[in]					
Interior Bolt							
Bolt hole edge clear distance	$L_c = L_s - d_h$				= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$						AISC 14th Eq J3-6b
	= 109.84 ≤ 75.32				= 75.32	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$				= 23.86	[kips]	
Number of bolt	interior n_{in} = 10						
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$				= 238.56	[kips]	
Required shear strength	V_u =				= **39.43**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕR_n =				= **178.92**	[kips]	
	ratio = **0.22**				> V_u	OK	

Gusset Plate to End Plate Weld Strength						ratio = 2.77 / 10.97	= **0.25**	**PASS**
Weld Group Forces								
	shear V = 39.43	[kips]		axial P = 30.77	[kips]	in compression		
Gusset-end plate fillet weld length	L = weld length tributary to bolt group			= **14.250**	[in]			
Combined Weld Stress								
Weld stress from axial force	f_a = P / L			= 0.000	[kip/in]	in compression		
Weld stress from shear force	f_v = V / L			= 2.767	[kip/in]			
Weld stress combined - max	f_{max} = f_v			= **2.767**	[kip/in]	AISC 14th Eq 8-11		
Weld stress load angle	θ =			= 0.0	[°]			
Fillet Weld Strength Calc								
Fillet weld leg size	w = 5/16	[in]	load angle θ = 0.0		[°]			
Electrode strength	F_{EXX} = 70.0	[ksi]	strength coeff C_1 = 1.00			AISC 14th Table 8-3		
Number of weld line	n = 2 for double fillet							
Load angle coefficient	C_2 = (1 + 0.5 $\sin^{1.5}$ θ)			= 1.00		AISC 14th Page 8-9		
Fillet weld shear strength	R_{n-w} = 0.6 (C_1 x 70 ksi) 0.707 w n C_2			= 18.559	[kip/in]	AISC 14th Eq 8-1		
Base metal - gusset plate	thickness t = 0.375	[in]	tensile F_u = 65.0		[ksi]			
Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked						AISC 14th J2.4		
Base metal shear rupture	R_{n-b} = 0.6 F_u t			= 14.625	[kip/in]	AISC 14th Eq J4-4		
Double fillet linear shear strength	R_n = min (R_{n-w} , R_{n-b})			= **14.625**	[kip/in]	AISC 14th Eq 9-2		
Resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq 8-1		
	ϕ R_n =			= **10.969**	[kip/in]			
	ratio = **0.25**			> f_{max}	OK			

Column Web Local Yielding						ratio = 30.77 / 292.79	= **0.11**	**PASS**
Concentrated force from gusset	P_u =			= **30.77**	[kips]			
Column section	d = 11.900	[in]		t_f = 0.515	[in]			
	t_w = 0.295	[in]		k = 1.020	[in]			
	yield F_y = 50.0	[ksi]						
Length of bearing	l_b = end plate length			= 14.750	[in]			
Column web local yielding strength	R_n = F_y t_w (5 k + l_b)			= 292.79	[kips]	AISC 14th Eq J10-2		
Resistance factor-LRFD	ϕ = 1.00							
	ϕ R_n =			= **292.79**	[kips]			
	ratio = **0.11**			> P_u	OK			

Column Web Local Crippling					ratio = 30.77 / 217.00	= **0.14**	**PASS**
Concentrated force from gusset	P_u =				= **30.77**	[kips]	
Column section	d = 11.900	[in]		t_f = 0.515	[in]		
	t_w = 0.295	[in]		k = 1.020	[in]		
	yield F_y = 50.0	[ksi]		E = 29000	[ksi]		
Length of bearing	l_b = end plate length			= 14.750	[in]		
Column web local crippling strength	$R_n = 0.8\, t_w^2\, [1+3\frac{l_b}{d}(\frac{t_w}{t_f})^{1.5}] \times (\frac{E\, F_y\, t_f}{t_w})^{0.5}$			= 289.33	[kips]	AISC 14th Eq J10-4	
Resistance factor-LRFD	ϕ = 0.75					AISC 14th J10.3	
	ϕR_n =			= **217.00**	[kips]		
	ratio = **0.14**			> P_u	OK		

Top Brace - Gusset to Beam | Direct Weld Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.44**	**PASS**

Brace Weld Limitation Checks - Gusset to Beam — PASS

Min Fillet Weld Size

Thinner part joined thickness	t =	= 0.375	[in]	
Min fillet weld size allowed	w_{min} =	= **0.188**	[in]	AISC 14th Table J2.4
Fillet weld size provided	w =	= **0.313**	[in]	
		> w_{min}	OK	

Min Fillet Weld Length

Fillet weld size provided	w =	= 0.313	[in]	
Min fillet weld length allowed	L_{min} = 4 x w	= **1.250**	[in]	AISC 14th J2.2b
Min fillet weld length	L =	= **15.757**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1

Gusset plate t=0.375 | P =-100.00 kips (T) | ratio = **0.44** | **PASS**

Gusset Plate - Shear Yielding — ratio = 39.94 / 177.27 = **0.23** — PASS

Plate Shear Yielding Check

Plate size	width b_p = 15.757 [in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 5.909	[in^2]	
Shear force required	V_u =	= **39.94**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 177.27	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕR_n =	= **177.27**	[kips]	
	ratio = **0.23**	> V_u	OK	

Gusset Plate - Shear Rupture — ratio = 39.94 / 172.83 = **0.23** — PASS

Plate Shear Rupture Check

Plate size	width b_p = 15.757 [in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0 [ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$	= 5.909	[in^2]	
Shear force in demand	V_u =	= **39.94**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 230.45	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4
	ϕR_n =	= **172.83**	[kips]	
	ratio = **0.23**	> V_u	OK	

Gusset Plate - Axial Tensile Yield			ratio = 31.28 / 265.90	= **0.12**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 15.757	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 5.909	[in^2]	
Tensile force required	P_u =		= **31.28**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 295.44	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **265.90**	[kips]	
	ratio = **0.12**		> P_u	OK	

Gusset Plate - Axial Tensile Rupture			ratio = 31.28 / 288.06	= **0.11**	**PASS**
Plate Tensile Rupture Check					
Plate size	width b_p = 15.757	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	$A_{nt} = b_p t_p$		= 5.909	[in^2]	
Tensile force required	P_u =		= **31.28**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 384.08	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕR_n =		= **288.06**	[kips]	AISC 14th Eq J4-2
	ratio = **0.11**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.08**	**PASS**
Gusset plate	width b_p = 15.757	[in]	thick t_p = 0.375	[in]	
	yield F_y = 50.0	[ksi]			
Shear plate - gross area	$A_g = b_p \times t_p$		= 5.909	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 23.277	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 87.29	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 3.33	[kip-ft]	
Axial strength available	P_c = from axial tensile yield check		= 265.90	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 31.28	[kips]	
Shear strength available	V_c = from shear yielding check		= 177.27	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 39.94	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.08**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact		ratio =	= **0.07**	**PASS**
Gusset plate	width b_p = 15.757 [in]	thick t_p = 0.375	[in]	
	tensile F_u = 65.0 [ksi]			
Net area of plate	$A_n = b_p \times t_p$	= 5.909	[in^2]	
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$	= 23.277	[in^3]	
Flexural strength available	$M_c = \phi F_u Z_{net}$ ϕ=0.75	= 94.56	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc	= 3.33	[kip-ft]	
Axial strength available	P_c = from axial tensile rupture check	= 288.06	[kips]	
Axial strength required	P_r = from gusset interface forces calc	= 31.28	[kips]	
Shear strength available	V_c = from shear rupture check	= 172.83	[kips]	
Shear strength required	V_r = from gusset interface forces calc	= 39.94	[kips]	
Flexural rupture interaction	$\text{ratio} = (\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$	= **0.07**		AISC 14th Eq 10-5
		< 1.0	OK	

Gusset to Beam Weld Strength ratio = 3.89 / 8.78 = **0.44** **PASS**

Gusset to Beam Interface - Forces

shear H_b = 39.94 [kips] axial V_b = -31.28 [kips] in tension

moment M_b = 3.33 [kip-ft]

Gusset-beam fillet weld length	L_w =	= 15.757	[in]	

Gusset to Beam Interface - Combined Weld Stress

Weld stress from axial force	$f_a = V_b / L_{wb}$	= -1.985	[kip/in]	in tension
Weld stress from shear force	$f_v = H_b / L_{wb}$	= 2.535	[kip/in]	
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$	= 0.966	[kip/in]	
Weld stress combined - max	$f_{max} = [(f_a - f_b)^2 + f_v^2]^{0.5}$	= **3.890**	[kip/in]	AISC 14th Eq 8-11
Weld resultant load angle	$\theta = \tan^{-1} [(f_b - f_a) / f_v]$	= 49.3	[°]	

Fillet Weld Strength Calc

Fillet weld leg size $w = {}^{5}/_{16}$ [in] load angle θ = 49.3 [°]

Electrode strength	F_{EXX} = 70.0 [ksi] strength coeff C_1 = 1.00			AISC 14th Table 8-3
Number of weld line	n = 2 for double fillet			
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$	= 1.33		AISC 14th Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$	= 24.689	[kip/in]	AISC 14th Eq 8-1

Base metal - gusset plate thickness t = 0.375 [in] tensile F_u = 65.0 [ksi]

Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked AISC 14th J2.4

Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	= 14.625	[kip/in]	AISC 14th Eq J4-4
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	= **14.625**	[kip/in]	AISC 14th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$			AISC 14th Eq 8-1
	ϕR_n =	= 10.969	[kip/in]	

When gusset plate is directly welded to beam or column, apply 1.25 ductility factor to allow adequate force redistribution in the weld group AISC 14th Page 13-11

Weld strength used for design after applying ductility factor	$\phi R_n = \phi R_n \times (1/1.25)$	= **8.775**	[kip/in]	
	ratio = **0.44**	> f_{max}	OK	

Beam Web Local Yielding ratio = 41.42 / 309.15 = **0.13** **PASS**

Gusset Edge Equivalent Normal Force

Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force

Gusset edge axial force	N =	= -31.28	[kips]	
Gusset edge moment force	M =	= 3.33	[kip-ft]	
Gusset edge interface length	L =	= 15.757	[in]	
Gusset edge equivalent normal force	$N_e = N - \frac{4\,M}{L}$	= -41.42	[kips]	AISC DG29 Fig B-1
Concentrated force from gusset	P_u =	= **41.42**	[kips]	
Beam section	d = 12.100 [in]	t_f = 0.575	[in]	
	t_w = 0.335 [in]	k = 1.080	[in]	
	yield F_y = 50.0 [ksi]			
Length of bearing	l_b = Gusset/Beam interface length	= 15.757	[in]	
Gusset plate corner clip	clip = from user input	= 0.750	[in]	
Distance from normal force applied point to member end	$l_N = 0.5\,l_b$ + clip	= 8.629	[in]	
	when $l_N \le d$, use AISC 14th Eq J10-3			AISC 14th Eq J10-3
Beam web local yielding strength	$R_n = F_y\,t_w\,(2.5\,k + l_b)$	= 309.15	[kips]	AISC 14th Eq J10-3
Resistance factor-LRFD	ϕ = 1.00			
	ϕR_n =	= **309.15**	[kips]	
	ratio = **0.13**	> P_u	OK	

Brace Force Load Case 2 Gusset plate t=0.375 P =100.00 kips (C) ratio = **0.29** **PASS**

Gusset Plate - Shear Yielding ratio = 39.94 / 177.27 = **0.23** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 15.757 [in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p\,t_p$	= 5.909	[in^2]	
Shear force required	V_u =	= **39.94**	[kips]	
Plate shear yielding strength	$R_n = 0.6\,F_y\,A_{gv}$	= 177.27	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕR_n =	= **177.27**	[kips]	
	ratio = **0.23**	> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 39.94 / 172.83	= **0.23**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 15.757 [in]		thickness t_p = 0.375 [in]		
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = b_p t_p$		= 5.909 [in^2]		
Shear force in demand	V_u =		= **39.94** [kips]		
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 230.45 [kips]	AISC 14th Eq J4-4	
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4	
	ϕR_n =		= **172.83** [kips]		
	ratio = **0.23**		> V_u	OK	

Gusset Plate - Axial Yield			ratio = 31.28 / 265.90	= **0.12**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 15.757 [in]		thickness t_p = 0.375 [in]		
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_g = b_p t_p$		= 5.909 [in^2]		
Tensile force required	P_u =		= **31.28** [kips]		
Plate tensile yielding strength	$R_n = F_y A_g$		= 295.44 [kips]	AISC 14th Eq J4-1	
Resistance factor-LRFD	ϕ = 0.90			AISC 14th Eq J4-1	
	ϕR_n =		= **265.90** [kips]		
	ratio = **0.12**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.08**	**PASS**
Gusset plate	width b_p = 15.757 [in]		thick t_p = 0.375 [in]		
	yield F_y = 50.0 [ksi]				
Shear plate - gross area	$A_g = b_p \times t_p$		= 5.909 [in^2]		
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 23.277 [in^3]		
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 87.29 [kip-ft]		
Flexural strength required	M_r = from gusset interface forces calc		= 3.33 [kip-ft]		
Axial strength available	P_c = from axial tensile yield check		= 265.90 [kips]		
Axial strength required	P_r = from gusset interface forces calc		= 31.28 [kips]		
Shear strength available	V_c = from shear yielding check		= 177.27 [kips]		
Shear strength required	V_r = from gusset interface forces calc		= 39.94 [kips]		
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.08**	AISC 14th Eq 10-5	
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact								ratio =	= **0.05**	**PASS**
Gusset plate	width b_p = 15.757	[in]			thick t_p = 0.375	[in]				
	tensile F_u = 65.0	[ksi]								
Net area of plate	$A_n = b_p \times t_p$							= 5.909	[in^2]	
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$							= 23.277	[in^3]	
Flexural strength available	$M_c = \phi F_u Z_{net}$	ϕ=0.75						= 94.56	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc							= 3.33	[kip-ft]	
Shear strength available	V_c = from shear rupture check							= 172.83	[kips]	
Shear strength required	V_r = from gusset interface forces calc							= 39.94	[kips]	
Flexural rupture interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{M_r}{M_c})^2$							= **0.05**		AISC 14th Eq 10-5
								< 1.0	OK	

Gusset to Beam Weld Strength								ratio = 2.53 / 8.78	= **0.29**	**PASS**
Gusset to Beam Interface - Forces										
	shear H_b = 39.94	[kips]			axial V_b = 31.28	[kips]	in compression			
	moment M_b = 3.33	[kip-ft]								
Gusset-beam fillet weld length	L_w =							= 15.757	[in]	
Gusset to Beam Interface - Combined Weld Stress										
Weld stress from axial force	$f_a = V_b / L_{wb}$							= 1.985	[kip/in]	in compression
Weld stress from shear force	$f_v = H_b / L_{wb}$							= 2.535	[kip/in]	
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$							= 0.966	[kip/in]	
Weld stress combined - max	$f_{max} = f_v$							= **2.535**	[kip/in]	AISC 14th Eq 8-11
Weld resultant load angle	θ = weld only has shear component							= 0.0	[°]	
Fillet Weld Strength Calc										
Fillet weld leg size	w = 5/16	[in]			load angle θ = 0.0	[°]				
Electrode strength	F_{EXX} = 70.0	[ksi]			strength coeff C_1 = 1.00					AISC 14th Table 8-3
Number of weld line	n = 2 for double fillet									
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$							= 1.00		AISC 14th Page 8-9
Fillet weld shear strength	R_{n-w} = 0.6 (C_1 x 70 ksi) 0.707 w n C_2							= 18.559	[kip/in]	AISC 14th Eq 8-1
Base metal - gusset plate	thickness t = 0.375	[in]			tensile F_u = 65.0	[ksi]				
Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked										AISC 14th J2.4
Base metal shear rupture	R_{n-b} = 0.6 F_u t							= 14.625	[kip/in]	AISC 14th Eq J4-4
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$							= **14.625**	[kip/in]	AISC 14th Eq 9-2
Resistance factor-LRFD	ϕ = 0.75									AISC 14th Eq 8-1
	ϕR_n =							= 10.969	[kip/in]	
When gusset plate is directly welded to beam or column, apply 1.25 ductility factor to allow adequate force redistribution in the weld group										AISC 14th Page 13-11
Weld strength used for design after applying ductility factor	$\phi R_n = \phi R_n \times (1/1.25)$							= **8.775**	[kip/in]	
	ratio = **0.29**							> f_{max}	OK	

Beam Web Local Yielding ratio = 41.42 / 309.15 = **0.13** **PASS**

Gusset Edge Equivalent Normal Force

Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force

Gusset edge axial force	N =	= 31.28	[kips]	
Gusset edge moment force	M =	= 3.33	[kip-ft]	
Gusset edge interface length	L =	= 15.757	[in]	
Gusset edge equivalent normal force	$N_e = N + \frac{4\,M}{L}$	= 41.42	[kips]	AISC DG29 Fig B-1
Concentrated force from gusset	P_u =	= **41.42**	[kips]	
Beam section	d = 12.100 [in]	t_f = 0.575	[in]	
	t_w = 0.335 [in]	k = 1.080	[in]	
	yield F_y = 50.0 [ksi]			
Length of bearing	l_b = Gusset/Beam interface length	= 15.757	[in]	
Gusset plate corner clip	clip = from user input	= 0.750	[in]	
Distance from normal force applied point to member end	$l_N = 0.5\,l_b$ + clip	= 8.629	[in]	
	when $l_N \le d$, use AISC 14th Eq J10-3			AISC 14th Eq J10-3
Beam web local yielding strength	$R_n = F_y\,t_w\,(2.5\,k + l_b)$	= 309.15	[kips]	AISC 14th Eq J10-3
Resistance factor-LRFD	ϕ = 1.00			
	$\phi\,R_n$ =	= **309.15**	[kips]	
	ratio = **0.13**	> P_u	OK	

Beam Web Local Crippling ratio = 41.42 / 290.78 = **0.14** **PASS**

Gusset Edge Equivalent Normal Force

Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force

Gusset edge axial force	N =	= 31.28	[kips]	
Gusset edge moment force	M =	= 3.33	[kip-ft]	
Gusset edge interface length	L =	= 15.757	[in]	
Gusset edge equivalent normal force	$N_e = N + \frac{4\,M}{L}$	= 41.42	[kips]	AISC DG29 Fig B-1
Concentrated force from gusset	P_u =	= **41.42**	[kips]	
Beam section	d = 12.100 [in]	t_f = 0.575	[in]	
	t_w = 0.335 [in]	k = 1.080	[in]	
	yield F_y = 50.0 [ksi]	E = 29000	[ksi]	
Length of bearing	l_b = Gusset/Beam interface length	= 15.757	[in]	
Gusset plate corner clip	clip = from user input	= 0.750	[in]	
Distance from normal force applied point to member end	$l_N = 0.5\,l_b$ + clip	= 8.629	[in]	
	when $l_N \geq d/2$, use Eq J10-4			AISC 14th Eq J10-4
Beam web local crippling strength	$R_n = 0.8\,t_w^2\,[1+3\frac{l_b}{d}(\frac{t_w}{t_f})^{1.5}]\,x\,(\frac{E\,F_y\,t_f}{t_w})^{0.5}$	= 387.70	[kips]	AISC 14th Eq J10-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th J10.3
	ϕR_n =	= **290.78**	[kips]	
	ratio = **0.14**	> P_u	OK	

Bottom Brace - Brace to Gusset Sect=W8X24 P_{LC1} =50.00 kips (C) P_{LC2} =-50.00 kips (T) Code=AISC 360-10 LRFD

Result Summary geometries & weld limitations = **PASS** limit states max ratio = **0.69** **PASS**

Geometry Restriction Checks - Web Plate to Gusset **PASS**

Min Bolt Edge Distance - Web Plate to Gusset

Bolt diameter	d_b =	= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in Web Plate to Gusset	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - Web Plate to Gusset

Bolt diameter	d_b =	= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in Web Plate to Gusset	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Geometry Restriction Checks - Web Plate to Brace Web **PASS**

Min Bolt Edge Distance - Web Plate to Brace Web

Bolt diameter	d_b =	= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in Web Plate to Brace Web	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - Web Plate to Brace Web

Bolt diameter	d_b =	= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in Web Plate to Brace Web	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Brace Force Load Case 1 Sect=W8X24 P =50.00 kips (C) ratio = **0.47** **PASS**

Web Plate - Brace Side - Bolt Shear ratio = 50.00 / 143.14 = **0.35** **PASS**

Bolt shear stress	bolt grade = A325-N	F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750 [in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0	shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =	= 1.000		
Required shear strength	V_u =	= **50.00**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$	= 190.85	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J3-1
	ϕR_n =	= **143.14**	[kips]	
	ratio = **0.35**	> V_u	OK	

Web Plate - Brace Side - Bolt Bearing on Web Plate	ratio = 25.00 / 71.57	= **0.35**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84	= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **25.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.35**		> V_u	OK	

Web Plate - Brace Side - Bolt Bearing on Brace Web			ratio = 50.00 / 107.49	= **0.47**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.245	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$				AISC 14th Eq J3-6b
	= 52.25 ≤ 35.83		= 35.83	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 35.83	[kips]	
Number of bolt	interior n_{in} = 4				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 143.33	[kips]	
Required shear strength	V_u =		= **50.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **107.49**	[kips]	
	ratio = **0.47**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Shear			ratio = 50.00 / 143.14	= **0.35**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **50.00**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 190.85	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕ R_n =		= **143.14**	[kips]	
	ratio = **0.35**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Bearing on Web Plate	ratio = 25.00 / 71.57	= **0.35**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)		= 23.86	[kips]	
Number of bolt	interior n_{in} = 4				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 95.43	[kips]	
Required shear strength	V_u =		= **25.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.35**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Bearing on Gusset Plate ratio = 50.00 / 143.14 = **0.35** **PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)		= 47.71	[kips]	
Number of bolt	interior n_{in} = 4				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 190.85	[kips]	
Required shear strength	V_u =		= **50.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **143.14**	[kips]	
	ratio = **0.35**		> V_u	OK	

Web Plate - Compression Buckling ratio = 25.00 / 73.02 = **0.34** **PASS**

Plate Compression Check

Plate size	width b_p = 5.750 [in]	thickness t_p = 0.375	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 2.156	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$	= 0.108	[in]	
Plate effective length factor	K =	= 1.00		
Plate unbraced length	L_u =	= 6.750	[in]	
Plate slenderness	$KL/r = 1.00 \times L_u / r$	= 62.35		
	when $\frac{KL}{r} > 25$, use Chapter E			AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$	= 73.62	[ksi]	AISC 14th Eq E3-4
	when $\frac{KL}{r} \le 4.71 \left(\frac{E}{F_y}\right)^{0.5} = 113.43$			AISC 14th E3 (a)
Critical stress	$F_{cr} = 0.658^{(F_y/F_e)} F_y$	= 37.63	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =	= **25.00**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$	= 81.13	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th E1
	ϕR_n =	= **73.02**	[kips]	
	ratio = **0.34**	> P_u	OK	

Gusset Plate - Compression (Whitmore) ratio = 50.00 / 109.08 = **0.46** **PASS**

Plate Compression Check

Plate size	width b_p = 6.464 [in]	thickness t_p = 0.375	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 2.424	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$	= 0.108	[in]	
Plate effective length factor	K =	= 0.50		
Plate unbraced length	L_u =	= 5.134	[in]	
Plate slenderness	$KL/r = 0.50 \times L_u / r$	= 23.71		
Plate compression required	P_u =	= **50.00**	[kips]	
	when $\frac{KL}{r} \le 25$			AISC 14th J4.4 (a)
Plate compression provided	$R_n = F_y \times A_g$	= 121.20	[kips]	AISC 14th Eq J4-6
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th J4.4 (a)
	ϕR_n =	= **109.08**	[kips]	
	ratio = **0.46**	> P_u	OK	

Brace Force Load Case 2 Sect=W8X24 P =-50.00 kips (T) ratio = **0.69** **PASS**

W Shape Brace - Tensile Yield			ratio = 50.00 / 318.60	= **0.16**	**PASS**
Gross area subject to tension	A_g =		= 7.080	[in^2]	
Steel yield strength	F_y =		= 50.0	[ksi]	
Tensile force required	P_u =		= **50.00**	[kips]	
Tensile yielding strength	$R_n = F_y A_g$		= 354.00	[kips]	AISC 14th Eq D2-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th D2 (a)
	ϕR_n =		= **318.60**	[kips]	AISC 14th Eq D2-1
	ratio = **0.16**		> P_u	OK	

W Shape Brace - Tensile Rupture			ratio = 50.00 / 101.14	= **0.49**	**PASS**
Section gross area	A_g =		= 7.080	[in^2]	
Tensile net area	A_n =		= 6.651	[in^2]	
No of bolt column	n_h = 2	bolt space s_h = 3.000		[in]	
Length of connection	$L = (n_h - 1) s_h$		= 3.000	[in]	
WT centroid to web bolt line dist	$\bar{x}$ = half of W8X24 sect centroid to web exterior row hor bolt line distance		= 2.064	[in]	
Shear lag factor	$U = 1 - \bar{x} / L$		= 0.312		AISC 14th Table D3.1
Tensile force required	P_u =		= **50.00**	[kips]	
Tensile effective net area	$A_e = A_n U$		= 2.075	[in^2]	
Plate tensile strength	F_u =		= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$		= 134.85	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th D2 (b)
	ϕR_n =		= **101.14**	[kips]	AISC 14th Eq D2-2
	ratio = **0.49**		> P_u	OK	

Web Plate - Tensile Yield			ratio = 25.00 / 97.03	= **0.26**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 5.750 [in]	thickness t_p = 0.375		[in]	
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_g = b_p t_p$		= 2.156	[in^2]	
Tensile force required	P_u =		= **25.00**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 107.81	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **97.03**	[kips]	
	ratio = **0.26**		> P_u	OK	

Web Plate - Tensile Rupture			ratio = 25.00 / 73.13	= **0.34**	**PASS**
Plate Tensile Rupture Check					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th B4.3b
Number of bolt	n = 2				
Plate size	width b_p = 5.750	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	A_{nt} = (b_p - n d_h) t_p		= 1.500	[in^2]	
Tensile force required	P_u =		= **25.00**	[kips]	
Plate tensile rupture strength	R_n = $F_u A_{nt}$		= 97.50	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕ R_n =		= **73.13**	[kips]	AISC 14th Eq J4-2
	ratio = **0.34**		> P_u	OK	

Web Plate - Brace Side - Bolt Shear			ratio = 50.00 / 143.14	= **0.35**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **50.00**	[kips]	
Bolt shear strength	R_n = $F_{nv} A_b n_s$ m C_{ec}		= 190.85	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕ R_n =		= **143.14**	[kips]	
	ratio = **0.35**		> V_u	OK	

Web Plate - Brace Side - Bolt Bearing on Web Plate			ratio = 25.00 / 71.57	= **0.35**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84		= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **25.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.35**		> V_u	OK	

Web Plate - Brace Side - Bolt Bearing on Brace Web				ratio = 50.00 / 97.42	= **0.51**	**PASS**
Single Bolt Shear Strength						
Bolt shear stress	bolt grade = A325-N			F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$			= 47.71	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate						
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]		edge distance L_e = 1.625	[in]	
Plate tensile strength	F_u = 65.0	[ksi]				
Plate thickness	t = 0.245	[in]				
Interior Bolt						
Bolt hole edge clear distance	$L_c = L_s - d_h$			= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$					AISC 14th Eq J3-6b
	= 52.25 ≤ 35.83			= 35.83	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$			= 35.83	[kips]	
Edge Bolt						
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$			= 1.219	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$					AISC 14th Eq J3-6b
	= 29.11 ≤ 35.83			= 29.11	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$			= 29.11	[kips]	
Number of bolt	interior n_{in} = 2			edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$			= 129.89	[kips]	
Required shear strength	V_u =			= **50.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th J3-10
	ϕR_n =			= **97.42**	[kips]	
	ratio = **0.51**			> V_u	OK	

Web Plate - Block Shear - Center Strip ratio = 25.00 / 106.03 = **0.24** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.375	[in]				
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 2		n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000	[in]	s_h = 3.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$		= 3.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$		= 2.297	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 0.797	[in^2]		
Block shear strength required	V_u =		= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$		= 141.38	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **106.03**	[kips]		
	ratio = **0.24**		> V_u	OK		

Web Plate - Block Shear - 1-Side Strip ratio = 25.00 / 89.58 = **0.28** **PASS**

Plate Block Shear - Side Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.375	[in]				
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 2		n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000	[in]	s_h = 3.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 1.641	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 1.148	[in^2]		
Net area subject to tension when sheared out by side strip	$A_{nt} = [(n_v - 1)s_v + e_v - ((n_v - 1) + 0.5)d_h] t_p$		= 1.148	[in^2]		
Block shear strength required	V_u =		= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$		= 119.44	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **89.58**	[kips]		
	ratio = **0.28**		> V_u	OK		

Web Plate - Block Shear - 2-Side Strip ratio = 25.00 / 101.46 = **0.25** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]			AISC 14th B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 3.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 2.297	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$	= 0.703	[in^2]		
Block shear strength required	V_u =	= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th Fig C-J4.2
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 135.28	[kips]		AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5
	ϕR_n =	= **101.46**	[kips]		
	ratio = **0.25**	> V_u	OK		

Brace Web - Block Shear - Center Strip ratio = 50.00 / 72.86 = **0.69** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]			AISC 14th B4.3b
Plate thickness	t_p = 0.245 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 2.465 [in]	e_h = 1.625 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 2.266	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 1.623	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 0.521	[in^2]		
Block shear strength required	V_u =	= **50.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th Fig C-J4.2
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 97.14	[kips]		AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5
	ϕR_n =	= **72.86**	[kips]		
	ratio = **0.69**	> V_u	OK		

Web Plate - Gusset PL Side - Bolt Shear			ratio = 50.00 / 143.14	= **0.35**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 2		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **50.00**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 190.85	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕR_n =		= **143.14**	[kips]	
	ratio = **0.35**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Bearing on Web Plate			ratio = 25.00 / 71.57	= **0.35**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5 L_c t F_u \le 3.0 d_b t F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5 L_c t F_u \le 3.0 d_b t F_u$				AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84		= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **25.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.35**		> V_u	OK	

Web Plate - Gusset PL Side - Bolt Bearing on Gusset Plate	ratio = 50.00 / 138.41	= **0.36**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.625	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 47.71	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 1.219	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 44.56 ≤ 54.84	= 44.56	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 44.56	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 184.55	[kips]	
Required shear strength	V_u =		= **50.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **138.41**	[kips]	
	ratio = **0.36**		> V_u	OK	

Gusset Plate at Web Plate - Block Shear - Center Strip

ratio = 50.00 / 111.52 = **0.45** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = 3/4 [in]	bolt hole dia d_h = 7/8 [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 2.465 [in]	e_h = 1.625 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 3.469	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 2.484	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 0.797	[in^2]		
Block shear strength required	V_u =	= **50.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 148.69	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **111.52**	[kips]		
	ratio = **0.45**	> V_u	OK		

Gusset Plate - Tensile Yield (Whitmore)

ratio = 50.00 / 109.08 = **0.46** **PASS**

Plate Tensile Yielding Check

Plate size	width b_p = 6.464 [in]	thickness t_p = 0.375 [in]			
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_g = b_p t_p$	= 2.424	[in^2]		
Tensile force required	P_u =	= **50.00**	[kips]		
Plate tensile yielding strength	$R_n = F_y A_g$	= 121.20	[kips]	AISC 14th	Eq J4-1
Resistance factor-LRFD	ϕ = 0.90			AISC 14th	Eq J4-1
	ϕR_n =	= **109.08**	[kips]		
	ratio = **0.46**	> P_u	OK		

Gusset Plate - Tensile Rupture (Whitmore)

ratio = 50.00 / 86.18 = **0.58** **PASS**

Plate Tensile Rupture Check

Bolt hole diameter	bolt dia d_b = 3/4 [in]	bolt hole dia d_h = 7/8 [in]		AISC 14th	B4.3b
Number of bolt	n = 2				
Plate size	width b_p = 6.464 [in]	thickness t_p = 0.375 [in]			
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in tension	$A_{nt} = (b_p - n d_h) t_p$	= 1.768	[in^2]		
Tensile force required	P_u =	= **50.00**	[kips]		
Plate tensile rupture strength	$R_n = F_u A_{nt}$	= 114.90	[kips]	AISC 14th	Eq J4-2
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-2
	ϕR_n =	= **86.18**	[kips]	AISC 14th	Eq J4-2
	ratio = **0.58**	> P_u	OK		

Bottom Brace - Gusset to Column | End Plate Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.71**	**PASS**

Geometry Restriction Checks - End Plate to Column Flange — PASS

Min Bolt Edge Distance - End Plate to Column Flange

Bolt diameter	d_b =	= 0.750	[in]		
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th	Table J3.4
Min edge distance in End Plate to Column Flange	L_e =	= **1.375**	[in]		
		> $L_{e\text{-}min}$	OK		

Min Bolt Spacing - End Plate to Column Flange

Bolt diameter	d_b =	= 0.750	[in]		
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th	J3.3
Min Bolt spacing in End Plate to Column Flange	L_s =	= **3.000**	[in]		
		> $L_{s\text{-}min}$	OK		

Geometry Restriction Checks - End Plate - Bolt Gage Clearance — PASS

Bolt Gage Entering Clearance Check - Plate Welded to End Plate

Bolt diameter	d_b = 0.750 [in]	gage g = 4.000	[in]		
Bolt entering clearance	c_3 = from AISC manual Table 7-15	= **0.750**	[in]	AISC 14th	Table 7-15
Plate thickness	t = 0.375 [in]	dbl fillet w = 0.313	[in]		
Bolt center clearance distance to fillet toe	c = (g - t - 2 w) / 2	= **1.500**	[in]		
		> c_3	OK	AISC 14th	Table 7-15

Geometry Restriction Checks - Col Flange - Bolt Gage Clearance — PASS

Bolt Gage Entering Clearance Check - Bolt on W Shape Flange

Bolt diameter	d_b = 0.750 [in]	gage g = 4.000	[in]		
Bolt entering clearance	c_3 = from AISC manual Table 7-15	= **0.750**	[in]	AISC 14th	Table 7-15
W section	t_w = 0.295 [in]	k_1 = 0.875	[in]		
Bolt center clearance distance to fillet toe	c = (g - 2 k_1) / 2	= **1.125**	[in]		
		> c_3	OK	AISC 14th	Table 7-15

Weld Limitation Checks - Gusset Plate to End Plate					**PASS**
Min Fillet Weld Size					
Thinner part joined thickness	t =		= 0.375	[in]	
Min fillet weld size allowed	w_{min} =		= **0.188**	[in]	AISC 14th Table J2.4
Fillet weld size provided	w =		= **0.313**	[in]	
			> w_{min}	OK	
Min Fillet Weld Length					
Fillet weld size provided	w =		= 0.313	[in]	
Min fillet weld length allowed	L_{min} = 4 x w		= **1.250**	[in]	AISC 14th J2.b
Min fillet weld length	L =		= **6.625**	[in]	
			> L_{min}	OK	

Brace Force Load Case 1 Gusset plate t=0.375 P =50.00 kips (C) ratio = **0.21** **PASS**

Gusset Plate - Shear Yielding					ratio = 15.08 / 74.53	= **0.20**	**PASS**
Plate Shear Yielding Check							
Plate size	width b_p = 6.625	[in]	thickness t_p = 0.375	[in]			
Plate yield strength	F_y = 50.0	[ksi]					
Plate gross area in shear	$A_{gv} = b_p t_p$		= 2.484	[in^2]			
Shear force required	V_u =		= **15.08**	[kips]			
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 74.53	[kips]	AISC 14th Eq J4-3		
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3		
	ϕR_n =		= **74.53**	[kips]			
	ratio = **0.20**		> V_u	OK			

Gusset Plate - Shear Rupture					ratio = 15.08 / 72.67	= **0.21**	**PASS**
Plate Shear Rupture Check							
Plate size	width b_p = 6.625	[in]	thickness t_p = 0.375	[in]			
Plate tensile strength	F_u = 65.0	[ksi]					
Plate net area in shear	$A_{nv} = b_p t_p$		= 2.484	[in^2]			
Shear force in demand	V_u =		= **15.08**	[kips]			
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 96.89	[kips]	AISC 14th Eq J4-4		
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4		
	ϕR_n =		= **72.67**	[kips]			
	ratio = **0.21**		> V_u	OK			

End Plate - Shear Yield ratio = 7.54 / 64.69 = **0.12** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 5.750 [in]	thickness t_p = 0.375	[in]		
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_{gv} = b_p t_p$	= 2.156	[in^2]		
Shear force required	V_u =	= **7.54**	[kips]		
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 64.69	[kips]	AISC 14th	Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th	Eq J4-3
	ϕR_n =	= **64.69**	[kips]		
	ratio = **0.12**	> V_u	OK		

End Plate - Shear Rupture ratio = 7.54 / 43.88 = **0.17** **PASS**

Plate Shear Rupture Check

Bolt hole diameter	bolt dia d_b = 3/4 [in]	bolt hole dia d_h = 7/8	[in]	AISC 14th	B4.3b
Number of bolt	n = 2				
Plate size	width b_p = 5.750 [in]	thickness t_p = 0.375	[in]		
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$	= 1.500	[in^2]		
Shear force required	V_u =	= **7.54**	[kips]		
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 58.50	[kips]	AISC 14th	Eq J4-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-4
	ϕR_n =	= **43.88**	[kips]		
	ratio = **0.17**	> V_u	OK		

End Plate - Block Shear - Center Strip ratio = 15.08 / 124.31 = **0.12** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = 3/4 [in]	bolt hole dia d_h = 7/8	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 3.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 2.297	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 1.172	[in^2]		
Block shear strength required	V_u =	= **15.08**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 165.75	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **124.31**	[kips]		
	ratio = **0.12**	> V_u	OK		

End Plate - Block Shear - 2-Side Strip ratio = 15.08 / 101.46 = **0.15** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375	[in]		
Gross area subject to shear	A_{gv} = [(n_h - 1) s_h + e_h] t_p x 2	= 3.281	[in^2]		
Net area subject to shear	A_{nv} = A_{gv} - [(n_h - 1)+ 0.5] d_h t_p x2	= 2.297	[in^2]		
Net area subject to tension when sheared out by 2 side strips	A_{nt} = (e_v - 0.5 d_h) t_p x 2	= 0.703	[in^2]		
Block shear strength required	V_u =	= **15.08**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 135.28	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **101.46**	[kips]		
	ratio = **0.15**	> V_u	OK		

End Plate - Bolt Bearing on End Plate			ratio = 15.08 / 71.57	= **0.21**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84		= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **15.08**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.21**		> V_u	OK	

End Plate / Column - Bolt Shear			ratio = 15.08 / 71.57	= **0.21**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 1		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **15.08**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 95.43	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.21**		> V_u	OK	

End Plate / Column - Bolt Bearing on Column					ratio = 15.08 / 71.57	= **0.21**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442		[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$				= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16		[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]					
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.515	[in]					
Interior Bolt							
Bolt hole edge clear distance	$L_c = L_s - d_h$				= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$						AISC 14th Eq J3-6b
	= 109.84 ≤ 75.32				= 75.32	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$				= 23.86	[kips]	
Number of bolt	interior n_{in} = 4						
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$				= 95.43	[kips]	
Required shear strength	V_u =				= **15.08**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕR_n =				= **71.57**	[kips]	
	ratio = **0.21**				> V_u	OK	

Gusset Plate to End Plate Weld Strength						ratio = 2.28 / 10.97	= **0.21**	**PASS**
Weld Group Forces								
	shear V = 15.08	[kips]		axial P = 19.94	[kips]	in compression		
Gusset-end plate fillet weld length	L = weld length tributary to bolt group				= **6.625**	[in]		
Combined Weld Stress								
Weld stress from axial force	f_a = P / L				= 0.000	[kip/in]	in compression	
Weld stress from shear force	f_v = V / L				= 2.276	[kip/in]		
Weld stress combined - max	f_{max} = f_v				= **2.276**	[kip/in]	AISC 14th Eq 8-11	
Weld stress load angle	θ =				= 0.0	[°]		
Fillet Weld Strength Calc								
Fillet weld leg size	w = 5/16	[in]		load angle θ = 0.0	[°]			
Electrode strength	F_{EXX} = 70.0	[ksi]		strength coeff C_1 = 1.00			AISC 14th Table 8-3	
Number of weld line	n = 2 for double fillet							
Load angle coefficient	C_2 = (1 + 0.5 $\sin^{1.5}$ θ)				= 1.00		AISC 14th Page 8-9	
Fillet weld shear strength	R_{n-w} = 0.6 (C_1 x 70 ksi) 0.707 w n C_2				= 18.559	[kip/in]	AISC 14th Eq 8-1	
Base metal - gusset plate	thickness t = 0.375	[in]		tensile F_u = 65.0	[ksi]			
Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked							AISC 14th J2.4	
Base metal shear rupture	R_{n-b} = 0.6 F_u t				= 14.625	[kip/in]	AISC 14th Eq J4-4	
Double fillet linear shear strength	R_n = min (R_{n-w} , R_{n-b})				= **14.625**	[kip/in]	AISC 14th Eq 9-2	
Resistance factor-LRFD	ϕ = 0.75						AISC 14th Eq 8-1	
	ϕ R_n =				= **10.969**	[kip/in]		
	ratio = **0.21**				> f_{max}	OK		

Column Web Local Yielding						ratio = 19.94 / 160.04	= **0.12**	**PASS**
Concentrated force from gusset	P_u =				= **19.94**	[kips]		
Column section	d = 11.900	[in]		t_f = 0.515	[in]			
	t_w = 0.295	[in]		k = 1.020	[in]			
	yield F_y = 50.0	[ksi]						
Length of bearing	l_b = end plate length				= 5.750	[in]		
Column web local yielding strength	R_n = F_y t_w (5 k + l_b)				= 160.04	[kips]	AISC 14th Eq J10-2	
Resistance factor-LRFD	ϕ = 1.00							
	ϕ R_n =				= **160.04**	[kips]		
	ratio = **0.12**				> P_u	OK		

Column Web Local Crippling			ratio = 19.94 / 135.28	= **0.15**	**PASS**
Concentrated force from gusset	P_u =		= **19.94**	[kips]	
Column section	d = 11.900	[in]	t_f = 0.515	[in]	
	t_w = 0.295	[in]	k = 1.020	[in]	
	yield F_y = 50.0	[ksi]	E = 29000	[ksi]	
Length of bearing	l_b = end plate length		= 5.750	[in]	
Column web local crippling strength	$R_n = 0.8\, t_w^2\, [1+3\frac{l_b}{d}(\frac{t_w}{t_f})^{1.5}]\, x\, (\frac{E\, F_y\, t_f}{t_w})^{0.5}$		= 180.38	[kips]	AISC 14th Eq J10-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J10.3
	ϕR_n =		= **135.28**	[kips]	
	ratio = **0.15**		> P_u	OK	

Brace Force Load Case 2 Gusset plate t=0.375 P =-50.00 kips (T) ratio = **0.71** **PASS**

Gusset Plate - Shear Yielding			ratio = 15.08 / 74.53	= **0.20**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 6.625	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p\, t_p$		= 2.484	[in^2]	
Shear force required	V_u =		= **15.08**	[kips]	
Plate shear yielding strength	$R_n = 0.6\, F_y\, A_{gv}$		= 74.53	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	$\phi\, R_n$ =		= **74.53**	[kips]	
	ratio = **0.20**		> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 15.08 / 72.67	= **0.21**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 6.625	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p\, t_p$		= 2.484	[in^2]	
Shear force in demand	V_u =		= **15.08**	[kips]	
Plate shear rupture strength	$R_n = 0.6\, F_u\, A_{nv}$		= 96.89	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	$\phi\, R_n$ =		= **72.67**	[kips]	
	ratio = **0.21**		> V_u	OK	

Gusset Plate - Axial Yield			ratio = 19.94 / 111.80	= **0.18**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 6.625	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 2.484	[in^2]	
Tensile force required	P_u =		= **19.94**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 124.22	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **111.80**	[kips]	
	ratio = **0.18**		> P_u	OK	

Gusset Plate - Axial Tensile Rupture			ratio = 19.94 / 121.11	= **0.16**	**PASS**
Tensile force required	P_u =		= **19.94**	[kips]	
Tensile effective net area	$A_e = A_n U$		= 2.484	[in^2]	
Plate tensile strength	F_u =		= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$		= 161.48	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th D2 (b)
	ϕR_n =		= **121.11**	[kips]	AISC 14th Eq D2-2
	ratio = **0.16**		> P_u	OK	

End Plate - Shear Yield			ratio = 7.54 / 64.69	= **0.12**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 5.750	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 2.156	[in^2]	
Shear force required	V_u =		= **7.54**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 64.69	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **64.69**	[kips]	
	ratio = **0.12**		> V_u	OK	

End Plate - Shear Rupture			ratio = 7.54 / 43.88	= **0.17**	**PASS**
Plate Shear Rupture Check					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 7/8	[in]	AISC 14th B4.3b
Number of bolt	n = 2				
Plate size	width b_p = 5.750	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$		= 1.500	[in^2]	
Shear force required	V_u =		= **7.54**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 58.50	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **43.88**	[kips]	
	ratio = **0.17**		> V_u	OK	

End Plate - Block Shear - Center Strip ratio = 15.08 / 124.31 = **0.12** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 3.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 2.297	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 1.172	[in^2]		
Block shear strength required	V_u =	= **15.08**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 165.75	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **124.31**	[kips]		
	ratio = **0.12**	> V_u	OK		

End Plate - Block Shear - 2-Side Strip ratio = 15.08 / 101.46 = **0.15** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 3.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 2.297	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p$ x 2	= 0.703	[in^2]		
Block shear strength required	V_u =	= **15.08**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 135.28	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **101.46**	[kips]		
	ratio = **0.15**	> V_u	OK		

End Plate - Bolt Bearing on End Plate			ratio = 15.08 / 71.57	= **0.21**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Edge Bolt					
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 35.42 ≤ 54.84		= 35.42	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	
Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **15.08**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.21**		> V_u	OK	

End Plate / Column - Bolt Shear			ratio = 15.08 / 71.57	= **0.21**	**PASS**
Bolt group forces	shear V = 15.08	[kips]	axial P = 19.94	[kips]	
Bolt shear stress	grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 1		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **15.08**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 95.43	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.21**		> V_u	OK	

End Plate / Column - Bolt Bearing on Column					ratio = 15.08 / 71.57	= **0.21**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442		[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$				= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16		[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]					
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.515	[in]					
Interior Bolt							
Bolt hole edge clear distance	$L_c = L_s - d_h$				= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$						AISC 14th Eq J3-6b
	= 109.84 ≤ 75.32				= 75.32	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$				= 23.86	[kips]	
Number of bolt	interior n_{in} = 4						
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$				= 95.43	[kips]	
Required shear strength	V_u =				= **15.08**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕR_n =				= **71.57**	[kips]	
	ratio = **0.21**				> V_u	OK	

Bolt Tensile Prying Action on End Plate			ratio = 4.99 / 7.06	= **0.71**	**PASS**
Bolt group forces	shear V = 15.08	[kips]	axial P = -19.94	[kips]	
Single Bolt Tensile Capacity Without Considering Prying					
Bolt grade	grade = A325-N				
Nominal tensile/shear stress	F_{nt} = 90.0	[ksi]	F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Bolt group shear force	shear V = 15.08	[kips]	no of bolt n = 4		
Shear stress required	$f_{rv} = V / (n A_b)$		= 8.53	[ksi]	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$		= **90.00**	[ksi]	AISC 14th Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$		= 39.76	[kips]	AISC 14th Eq J3-1
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.6
Single bolt tensile capacity	ϕr_n =		= **29.82**	[kips]	
Single Bolt Tensile Capacity After Considering Prying					
End plate	width w = 6.750	[in]	bolt gage g = 4.000	[in]	
	web t_w = 0.375	[in]			
Dist from bolt center to plate edge	a = 0.5 (w - g)		= 1.375	[in]	
	$a' = a + 0.5 d_b \le (1.25 b + 0.5 d_b)$		= 1.750	[in]	AISC 14th Eq 9-27
Bolt hole diameter	bolt dia d_b = 0.750	[in]	bolt hole dia d_h = 0.813	[in]	AISC 14th B4.3b
Dist from bolt center to face of web	$b = 0.5(g - t_w)$		= 1.813	[in]	
	$b' = b - 0.5 d_b$		= 1.438	[in]	AISC 14th Eq 9-21
Bolt pitch spacing	s_v = 3.000				
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$		= 2.875	[in]	AISC 14th Page 9-11
	$\rho = b' / a'$		= 0.821		AISC 14th Eq 9-26
	$\delta = 1 - d_h / p$		= 0.717		AISC 14th Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section		= 29.82	[kips]	
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Page 9-10
End plate thickness	t = 0.375	[in]	tensile F_u = 65.0	[ksi]	
Plate thickness req'd to develop bolt tensile capacity without prying	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$		= 1.010	[in]	AISC 14th Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$		= 4.783		AISC 14th Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$		= 0.237		AISC 14th Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below		= **4.99**	[kips]	
Tensile strength per bolt after considering prying	$\phi r_n = B \times Q$		= **7.06**	[kips]	AISC 14th Eq 9-31
	ratio = **0.71**		> T	OK	
Calculate Max Single Bolt Tensile Load					
Bolt group force	axial P = 19.94	[kips]			
Bolt number	Bolt Row n_h = 2		Bolt Col n_v = 2		
Bolt tensile force per bolt	$T = P / (n_v n_h)$		= **4.99**	[kips]	

Bolt Tensile Prying Action on Column Flange			ratio = 4.99 / 13.62	= **0.37**	**PASS**
Bolt group forces	shear V = 15.08	[kips]	axial P = -19.94	[kips]	
Single Bolt Tensile Capacity Without Considering Prying					
Bolt grade	grade = A325-N				
Nominal tensile/shear stress	F_{nt} = 90.0	[ksi]	F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Bolt group shear force	shear V = 15.08	[kips]	no of bolt n = 4		
Shear stress required	$f_{rv} = V / (n A_b)$		= 8.53	[ksi]	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$		= **90.00**	[ksi]	AISC 14th Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$		= 39.76	[kips]	AISC 14th Eq J3-1
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.6
Single bolt tensile capacity	ϕr_n =		= **29.82**	[kips]	
Single Bolt Tensile Capacity After Considering Prying					
Column flange as tee	b_f = 8.010	[in]	bolt gage g = 4.000	[in]	
	web t_w = 0.295	[in]			
Dist from bolt center to flange edge	$a_{cf} = 0.5 (b_f - g)$		= 2.005	[in]	
End plate	width w = 6.750	[in]	bolt gage g = 4.000	[in]	
Dist from bolt center to plate edge	$a_{pl} = 0.5 (w - g)$		= 1.375	[in]	
Dist from bolt center to plate edge	$a = \min (a_{cf}, a_{pl})$		= 1.375	[in]	
	$a' = a + 0.5 d_b \le (1.25 b + 0.5 d_b)$		= 1.750	[in]	AISC 14th Eq 9-27
Bolt hole diameter	bolt dia d_b = 0.750	[in]	bolt hole dia d_h = 0.813	[in]	AISC 14th B4.3b
Dist from bolt center to face of web	$b = 0.5(g - t_w)$		= 1.853	[in]	
	$b' = b - 0.5 d_b$		= 1.478	[in]	AISC 14th Eq 9-21
Bolt pitch spacing	s_v = 3.000				
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$		= 3.000	[in]	AISC 14th Page 9-11
	$\rho = b' / a'$		= 0.844		AISC 14th Eq 9-26
	$\delta = 1 - d_h / p$		= 0.729		AISC 14th Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section		= 29.82	[kips]	
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Page 9-10
Column flange thickness	t = 0.515	[in]	tensile F_u = 65.0	[ksi]	
Plate thickness req'd to develop bolt tensile capacity without prying	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$		= 1.002	[in]	AISC 14th Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$		= 2.072		AISC 14th Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$		= 0.457		AISC 14th Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below		= **4.99**	[kips]	
Tensile strength per bolt after considering prying	ϕr_n = B x Q		= **13.62**	[kips]	AISC 14th Eq 9-31
	ratio = **0.37**		> T	OK	
Calculate Max Single Bolt Tensile Load					
Bolt group force	axial P = 19.94	[kips]			

Gusset Plate to End Plate Weld Strength				ratio = 3.77 / 10.97	= **0.34**	**PASS**
Weld Group Forces						
	shear V = 15.08	[kips]	axial P = -19.94	[kips]	in tension	
Gusset-end plate fillet weld length	L = weld length tributary to bolt group		= **6.625**	[in]		
Combined Weld Stress						
Weld stress from axial force	$f_a = P / L$		= -3.010	[kip/in]	in tension	
Weld stress from shear force	$f_v = V / L$		= 2.276	[kip/in]		
Weld stress combined - max	$f_{max} = (f_a^2 + f_v^2)^{0.5}$		= **3.774**	[kip/in]	AISC 14th Eq 8-11	
Weld stress load angle	$\theta = \tan^{-1} (f_a / f_v)$		= 52.9	[°]		
Fillet Weld Strength Calc						
Fillet weld leg size	w = 5/16	[in]	load angle θ = 52.9	[°]		
Electrode strength	F_{EXX} = 70.0	[ksi]	strength coeff C_1 = 1.00		AISC 14th Table 8-3	
Number of weld line	n = 2 for double fillet					
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$		= 1.36		AISC 14th Page 8-9	
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$		= 25.169	[kip/in]	AISC 14th Eq 8-1	
Base metal - gusset plate	thickness t = 0.375	[in]	tensile F_u = 65.0	[ksi]		
Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked					AISC 14th J2.4	
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$		= 14.625	[kip/in]	AISC 14th Eq J4-4	
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$		= **14.625**	[kip/in]	AISC 14th Eq 9-2	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq 8-1	
	ϕR_n =		= **10.969**	[kip/in]		
	ratio = **0.34**		> f_{max}	OK		

Column Web Local Yielding				ratio = 19.94 / 160.04	= **0.12**	**PASS**
Concentrated force from gusset	P_u =		= **19.94**	[kips]		
Column section	d = 11.900	[in]	t_f = 0.515	[in]		
	t_w = 0.295	[in]	k = 1.020	[in]		
	yield F_y = 50.0	[ksi]				
Length of bearing	l_b = end plate length		= 5.750	[in]		
Column web local yielding strength	$R_n = F_y t_w (5 k + l_b)$		= 160.04	[kips]	AISC 14th Eq J10-2	
Resistance factor-LRFD	ϕ = 1.00					
	ϕR_n =		= **160.04**	[kips]		
	ratio = **0.12**		> P_u	OK		

Column Flange Local Bending		ratio = 19.94 / 74.59	= **0.27**	**PASS**
Concentrated force from gusset	P_u =	= **19.94**	[kips]	
Column w section	t_f = 0.515 [in]	yield F_y = 50.0	[ksi]	
Column flange local bending strength	$R_n = 6.25\ F_y t_f^2$	= 82.88	[kips]	AISC 14th Eq J10-1
Resistance factor-LRFD	ϕ = 0.90			AISC 14th J10.1
	ϕR_n =	= **74.59**	[kips]	
	ratio = **0.27**	> P_u	OK	

Bottom Brace - Gusset to Beam | Direct Weld Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.48**	**PASS**

Brace Weld Limitation Checks - Gusset to Beam — PASS

Min Fillet Weld Size

Thinner part joined thickness	t =	= 0.375	[in]	
Min fillet weld size allowed	w_{min} =	= **0.188**	[in]	AISC 14th Table J2.4
Fillet weld size provided	w =	= **0.313**	[in]	
		> w_{min}	OK	

Min Fillet Weld Length

Fillet weld size provided	w =	= 0.313	[in]	
Min fillet weld length allowed	L_{min} = 4 x w	= **1.250**	[in]	AISC 14th J2.2b
Min fillet weld length	L =	= **9.266**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1

Gusset plate t=0.375 | P =50.00 kips (C) | ratio = **0.25** | **PASS**

Gusset Plate - Shear Yielding — ratio = 15.42 / 104.24 = **0.15** — PASS

Plate Shear Yielding Check

Plate size	width b_p = 9.266	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 3.475	[in^2]	
Shear force required	V_u =		= **15.42**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 104.24	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **104.24**	[kips]	
	ratio = **0.15**		> V_u	OK	

Gusset Plate - Shear Rupture — ratio = 15.42 / 101.64 = **0.15** — PASS

Plate Shear Rupture Check

Plate size	width b_p = 9.266	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 3.475	[in^2]	
Shear force in demand	V_u =		= **15.42**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 135.52	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **101.64**	[kips]	
	ratio = **0.15**		> V_u	OK	

Gusset Plate - Axial Tensile Yield			ratio = 20.27 / 156.36	= **0.13**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 9.266	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 3.475	[in^2]	
Tensile force required	P_u =		= **20.27**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 173.74	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **156.36**	[kips]	
	ratio = **0.13**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.06**	**PASS**
Gusset plate	width b_p = 9.266	[in]	thick t_p = 0.375	[in]	
	yield F_y = 50.0	[ksi]			
Shear plate - gross area	$A_g = b_p \times t_p$		= 3.475	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 8.049	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 30.18	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 1.96	[kip-ft]	
Axial strength available	P_c = from axial tensile yield check		= 156.36	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 20.27	[kips]	
Shear strength available	V_c = from shear yielding check		= 104.24	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 15.42	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.06**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact			ratio =	= **0.03**	**PASS**
Gusset plate	width b_p = 9.266	[in]	thick t_p = 0.375	[in]	
	tensile F_u = 65.0	[ksi]			
Net area of plate	$A_n = b_p \times t_p$		= 3.475	[in^2]	
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$		= 8.049	[in^3]	
Flexural strength available	$M_c = \phi F_u Z_{net}$ ϕ=0.75		= 32.70	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 1.96	[kip-ft]	
Shear strength available	V_c = from shear rupture check		= 101.64	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 15.42	[kips]	
Flexural rupture interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{M_r}{M_c})^2$		= **0.03**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset to Beam Weld Strength ratio = 1.66 / 8.78 = **0.19** **PASS**

Gusset to Beam Interface - Forces

shear H_b = 15.42 [kips] axial V_b = 20.27 [kips] in compression

moment M_b = 1.96 [kip-ft]

Gusset-beam fillet weld length	L_w =	= 9.266	[in]	

Gusset to Beam Interface - Combined Weld Stress

Weld stress from axial force	$f_a = V_b / L_{wb}$	= 2.188	[kip/in]	in compression
Weld stress from shear force	$f_v = H_b / L_{wb}$	= 1.664	[kip/in]	
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$	= 1.644	[kip/in]	
Weld stress combined - max	$f_{max} = f_v$	= **1.664**	[kip/in]	AISC 14th Eq 8-11
Weld resultant load angle	θ = weld only has shear component	= 0.0	[°]	

Fillet Weld Strength Calc

Fillet weld leg size w = 5/16 [in] load angle θ = 0.0 [°]

Electrode strength F_{EXX} = 70.0 [ksi] strength coeff C_1 = 1.00 AISC 14th Table 8-3

Number of weld line n = 2 for double fillet

Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$	= 1.00		AISC 14th Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 \text{ w n } C_2$	= 18.559	[kip/in]	AISC 14th Eq 8-1

Base metal - gusset plate thickness t = 0.375 [in] tensile F_u = 65.0 [ksi]

Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked AISC 14th J2.4

Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	= 14.625	[kip/in]	AISC 14th Eq J4-4
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	= **14.625**	[kip/in]	AISC 14th Eq 9-2
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq 8-1
	ϕR_n =	= 10.969	[kip/in]	

When gusset plate is directly welded to beam or column, apply 1.25 ductility factor to allow adequate force redistribution in the weld group AISC 14th Page 13-11

Weld strength used for design after applying ductility factor	$\phi R_n = \phi R_n \times (1/1.25)$	= **8.775**	[kip/in]	
	ratio = **0.19**	> f_{max}	OK	

Beam Web Local Yielding ratio = 30.42 / 200.43 = **0.15** **PASS**

Gusset Edge Equivalent Normal Force

Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force

Gusset edge axial force	N =	= 20.27	[kips]	
Gusset edge moment force	M =	= 1.96	[kip-ft]	
Gusset edge interface length	L =	= 9.266	[in]	
Gusset edge equivalent normal force	$N_e = N + \frac{4\,M}{L}$	= 30.42	[kips]	AISC DG29 Fig B-1
Concentrated force from gusset	P_u =	= **30.42**	[kips]	
Beam section	d = 12.100 [in]	t_f = 0.575	[in]	
	t_w = 0.335 [in]	k = 1.080	[in]	
	yield F_y = 50.0 [ksi]			
Length of bearing	l_b = Gusset/Beam interface length	= 9.266	[in]	
Gusset plate corner clip	clip = from user input	= 0.750	[in]	
Distance from normal force applied point to member end	$l_N = 0.5\,l_b$ + clip	= 5.383	[in]	
	when $l_N \le d$, use AISC 14th Eq J10-3			AISC 14th Eq J10-3
Beam web local yielding strength	$R_n = F_y\,t_w\,(2.5\,k + l_b)$	= 200.43	[kips]	AISC 14th Eq J10-3
Resistance factor-LRFD	ϕ = 1.00			
	ϕR_n =	= **200.43**	[kips]	
	ratio = **0.15**	> P_u	OK	

Beam Web Local Crippling ratio = 30.42 / 120.74 = **0.25** **PASS**

Gusset Edge Equivalent Normal Force

Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force

Gusset edge axial force	N =	= 20.27	[kips]	
Gusset edge moment force	M =	= 1.96	[kip-ft]	
Gusset edge interface length	L =	= 9.266	[in]	
Gusset edge equivalent normal force	$N_e = N + \frac{4\,M}{L}$	= 30.42	[kips]	AISC DG29 Fig B-1
Concentrated force from gusset	P_u =	= **30.42**	[kips]	
Beam section	d = 12.100 [in]	t_f = 0.575	[in]	
	t_w = 0.335 [in]	k = 1.080	[in]	
	yield F_y = 50.0 [ksi]	E = 29000	[ksi]	
Length of bearing	l_b = Gusset/Beam interface length	= 9.266	[in]	
Gusset plate corner clip	clip = from user input	= 0.750	[in]	
Distance from normal force applied point to member end	$l_N = 0.5\,l_b$ + clip	= 5.383	[in]	
	when l_N < d/2 and l_b / d =0.77 > 0.2, use Eq J10-5b			AISC 14th Eq J10-5b
Beam web local crippling strength	$R_n = 0.4 t_w^2 [1+(\frac{4\,l_b}{d}-0.2)(\frac{t_w}{t_f})^{1.5}] \times (\frac{E\,F_y\,t_f}{t_w})^{0.5}$	= 160.99	[kips]	AISC 14th Eq J10-5b
Resistance factor-LRFD	ϕ = 0.75			AISC 14th J10.3
	ϕR_n =	= **120.74**	[kips]	
	ratio = **0.25**	> P_u	OK	

Brace Force Load Case 2 Gusset plate t=0.375 P =-50.00 kips (T) ratio = **0.48** **PASS**

Gusset Plate - Shear Yielding ratio = 15.42 / 104.24 = **0.15** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 9.266 [in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 3.475	[in^2]	
Shear force required	V_u =	= **15.42**	[kips]	
Plate shear yielding strength	$R_n = 0.6\,F_y\,A_{gv}$	= 104.24	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	$\phi\,R_n$ =	= **104.24**	[kips]	
	ratio = **0.15**	> V_u	OK	

Gusset Plate - Shear Rupture					ratio = 15.42 / 101.64	= **0.15**	**PASS**
Plate Shear Rupture Check							
Plate size	width b_p = 9.266	[in]	thickness t_p = 0.375	[in]			
Plate tensile strength	F_u = 65.0	[ksi]					
Plate net area in shear	$A_{nv} = b_p t_p$		= 3.475	[in^2]			
Shear force in demand	V_u =		= **15.42**	[kips]			
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 135.52	[kips]	AISC 14th Eq J4-4		
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4		
	ϕR_n =		= **101.64**	[kips]			
	ratio = **0.15**		> V_u	OK			

Gusset Plate - Axial Yield					ratio = 20.27 / 156.36	= **0.13**	**PASS**
Plate Tensile Yielding Check							
Plate size	width b_p = 9.266	[in]	thickness t_p = 0.375	[in]			
Plate yield strength	F_y = 50.0	[ksi]					
Plate gross area in shear	$A_g = b_p t_p$		= 3.475	[in^2]			
Tensile force required	P_u =		= **20.27**	[kips]			
Plate tensile yielding strength	$R_n = F_y A_g$		= 173.74	[kips]	AISC 14th Eq J4-1		
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1		
	ϕR_n =		= **156.36**	[kips]			
	ratio = **0.13**		> P_u	OK			

Gusset Plate - Axial Tensile Rupture					ratio = 20.27 / 169.39	= **0.12**	**PASS**
Plate Tensile Rupture Check							
Plate size	width b_p = 9.266	[in]	thickness t_p = 0.375	[in]			
Plate tensile strength	F_u = 65.0	[ksi]					
Plate net area in tension	$A_{nt} = b_p t_p$		= 3.475	[in^2]			
Tensile force required	P_u =		= **20.27**	[kips]			
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 225.86	[kips]	AISC 14th Eq J4-2		
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2		
	ϕR_n =		= **169.39**	[kips]	AISC 14th Eq J4-2		
	ratio = **0.12**		> P_u	OK			

Gusset Plate - Flexural Yield Interact			ratio =	= **0.06**	**PASS**
Gusset plate	width b_p = 9.266 [in]		thick t_p = 0.375	[in]	
	yield F_y = 50.0 [ksi]				
Shear plate - gross area	$A_g = b_p \times t_p$		= 3.475	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 8.049	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 30.18	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 1.96	[kip-ft]	
Axial strength available	P_c = from axial tensile yield check		= 156.36	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 20.27	[kips]	
Shear strength available	V_c = from shear yielding check		= 104.24	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 15.42	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.06**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact			ratio =	= **0.06**	**PASS**
Gusset plate	width b_p = 9.266 [in]		thick t_p = 0.375	[in]	
	tensile F_u = 65.0 [ksi]				
Net area of plate	$A_n = b_p \times t_p$		= 3.475	[in^2]	
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$		= 8.049	[in^3]	
Flexural strength available	$M_c = \phi F_u Z_{net}$ ϕ=0.75		= 32.70	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 1.96	[kip-ft]	
Axial strength available	P_c = from axial tensile rupture check		= 169.39	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 20.27	[kips]	
Shear strength available	V_c = from shear rupture check		= 101.64	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 15.42	[kips]	
Flexural rupture interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.06**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset to Beam Weld Strength							ratio = 4.18 / 8.78	= **0.48**	**PASS**
Gusset to Beam Interface - Forces									
	shear H_b = 15.42	[kips]		axial V_b = -20.27	[kips]	in tension			
	moment M_b = 1.96	[kip-ft]							
Gusset-beam fillet weld length	L_w =				= 9.266	[in]			
Gusset to Beam Interface - Combined Weld Stress									
Weld stress from axial force	$f_a = V_b / L_{wb}$				= -2.188	[kip/in]	in tension		
Weld stress from shear force	$f_v = H_b / L_{wb}$				= 1.664	[kip/in]			
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$				= 1.644	[kip/in]			
Weld stress combined - max	$f_{max} = [(f_a - f_b)^2 + f_v^2]^{0.5}$				= **4.177**	[kip/in]	AISC 14th Eq 8-11		
Weld resultant load angle	$\theta = \tan^{-1} [(f_b - f_a) / f_v]$				= 66.5	[°]			
Fillet Weld Strength Calc									
Fillet weld leg size	w = 5/16	[in]		load angle θ = 66.5		[°]			
Electrode strength	F_{EXX} = 70.0	[ksi]		strength coeff C_1 = 1.00			AISC 14th Table 8-3		
Number of weld line	n = 2 for double fillet								
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$				= 1.44		AISC 14th Page 8-9		
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$				= 26.710	[kip/in]	AISC 14th Eq 8-1		
Base metal - gusset plate	thickness t = 0.375	[in]		tensile F_u = 65.0		[ksi]			
Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked							AISC 14th J2.4		
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$				= 14.625	[kip/in]	AISC 14th Eq J4-4		
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$				= **14.625**	[kip/in]	AISC 14th Eq 9-2		
Resistance factor-LRFD	$\phi = 0.75$						AISC 14th Eq 8-1		
	ϕR_n =				= 10.969	[kip/in]			
When gusset plate is directly welded to beam or column, apply 1.25 ductility factor to allow adequate force redistribution in the weld group							AISC 14th Page 13-11		
Weld strength used for design after applying ductility factor	$\phi R_n = \phi R_n \times (1/1.25)$				= **8.775**	[kip/in]			
	ratio = **0.48**				> f_{max}	OK			

Beam Web Local Yielding ratio = 30.42 / 200.43 = **0.15** **PASS**

Gusset Edge Equivalent Normal Force

Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force

Gusset edge axial force	N =	= -20.27	[kips]	
Gusset edge moment force	M =	= 1.96	[kip-ft]	
Gusset edge interface length	L =	= 9.266	[in]	
Gusset edge equivalent normal force	$N_e = N - \frac{4\,M}{L}$	= -30.42	[kips]	AISC DG29 Fig B-1
Concentrated force from gusset	P_u =	= **30.42**	[kips]	
Beam section	d = 12.100 [in]	t_f = 0.575	[in]	
	t_w = 0.335 [in]	k = 1.080	[in]	
	yield F_y = 50.0 [ksi]			
Length of bearing	l_b = Gusset/Beam interface length	= 9.266	[in]	
Gusset plate corner clip	clip = from user input	= 0.750	[in]	
Distance from normal force applied point to member end	$l_N = 0.5\,l_b$ + clip	= 5.383	[in]	
	when $l_N \le d$, use AISC 14th Eq J10-3			AISC 14th Eq J10-3
Beam web local yielding strength	$R_n = F_y\,t_w\,(2.5\,k + l_b)$	= 200.43	[kips]	AISC 14th Eq J10-3
Resistance factor-LRFD	ϕ = 1.00			
	ϕR_n =	= **200.43**	[kips]	
	ratio = **0.15**	> P_u	OK	

Beam to Column | End Plate Connection | Code=AISC 360-10 LRFD

Result Summary geometries & weld limitations = **PASS** limit states max ratio = **0.84** **PASS**

Geometry Restriction Check - End Plate to Column Flange — PASS

Min Bolt Edge Distance - End Plate to Column Flange

Bolt diameter	d_b =	= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in End Plate to Column Flange	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - End Plate to Column Flange

Bolt diameter	d_b =	= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in End Plate to Column Flange	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Geometry Restriction Check - End Plate-Bolt Gage Clearance — PASS

Bolt Gage Entering Clearance Check - Plate Welded to End Plate

Bolt diameter	d_b = 0.750 [in]	gage g = 4.000	[in]		
Bolt entering clearance	c_3 = from AISC manual Table 7-15	= **0.750**	[in]	AISC 14th Table 7-15	
Plate thickness	t = 0.335 [in]	dbl fillet w = 0.375	[in]		
Bolt center clearance distance to fillet toe	c = (g - t - 2 w) / 2	= **1.458**	[in]		
		> c_3	OK	AISC 14th Table 7-15	

Geometry Restriction Check - Column Flange-Bolt Gage Clearance — PASS

Bolt Gage Entering Clearance Check - Bolt on W Shape Flange

Bolt diameter	d_b = 0.750 [in]	gage g = 4.000	[in]		
Bolt entering clearance	c_3 = from AISC manual Table 7-15	= **0.750**	[in]	AISC 14th Table 7-15	
W section	t_w = 0.295 [in]	k_1 = 0.875	[in]		
Bolt center clearance distance to fillet toe	c = (g - 2 k_1) / 2	= **1.125**	[in]		
		> c_3	OK	AISC 14th Table 7-15	

Beam Flange Fillet Weld Limitation				**PASS**
Min Fillet Weld Size				
Thinner part joined thickness	t =	= 0.375	[in]	
Min fillet weld size allowed	w_{min} =	= **0.188**	[in]	AISC 14th Table J2.4
Fillet weld size provided	w =	= **0.375**	[in]	
		> w_{min}	OK	
Min Fillet Weld Length				
Fillet weld size provided	w =	= 0.375	[in]	
Min fillet weld length allowed	$L_{min} = 4 \times w$	= **1.500**	[in]	AISC 14th J2.2b
Min fillet weld length	$L = 0.5\, b_f - k_1$	= **2.437**	[in]	
		> L_{min}	OK	

Beam Web Fillet Weld Limitation				**PASS**
Min Fillet Weld Size				
Thinner part joined thickness	t =	= 0.335	[in]	
Min fillet weld size allowed	w_{min} =	= **0.188**	[in]	AISC 14th Table J2.4
Fillet weld size provided	w =	= **0.375**	[in]	
		> w_{min}	OK	
Min Fillet Weld Length				
Fillet weld size provided	w =	= 0.375	[in]	
Min fillet weld length allowed	$L_{min} = 4 \times w$	= **1.500**	[in]	AISC 14th J2.2b
Min fillet weld length	$L = d - 2k$	= **9.350**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1 shear V = -26.55 kips axial P = -4.17 kips (T) ratio = **0.34** **PASS**

Beam - Shear Yielding - Vy		ratio = 26.55 / 121.61	= **0.22**	**PASS**
Section Shear Yielding Check				
Sect yield strength	F_y = 50.0 [ksi]			
Sect gross area in shear	A_{gv} =	= 4.054	[in^2]	
Shear force required	V_u =	= **26.55**	[kips]	
Sect shear yielding strength	$R_n = 0.6\, F_y A_{gv}$	= 121.61	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕR_n =	= **121.61**	[kips]	
	ratio = **0.22**	> V_u	OK	

Beam - Shear Rupture - Vy			ratio = 26.55 / 118.56	= **0.22**	**PASS**
Section Shear Rupture Check					
Sect tensile strength	F_u = 65.0	[ksi]			
Sect net area in shear	A_{nv} =		= 4.054	[in^2]	
Shear force in demand	V_u =		= **26.55**	[kips]	
Sect shear rupture strength	$R_n = 0.6\ F_u A_{nv}$		= 158.09	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **118.56**	[kips]	
	ratio = **0.22**		> V_u	OK	

Beam - Shear Yielding - Vz			ratio = 25.00 / 277.73	= **0.09**	**PASS**
Section Shear Yielding Check					
Sect yield strength	F_y = 50.0	[ksi]			
Sect gross area in shear	A_{gv} =		= 9.258	[in^2]	
Shear force required	V_u =		= **25.00**	[kips]	
Sect shear yielding strength	$R_n = 0.6\ F_y A_{gv}$		= 277.73	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **277.73**	[kips]	
	ratio = **0.09**		> V_u	OK	

Beam - Shear Rupture - Vz			ratio = 25.00 / 270.78	= **0.09**	**PASS**
Section Shear Rupture Check					
Sect tensile strength	F_u = 65.0	[ksi]			
Sect net area in shear	A_{nv} =		= 9.258	[in^2]	
Shear force in demand	V_u =		= **25.00**	[kips]	
Sect shear rupture strength	$R_n = 0.6\ F_u A_{nv}$		= 361.04	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **270.78**	[kips]	
	ratio = **0.09**		> V_u	OK	

Beam - Axial Tensile Yield - Px			ratio = 4.17 / 589.50	= **0.01**	**PASS**
Gross area subject to tension	A_g =		= 13.100	[in^2]	
Steel yield strength	F_y =		= 50.0	[ksi]	
Tensile force required	P_u =		= **4.17**	[kips]	
Tensile yielding strength	$R_n = F_y A_g$		= 655.00	[kips]	AISC 14th Eq D2-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th D2 (a)
	ϕR_n =		= **589.50**	[kips]	AISC 14th Eq D2-1
	ratio = **0.01**		> P_u	OK	

Beam - Axial Tensile Rupture - Px			ratio = 4.17 / 638.63	= **0.01**	**PASS**
Tensile force required	P_u =		= **4.17**	[kips]	
Tensile effective net area	$A_e = A_n U$		= 13.100	[in^2]	
Plate tensile strength	F_u =		= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$		= 851.50	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th D2 (b)
	ϕR_n =		= **638.63**	[kips]	AISC 14th Eq D2-2
	ratio = **0.01**		> P_u	OK	

End Plate - Shear Yielding - Vy			ratio = 13.28 / 136.13	= **0.10**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 12.100	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.538	[in^2]	
Shear force required	V_u =		= **13.28**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 136.13	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **136.13**	[kips]	
	ratio = **0.10**		> V_u	OK	

End Plate - Shear Rupture - Vy			ratio = 13.28 / 103.93	= **0.13**	**PASS**
Plate Shear Rupture Check					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 7/8	[in]	AISC 14th B4.3b
Number of bolt	n = 3				
Plate size	width b_p = 12.100	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$		= 3.553	[in^2]	
Shear force required	V_u =		= **13.28**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 138.57	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **103.93**	[kips]	
	ratio = **0.13**		> V_u	OK	

End Plate - Shear Yielding - Vz			ratio = 12.50 / 75.94	= **0.16**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 6.750	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 2.531	[in^2]	
Shear force required	V_u =		= **12.50**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 75.94	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **75.94**	[kips]	
	ratio = **0.16**		> V_u	OK	

End Plate - Shear Rupture - Vz			ratio = 12.50 / 54.84	= **0.23**	**PASS**
Plate Shear Rupture Check					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th B4.3b
Number of bolt	n = 2				
Plate size	width b_p = 6.750	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	A_{nv} = (b_p - n d_h) t_p		= 1.875	[in^2]	
Shear force required	V_u =		= **12.50**	[kips]	
Plate shear rupture strength	R_n = 0.6 F_u A_{nv}		= 73.13	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **54.84**	[kips]	
	ratio = **0.23**		> V_u	OK	

End Plate - Bolt Bearing on End Plate - Vy Vz Combined ratio = 36.47 / 107.35 = **0.34** **PASS**

The bolt group is oriented so that the shear V_y is in ver. direction and the shear V_z is in hor. direction

Bolt group forces	shear V_y = -26.55 [kips]	shear V_z = 25.00	[kips]		
Bolt group resultant force	$R = (V_y^2 + V_z^2)^{0.5}$	= **36.47**	[kips]		
Resultant force/hor line load angle	$\theta = \tan^{-1} (V_y / V_z)$	= 46.72	[°]		
Bolt hole diameter	bolt dia d_b = 0.750 [in]	bolt hole dia d_{bh} = 0.813	[in]	AISC 14th	B4.3b
Bolt hole ver. dimension	d_v =	= 0.813	[in]		
Bolt hole hor. dimension	d_h =	= 0.813	[in]		
Bolt center to bolt hole edge dist	$d_c = 0.5\, d_{bh}$	= 0.406	[in]		
Bolt no in ver & hor direction	Bolt Row n_v = 3	Bolt Col n_h = 2			
Bolt spacing	ver s_v = 3.000 [in]	hor s_h = 4.000	[in]		
Bolt edge distance	ver e_v = 10.425 [in]	hor e_h = 1.375	[in]		
Bolt clear dist - bot right corner bolt	$L_{cA} = \min (\frac{e_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.599	[in]		
Bolt clear dist - right side edge bolt	$L_{cB} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.599	[in]		
Bolt clear dist - bot side edge bolt	$L_{cC} = \min (\frac{e_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 4.836	[in]		
Bolt clear dist - inner edge bolt	$L_{cD} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 3.156	[in]		

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N	F_{nv} = 54.0	[ksi]	AISC 14th	Table J3.2
	bolt dia d_b = 0.750 [in]	bolt area A_b = 0.442	[in^2]		
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$	= 23.86	[kips]	AISC 14th	Eq J3-1
Bolt bearing on plate	thick t = 0.375 [in]	tensile F_u = 65.0	[ksi]		
Bolt bearing strength	$R_{n\text{-}br} = 3.0\, d_b\, t\, F_u$	= 54.84	[kips]	AISC 14th	Eq J3-6b

Type A - Bolt Group Bottom Right Corner Bolt

Number of bolt	n_A = 1				
Bolt tear out strength	$R_{n\text{-}tA} = 1.5\, L_{cA}\, t\, F_u$	= 58.48	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nA} = \min (R_{n\text{-}tA}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type B - Bolt Group Right Side Edge Bolt

Number of bolt	n_B = 2				
Bolt tear out strength	$R_{n\text{-}tB} = 1.5\, L_{cB}\, t\, F_u$	= 58.48	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nB} = \min (R_{n\text{-}tB}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type C - Bolt Group Bottom Side Edge Bolt

Number of bolt	n_C = 1				
Bolt tear out strength	$R_{n\text{-}tC} = 1.5\, L_{cC}\, t\, F_u$	= 176.82	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nC} = \min (R_{n\text{-}tC}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type D - Bolt Group Inner Edge Bolt

Number of bolt	n_D = 2				
Bolt tear out strength	$R_{n\text{-}tD} = 1.5\, L_{cD}\, t\, F_u$	= 115.41	[kips]	AISC 14th	Eq J3-6b

End Plate - Bolt Bearing on Column Flange - Vy Vz Combined ratio = 36.47 / 107.35 = **0.34** **PASS**

The bolt group is oriented so that the shear V_y is in ver. direction and the shear V_z is in hor. direction

Bolt group forces	shear V_y = -26.55 [kips]	shear V_z = 25.00	[kips]		
Bolt group resultant force	$R = (V_y^2 + V_z^2)^{0.5}$	= **36.47**	[kips]		
Resultant force/hor line load angle	$\theta = \tan^{-1} (V_y / V_z)$	= 46.72	[°]		
Bolt hole diameter	bolt dia d_b = 0.750 [in]	bolt hole dia d_{bh} = 0.813	[in]	AISC 14th	B4.3b
Bolt hole ver. dimension	d_v =	= 0.813	[in]		
Bolt hole hor. dimension	d_h =	= 0.813	[in]		
Bolt center to bolt hole edge dist	$d_c = 0.5\, d_{bh}$	= 0.406	[in]		
Bolt no in ver & hor direction	Bolt Row n_v = 3	Bolt Col n_h = 2			
Bolt spacing	ver s_v = 3.000 [in]	hor s_h = 4.000	[in]		
Bolt edge distance	ver e_v = 10.425 [in]	hor e_h = 1.375	[in]		
Bolt clear dist - bot right corner bolt	$L_{cA} = \min (\frac{e_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.599	[in]		
Bolt clear dist - right side edge bolt	$L_{cB} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.599	[in]		
Bolt clear dist - bot side edge bolt	$L_{cC} = \min (\frac{e_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 4.836	[in]		
Bolt clear dist - inner edge bolt	$L_{cD} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 3.156	[in]		

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N	F_{nv} = 54.0	[ksi]	AISC 14th	Table J3.2
	bolt dia d_b = 0.750 [in]	bolt area A_b = 0.442	[in^2]		
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$	= 23.86	[kips]	AISC 14th	Eq J3-1
Bolt bearing on plate	thick t = 0.515 [in]	tensile F_u = 65.0	[ksi]		
Bolt bearing strength	$R_{n\text{-}br} = 3.0\, d_b\, t\, F_u$	= 75.32	[kips]	AISC 14th	Eq J3-6b
Type A - Bolt Group Bottom Right Corner Bolt					
Number of bolt	n_A = 1				
Bolt tear out strength	$R_{n\text{-}tA} = 1.5\, L_{cA}\, t\, F_u$	= 80.31	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nA} = \min (R_{n\text{-}tA}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		
Type B - Bolt Group Right Side Edge Bolt					
Number of bolt	n_B = 2				
Bolt tear out strength	$R_{n\text{-}tB} = 1.5\, L_{cB}\, t\, F_u$	= 80.31	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nB} = \min (R_{n\text{-}tB}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		
Type C - Bolt Group Bottom Side Edge Bolt					
Number of bolt	n_C = 1				
Bolt tear out strength	$R_{n\text{-}tC} = 1.5\, L_{cC}\, t\, F_u$	= 242.83	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nC} = \min (R_{n\text{-}tC}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		
Type D - Bolt Group Inner Edge Bolt					
Number of bolt	n_D = 2				
Bolt tear out strength	$R_{n\text{-}tD} = 1.5\, L_{cD}\, t\, F_u$	= 158.49	[kips]	AISC 14th	Eq J3-6b

End Plate - Shear in Vy - Block Shear - Center Strip ratio = 26.55 / 334.30 = **0.08** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 10.425 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 12.319	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 10.678	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 1.172	[in^2]		
Block shear strength required	V_u =	= **26.55**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 445.73	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **334.30**	[kips]		
	ratio = **0.08**	> V_u	OK		

End Plate - Shear in Vy - Block Shear - 2-Side Strip ratio = 26.55 / 311.45 = **0.09** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 10.425 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 12.319	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 10.678	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p$ x 2	= 0.703	[in^2]		
Block shear strength required	V_u =	= **26.55**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 415.27	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **311.45**	[kips]		
	ratio = **0.09**	> V_u	OK		

End Plate - Shear in Vz - Block Shear - Center Strip ratio = 25.00 / 166.82 = **0.15** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 3	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 4.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 10.425 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 4.031	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 3.047	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 1.594	[in^2]		
Block shear strength required	V_u =	= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 222.42	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **166.82**	[kips]		
	ratio = **0.15**	> V_u	OK		

End Plate - Shear in Vz - Block Shear - 2-Side Strip ratio = 25.00 / 454.29 = **0.06** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 3	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 4.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 10.425 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 4.031	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 3.047	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p$ x 2	= 7.491	[in^2]		
Block shear strength required	V_u =	= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 605.72	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **454.29**	[kips]		
	ratio = **0.06**	> V_u	OK		

End Plate / Column Flange - Bolt Shear					ratio = 36.47 / 107.35	= **0.34**	**PASS**
Bolt group forces	shear V_y = -26.55	[kips]			shear V_z = 25.00	[kips]	
Shear resultant force	$R = (V_y^2 + V_z^2)^{0.5}$				= **36.47**	[kips]	
Bolt shear stress	grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]			bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 6.0				shear plane m = 1		
Bolt group eccentricity coefficient	C_{ec} =				= 1.000		
Required shear strength	V_u =				= **36.47**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$				= 143.14	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th Eq J3-1
	ϕR_n =				= **107.35**	[kips]	
	ratio = **0.34**				> V_u	OK	

Bolt Tensile Prying Action on End Plate			ratio = 0.70 / 7.32	= **0.09**	**PASS**
Bolt group forces	shear V = 36.47	[kips]	axial P = -4.17	[kips]	
Single Bolt Tensile Capacity Without Considering Prying					
Bolt grade	grade = A325-N				
Nominal tensile/shear stress	F_{nt} = 90.0	[ksi]	F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Bolt group shear force	shear V = 36.47	[kips]	no of bolt n = 6		
Shear stress required	$f_{rv} = V / (n A_b)$		= 13.76	[ksi]	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$		= **86.43**	[ksi]	AISC 14th Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$		= 38.18	[kips]	AISC 14th Eq J3-1
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.6
Single bolt tensile capacity	ϕr_n =		= **28.64**	[kips]	
Single Bolt Tensile Capacity After Considering Prying					
End plate	width w = 6.750	[in]	bolt gage g = 4.000	[in]	
	web t_w = 0.335	[in]			
Dist from bolt center to plate edge	a = 0.5 (w - g)		= 1.375	[in]	
	$a' = a + 0.5 d_b \le (1.25 b + 0.5 d_b)$		= 1.750	[in]	AISC 14th Eq 9-27
Bolt hole diameter	bolt dia d_b = 0.750	[in]	bolt hole dia d_h = 0.813	[in]	AISC 14th B4.3b
Dist from bolt center to face of web	$b = 0.5(g - t_w)$		= 1.833	[in]	
	$b' = b - 0.5 d_b$		= 1.458	[in]	AISC 14th Eq 9-21
Bolt pitch spacing	s_v = 3.000				
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$		= 3.000	[in]	AISC 14th Page 9-11
	$\rho = b' / a'$		= 0.833		AISC 14th Eq 9-26
	$\delta = 1 - d_h / p$		= 0.729		AISC 14th Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section		= 28.64	[kips]	
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Page 9-10
End plate thickness	t = 0.375	[in]	tensile F_u = 65.0	[ksi]	
Plate thickness req'd to develop bolt tensile capacity without prying	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$		= 0.975	[in]	AISC 14th Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$		= 4.313		AISC 14th Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$		= 0.256		AISC 14th Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below		= **0.70**	[kips]	
Tensile strength per bolt after considering prying	ϕr_n = B x Q		= **7.32**	[kips]	AISC 14th Eq 9-31
	ratio = **0.09**		> T	OK	
Calculate Max Single Bolt Tensile Load					
Bolt group force	axial P = 4.17	[kips]			
Bolt number	Bolt Row n_h = 2		Bolt Col n_v = 3		
Bolt tensile force per bolt	$T = P / (n_v n_h)$		= **0.70**	[kips]	

Bolt Tensile Prying Action on Column Flange					ratio = 0.70 / 13.62	= **0.05**	**PASS**
Bolt group forces	shear V = 36.47	[kips]		axial P = -4.17	[kips]		
Single Bolt Tensile Capacity Without Considering Prying							
Bolt grade	grade = A325-N						
Nominal tensile/shear stress	F_{nt} = 90.0	[ksi]		F_{nv} = 54.0	[ksi]	AISC 14th	Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]		
Bolt group shear force	shear V = 36.47	[kips]		no of bolt n = 6			
Shear stress required	$f_{rv} = V / (n A_b)$			= 13.76	[ksi]		
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$			= **86.43**	[ksi]	AISC 14th	Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$			= 38.18	[kips]	AISC 14th	Eq J3-1
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.6
Single bolt tensile capacity	ϕr_n =			= **28.64**	[kips]		
Single Bolt Tensile Capacity After Considering Prying							
Column flange as tee	b_f = 8.010	[in]		bolt gage g = 4.000	[in]		
	web t_w = 0.295	[in]					
Dist from bolt center to flange edge	$a_{cf} = 0.5 (b_f - g)$			= 2.005	[in]		
End plate	width w = 6.750	[in]		bolt gage g = 4.000	[in]		
Dist from bolt center to plate edge	$a_{pl} = 0.5 (w - g)$			= 1.375	[in]		
Dist from bolt center to plate edge	$a = \min (a_{cf}, a_{pl})$			= 1.375	[in]		
	$a' = a + 0.5 d_b \le (1.25 b + 0.5 d_b)$			= 1.750	[in]	AISC 14th	Eq 9-27
Bolt hole diameter	bolt dia d_b = 0.750	[in]		bolt hole dia d_h = 0.813	[in]	AISC 14th	B4.3b
Dist from bolt center to face of web	$b = 0.5(g - t_w)$			= 1.853	[in]		
	$b' = b - 0.5 d_b$			= 1.478	[in]	AISC 14th	Eq 9-21
Bolt pitch spacing	s_v = 3.000						
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$			= 3.000	[in]	AISC 14th	Page 9-11
	$\rho = b' / a'$			= 0.844		AISC 14th	Eq 9-26
	$\delta = 1 - d_h / p$			= 0.729		AISC 14th	Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section			= 28.64	[kips]		
Resistance factor-LRFD	ϕ = 0.90					AISC 14th	Page 9-10
Column flange thickness	t = 0.515	[in]		tensile F_u = 65.0	[ksi]		
Plate thickness req'd to develop bolt tensile capacity without prying	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$			= 0.982	[in]	AISC 14th	Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$			= 1.960		AISC 14th	Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$			= 0.476		AISC 14th	Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below			= **0.70**	[kips]		
Tensile strength per bolt after considering prying	ϕr_n = B x Q			= **13.62**	[kips]	AISC 14th	Eq 9-31
	ratio = **0.05**			> T	OK		
Calculate Max Single Bolt Tensile Load							
Bolt group force	axial P = 4.17	[kips]					

Beam Flange Weld Strength ratio = 2.18 / 16.82 = **0.13** **PASS**

Assume all axial tensile force P carried by flange weld

Beam section W12X45	b_{fb} = 8.050	[in]	k_{1b} = 0.938	[in]	
Fillet weld length - double fillet	L = [b_{fb} + (b_{fb} - 2k_{1b})] /2 as dbl fillet		= 5.812	[in]	

Weld Group Forces

	shear V = 12.50	[kips]	axial P = -2.09	[kips]	in tension
Beam flg-end plate weld length	L =		= 5.812	[in]	
Beam flg-end plate fillet weld size	w =		= 0.375	[in]	

Combined Weld Stress

Weld stress from axial force	f_a = P / L		= -0.359	[kip/in]	in tension
Weld stress from shear force	f_v = V / L		= 2.151	[kip/in]	
Weld stress combined - max	$f_{max} = (f_a^2 + f_v^2)^{0.5}$		= **2.180**	[kip/in]	AISC 14th Eq 8-11
Weld stress load angle	$\theta = \tan^{-1} (\frac{f_a}{f_v})$		= 9.5	[°]	

Fillet Weld Strength Calc

Fillet weld leg size	w = 3/8	[in]	load angle θ = 9.5	[°]	
Electrode strength	F_{EXX} = 70.0	[ksi]	strength coeff C_1 = 1.00		AISC 14th Table 8-3
Number of weld line	n = 2 for double fillet				
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$		= 1.03		AISC 14th Page 8-9
Fillet weld shear strength	R_{n-w} = 0.6 (C_1 x 70 ksi) 0.707 w n C_2		= 23.014	[kip/in]	AISC 14th Eq 8-1

Base metal - beam flange	thickness t = 0.575	[in]	tensile F_u = 65.0	[ksi]	
Base metal - beam flange is in shear, shear rupture as per AISC 14th Eq J4-4 is checked					AISC 14th J2.4
Base metal shear rupture	R_{n-b} = 0.6 F_u t		= 22.425	[kip/in]	AISC 14th Eq J4-4

Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$		= **22.425**	[kip/in]	AISC 14th Eq 9-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq 8-1
	ϕ R_n =		= **16.819**	[kip/in]	
	ratio = **0.13**		> f_{max}	OK	

Beam Web Weld Strength					ratio = 26.55 / 91.62	= **0.29**	**PASS**
Assume tensile force carried by flange weld and shear force carried by web weld, so there will be no combined weld tensile/shear stress required							
Web weld shear force required	V_u = from gusset interface force calc				= **26.55**	[kips]	
Beam section W12X45	d_b = 12.100	[in]		k_b = 1.375	[in]		
Fillet weld length on beam web	L = d_b - 2 k_b				= 9.350	[in]	
Fillet Weld Strength Check							
Fillet weld leg size	w = $^3/_8$	[in]	load angle θ = 0.0		[°]		
Electrode strength	F_{EXX} = 70.0	[ksi]	strength coeff C_1 = 1.00			AISC 14th	Table 8-3
Number of weld line	n = 2 for double fillet						
Load angle coefficient	C_2 = (1 + 0.5 $\sin^{1.5}$ θ)				= 1.00	AISC 14th	Page 8-9
Fillet weld shear strength	R_{n-w} = 0.6 (C_1 x 70 ksi) 0.707 w n C_2				= 22.271	[kip/in]	AISC 14th Eq 8-1
Base metal - beam web	thickness t = 0.335	[in]	tensile F_u = 65.0		[ksi]		
Base metal - beam web is in shear, shear rupture as per AISC 14th Eq J4-4 is checked						AISC 14th	J2.4
Base metal shear rupture	R_{n-b} = 0.6 F_u t				= 13.065	[kip/in]	AISC 14th Eq J4-4
Double fillet linear shear strength	R_n = min (R_{n-w} , R_{n-b})				= **13.065**	[kip/in]	AISC 14th Eq 9-2
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	Eq 8-1
	ϕ R_n =				= **9.799**	[kip/in]	
Shear resistance required	V_u =				= **26.55**	[kips]	
Fillet weld length - double fillet	L =				= 9.350	[in]	
Shear resistance provided	ϕ F_n = ϕ R_n x L				= **91.62**	[kips]	
	ratio = **0.29**				> V_u	OK	

Column Web Local Yielding					ratio = 4.17 / 252.23	= **0.02**	**PASS**
Concentrated force from gusset	P_u =				= **4.17**	[kips]	
Column section	d = 11.900	[in]		t_f = 0.515	[in]		
	t_w = 0.295	[in]		k = 1.020	[in]		
	yield F_y = 50.0	[ksi]					
Length of bearing	l_b = end plate length				= 12.000	[in]	
Column web local yielding strength	R_n = F_y t_w (5 k + l_b)				= 252.23	[kips]	AISC 14th Eq J10-2
Resistance factor-LRFD	ϕ = 1.00						
	ϕ R_n =				= **252.23**	[kips]	
	ratio = **0.02**				> P_u	OK	

Column Flange Local Bending			ratio = 4.17 / 74.59	= **0.06**	**PASS**
Concentrated force from gusset	P_u =		= **4.17**	[kips]	
Column w section	t_f = 0.515 [in]		yield F_y = 50.0	[ksi]	
Column flange local bending strength	$R_n = 6.25\ F_y t_f^2$		= 82.88	[kips]	AISC 14th Eq J10-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th J10.1
	ϕR_n =		= **74.59**	[kips]	
	ratio = **0.06**		> P_u	OK	

Brace Force Load Case 2 shear V = 76.55 kips axial P = -25.83 kips (T) ratio = **0.84** **PASS**

Beam - Shear Yielding - Vy			ratio = 76.55 / 121.61	= **0.63**	**PASS**
Section Shear Yielding Check					
Sect yield strength	F_y = 50.0 [ksi]				
Sect gross area in shear	A_{gv} =		= 4.054	[in^2]	
Shear force required	V_u =		= **76.55**	[kips]	
Sect shear yielding strength	$R_n = 0.6\ F_y A_{gv}$		= 121.61	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **121.61**	[kips]	
	ratio = **0.63**		> V_u	OK	

Beam - Shear Rupture - Vy			ratio = 76.55 / 118.56	= **0.65**	**PASS**
Section Shear Rupture Check					
Sect tensile strength	F_u = 65.0 [ksi]				
Sect net area in shear	A_{nv} =		= 4.054	[in^2]	
Shear force in demand	V_u =		= **76.55**	[kips]	
Sect shear rupture strength	$R_n = 0.6\ F_u A_{nv}$		= 158.09	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **118.56**	[kips]	
	ratio = **0.65**		> V_u	OK	

Beam - Shear Yielding - Vz			ratio = 25.00 / 277.73	= **0.09**	**PASS**
Section Shear Yielding Check					
Sect yield strength	F_y = 50.0 [ksi]				
Sect gross area in shear	A_{gv} =		= 9.258	[in^2]	
Shear force required	V_u =		= **25.00**	[kips]	
Sect shear yielding strength	$R_n = 0.6\ F_y A_{gv}$		= 277.73	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **277.73**	[kips]	
	ratio = **0.09**		> V_u	OK	

Beam - Shear Rupture - Vz			ratio = 25.00 / 270.78	= **0.09**	**PASS**
Section Shear Rupture Check					
Sect tensile strength	F_u = 65.0	[ksi]			
Sect net area in shear	A_{nv} =		= 9.258	[in^2]	
Shear force in demand	V_u =		= **25.00**	[kips]	
Sect shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 361.04	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **270.78**	[kips]	
	ratio = **0.09**		> V_u	OK	

Beam - Axial Tensile Yield - Px			ratio = 25.83 / 589.50	= **0.04**	**PASS**
Gross area subject to tension	A_g =		= 13.100	[in^2]	
Steel yield strength	F_y =		= 50.0	[ksi]	
Tensile force required	P_u =		= **25.83**	[kips]	
Tensile yielding strength	$R_n = F_y A_g$		= 655.00	[kips]	AISC 14th Eq D2-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th D2 (a)
	ϕR_n =		= **589.50**	[kips]	AISC 14th Eq D2-1
	ratio = **0.04**		> P_u	OK	

Beam - Axial Tensile Rupture - Px			ratio = 25.83 / 638.63	= **0.04**	**PASS**
Tensile force required	P_u =		= **25.83**	[kips]	
Tensile effective net area	$A_e = A_n U$		= 13.100	[in^2]	
Plate tensile strength	F_u =		= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$		= 851.50	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th D2 (b)
	ϕR_n =		= **638.63**	[kips]	AISC 14th Eq D2-2
	ratio = **0.04**		> P_u	OK	

End Plate - Shear Yielding - Vy			ratio = 38.28 / 136.13	= **0.28**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 12.100	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.538	[in^2]	
Shear force required	V_u =		= **38.28**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 136.13	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **136.13**	[kips]	
	ratio = **0.28**		> V_u	OK	

End Plate - Shear Rupture - Vy ratio = 38.28 / 103.93 = **0.37** **PASS**

Plate Shear Rupture Check

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]			AISC 14th B4.3b
Number of bolt	n = 3				
Plate size	width b_p = 12.100 [in]	thickness t_p = 0.375 [in]			
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = (b_p - n\, d_h)\, t_p$	= 3.553	[in^2]		
Shear force required	V_u =	= **38.28**	[kips]		
Plate shear rupture strength	$R_n = 0.6\, F_u\, A_{nv}$	= 138.57	[kips]		AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	$\phi\, R_n$ =	= **103.93**	[kips]		
	ratio = **0.37**	> V_u	OK		

End Plate - Shear Yielding - Vz ratio = 12.50 / 75.94 = **0.16** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 6.750 [in]	thickness t_p = 0.375 [in]			
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_{gv} = b_p\, t_p$	= 2.531	[in^2]		
Shear force required	V_u =	= **12.50**	[kips]		
Plate shear yielding strength	$R_n = 0.6\, F_y\, A_{gv}$	= 75.94	[kips]		AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	$\phi\, R_n$ =	= **75.94**	[kips]		
	ratio = **0.16**	> V_u	OK		

End Plate - Shear Rupture - Vz ratio = 12.50 / 54.84 = **0.23** **PASS**

Plate Shear Rupture Check

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]			AISC 14th B4.3b
Number of bolt	n = 2				
Plate size	width b_p = 6.750 [in]	thickness t_p = 0.375 [in]			
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = (b_p - n\, d_h)\, t_p$	= 1.875	[in^2]		
Shear force required	V_u =	= **12.50**	[kips]		
Plate shear rupture strength	$R_n = 0.6\, F_u\, A_{nv}$	= 73.13	[kips]		AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	$\phi\, R_n$ =	= **54.84**	[kips]		
	ratio = **0.23**	> V_u	OK		

End Plate - Bolt Bearing on End Plate - Vy Vz Combined ratio = 80.53 / 107.35 = **0.75** **PASS**

The bolt group is oriented so that the shear V_y is in ver. direction and the shear V_z is in hor. direction

Bolt group forces	shear V_y = 76.55 [kips]	shear V_z = 25.00	[kips]		
Bolt group resultant force	$R = (V_y^2 + V_z^2)^{0.5}$	= **80.53**	[kips]		
Resultant force/hor line load angle	$\theta = \tan^{-1} (V_y / V_z)$	= 71.91	[°]		
Bolt hole diameter	bolt dia d_b = 0.750 [in]	bolt hole dia d_{bh} = 0.813	[in]	AISC 14th	B4.3b
Bolt hole ver. dimension	d_v =	= 0.813	[in]		
Bolt hole hor. dimension	d_h =	= 0.813	[in]		
Bolt center to bolt hole edge dist	$d_c = 0.5\, d_{bh}$	= 0.406	[in]		
Bolt no in ver & hor direction	Bolt Row n_v = 3	Bolt Col n_h = 2			
Bolt spacing	ver s_v = 3.000 [in]	hor s_h = 4.000	[in]		
Bolt edge distance	ver e_v = 10.425 [in]	hor e_h = 1.375	[in]		
Bolt clear dist - bot right corner bolt	$L_{cA} = \min (\frac{e_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 4.023	[in]		
Bolt clear dist - right side edge bolt	$L_{cB} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 2.322	[in]		
Bolt clear dist - bot side edge bolt	$L_{cC} = \min (\frac{e_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 10.561	[in]		
Bolt clear dist - inner edge bolt	$L_{cD} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 2.322	[in]		

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N	F_{nv} = 54.0	[ksi]	AISC 14th	Table J3.2
	bolt dia d_b = 0.750 [in]	bolt area A_b = 0.442	[in^2]		
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$	= 23.86	[kips]	AISC 14th	Eq J3-1
Bolt bearing on plate	thick t = 0.375 [in]	tensile F_u = 65.0	[ksi]		
Bolt bearing strength	$R_{n\text{-}br} = 3.0\, d_b\, t\, F_u$	= 54.84	[kips]	AISC 14th	Eq J3-6b

Type A - Bolt Group Bottom Right Corner Bolt

Number of bolt	n_A = 1				
Bolt tear out strength	$R_{n\text{-}tA} = 1.5\, L_{cA}\, t\, F_u$	= 147.09	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nA} = \min (R_{n\text{-}tA}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type B - Bolt Group Right Side Edge Bolt

Number of bolt	n_B = 2				
Bolt tear out strength	$R_{n\text{-}tB} = 1.5\, L_{cB}\, t\, F_u$	= 84.91	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nB} = \min (R_{n\text{-}tB}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type C - Bolt Group Bottom Side Edge Bolt

Number of bolt	n_C = 1				
Bolt tear out strength	$R_{n\text{-}tC} = 1.5\, L_{cC}\, t\, F_u$	= 386.12	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nC} = \min (R_{n\text{-}tC}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type D - Bolt Group Inner Edge Bolt

Number of bolt	n_D = 2				
Bolt tear out strength	$R_{n\text{-}tD} = 1.5\, L_{cD}\, t\, F_u$	= 84.91	[kips]	AISC 14th	Eq J3-6b

End Plate - Bolt Bearing on Column Flange - Vy Vz Combined ratio = 80.53 / 107.35 = **0.75** **PASS**

The bolt group is oriented so that the shear V_y is in ver. direction and the shear V_z is in hor. direction

Bolt group forces	shear V_y = 76.55 [kips]	shear V_z = 25.00	[kips]		
Bolt group resultant force	$R = (V_y^2 + V_z^2)^{0.5}$	= **80.53**	[kips]		
Resultant force/hor line load angle	$\theta = \tan^{-1} (V_y / V_z)$	= 71.91	[°]		
Bolt hole diameter	bolt dia d_b = 0.750 [in]	bolt hole dia d_{bh} = 0.813	[in]	AISC 14th	B4.3b
Bolt hole ver. dimension	d_v =	= 0.813	[in]		
Bolt hole hor. dimension	d_h =	= 0.813	[in]		
Bolt center to bolt hole edge dist	$d_c = 0.5\, d_{bh}$	= 0.406	[in]		
Bolt no in ver & hor direction	Bolt Row n_v = 3	Bolt Col n_h = 2			
Bolt spacing	ver s_v = 3.000 [in]	hor s_h = 4.000	[in]		
Bolt edge distance	ver e_v = 10.425 [in]	hor e_h = 1.375	[in]		
Bolt clear dist - bot right corner bolt	$L_{cA} = \min (\frac{e_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 4.023	[in]		
Bolt clear dist - right side edge bolt	$L_{cB} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 2.322	[in]		
Bolt clear dist - bot side edge bolt	$L_{cC} = \min (\frac{e_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 10.561	[in]		
Bolt clear dist - inner edge bolt	$L_{cD} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 2.322	[in]		

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N	F_{nv} = 54.0	[ksi]	AISC 14th	Table J3.2
	bolt dia d_b = 0.750 [in]	bolt area A_b = 0.442	[in^2]		
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$	= 23.86	[kips]	AISC 14th	Eq J3-1
Bolt bearing on plate	thick t = 0.515 [in]	tensile F_u = 65.0	[ksi]		
Bolt bearing strength	$R_{n\text{-}br} = 3.0\, d_b\, t\, F_u$	= 75.32	[kips]	AISC 14th	Eq J3-6b

Type A - Bolt Group Bottom Right Corner Bolt

Number of bolt	n_A = 1				
Bolt tear out strength	$R_{n\text{-}tA} = 1.5\, L_{cA}\, t\, F_u$	= 202.00	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nA} = \min (R_{n\text{-}tA}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type B - Bolt Group Right Side Edge Bolt

Number of bolt	n_B = 2				
Bolt tear out strength	$R_{n\text{-}tB} = 1.5\, L_{cB}\, t\, F_u$	= 116.61	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nB} = \min (R_{n\text{-}tB}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type C - Bolt Group Bottom Side Edge Bolt

Number of bolt	n_C = 1				
Bolt tear out strength	$R_{n\text{-}tC} = 1.5\, L_{cC}\, t\, F_u$	= 530.28	[kips]	AISC 14th	Eq J3-6b
Bolt bearing strength	$R_{nC} = \min (R_{n\text{-}tC}, R_{n\text{-}br}, R_{n\text{-}bolt})$	= **23.86**	[kips]		

Type D - Bolt Group Inner Edge Bolt

Number of bolt	n_D = 2				
Bolt tear out strength	$R_{n\text{-}tD} = 1.5\, L_{cD}\, t\, F_u$	= 116.61	[kips]	AISC 14th	Eq J3-6b

End Plate - Shear in Vy - Block Shear - Center Strip ratio = 76.55 / 334.30 = **0.23** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]			AISC 14th B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 10.425 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 12.319	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 10.678	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 1.172	[in^2]		
Block shear strength required	V_u =	= **76.55**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 445.73	[kips]		AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5
	ϕR_n =	= **334.30**	[kips]		
	ratio = **0.23**	> V_u	OK		

End Plate - Shear in Vy - Block Shear - 2-Side Strip ratio = 76.55 / 311.45 = **0.25** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]			AISC 14th B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 10.425 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 12.319	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 10.678	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p$ x 2	= 0.703	[in^2]		
Block shear strength required	V_u =	= **76.55**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 415.27	[kips]		AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5
	ϕR_n =	= **311.45**	[kips]		
	ratio = **0.25**	> V_u	OK		

End Plate - Shear in Vz - Block Shear - Center Strip ratio = 25.00 / 166.82 = **0.15** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 3	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 4.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 10.425 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 4.031	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 3.047	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 1.594	[in^2]		
Block shear strength required	V_u =	= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 222.42	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **166.82**	[kips]		
	ratio = **0.15**	> V_u	OK		

End Plate - Shear in Vz - Block Shear - 2-Side Strip ratio = 25.00 / 454.29 = **0.06** **PASS**

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 3	n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000 [in]	s_h = 4.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 10.425 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 4.031	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 3.047	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$	= 7.491	[in^2]		
Block shear strength required	V_u =	= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 605.72	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **454.29**	[kips]		
	ratio = **0.06**	> V_u	OK		

End Plate / Column Flange - Bolt Shear					ratio = 80.53 / 107.35	= **0.75**	**PASS**
Bolt group forces	shear V_y = 76.55	[kips]			shear V_z = 25.00	[kips]	
Shear resultant force	$R = (V_y^2 + V_z^2)^{0.5}$				= **80.53**	[kips]	
Bolt shear stress	grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]			bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 6.0				shear plane m = 1		
Bolt group eccentricity coefficient	C_{ec} =				= 1.000		
Required shear strength	V_u =				= **80.53**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$				= 143.14	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th Eq J3-1
	ϕR_n =				= **107.35**	[kips]	
	ratio = **0.75**				> V_u	OK	

Bolt Tensile Prying Action on End Plate					ratio = 4.31 / 7.32	= **0.59**	**PASS**
Bolt group forces	shear V = 80.53	[kips]		axial P = -25.83	[kips]		
Single Bolt Tensile Capacity Without Considering Prying							
Bolt grade	grade = A325-N						
Nominal tensile/shear stress	F_{nt} = 90.0	[ksi]		F_{nv} = 54.0	[ksi]	AISC 14th	Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]		
Bolt group shear force	shear V = 80.53	[kips]		no of bolt n = 6			
Shear stress required	$f_{rv} = V / (n A_b)$			= 30.38	[ksi]		
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$			= **49.49**	[ksi]	AISC 14th	Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$			= 21.86	[kips]	AISC 14th	Eq J3-1
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.6
Single bolt tensile capacity	ϕr_n =			= **16.40**	[kips]		
Single Bolt Tensile Capacity After Considering Prying							
End plate	width w = 6.750	[in]		bolt gage g = 4.000	[in]		
	web t_w = 0.335	[in]					
Dist from bolt center to plate edge	a = 0.5 (w - g)			= 1.375	[in]		
	$a' = a + 0.5 d_b \le (1.25 b + 0.5 d_b)$			= 1.750	[in]	AISC 14th	Eq 9-27
Bolt hole diameter	bolt dia d_b = 0.750	[in]		bolt hole dia d_h = 0.813	[in]	AISC 14th	B4.3b
Dist from bolt center to face of web	$b = 0.5(g - t_w)$			= 1.833	[in]		
	$b' = b - 0.5 d_b$			= 1.458	[in]	AISC 14th	Eq 9-21
Bolt pitch spacing	s_v = 3.000						
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$			= 3.000	[in]	AISC 14th	Page 9-11
	$\rho = b' / a'$			= 0.833		AISC 14th	Eq 9-26
	$\delta = 1 - d_h / p$			= 0.729		AISC 14th	Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section			= 16.40	[kips]		
Resistance factor-LRFD	ϕ = 0.90					AISC 14th	Page 9-10
End plate thickness	t = 0.375	[in]		tensile F_u = 65.0	[ksi]		
Plate thickness req'd to develop bolt tensile capacity without prying	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$			= 0.738	[in]	AISC 14th	Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$			= 2.150		AISC 14th	Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$			= 0.446		AISC 14th	Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below			= **4.31**	[kips]		
Tensile strength per bolt after considering prying	ϕr_n = B x Q			= **7.32**	[kips]	AISC 14th	Eq 9-31
	ratio = **0.59**			> T	OK		
Calculate Max Single Bolt Tensile Load							
Bolt group force	axial P = 25.83	[kips]					
Bolt number	Bolt Row n_h = 2			Bolt Col n_v = 3			
Bolt tensile force per bolt	$T = P / (n_v n_h)$			= **4.31**	[kips]		

Bolt Tensile Prying Action on Column Flange			ratio = 4.31 / 12.50	= **0.34**	**PASS**
Bolt group forces	shear V = 80.53	[kips]	axial P = -25.83	[kips]	
Single Bolt Tensile Capacity Without Considering Prying					
Bolt grade	grade = A325-N				
Nominal tensile/shear stress	F_{nt} = 90.0	[ksi]	F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Bolt group shear force	shear V = 80.53	[kips]	no of bolt n = 6		
Shear stress required	$f_{rv} = V / (n A_b)$		= 30.38	[ksi]	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$		= **49.49**	[ksi]	AISC 14th Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$		= 21.86	[kips]	AISC 14th Eq J3-1
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.6
Single bolt tensile capacity	ϕr_n =		= **16.40**	[kips]	
Single Bolt Tensile Capacity After Considering Prying					
Column flange as tee	b_f = 8.010	[in]	bolt gage g = 4.000	[in]	
	web t_w = 0.295	[in]			
Dist from bolt center to flange edge	$a_{cf} = 0.5 (b_f - g)$		= 2.005	[in]	
End plate	width w = 6.750	[in]	bolt gage g = 4.000	[in]	
Dist from bolt center to plate edge	$a_{pl} = 0.5 (w - g)$		= 1.375	[in]	
Dist from bolt center to plate edge	$a = \min (a_{cf}, a_{pl})$		= 1.375	[in]	
	$a' = a + 0.5 d_b \le (1.25 b + 0.5 d_b)$		= 1.750	[in]	AISC 14th Eq 9-27
Bolt hole diameter	bolt dia d_b = 0.750	[in]	bolt hole dia d_h = 0.813	[in]	AISC 14th B4.3b
Dist from bolt center to face of web	$b = 0.5(g - t_w)$		= 1.853	[in]	
	$b' = b - 0.5 d_b$		= 1.478	[in]	AISC 14th Eq 9-21
Bolt pitch spacing	s_v = 3.000				
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$		= 3.000	[in]	AISC 14th Page 9-11
	$\rho = b' / a'$		= 0.844		AISC 14th Eq 9-26
	$\delta = 1 - d_h / p$		= 0.729		AISC 14th Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section		= 16.40	[kips]	
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Page 9-10
Column flange thickness	t = 0.515	[in]	tensile F_u = 65.0	[ksi]	
Plate thickness req'd to develop bolt tensile capacity without prying	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$		= 0.743	[in]	AISC 14th Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$		= 0.805		AISC 14th Eq 9-35
when $0 \le \alpha' \le 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta \alpha')$		= 0.762		AISC 14th Eq 9-33
Bolt tensile force per bolt in demand	T = from calc shown below		= **4.31**	[kips]	
Tensile strength per bolt after considering prying	ϕr_n = B x Q		= **12.50**	[kips]	AISC 14th Eq 9-31
	ratio = **0.34**		> T	OK	
Calculate Max Single Bolt Tensile Load					
Bolt group force	axial P = 25.83	[kips]			

Beam Flange Weld Strength ratio = 3.09 / 16.82 = **0.18** **PASS**

Assume all axial tensile force P carried by flange weld

Beam section W12X45	b_{fb} = 8.050	[in]	k_{1b} = 0.938	[in]	
Fillet weld length - double fillet	L = [b_{fb} + (b_{fb} - 2k_{1b})] /2 as dbl fillet		= 5.812	[in]	
Weld Group Forces					
	shear V = 12.50	[kips]	axial P = -12.92	[kips]	in tension
Beam flg-end plate weld length	L =		= 5.812	[in]	
Beam flg-end plate fillet weld size	w =		= 0.375	[in]	
Combined Weld Stress					
Weld stress from axial force	f_a = P / L		= -2.222	[kip/in]	in tension
Weld stress from shear force	f_v = V / L		= 2.151	[kip/in]	
Weld stress combined - max	$f_{max} = (f_a^2 + f_v^2)^{0.5}$		= **3.092**	[kip/in]	AISC 14th Eq 8-11
Weld stress load angle	$\theta = \tan^{-1} (\frac{f_a}{f_v})$		= 45.9	[°]	
Fillet Weld Strength Calc					
Fillet weld leg size	w = 3/8	[in]	load angle θ = 45.9	[°]	
Electrode strength	F_{EXX} = 70.0	[ksi]	strength coeff C_1 = 1.00		AISC 14th Table 8-3
Number of weld line	n = 2 for double fillet				
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$		= 1.30		AISC 14th Page 8-9
Fillet weld shear strength	R_{n-w} = 0.6 (C_1 x 70 ksi) 0.707 w n C_2		= 29.053	[kip/in]	AISC 14th Eq 8-1
Base metal - beam flange	thickness t = 0.575	[in]	tensile F_u = 65.0	[ksi]	
Base metal - beam flange is in shear, shear rupture as per AISC 14th Eq J4-4 is checked					AISC 14th J2.4
Base metal shear rupture	R_{n-b} = 0.6 F_u t		= 22.425	[kip/in]	AISC 14th Eq J4-4
Double fillet linear shear strength	R_n = min (R_{n-w} , R_{n-b})		= **22.425**	[kip/in]	AISC 14th Eq 9-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq 8-1
	ϕ R_n =		= **16.819**	[kip/in]	
	ratio = **0.18**		> f_{max}	OK	

Beam Web Weld Strength ratio = 76.55 / 91.62 = **0.84** **PASS**

Assume tensile force carried by flange weld and shear force carried by web weld, so there will be no combined weld tensile/shear stress required

Web weld shear force required	V_u = from gusset interface force calc	= **76.55**	[kips]	
Beam section W12X45	d_b = 12.100 [in]	k_b = 1.375	[in]	
Fillet weld length on beam web	L = d_b - 2 k_b	= 9.350	[in]	

Fillet Weld Strength Check

Fillet weld leg size	w = $^3/_8$ [in]	load angle θ = 0.0	[°]	
Electrode strength	F_{EXX} = 70.0 [ksi]	strength coeff C_1 = 1.00		AISC 14th Table 8-3
Number of weld line	n = 2 for double fillet			
Load angle coefficient	C_2 = (1 + 0.5 $\sin^{1.5}$ θ)	= 1.00		AISC 14th Page 8-9
Fillet weld shear strength	R_{n-w} = 0.6 (C_1 x 70 ksi) 0.707 w n C_2	= 22.271	[kip/in]	AISC 14th Eq 8-1
Base metal - beam web	thickness t = 0.335 [in]	tensile F_u = 65.0	[ksi]	
Base metal - beam web is in shear, shear rupture as per AISC 14th Eq J4-4 is checked				AISC 14th J2.4
Base metal shear rupture	R_{n-b} = 0.6 F_u t	= 13.065	[kip/in]	AISC 14th Eq J4-4
Double fillet linear shear strength	R_n = min (R_{n-w} , R_{n-b})	= **13.065**	[kip/in]	AISC 14th Eq 9-2
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq 8-1
	ϕ R_n =	= **9.799**	[kip/in]	
Shear resistance required	V_u =	= **76.55**	[kips]	
Fillet weld length - double fillet	L =	= 9.350	[in]	
Shear resistance provided	ϕ F_n = ϕ R_n x L	= **91.62**	[kips]	
	ratio = **0.84**	> V_u	OK	

Column Web Local Yielding ratio = 25.83 / 252.23 = **0.10** **PASS**

Concentrated force from gusset	P_u =	= **25.83**	[kips]	
Column section	d = 11.900 [in]	t_f = 0.515	[in]	
	t_w = 0.295 [in]	k = 1.020	[in]	
	yield F_y = 50.0 [ksi]			
Length of bearing	l_b = end plate length	= 12.000	[in]	
Column web local yielding strength	R_n = F_y t_w (5 k + l_b)	= 252.23	[kips]	AISC 14th Eq J10-2
Resistance factor-LRFD	ϕ = 1.00			
	ϕ R_n =	= **252.23**	[kips]	
	ratio = **0.10**	> P_u	OK	

Column Flange Local Bending		ratio = 25.83 / 74.59	= **0.35**	**PASS**
Concentrated force from gusset	P_u =	= **25.83**	[kips]	
Column w section	t_f = 0.515 [in]	yield F_y = 50.0	[ksi]	
Column flange local bending strength	$R_n = 6.25\ F_y t_f^2$	= 82.88	[kips]	AISC 14th Eq J10-1
Resistance factor-LRFD	ϕ = 0.90			AISC 14th J10.1
	ϕR_n =	= **74.59**	[kips]	
	ratio = **0.35**	> P_u	OK	