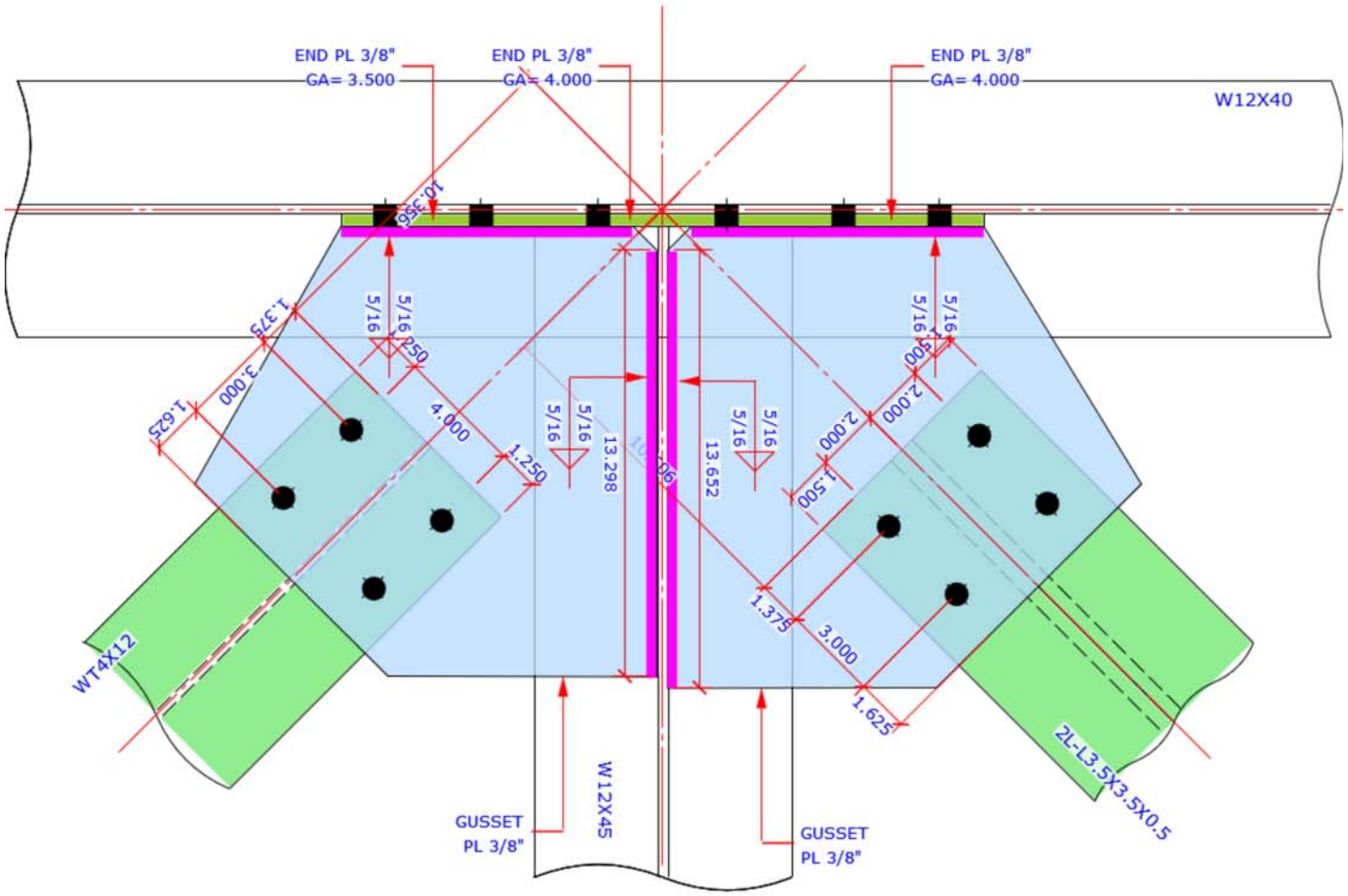
Result Summary - Overall Horizontal Brace Connection Code=AISC 360-10 LRFD

Result Summary - Overall	geometries & weld limitations = **PASS**	limit states max ratio = **0.92**	**PASS**
Right Brace - Brace to Gusset	geometries & weld limitations = **PASS**	limit states max ratio = **0.92**	**PASS**
Right Brace - Gusset to Girder	geometries & weld limitations = **PASS**	limit states max ratio = **0.64**	**PASS**
Right Brace - Gusset to Beam	geometries & weld limitations = **PASS**	limit states max ratio = **0.20**	**PASS**
Left Brace - Brace to Gusset	geometries & weld limitations = **PASS**	limit states max ratio = **0.92**	**PASS**
Left Brace - Gusset to Girder	geometries & weld limitations = **PASS**	limit states max ratio = **0.64**	**PASS**
Left Brace - Gusset to Beam	geometries & weld limitations = **PASS**	limit states max ratio = **0.21**	**PASS**
Beam to Girder	geometries & weld limitations = **PASS**	limit states max ratio = **0.47**	**PASS**

Sketch Horizontal Brace Connection Code=AISC 360-10 LRFD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1.625
5/16
5/16
1.250
4.000
1.250
5/16
5/16
13.298
10.296
5/16
5/16
13.652
5/16
2.500
5/16
2.000
2.000
1.500
1.375
3.000
1.625
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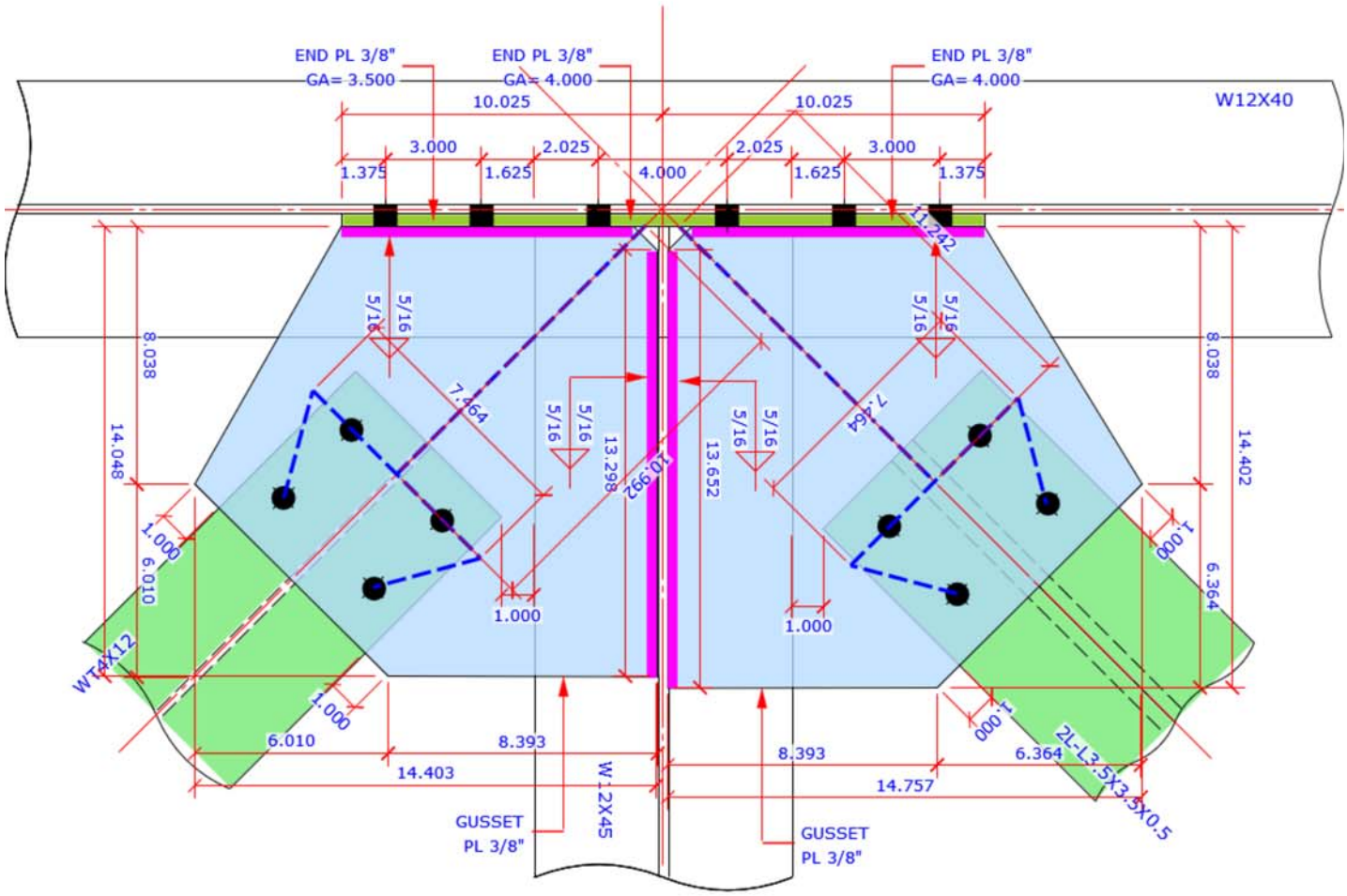
W12X45
GUSSET
PL 3/8"
GUSSET
PL 3/8"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1.375
11.242
5/16
5/16
5/16
5/16
8.038
14.048
7.464
7.464
5/16
5/16
5/16
5/16
13.298
10.992
13.652
8.038
14.402
1.000
6.010
1.000
1.000
6.364
WT4X12
1.000
1.000
6.010
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8.393
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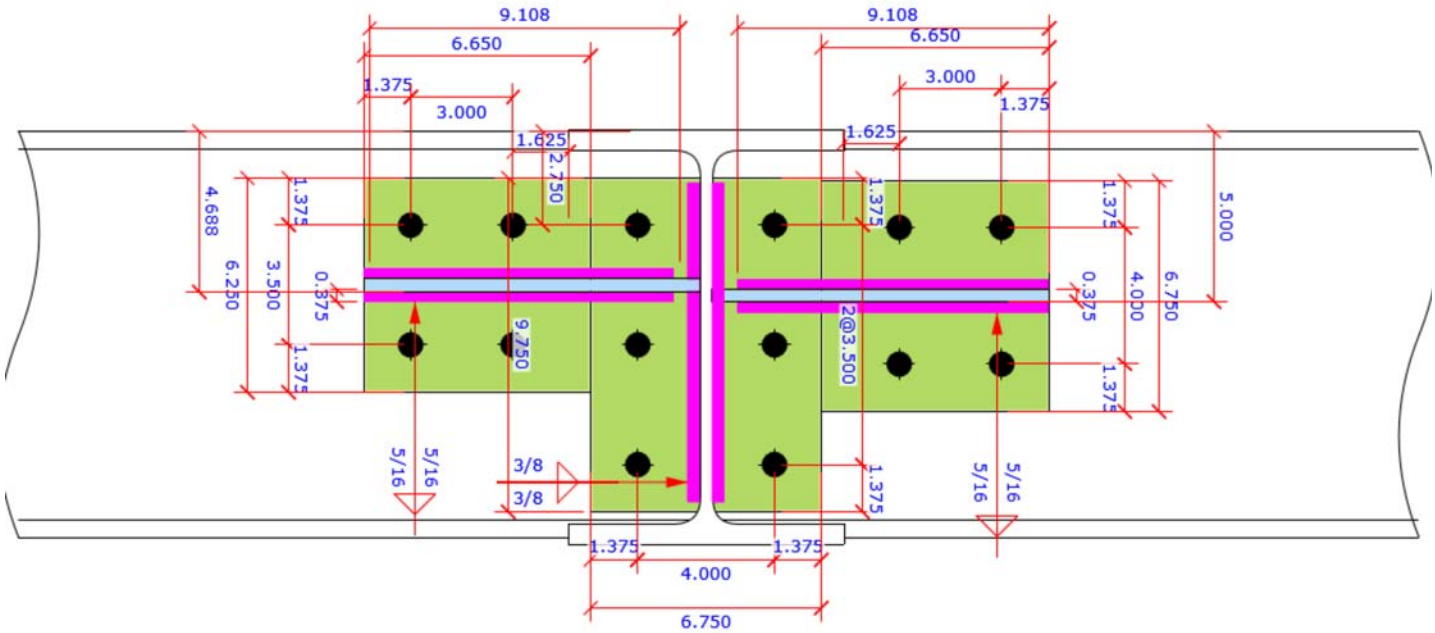
PL 3/8"
GUSSET
PL 3/8"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1.625
2.750
4.688
6.250
3.500
0.375
1.375
9.750
5/16
5/16
3/8
3/8
1.375
4.000
6.750
9.108
6.650
3.000
1.375
1.625
1.375
2@3.500
1.375
5.000
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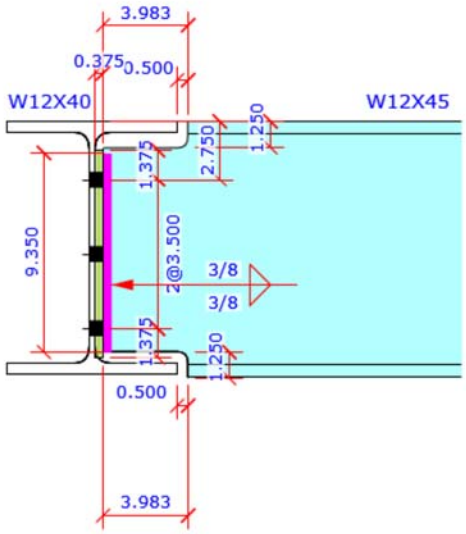
4.000
6.750
1.375
5/16
5/16
1.375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W12X45
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9.350
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3/8
3/8
1.375
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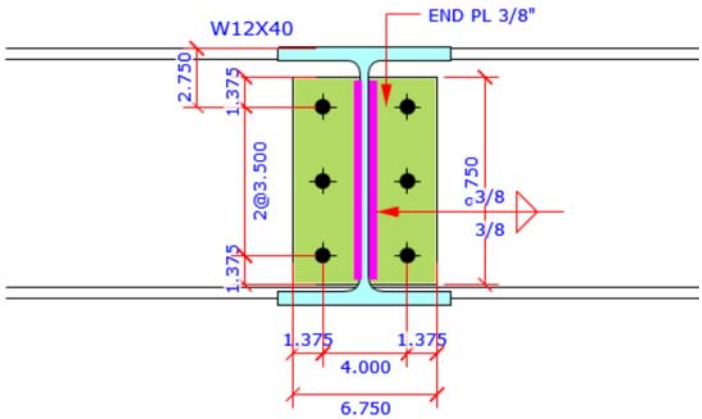
0.500
3.983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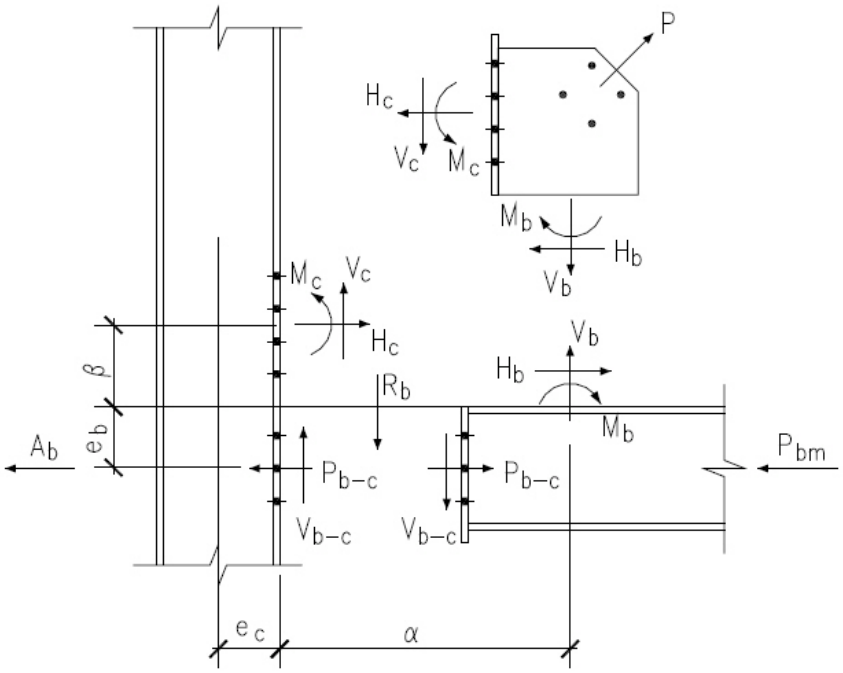
3/8
3/8
1.375
1.375
1.375
4.000
6.750

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

Right and left brace force	R P_{rt} = -35.00	[kips] (T)	L P_{lt} = 35.00	[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 = 0.168 [in] e_c = 0.148 [in]

α = 7.951 [in] β = 6.983 [in]

θ = 45.0 [°]

$K = e_b \tan\theta - e_c$	= 0.020	[in]	AISC 14th Eq. 13-16
$D = \tan^2\theta + (\frac{\alpha}{\beta})^2$	= 2.297		AISC 14th Eq. 13-24
$K' = \alpha (\tan\theta + \frac{\alpha}{\beta})$	= 17.005		AISC 14th Eq. 13-23
$\bar{\alpha} = [K' \tan\theta + K (\frac{\alpha}{\beta})^2] / D$	= 7.003	[in]	AISC 14th Eq. 13-21
$\bar{\beta} = (K' - K \tan\theta) / D$	= 6.983	[in]	AISC 14th Eq. 13-22
$r = [(e_b + \bar{\beta})^2 + (e_c + \bar{\alpha})^2]^{0.5}$	= 10.112	[in]	AISC 14th Eq. 13-6

Brace axial force	P_u = from user input	= -35.00	[kips]	in tension
Gusset to Girder Interface Forces				
Shear force	$V_c = (\bar{\beta} / r) P_u$	= **-24.17**	[kips]	AISC 14th Eq. 13-2
Axial force	$H_c = (e_c / r) P_u$	= **-0.51**	[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	$H_b = (\bar{\alpha} / r) P_u$	= **-24.24**	[kips]	AISC 14th Eq. 13-5

Right Brace - Brace to Gusset Sect=2L3 1/2 x 3 1/2 x 1/2 P_{LC1} =-35.00 kips (T) P_{LC2} =35.00 kips (C) Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.92**	**PASS**

Geometry Restriction Checks - Double Angle to Gusset				**PASS**
Min Bolt Edge Distance - Double 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 Double Angle to Gusset	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	
Min Bolt Spacing - Double 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 Double Angle to Gusset	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Brace Force Load Case 1 Sect=2L3 1/2 x 3 1/2 x 1/2 P =-35.00 kips (T) ratio = **0.92** **PASS**

Double Angle Brace - Tensile Yield		ratio = 35.00 / 292.50	= **0.12**	**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 =	= **35.00**	[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 = **0.12**	> P_u	OK	

Double Angle Brace - Tensile Rupture			ratio = 35.00 / 178.24	= **0.20**	**PASS**
Section gross area	A_g = 2L3 1/2 x 3 1/2 x 1/2		= 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	$A_n = A_g - n_v d_h t$ x 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 =		= **35.00**	[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 = **0.20**		> P_u	OK	

Double Angle Brace - Bolt Shear			ratio = 17.50 / 35.78	= **0.49**	**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 = 1		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **17.50**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 47.71	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕR_n =		= **35.78**	[kips]	
	ratio = **0.49**		> V_u	OK	

Double Angle Brace - Slip Critical - Angle / Gusset Plate			ratio = 17.50 / 18.98	= **0.92**	**PASS**
Bolt dia & bolt pretension	dia d_b = 3/4 [in]		Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 1		n_c = 2		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **17.50**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 18.98	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **18.98**	[kips]	
	ratio = **0.92**		> V_u	OK	

Double Angle Brace - Bolt Bearing on Angle					ratio = 17.50 / 35.78	= **0.49**	**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 =				= **17.50**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕ R_n =				= **35.78**	[kips]	
	ratio = **0.49**				> V_u	OK	

Double Angle Brace - Bolt Bearing on Gusset Plate					ratio = 17.50 / 35.78	= **0.49**	**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 = 0.375	[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	$L_c = L_e - d_h / 2$			= 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	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$			= 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 =			= **17.50**	[kips]		
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th J3-10	
	ϕ R_n =			= **35.78**	[kips]		
	ratio = **0.49**			> V_u	OK		

Double Angle Brace - Block Shear - 1-Side Strip ratio = 17.50 / 70.69 = **0.25** **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 =	= **17.50**	[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 = **0.25**	> V_u	OK		

Gusset Plate - Tensile Yield (Whitmore) ratio = 35.00 / 125.96 = **0.28** **PASS**

Plate Tensile Yielding Check

Plate size	width b_p = 7.464 [in]	thickness t_p = 0.375	[in]		
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_g = b_p t_p$	= 2.799	[in^2]		
Tensile force required	P_u =	= **35.00**	[kips]		
Plate tensile yielding strength	$R_n = F_y A_g$	= 139.95	[kips]	AISC 14th	Eq J4-1
Resistance factor-LRFD	ϕ = 0.90			AISC 14th	Eq J4-1
	ϕR_n =	= **125.96**	[kips]		
	ratio = **0.28**	> P_u	OK		

Gusset Plate - Tensile Rupture (Whitmore) ratio = 35.00 / 104.46 = **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 = 7.464 [in]	thickness t_p = 0.375	[in]		
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in tension	$A_{nt} = (b_p - n d_h) t_p$	= 2.143	[in^2]		
Tensile force required	P_u =	= **35.00**	[kips]		
Plate tensile rupture strength	$R_n = F_u A_{nt}$	= 139.28	[kips]	AISC 14th	Eq J4-2
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-2
	ϕR_n =	= **104.46**	[kips]	AISC 14th	Eq J4-2
	ratio = **0.34**	> P_u	OK		

Gusset Plate - Block Shear - Center Strip					ratio = 35.00 / 129.80	= **0.27**	**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 = 2.0		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} = 4.000	[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	$A_{nt} = [W_{bs} - (n_v - 1) d_h] t_p$		= 1.172	[in^2]			
Block shear strength required	V_u =		= **35.00**	[kips]			
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2	
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 173.06	[kips]	AISC 14th	Eq J4-5	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5	
	ϕR_n =		= **129.80**	[kips]			
	ratio = **0.27**		> V_u	OK			

Brace Force Load Case 2 Sect=2L3$^1/_2$ x 3$^1/_2$ x $^1/_2$ P =35.00 kips (C) ratio = **0.92** **PASS**

Double Angle Brace - Bolt Shear					ratio = 17.50 / 35.78	= **0.49**	**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 = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000				
Required shear strength	V_u =		= **17.50**	[kips]			
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 47.71	[kips]	AISC 14th	Eq J3-1	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J3-1	
	ϕR_n =		= **35.78**	[kips]			
	ratio = **0.49**		> V_u	OK			

Double Angle Brace - Slip Critical - Angle / Gusset Plate			ratio = 17.50 / 18.98	= **0.92**	**PASS**
Bolt dia & bolt pretension	dia d_b = $^3/_4$	[in]	Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 1		n_c = 2		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **17.50**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 18.98	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **18.98**	[kips]	
	ratio = **0.92**		> V_u	OK	

Double Angle Brace - Bolt Bearing on Angle			ratio = 17.50 / 35.78	= **0.49**	**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 =		= **17.50**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **35.78**	[kips]	
	ratio = **0.49**		> V_u	OK	

Double Angle Brace - Bolt Bearing on Gusset Plate					ratio = 17.50 / 35.78	= **0.49**	**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} = 2						
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$				= 47.71	[kips]	
Required shear strength	V_u =				= **17.50**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕ R_n =				= **35.78**	[kips]	
	ratio = **0.49**				> V_u	OK	

Gusset Plate - Compression (Whitmore) ratio = 35.00 / 103.42 = **0.34** **PASS**

Plate Compression Check

Plate size	width b_p = 7.464 [in]	thickness t_p = 0.375	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 2.799	[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 =	= 11.242	[in]	
Plate slenderness	$KL/r = 0.50 \times L_u / r$	= 51.92		
	when $\frac{KL}{r} > 25$, use Chapter E			AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$	= 106.16	[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	$F_{cr} = 0.658^{(F_y/F_e)} F_y$	= 41.05	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =	= **35.00**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$	= 114.91	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th E1
	ϕR_n =	= **103.42**	[kips]	
	ratio = **0.34**	> P_u	OK	

Right Brace - Gusset to Girder | End Plate Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.64**	**PASS**

Geometry Restriction Checks - End Plate to Column Web — PASS

Min Bolt Edge Distance - End Plate to Column 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 End Plate to Column Web	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - End Plate to Column 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 End Plate to Column Web	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

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 =	= **9.108**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1 | Gusset plate t=0.375 | P =-35.00 kips (T) | ratio = **0.64** | **PASS**

Gusset Plate - Shear Yielding — ratio = 24.17 / 102.47 = **0.24** — PASS

Plate Shear Yielding Check

Plate size	width b_p = 9.108	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 3.416	[in^2]	
Shear force required	V_u =		= **24.17**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 102.47	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **102.47**	[kips]	
	ratio = **0.24**		> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 24.17 / 99.90	= **0.24**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 9.108	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 3.416	[in^2]	
Shear force in demand	V_u =		= **24.17**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 133.20	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **99.90**	[kips]	
	ratio = **0.24**		> V_u	OK	

End Plate - Shear Yield			ratio = 12.09 / 64.69	= **0.19**	**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 =		= **12.09**	[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 = **0.19**		> V_u	OK	

End Plate - Shear Rupture			ratio = 12.09 / 43.88	= **0.28**	**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 =		= **12.09**	[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 = **0.28**		> V_u	OK	

End Plate - Block Shear - Center Strip ratio = 24.17 / 124.31 = **0.19** **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 =	= **24.17**	[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 = **0.19**	> V_u	OK		

End Plate - Block Shear - 2-Side Strip ratio = 24.17 / 101.46 = **0.24** **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 =	= **24.17**	[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 = **0.24**	> V_u	OK		

End Plate - Bolt Bearing on End Plate			ratio = 24.17 / 71.57	= **0.34**	**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 =		= **24.17**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.34**		> V_u	OK	

End Plate / Girder - Bolt Shear			ratio = 24.17 / 71.57	= **0.34**	**PASS**
Bolt group forces	shear V = 24.17	[kips]	axial P = 0.51	[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 =		= **24.17**	[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 = **0.34**		> V_u	OK	

End Plate / Girder - Slip Critical			ratio = 24.17 / 37.82	= **0.64**	**PASS**
Bolt dia & bolt pretension	dia d_b = $^3/_4$	[in]	Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 2		n_c = 2		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **24.17**	[kips]	
Tension Reduction Factor					
Bolt group tensile load	T_u =		= 0.51	[kips]	
Number of bolt	$n_b = n_r \times n_c$		= 4		
Tension reduction factor	$k_{sc} = 1 - \frac{T_u}{D_u T_b n_b}$		= 1.00		AISC 14th Eq J3-5a
Slip resistance	$R_n = k_{sc} \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 37.82	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **37.82**	[kips]	
	ratio = **0.64**		> V_u	OK	

End Plate / Girder - Bolt Bearing on Girder			ratio = 24.17 / 71.57	= **0.34**	**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 = 0.295	[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
	= 62.92 ≤ 43.14		= 43.14	[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 =		= **24.17**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.34**		> V_u	OK	

Bolt Tensile Prying Action on End Plate			ratio = 0.13 / 7.06	= **0.02**	**PASS**
Bolt group forces	shear V = 24.17	[kips]	axial P = -0.51	[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 = 24.17	[kips]	no of bolt n = 4		
Shear stress required	$f_{rv} = V / (n A_b)$		= 13.68	[ksi]	
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$		= **86.61**	[ksi]	AISC 14th Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$		= 38.26	[kips]	AISC 14th Eq J3-1
Resistance factor-LRFD	ϕ = 0.75				AISC 14th J3.6
Single bolt tensile capacity	ϕr_n =		= **28.70**	[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		= 28.70	[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	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$		= 0.990	[in]	AISC 14th Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$		= 4.574		AISC 14th Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$		= 0.246		AISC 14th Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below		= **0.13**	[kips]	
Tensile strength per bolt after considering prying	ϕr_n = B x Q		= **7.06**	[kips]	AISC 14th Eq 9-31
	ratio = **0.02**		> T	OK	
Calculate Max Single Bolt Tensile Load					
Bolt group force	axial P = 0.51	[kips]			
Bolt number	Bolt Row n_h = 2		Bolt Col n_v = 2		
Bolt tensile force per bolt	$T = P / (n_v n_h)$		= **0.13**	[kips]	

Gusset Plate to End Plate Weld Strength ratio = 2.65 / 10.97 = **0.24** **PASS**

Weld Group Forces

shear V = 24.17 [kips] axial P = -0.51 [kips] in tension

Gusset-end plate fillet weld length	L = weld length tributary to bolt group	= **9.108**	[in]		
Combined Weld Stress					
Weld stress from axial force	$f_a = P / L$	= -0.056	[kip/in]	in tension	
Weld stress from shear force	$f_v = V / L$	= 2.654	[kip/in]		
Weld stress combined - max	$f_{max} = (f_a^2 + f_v^2)^{0.5}$	= **2.654**	[kip/in]	AISC 14th	Eq 8-11
Weld stress load angle	$\theta = \tan^{-1} (f_a / f_v)$	= 1.2	[°]		
Fillet Weld Strength Calc					
Fillet weld leg size	w = 5/16 [in]	load angle θ = 1.2	[°]		
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	= 18.587	[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 = **0.24**	> f_{max}	OK		

Brace Force Load Case 2 Gusset plate t=0.375 P =35.00 kips (C) ratio = **0.64** **PASS**

Gusset Plate - Shear Yielding ratio = 24.17 / 102.47 = **0.24** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 9.108 [in]	thickness t_p = 0.375	[in]		
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_{gv} = b_p t_p$	= 3.416	[in^2]		
Shear force required	V_u =	= **24.17**	[kips]		
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 102.47	[kips]	AISC 14th	Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th	Eq J4-3
	ϕ R_n =	= **102.47**	[kips]		
	ratio = **0.24**	> V_u	OK		

Gusset Plate - Shear Rupture			ratio = 24.17 / 99.90	= **0.24**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 9.108	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 3.416	[in^2]	
Shear force in demand	V_u =		= **24.17**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 133.20	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **99.90**	[kips]	
	ratio = **0.24**		> V_u	OK	

End Plate - Shear Yield			ratio = 12.09 / 64.69	= **0.19**	**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 =		= **12.09**	[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 = **0.19**		> V_u	OK	

End Plate - Shear Rupture			ratio = 12.09 / 43.88	= **0.28**	**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 =		= **12.09**	[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 = **0.28**		> V_u	OK	

End Plate - Block Shear - Center Strip ratio = 24.17 / 124.31 = **0.19** **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 =		= **24.17**	[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 = **0.19**		> V_u	OK		

End Plate - Block Shear - 2-Side Strip ratio = 24.17 / 101.46 = **0.24** **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 =		= **24.17**	[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 = **0.24**		> V_u	OK		

End Plate - Bolt Bearing on End Plate			ratio = 24.17 / 71.57	= **0.34**	**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 =		= **24.17**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.34**		> V_u	OK	

End Plate / Girder - Bolt Shear			ratio = 24.17 / 71.57	= **0.34**	**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 =		= **24.17**	[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 = **0.34**		> V_u	OK	

End Plate / Girder - Slip Critical			ratio = 24.17 / 37.97	= **0.64**	**PASS**
Bolt dia & bolt pretension	dia d_b = $^3/_4$	[in]	Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 2		n_c = 2		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **24.17**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 37.97	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **37.97**	[kips]	
	ratio = **0.64**		> V_u	OK	

End Plate / Girder - Bolt Bearing on Girder			ratio = 24.17 / 71.57	= **0.34**	**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 = 0.295	[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
	= 62.92 ≤ 43.14		= 43.14	[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 =		= **24.17**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.34**		> V_u	OK	

Gusset Plate to End Plate Weld Strength						ratio = 2.65 / 10.97	= **0.24**	**PASS**
Weld Group Forces								
	shear V = 24.17	[kips]		axial P = 0.51	[kips]	in compression		
Gusset-end plate fillet weld length	L = weld length tributary to bolt group				= **9.108**	[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				= 2.654	[kip/in]		
Weld stress combined - max	f_{max} = f_v				= **2.654**	[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 = **0.24**				> f_{max}	OK		

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

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.20**	**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 =	= **13.652**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1

Gusset plate t=0.375 | P =-35.00 kips (T) | ratio = **0.20** | **PASS**

Gusset Plate - Shear Yielding — ratio = 24.24 / 153.59 = **0.16** — PASS

Plate Shear Yielding Check

Plate size	width b_p = 13.652 [in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 5.120	[in^2]	
Shear force required	V_u =	= **24.24**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 153.59	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕR_n =	= **153.59**	[kips]	
	ratio = **0.16**	> V_u	OK	

Gusset Plate - Shear Rupture — ratio = 24.24 / 149.75 = **0.16** — PASS

Plate Shear Rupture Check

Plate size	width b_p = 13.652 [in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0 [ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$	= 5.120	[in^2]	
Shear force in demand	V_u =	= **24.24**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 199.66	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4
	ϕR_n =	= **149.75**	[kips]	
	ratio = **0.16**	> V_u	OK	

Gusset Plate - Axial Tensile Yield			ratio = 0.58 / 230.38	= **0.00**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 13.652	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 5.120	[in^2]	
Tensile force required	P_u =		= **0.58**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 255.98	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **230.38**	[kips]	
	ratio = **0.00**		> P_u	OK	

Gusset Plate - Axial Tensile Rupture			ratio = 0.58 / 249.58	= **0.00**	**PASS**
Plate Tensile Rupture Check					
Plate size	width b_p = 13.652	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	$A_{nt} = b_p t_p$		= 5.120	[in^2]	
Tensile force required	P_u =		= **0.58**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 332.77	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕR_n =		= **249.58**	[kips]	AISC 14th Eq J4-2
	ratio = **0.00**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.02**	**PASS**
Gusset plate	width b_p = 13.652	[in]	thick t_p = 0.375	[in]	
	yield F_y = 50.0	[ksi]			
Shear plate - gross area	$A_g = b_p \times t_p$		= 5.120	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 17.473	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 65.52	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 0.00	[kip-ft]	
Axial strength available	P_c = from axial tensile yield check		= 230.38	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 0.58	[kips]	
Shear strength available	V_c = from shear yielding check		= 153.59	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 24.24	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.02**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact		ratio =	= **0.03**	**PASS**
Gusset plate	width b_p = 13.652 [in]	thick t_p = 0.375	[in]	
	tensile F_u = 65.0 [ksi]			
Net area of plate	$A_n = b_p \times t_p$	= 5.120	[in^2]	
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$	= 17.473	[in^3]	
Flexural strength available	$M_c = \phi F_u Z_{net}$ ϕ=0.75	= 70.98	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc	= 0.00	[kip-ft]	
Axial strength available	P_c = from axial tensile rupture check	= 249.58	[kips]	
Axial strength required	P_r = from gusset interface forces calc	= 0.58	[kips]	
Shear strength available	V_c = from shear rupture check	= 149.75	[kips]	
Shear strength required	V_r = from gusset interface forces calc	= 24.24	[kips]	
Flexural rupture interaction	$\text{ratio} = (\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$	= **0.03**		AISC 14th Eq 10-5
		< 1.0	OK	

Gusset to Beam Weld Strength							ratio = 1.78 / 8.78	= **0.20**	**PASS**
Gusset to Beam Interface - Forces									
	shear H_b = 24.24	[kips]		axial V_b = -0.58	[kips]	in tension			
	moment M_b = 0.00	[kip-ft]							
Gusset-beam fillet weld length	L_w =				= 13.652	[in]			
Gusset to Beam Interface - Combined Weld Stress									
Weld stress from axial force	$f_a = V_b / L_{wb}$				= -0.042	[kip/in]	in tension		
Weld stress from shear force	$f_v = H_b / L_{wb}$				= 1.776	[kip/in]			
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$				= 0.000	[kip/in]			
Weld stress combined - max	$f_{max} = [(f_a - f_b)^2 + f_v^2]^{0.5}$				= **1.776**	[kip/in]	AISC 14th Eq 8-11		
Weld resultant load angle	$\theta = \tan^{-1} [(f_b - f_a) / f_v]$				= 1.4	[°]			
Fillet Weld Strength Calc									
Fillet weld leg size	w = 5/16	[in]		load angle θ = 1.4		[°]			
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				= 18.593	[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]			
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	ϕ R_n = ϕ R_n x (1/1.25)				= **8.775**	[kip/in]			
	ratio = **0.20**				> f_{max}	OK			

Brace Force Load Case 2 Gusset plate t=0.375 P =35.00 kips (C) ratio = **0.20** **PASS**

Gusset Plate - Shear Yielding							ratio = 24.24 / 153.59	= **0.16**	**PASS**
Plate Shear Yielding Check									
Plate size	width b_p = 13.652	[in]		thickness t_p = 0.375		[in]			
Plate yield strength	F_y = 50.0	[ksi]							
Plate gross area in shear	$A_{gv} = b_p t_p$				= 5.120	[in^2]			
Shear force required	V_u =				= **24.24**	[kips]			
Plate shear yielding strength	R_n = 0.6 $F_y A_{gv}$				= 153.59	[kips]	AISC 14th Eq J4-3		
Resistance factor-LRFD	ϕ = 1.00						AISC 14th Eq J4-3		
	ϕ R_n =				= **153.59**	[kips]			
	ratio = **0.16**				> V_u	OK			

Gusset Plate - Shear Rupture			ratio = 24.24 / 149.75	= **0.16**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 13.652 [in]		thickness t_p = 0.375 [in]		
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = b_p t_p$		= 5.120	[in^2]	
Shear force in demand	V_u =		= **24.24**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 199.66	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **149.75**	[kips]	
	ratio = **0.16**		> V_u	OK	

Gusset Plate - Axial Yield			ratio = 0.58 / 230.38	= **0.00**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 13.652 [in]		thickness t_p = 0.375 [in]		
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_g = b_p t_p$		= 5.120	[in^2]	
Tensile force required	P_u =		= **0.58**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 255.98	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **230.38**	[kips]	
	ratio = **0.00**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.02**	**PASS**
Gusset plate	width b_p = 13.652 [in]		thick t_p = 0.375 [in]		
	yield F_y = 50.0 [ksi]				
Shear plate - gross area	$A_g = b_p \times t_p$		= 5.120	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 17.473	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 65.52	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 0.00	[kip-ft]	
Axial strength available	P_c = from axial tensile yield check		= 230.38	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 0.58	[kips]	
Shear strength available	V_c = from shear yielding check		= 153.59	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 24.24	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.02**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact							ratio =	= **0.03**	**PASS**
Gusset plate	width b_p = 13.652	[in]		thick t_p = 0.375	[in]				
	tensile F_u = 65.0	[ksi]							
Net area of plate	$A_n = b_p \times t_p$						= 5.120	[in^2]	
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$						= 17.473	[in^3]	
Flexural strength available	$M_c = \phi F_u Z_{net}$	ϕ=0.75					= 70.98	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc						= 0.00	[kip-ft]	
Shear strength available	V_c = from shear rupture check						= 149.75	[kips]	
Shear strength required	V_r = from gusset interface forces calc						= 24.24	[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 = 1.78 / 8.78	= **0.20**	**PASS**
Gusset to Beam Interface - Forces									
	shear H_b = 24.24	[kips]		axial V_b = 0.58	[kips]	in compression			
	moment M_b = 0.00	[kip-ft]							
Gusset-beam fillet weld length	L_w =						= 13.652	[in]	
Gusset to Beam Interface - Combined Weld Stress									
Weld stress from axial force	$f_a = V_b / L_{wb}$						= 0.000	[kip/in]	in compression
Weld stress from shear force	$f_v = H_b / L_{wb}$						= 1.776	[kip/in]	
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$						= 0.000	[kip/in]	
Weld stress combined - max	$f_{max} = f_v$						= **1.776**	[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 = **0.20**						> f_{max}	OK	

Beam Web Local Yielding				ratio = 0.58 / 273.90	= **0.00**	**PASS**
Concentrated force from gusset	P_u =			= **0.58**	[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			= 13.652	[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			= 7.576	[in]	
	when $l_N \le d$, use AISC 14th Eq J10-3					AISC 14th Eq J10-3
Beam web local yielding strength	$R_n = F_y t_w (2.5\, k + l_b)$			= 273.90	[kips]	AISC 14th Eq J10-3
Resistance factor-LRFD	ϕ = 1.00					
	ϕR_n =			= **273.90**	[kips]	
	ratio = **0.00**			> P_u	OK	

Beam Web Local Crippling				ratio = 0.58 / 266.12	= **0.00**	**PASS**
Concentrated force from gusset	P_u =			= **0.58**	[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			= 13.652	[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			= 7.576	[in]	
	when $l_N \ge d/2$, use Eq J10-4					AISC 14th Eq J10-4
Beam web local crippling strength	$R_n = 0.8\, t_w^2 \left[1+3\frac{l_b}{d}\left(\frac{t_w}{t_f}\right)^{1.5}\right] \times \left(\frac{E F_y t_f}{t_w}\right)^{0.5}$			= 354.83	[kips]	AISC 14th Eq J10-4
Resistance factor-LRFD	ϕ = 0.75					AISC 14th J10.3
	ϕR_n =			= **266.12**	[kips]	
	ratio = **0.00**			> P_u	OK	

Left Brace - Brace to Gusset Sect=WT4X12 P_{LC1} =35.00 kips (C) P_{LC2} =-35.00 kips (T) Code=AISC 360-10 LRFD

Result Summary geometries & weld limitations = **PASS** limit states max ratio = **0.92** **PASS**

Geometry Restriction Checks - WT Flange to Gusset — PASS

Min Bolt Edge Distance - WT Flange 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 WT Flange to Gusset	L_e =	= **1.250**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - WT Flange 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 WT Flange to Gusset	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Brace Force Load Case 1 Sect=WT4X12 P =35.00 kips (C) ratio = **0.92** **PASS**

WT Brace - Bolt Shear — ratio = 35.00 / 71.57 = **0.49** 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 =	= **35.00**	[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 = **0.49**	> V_u	OK	

WT Brace - Slip Critical - WT Flange / Gusset Plate — ratio = 35.00 / 37.97 = **0.92** PASS

Bolt dia & bolt pretension	dia d_b = $^3/_4$ [in]	Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A	Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13	Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 2	n_c = 2		
No of slip plane	n_s = 1			
Bolt group eccentricity coefficient	C_{ec} =	= 1.000		
Required shear strength	V_u =	= **35.00**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$	= 37.97	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00 for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =	= **37.97**	[kips]	
	ratio = **0.92**	> V_u	OK	

WT Brace - Bolt Bearing on WT Flange					ratio = 35.00 / 71.57	= **0.49**	**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 =				= **35.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕR_n =				= **71.57**	[kips]	
	ratio = **0.49**				> V_u	OK	

WT Brace - Bolt Bearing on Gusset Plate					ratio = 35.00 / 71.57	= **0.49**	**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 =				= **35.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕ R_n =				= **71.57**	[kips]	
	ratio = **0.49**				> V_u	OK	

Gusset Plate - Compression (Whitmore)			ratio = 35.00 / 104.32	= **0.34**	**PASS**
Plate Compression Check					
Plate size	width b_p = 7.464	[in]	thickness t_p = 0.375	[in]	
	F_y = 50.0	[ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$		= 2.799	[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 =		= 10.992	[in]	
Plate slenderness	$KL/r = 0.50 \times L_u / r$		= 50.77		
	when $\frac{KL}{r} > 25$, use Chapter E				AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$		= 111.04	[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	$F_{cr} = 0.658^{(F_y/F_e)} F_y$		= 41.41	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =		= **35.00**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$		= 115.91	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90				AISC 14th E1
	ϕR_n =		= **104.32**	[kips]	
	ratio = **0.34**		> P_u	OK	

Brace Force Load Case 2 Sect=WT4X12 P =-35.00 kips (T) ratio = **0.92** **PASS**

WT Shape Brace - Tensile Yield			ratio = 35.00 / 159.30	= **0.22**	**PASS**
Gross area subject to tension	A_g =		= 3.540	[in^2]	
Steel yield strength	F_y =		= 50.0	[ksi]	
Tensile force required	P_u =		= **35.00**	[kips]	
Tensile yielding strength	$R_n = F_y A_g$		= 177.00	[kips]	AISC 14th Eq D2-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th D2 (a)
	ϕR_n =		= **159.30**	[kips]	AISC 14th Eq D2-1
	ratio = **0.22**		> P_u	OK	

WT Shape Brace - Tensile Rupture			ratio = 35.00 / 106.38	= **0.33**	**PASS**
Section gross area	A_g = WT4X12		= 3.540	[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 = 2		flange t_f = 0.400	[in]	
Tensile net area	$A_n = A_g - n_v d_h t_f$		= 2.840	[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 WT4X12		= 0.695	[in]	
Shear lag factor	$U = 1 - \bar{x} / L$		= 0.768		AISC 14th Table D3.1
Tensile force required	P_u =		= **35.00**	[kips]	
Tensile effective net area	$A_e = A_n U$		= 2.182	[in^2]	
Plate tensile strength	F_u =		= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$		= 141.83	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th D2 (b)
	ϕR_n =		= **106.38**	[kips]	AISC 14th Eq D2-2
	ratio = **0.33**		> P_u	OK	

WT Brace - Bolt Shear			ratio = 35.00 / 71.57	= **0.49**	**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 =		= **35.00**	[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 = **0.49**		> V_u	OK	

WT Brace - Slip Critical - WT Flange / Gusset Plate			ratio = 35.00 / 37.97	= **0.92**	**PASS**
Bolt dia & bolt pretension	dia d_b = $^3/_4$ [in]		Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 2		n_c = 2		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **35.00**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 37.97	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **37.97**	[kips]	
	ratio = **0.92**		> V_u	OK	

WT Brace - Bolt Bearing on WT Flange			ratio = 35.00 / 71.57	= **0.49**	**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 = 0.400	[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	$L_c = L_e - d_h / 2$		= 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
	= 37.78 ≤ 58.50		= 37.78	[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 =		= **35.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.49**		> V_u	OK	

WT Brace - Bolt Bearing on Gusset Plate			ratio = 35.00 / 71.57	= **0.49**	**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 = 0.375	[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	$L_c = L_e - d_h / 2$		= 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	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 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 =		= **35.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.49**		> V_u	OK	

WT Brace Flange - Block Shear - 1-Side Strip					ratio = 17.50 / 51.68	= **0.34**	**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 = 1.250	[in]	e_h = 1.375	[in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 1.750	[in^2]			
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 1.225	[in^2]			
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$		= 0.325	[in^2]			
Block shear strength required	V_u =		= **17.50**	[kips]			
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th Fig C-J4.2		
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 68.90	[kips]	AISC 14th Eq J4-5		
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5		
	ϕR_n =		= **51.68**	[kips]			
	ratio = **0.34**		> V_u	OK			

Gusset Plate - Tensile Yield (Whitmore)					ratio = 35.00 / 125.96	= **0.28**	**PASS**
Plate Tensile Yielding Check							
Plate size	width b_p = 7.464	[in]	thickness t_p = 0.375	[in]			
Plate yield strength	F_y = 50.0	[ksi]					
Plate gross area in shear	$A_g = b_p t_p$		= 2.799	[in^2]			
Tensile force required	P_u =		= **35.00**	[kips]			
Plate tensile yielding strength	$R_n = F_y A_g$		= 139.95	[kips]	AISC 14th Eq J4-1		
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1		
	ϕR_n =		= **125.96**	[kips]			
	ratio = **0.28**		> P_u	OK			

Gusset Plate - Tensile Rupture (Whitmore)					ratio = 35.00 / 104.46	= **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 = 7.464	[in]	thickness t_p = 0.375	[in]			
Plate tensile strength	F_u = 65.0	[ksi]					
Plate net area in tension	$A_{nt} = (b_p - n d_h) t_p$		= 2.143	[in^2]			
Tensile force required	P_u =		= **35.00**	[kips]			
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 139.28	[kips]	AISC 14th Eq J4-2		
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2		
	ϕR_n =		= **104.46**	[kips]	AISC 14th Eq J4-2		
	ratio = **0.34**		> P_u	OK			

Gusset Plate - Block Shear - Center Strip ratio = 35.00 / 129.80 = **0.27** **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 = 2.0	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} = 4.000 [in]				
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2	= 3.469	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2	= 2.484	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = [W_{bs} - (n_v - 1) d_h] t_p$	= 1.172	[in^2]		
Block shear strength required	V_u =	= **35.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 173.06	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **129.80**	[kips]		
	ratio = **0.27**	> V_u	OK		

Left Brace - Gusset to Girder | End Plate Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.64**	**PASS**

Geometry Restriction Checks - End Plate to Column Web — PASS

Min Bolt Edge Distance - End Plate to Column 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 End Plate to Column Web	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - End Plate to Column 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 End Plate to Column Web	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

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 =	= **9.108**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1 | Gusset plate t=0.375 | P =35.00 kips (C) | ratio = **0.64** | **PASS**

Gusset Plate - Shear Yielding — ratio = 24.17 / 102.47 = **0.24** — PASS

Plate Shear Yielding Check

Plate size	width b_p = 9.108 [in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	A_{gv} = $b_p t_p$	= 3.416	[in^2]	
Shear force required	V_u =	= **24.17**	[kips]	
Plate shear yielding strength	R_n = 0.6 $F_y A_{gv}$	= 102.47	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕR_n =	= **102.47**	[kips]	
	ratio = **0.24**	> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 24.17 / 99.90	= **0.24**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 9.108	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 3.416	[in^2]	
Shear force in demand	V_u =		= **24.17**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 133.20	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **99.90**	[kips]	
	ratio = **0.24**		> V_u	OK	

End Plate - Shear Yield			ratio = 12.09 / 64.69	= **0.19**	**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 =		= **12.09**	[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 = **0.19**		> V_u	OK	

End Plate - Shear Rupture			ratio = 12.09 / 43.88	= **0.28**	**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 =		= **12.09**	[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 = **0.28**		> V_u	OK	

End Plate - Block Shear - Center Strip ratio = 24.17 / 115.17 = **0.21** **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 = 3.500	[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	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 0.984	[in^2]		
Block shear strength required	V_u =		= **24.17**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 153.56	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **115.17**	[kips]		
	ratio = **0.21**		> V_u	OK		

End Plate - Block Shear - 2-Side Strip ratio = 24.17 / 101.46 = **0.24** **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 = 3.500	[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 =		= **24.17**	[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 = **0.24**		> V_u	OK		

End Plate - Bolt Bearing on End Plate			ratio = 24.17 / 71.57	= **0.34**	**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 =		= **24.17**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.34**		> V_u	OK	

End Plate / Girder - Bolt Shear			ratio = 24.17 / 71.57	= **0.34**	**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 =		= **24.17**	[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 = **0.34**		> V_u	OK	

End Plate / Girder - Slip Critical			ratio = 24.17 / 37.97	= **0.64**	**PASS**
Bolt dia & bolt pretension	dia d_b = $^3/_4$	[in]	Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 2		n_c = 2		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **24.17**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 37.97	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **37.97**	[kips]	
	ratio = **0.64**		> V_u	OK	

End Plate / Girder - Bolt Bearing on Girder			ratio = 24.17 / 71.57	= **0.34**	**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 = 0.295	[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
	= 62.92 ≤ 43.14		= 43.14	[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 =		= **24.17**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.34**		> V_u	OK	

Gusset Plate to End Plate Weld Strength ratio = 2.65 / 10.97 = **0.24** **PASS**

Weld Group Forces

shear V = 24.17 [kips] axial P = 0.51 [kips] in compression

Gusset-end plate fillet weld length L = weld length tributary to bolt group = **9.108** [in]

Combined Weld Stress

Weld stress from axial force	$f_a = P / L$	= 0.000	[kip/in]	in compression
Weld stress from shear force	$f_v = V / L$	= 2.654	[kip/in]	
Weld stress combined - max	$f_{max} = f_v$	= **2.654**	[kip/in]	AISC 14th Eq 8-11
Weld stress load angle	$\theta =$	= 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	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$	= 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	$\phi = 0.75$			AISC 14th Eq 8-1
	$\phi R_n =$	= **10.969**	[kip/in]	
	ratio = **0.24**	> f_{max}	OK	

Brace Force Load Case 2 Gusset plate t=0.375 P =-35.00 kips (T) ratio = **0.64** **PASS**

Gusset Plate - Shear Yielding ratio = 24.17 / 102.47 = **0.24** **PASS**

Plate Shear Yielding Check

Plate size width b_p = 9.108 [in] thickness t_p = 0.375 [in]

Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 3.416	[in^2]	
Shear force required	$V_u =$	= **24.17**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 102.47	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	$\phi = 1.00$			AISC 14th Eq J4-3
	$\phi R_n =$	= **102.47**	[kips]	
	ratio = **0.24**	> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 24.17 / 99.90	= **0.24**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 9.108	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 3.416	[in^2]	
Shear force in demand	V_u =		= **24.17**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 133.20	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **99.90**	[kips]	
	ratio = **0.24**		> V_u	OK	

End Plate - Shear Yield			ratio = 12.09 / 64.69	= **0.19**	**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 =		= **12.09**	[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 = **0.19**		> V_u	OK	

End Plate - Shear Rupture			ratio = 12.09 / 43.88	= **0.28**	**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 =		= **12.09**	[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 = **0.28**		> V_u	OK	

End Plate - Block Shear - Center Strip ratio = 24.17 / 115.17 = **0.21** **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 = 3.500	[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	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 0.984	[in^2]		
Block shear strength required	V_u =		= **24.17**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 153.56	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **115.17**	[kips]		
	ratio = **0.21**		> V_u	OK		

End Plate - Block Shear - 2-Side Strip ratio = 24.17 / 101.46 = **0.24** **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 = 3.500	[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 =		= **24.17**	[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 = **0.24**		> V_u	OK		

End Plate - Bolt Bearing on End Plate			ratio = 24.17 / 71.57	= **0.34**	**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 =		= **24.17**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.34**		> V_u	OK	

End Plate / Girder - Bolt Shear			ratio = 24.17 / 71.57	= **0.34**	**PASS**
Bolt group forces	shear V = 24.17	[kips]	axial P = 0.51	[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 =		= **24.17**	[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 = **0.34**		> V_u	OK	

End Plate / Girder - Slip Critical			ratio = 24.17 / 37.82	= **0.64**	**PASS**
Bolt dia & bolt pretension	dia d_b = $^3/_4$	[in]	Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 2		n_c = 2		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **24.17**	[kips]	
Tension Reduction Factor					
Bolt group tensile load	T_u =		= 0.51	[kips]	
Number of bolt	$n_b = n_r \times n_c$		= 4		
Tension reduction factor	$k_{sc} = 1 - \frac{T_u}{D_u T_b n_b}$		= 1.00		AISC 14th Eq J3-5a
Slip resistance	$R_n = k_{sc} \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 37.82	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **37.82**	[kips]	
	ratio = **0.64**		> V_u	OK	

End Plate / Girder - Bolt Bearing on Girder			ratio = 24.17 / 71.57	= **0.34**	**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 = 0.295	[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
	= 62.92 ≤ 43.14		= 43.14	[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 =		= **24.17**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.34**		> V_u	OK	

Bolt Tensile Prying Action on End Plate					ratio = 0.13 / 8.55	= **0.01**	**PASS**
Bolt group forces	shear V = 24.17	[kips]		axial P = -0.51	[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 = 24.17	[kips]		no of bolt n = 4			
Shear stress required	$f_{rv} = V / (n A_b)$			= 13.68	[ksi]		
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$			= **86.61**	[ksi]	AISC 14th	Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$			= 38.26	[kips]	AISC 14th	Eq J3-1
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.6
Single bolt tensile capacity	ϕr_n =			= **28.70**	[kips]		
Single Bolt Tensile Capacity After Considering Prying							
End plate	width w = 6.250	[in]		bolt gage g = 3.500	[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	$b = 0.5(g - t_w)$			= 1.563	[in]		
	$b' = b - 0.5 d_b$			= 1.188	[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
	$\rho = b' / a'$			= 0.679		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			= 28.70	[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	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$			= 0.900	[in]	AISC 14th	Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$			= 3.955		AISC 14th	Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$			= 0.298		AISC 14th	Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below			= **0.13**	[kips]		
Tensile strength per bolt after considering prying	$\phi r_n = B \times Q$			= **8.55**	[kips]	AISC 14th	Eq 9-31
	ratio = **0.01**			> T	OK		
Calculate Max Single Bolt Tensile Load							
Bolt group force	axial P = 0.51	[kips]					
Bolt number	Bolt Row n_h = 2			Bolt Col n_v = 2			
Bolt tensile force per bolt	$T = P / (n_v n_h)$			= **0.13**	[kips]		

Gusset Plate to End Plate Weld Strength ratio = 2.65 / 10.97 = **0.24** **PASS**

Weld Group Forces

shear V = 24.17 [kips] axial P = -0.51 [kips] in tension

Gusset-end plate fillet weld length	L = weld length tributary to bolt group	= **9.108**	[in]		
Combined Weld Stress					
Weld stress from axial force	$f_a = P / L$	= -0.056	[kip/in]	in tension	
Weld stress from shear force	$f_v = V / L$	= 2.654	[kip/in]		
Weld stress combined - max	$f_{max} = (f_a^2 + f_v^2)^{0.5}$	= **2.654**	[kip/in]	AISC 14th	Eq 8-11
Weld stress load angle	$\theta = \tan^{-1} (\frac{f_a}{f_v})$	= 1.2	[°]		
Fillet Weld Strength Calc					
Fillet weld leg size	$w = 5/16$ [in]	load angle θ = 1.2	[°]		
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	= 18.587	[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 = **0.24**	> f_{max}	OK		

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

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.21**	**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 =	= **13.298**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1

Gusset plate t=0.375 | P =35.00 kips (C) | ratio = **0.21** | **PASS**

Gusset Plate - Shear Yielding — ratio = 24.24 / 149.60 = **0.16** — PASS

Plate Shear Yielding Check

Plate size	width b_p = 13.298	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.987	[in^2]	
Shear force required	V_u =		= **24.24**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 149.60	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **149.60**	[kips]	
	ratio = **0.16**		> V_u	OK	

Gusset Plate - Shear Rupture — ratio = 24.24 / 145.86 = **0.17** — PASS

Plate Shear Rupture Check

Plate size	width b_p = 13.298	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 4.987	[in^2]	
Shear force in demand	V_u =		= **24.24**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 194.48	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **145.86**	[kips]	
	ratio = **0.17**		> V_u	OK	

Gusset Plate - Axial Tensile Yield			ratio = 0.58 / 224.40	= **0.00**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 13.298	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 4.987	[in^2]	
Tensile force required	P_u =		= **0.58**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 249.34	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **224.40**	[kips]	
	ratio = **0.00**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.03**	**PASS**
Gusset plate	width b_p = 13.298	[in]	thick t_p = 0.375	[in]	
	yield F_y = 50.0	[ksi]			
Shear plate - gross area	$A_g = b_p \times t_p$		= 4.987	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 16.578	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 62.17	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 0.00	[kip-ft]	
Axial strength available	P_c = from axial tensile yield check		= 224.40	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 0.58	[kips]	
Shear strength available	V_c = from shear yielding check		= 149.60	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 24.24	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.03**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact			ratio =	= **0.03**	**PASS**
Gusset plate	width b_p = 13.298	[in]	thick t_p = 0.375	[in]	
	tensile F_u = 65.0	[ksi]			
Net area of plate	$A_n = b_p \times t_p$		= 4.987	[in^2]	
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$		= 16.578	[in^3]	
Flexural strength available	$M_c = \phi F_u Z_{net}$ ϕ=0.75		= 67.35	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 0.00	[kip-ft]	
Shear strength available	V_c = from shear rupture check		= 145.86	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 24.24	[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 = 1.82 / 8.78 = **0.21** **PASS**

Gusset to Beam Interface - Forces

shear H_b = 24.24 [kips] axial V_b = 0.58 [kips] in compression

moment M_b = 0.00 [kip-ft]

Gusset-beam fillet weld length	L_w =	= 13.298	[in]	

Gusset to Beam Interface - Combined Weld Stress

Weld stress from axial force	$f_a = V_b / L_{wb}$	= 0.000	[kip/in]	in compression
Weld stress from shear force	$f_v = H_b / L_{wb}$	= 1.823	[kip/in]	
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$	= 0.000	[kip/in]	
Weld stress combined - max	$f_{max} = f_v$	= **1.823**	[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
	ϕ R_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	ϕ R_n = ϕ R_n x (1/1.25)	= **8.775**	[kip/in]	
	ratio = **0.21**	> f_{max}	OK	

Brace Force Load Case 2 Gusset plate t=0.375 P =-35.00 kips (T) ratio = **0.21** **PASS**

Gusset Plate - Shear Yielding ratio = 24.24 / 149.60 = **0.16** **PASS**

Plate Shear Yielding Check

Plate size width b_p = 13.298 [in] thickness t_p = 0.375 [in]

Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 4.987	[in^2]	
Shear force required	V_u =	= **24.24**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 149.60	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕ R_n =	= **149.60**	[kips]	
	ratio = **0.16**	> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 24.24 / 145.86	= **0.17**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 13.298	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 4.987	[in^2]	
Shear force in demand	V_u =		= **24.24**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 194.48	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **145.86**	[kips]	
	ratio = **0.17**		> V_u	OK	

Gusset Plate - Axial Yield			ratio = 0.58 / 224.40	= **0.00**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 13.298	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 4.987	[in^2]	
Tensile force required	P_u =		= **0.58**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 249.34	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **224.40**	[kips]	
	ratio = **0.00**		> P_u	OK	

Gusset Plate - Axial Tensile Rupture			ratio = 0.58 / 243.10	= **0.00**	**PASS**
Plate Tensile Rupture Check					
Plate size	width b_p = 13.298	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	$A_{nt} = b_p t_p$		= 4.987	[in^2]	
Tensile force required	P_u =		= **0.58**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 324.14	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕR_n =		= **243.10**	[kips]	AISC 14th Eq J4-2
	ratio = **0.00**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.03**	**PASS**
Gusset plate	width b_p = 13.298 [in]		thick t_p = 0.375	[in]	
	yield F_y = 50.0 [ksi]				
Shear plate - gross area	$A_g = b_p \times t_p$		= 4.987	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 16.578	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 62.17	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 0.00	[kip-ft]	
Axial strength available	P_c = from axial tensile yield check		= 224.40	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 0.58	[kips]	
Shear strength available	V_c = from shear yielding check		= 149.60	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 24.24	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.03**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact			ratio =	= **0.03**	**PASS**
Gusset plate	width b_p = 13.298 [in]		thick t_p = 0.375	[in]	
	tensile F_u = 65.0 [ksi]				
Net area of plate	$A_n = b_p \times t_p$		= 4.987	[in^2]	
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$		= 16.578	[in^3]	
Flexural strength available	$M_c = \phi F_u Z_{net}$ ϕ=0.75		= 67.35	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 0.00	[kip-ft]	
Axial strength available	P_c = from axial tensile rupture check		= 243.10	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 0.58	[kips]	
Shear strength available	V_c = from shear rupture check		= 145.86	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 24.24	[kips]	
Flexural rupture interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.03**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset to Beam Weld Strength ratio = 1.82 / 8.78 = **0.21** **PASS**

Gusset to Beam Interface - Forces

shear H_b = 24.24 [kips] axial V_b = -0.58 [kips] in tension

moment M_b = 0.00 [kip-ft]

Gusset-beam fillet weld length	L_w =	= 13.298	[in]	

Gusset to Beam Interface - Combined Weld Stress

Weld stress from axial force	$f_a = V_b / L_{wb}$	= -0.044	[kip/in]	in tension
Weld stress from shear force	$f_v = H_b / L_{wb}$	= 1.823	[kip/in]	
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$	= 0.000	[kip/in]	
Weld stress combined - max	$f_{max} = [(f_a - f_b)^2 + f_v^2]^{0.5}$	= **1.823**	[kip/in]	AISC 14th Eq 8-11
Weld resultant load angle	$\theta = \tan^{-1} [(f_b - f_a) / f_v]$	= 1.4	[°]	

Fillet Weld Strength Calc

Fillet weld leg size $w = {}^{5}/_{16}$ [in] load angle θ = 1.4 [°]

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	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$	= 18.593	[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 = **0.21**	> f_{max}	OK	

Beam Web Local Yielding					ratio = 0.58 / 267.97	= **0.00**	**PASS**
Concentrated force from gusset	P_u =				= **0.58**	[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				= 13.298	[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				= 7.399	[in]	
	when $l_N \leq d$, use AISC 14th Eq J10-3						AISC 14th Eq J10-3
Beam web local yielding strength	$R_n = F_y t_w (2.5 k + l_b)$				= 267.97	[kips]	AISC 14th Eq J10-3
Resistance factor-LRFD	ϕ = 1.00						
	ϕR_n =				= **267.97**	[kips]	
	ratio = **0.00**				> P_u	OK	

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

Result Summary geometries & weld limitations = **PASS** limit states max ratio = **0.47** **PASS**

Geometry Restriction Check - End Plate to Column Web — PASS

Min Bolt Edge Distance - End Plate to Column 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 End Plate to Column Web	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - End Plate to Column 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 End Plate to Column Web	L_s =	= **3.500**	[in]	
		> $L_{s\text{-}min}$	OK	

Weld Limitation Check - Beam Web to End Plate — 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 x w	= **1.500**	[in]	AISC 14th J2.2b
Min fillet weld length	L =	= **9.350**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1 shear V = 23.84 kips axial P = -15.00 kips (T) ratio = **0.47** **PASS**

Beam - Shear Yielding - Vy — ratio = 25.00 / 121.61 = **0.21** 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 =	= **25.00**	[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 = **0.21**	> V_u	OK	

Beam - Shear Rupture - Vy			ratio = 25.00 / 118.56	= **0.21**	**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 =		= **25.00**	[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 = **0.21**		> V_u	OK	

Beam - Shear Yielding - Vz			ratio = 23.84 / 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 =		= **23.84**	[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 = 23.84 / 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 =		= **23.84**	[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 = 15.00 / 589.50	= **0.03**	**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 =		= **15.00**	[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 = **0.03**		> P_u	OK	

Beam Web - Axial Tensile Rupture - Px				ratio = 15.00 / 140.45	= **0.11**	**PASS**
End Plate Direct Connect Length Calc						
Beam web-end plate weld length	L =			= 9.350	[in]	
Beam web-end plate fillet weld size	w =			= 0.375	[in]	
Beam web-end plate connect length	$L_w = L - 2w$			= 8.600	[in]	
Plate Tensile Rupture Check						
Plate size	width b_p = 8.600	[in]	thickness t_p = 0.335		[in]	
Plate tensile strength	F_u = 65.0	[ksi]				
Plate net area in tension	$A_{nt} = b_p t_p$			= 2.881	[in^2]	
Tensile force in demand	P_u =			= **15.00**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$			= 187.27	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq J4-2
	ϕR_n =			= **140.45**	[kips]	AISC 14th Eq J4-2
	ratio = **0.11**			> P_u	OK	

End Plate - Shear Yielding - Vy				ratio = 12.50 / 109.69	= **0.11**	**PASS**
Plate Shear Yielding Check						
Plate size	width b_p = 9.750	[in]	thickness t_p = 0.375		[in]	
Plate yield strength	F_y = 50.0	[ksi]				
Plate gross area in shear	$A_{gv} = b_p t_p$			= 3.656	[in^2]	
Shear force required	V_u =			= **12.50**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$			= 109.69	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00					AISC 14th Eq J4-3
	ϕR_n =			= **109.69**	[kips]	
	ratio = **0.11**			> V_u	OK	

End Plate - Shear Rupture - Vy				ratio = 12.50 / 78.15	= **0.16**	**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 = 9.750	[in]	thickness t_p = 0.375		[in]	
Plate tensile strength	F_u = 65.0	[ksi]				
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$			= 2.672	[in^2]	
Shear force required	V_u =			= **12.50**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$			= 104.20	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq J4-4
	ϕR_n =			= **78.15**	[kips]	
	ratio = **0.16**			> V_u	OK	

End Plate - Shear Yielding - Vz			ratio = 11.92 / 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 =		= **11.92**	[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
	ϕ R_n =		= **75.94**	[kips]	
	ratio = **0.16**		> V_u	OK	

End Plate - Shear Rupture - Vz			ratio = 11.92 / 54.84	= **0.22**	**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 =		= **11.92**	[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 = **0.22**		> V_u	OK	

Coped Beam - Flexural Rupture			ratio = 25.00 / 57.56	= **0.43**	**PASS**
Beam section & cope side	sect = W12X45		cope side = double cope		
Beam top flange cope	depth d_c = 1.250	[in]	length L_c = 3.983	[in]	
Beam bottom flange cope	depth d_c = 1.250	[in]	length L_c = 3.983	[in]	
Beam section elastic modulus	S_{net} =		= 5.146	[in^3]	
Beam section tensile strength	F_u =		= 65.0	[ksi]	
Distance from face of cope to the point of inflection of beam	e =		= 4.358	[in]	AISC 14th Page 9-6
Beam end shear force	V_u =		= **25.00**	[kips]	
Beam end shear resistance	$R_n = F_u S_{net} / e$		= 76.75	[kips]	AISC 14th Eq 9-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq 9-4
	ϕ R_n =		= **57.56**	[kips]	
	ratio = **0.43**		> V_u	OK	

Coped Beam - Local Web Buckling					ratio = 25.00 / 53.13	= **0.47**	**PASS**
Beam section & cope side	sect = W12X45				cope side = double cope		
Beam top flange cope	depth d_{ct} = 1.250	[in]			length L_{ct} = 3.983	[in]	
Beam bottom flange cope	depth d_{cb} = 1.250	[in]			length L_{cb} = 3.983	[in]	
Beam section elastic modulus	S_{net} =				= 5.146	[in^3]	
Distance from face of cope to the point of inflection of beam	e =				= 4.358	[in]	AISC 14th Page 9-6
Beam section	depth d = 12.100	[in]			web t_w = 0.335	[in]	
	F_y = 50.0	[ksi]			E = 29000	[ksi]	
	f_d = 3.5 - 7.5 (d_{ct} / d)				= 2.725		AISC 14th Eq 9-13
Reduced beam depth	h_0 = d - d_{ct} - d_{cb}				= 9.600	[in]	
Plate local buckling stress	$F_{cr} = 0.62 \pi E \frac{t_w^2}{L_{ct} h_0} f_d$				= 451.8	[ksi]	AISC 14th Eq 9-12
	$F_{cr} = F_{cr} \leq F_y$				= 50.0	[ksi]	AISC 14th Eq 9-12
Beam end shear force	V_u =				= **25.00**	[kips]	
Beam end shear resistance	$R_n = F_{cr} S_{net} / e$				= 59.04	[kips]	AISC 14th Eq 9-6
Resistance factor-LRFD	ϕ = 0.90						AISC 14th Eq 9-6
	ϕR_n =				= **53.13**	[kips]	
	ratio = **0.47**				> V_u	OK	

End Plate - Bolt Bearing on End Plate - Vy Vz Combined ratio = 34.54 / 107.35 = **0.32** **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 = 25.00 [kips]	shear V_z = 23.84	[kips]		
Bolt group resultant force	$R = (V_y^2 + V_z^2)^{0.5}$	= **34.54**	[kips]		
Resultant force/hor line load angle	$\theta = \tan^{-1} (V_y / V_z)$	= 46.36	[°]		
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 = 3.500 [in]	hor s_h = 4.000	[in]		
Bolt edge distance	ver e_v = 1.375 [in]	hor e_h = 1.375	[in]		
Bolt clear dist - bot right corner bolt	$L_{cA} = \min (\frac{e_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.494	[in]		
Bolt clear dist - right side edge bolt	$L_{cB} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.586	[in]		
Bolt clear dist - bot side edge bolt	$L_{cC} = \min (\frac{e_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 1.494	[in]		
Bolt clear dist - inner edge bolt	$L_{cD} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 3.869	[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	$R_{n\text{-}tA} = 1.5\, L_{cA}\, t\, F_u$	= 54.61	[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	$R_{n\text{-}tB} = 1.5\, L_{cB}\, t\, F_u$	= 57.99	[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	$R_{n\text{-}tC} = 1.5\, L_{cC}\, t\, F_u$	= 54.61	[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	$R_{n\text{-}tD} = 1.5\, L_{cD}\, t\, F_u$	= 141.45	[kips]	AISC 14th	Eq J3-6b

End Plate - Bolt Bearing on Column Web - Vy Vz Combined ratio = 34.54 / 107.35 = **0.32** **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 = 25.00 [kips]	shear V_z = 23.84	[kips]		
Bolt group resultant force	$R = (V_y^2 + V_z^2)^{0.5}$	= **34.54**	[kips]		
Resultant force/hor line load angle	$\theta = \tan^{-1} (V_y / V_z)$	= 46.36	[°]		
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 = 3.500 [in]	hor s_h = 4.000	[in]		
Bolt edge distance	ver e_v = 1.375 [in]	hor e_h = 1.375	[in]		
Bolt clear dist - bot right corner bolt	$L_{cA} = \min (\frac{e_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.494	[in]		
Bolt clear dist - right side edge bolt	$L_{cB} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.586	[in]		
Bolt clear dist - bot side edge bolt	$L_{cC} = \min (\frac{e_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 1.494	[in]		
Bolt clear dist - inner edge bolt	$L_{cD} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 3.869	[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 = 0.295 [in]	tensile F_u = 65.0	[ksi]		
Bolt bearing strength	$R_{n\text{-}br} = 3.0\, d_b\, t\, F_u$	= 43.14	[kips]	AISC 14th	Eq J3-6b

Type A - Bolt Group Bottom Right Corner Bolt

Number of bolt	n_A = 1				
Bolt tear out strength	$R_{n\text{-}tA} = 1.5\, L_{cA}\, t\, F_u$	= 42.96	[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	$R_{n\text{-}tB} = 1.5\, L_{cB}\, t\, F_u$	= 45.62	[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	$R_{n\text{-}tC} = 1.5\, L_{cC}\, t\, F_u$	= 42.96	[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	$R_{n\text{-}tD} = 1.5\, L_{cD}\, t\, F_u$	= 111.27	[kips]	AISC 14th	Eq J3-6b

End Plate - Shear in Vy - Block Shear - Center Strip ratio = 25.00 / 192.87 = **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 = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.500 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 6.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 4.641	[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 =	= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 257.16	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **192.87**	[kips]		
	ratio = **0.13**	> V_u	OK		

End Plate - Shear in Vy - Block Shear - 2-Side Strip ratio = 25.00 / 170.02 = **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 = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.500 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 6.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 4.641	[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 ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 226.69	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **170.02**	[kips]		
	ratio = **0.15**	> V_u	OK		

End Plate - Shear in Vz - Block Shear - Center Strip ratio = 23.84 / 185.10 = **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 = 3		n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.500	[in]	s_h = 4.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$		= 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	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 1.969	[in^2]		
Block shear strength required	V_u =		= **23.84**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$		= 246.80	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **185.10**	[kips]		
	ratio = **0.13**		> V_u	OK		

End Plate - Shear in Vz - Block Shear - 2-Side Strip ratio = 23.84 / 123.40 = **0.19** **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 = 3.500	[in]	s_h = 4.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$		= 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	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$		= 0.703	[in^2]		
Block shear strength required	V_u =		= **23.84**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$		= 164.53	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **123.40**	[kips]		
	ratio = **0.19**		> V_u	OK		

End Plate / Column Web - Bolt Shear					ratio = 34.54 / 107.35	= **0.32**	**PASS**
Bolt group forces	shear V_y = 25.00	[kips]			shear V_z = 23.84	[kips]	
Shear resultant force	$R = (V_y^2 + V_z^2)^{0.5}$				= **34.54**	[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 =				= **34.54**	[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 = **0.32**				> V_u	OK	

Bolt Tensile Prying Action on End Plate					ratio = 2.50 / 8.03	= **0.31**	**PASS**
Bolt group forces	shear V = 34.54	[kips]		axial P = -15.00	[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 = 34.54	[kips]		no of bolt n = 6			
Shear stress required	$f_{rv} = V / (n A_b)$			= 13.03	[ksi]		
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$			= **88.04**	[ksi]	AISC 14th	Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$			= 38.89	[kips]	AISC 14th	Eq J3-1
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.6
Single bolt tensile capacity	ϕr_n =			= **29.17**	[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 = 3.500						
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$			= 3.250	[in]	AISC 14th	Page 9-11
	$\rho = b' / a'$			= 0.833		AISC 14th	Eq 9-26
	$\delta = 1 - d_h / p$			= 0.750		AISC 14th	Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section			= 29.17	[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	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$			= 0.946	[in]	AISC 14th	Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$			= 3.900		AISC 14th	Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$			= 0.275		AISC 14th	Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below			= **2.50**	[kips]		
Tensile strength per bolt after considering prying	$\phi r_n = B \times Q$			= **8.03**	[kips]	AISC 14th	Eq 9-31
	ratio = **0.31**			> T	OK		
Calculate Max Single Bolt Tensile Load							
Bolt group force	axial P = 15.00	[kips]					
Bolt number	Bolt Row n_h = 2			Bolt Col n_v = 3			
Bolt tensile force per bolt	$T = P / (n_v n_h)$			= **2.50**	[kips]		

Beam Web Weld Strength						ratio = 4.03 / 9.80	= **0.41**	**PASS**
Weld Group Forces								
Web weld shear force	$V_u = (V_y^2 + V_z^2)^{0.5}$				= 34.54	[kips]		
Weld group forces	shear V = 34.54	[kips]		axial P = -15.00	[kips]	in tension		
Beam web-end plate weld length	L =				= 9.350	[in]		
Beam web-end plate fillet weld size	w =				= 0.375	[in]		
Combined Weld Stress								
Weld stress from axial force	$f_a = P / L$				= -1.604	[kip/in]	in tension	
Weld stress from shear force	$f_v = V / L$				= 3.695	[kip/in]		
Weld stress combined - max	$f_{max} = (f_a^2 + f_v^2)^{0.5}$				= **4.028**	[kip/in]	AISC 14th	Eq 8-11
Weld stress load angle	$\theta = \tan^{-1} (\frac{f_a}{f_v})$				= 23.5	[°]		
Fillet Weld Strength Calc								
Fillet weld leg size	w = 3/8	[in]		load angle θ = 23.5		[°]		
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	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$				= 1.13		AISC 14th	Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$				= 25.069	[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
	ϕR_n =				= **9.799**	[kip/in]		
	ratio = **0.41**				> f_{max}	OK		

Brace Force Load Case 2 shear V = 26.16 kips axial P = -15.00 kips (T) ratio = **0.47** **PASS**

Beam - Shear Yielding - Vy						ratio = 25.00 / 121.61	= **0.21**	**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 =				= **25.00**	[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 = **0.21**				> V_u	OK		

Beam - Shear Rupture - Vy			ratio = 25.00 / 118.56	= **0.21**	**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 =		= **25.00**	[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 = **0.21**		> V_u	OK	

Beam - Shear Yielding - Vz			ratio = 26.16 / 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 =		= **26.16**	[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 = 26.16 / 270.78	= **0.10**	**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 =		= **26.16**	[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 = **0.10**		> V_u	OK	

Beam - Axial Tensile Yield - Px			ratio = 15.00 / 589.50	= **0.03**	**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 =		= **15.00**	[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 = **0.03**		> P_u	OK	

Beam Web - Axial Tensile Rupture - Px				ratio = 15.00 / 140.45	= **0.11**	**PASS**
End Plate Direct Connect Length Calc						
Beam web-end plate weld length	L =			= 9.350	[in]	
Beam web-end plate fillet weld size	w =			= 0.375	[in]	
Beam web-end plate connect length	$L_w = L - 2w$			= 8.600	[in]	
Plate Tensile Rupture Check						
Plate size	width b_p = 8.600	[in]	thickness t_p = 0.335		[in]	
Plate tensile strength	F_u = 65.0	[ksi]				
Plate net area in tension	$A_{nt} = b_p t_p$			= 2.881	[in^2]	
Tensile force in demand	P_u =			= **15.00**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$			= 187.27	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq J4-2
	ϕR_n =			= **140.45**	[kips]	AISC 14th Eq J4-2
	ratio = **0.11**			> P_u	OK	

End Plate - Shear Yielding - Vy				ratio = 12.50 / 109.69	= **0.11**	**PASS**
Plate Shear Yielding Check						
Plate size	width b_p = 9.750	[in]	thickness t_p = 0.375		[in]	
Plate yield strength	F_y = 50.0	[ksi]				
Plate gross area in shear	$A_{gv} = b_p t_p$			= 3.656	[in^2]	
Shear force required	V_u =			= **12.50**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$			= 109.69	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00					AISC 14th Eq J4-3
	ϕR_n =			= **109.69**	[kips]	
	ratio = **0.11**			> V_u	OK	

End Plate - Shear Rupture - Vy				ratio = 12.50 / 78.15	= **0.16**	**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 = 9.750	[in]	thickness t_p = 0.375		[in]	
Plate tensile strength	F_u = 65.0	[ksi]				
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$			= 2.672	[in^2]	
Shear force required	V_u =			= **12.50**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$			= 104.20	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq J4-4
	ϕR_n =			= **78.15**	[kips]	
	ratio = **0.16**			> V_u	OK	

End Plate - Shear Yielding - Vz			ratio = 13.08 / 75.94	= **0.17**	**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 =		= **13.08**	[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
	ϕ R_n =		= **75.94**	[kips]	
	ratio = **0.17**		> V_u	OK	

End Plate - Shear Rupture - Vz			ratio = 13.08 / 54.84	= **0.24**	**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 =		= **13.08**	[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 = **0.24**		> V_u	OK	

Coped Beam - Flexural Rupture			ratio = 25.00 / 57.56	= **0.43**	**PASS**
Beam section & cope side	sect = W12X45		cope side = double cope		
Beam top flange cope	depth d_c = 1.250	[in]	length L_c = 3.983	[in]	
Beam bottom flange cope	depth d_c = 1.250	[in]	length L_c = 3.983	[in]	
Beam section elastic modulus	S_{net} =		= 5.146	[in^3]	
Beam section tensile strength	F_u =		= 65.0	[ksi]	
Distance from face of cope to the point of inflection of beam	e =		= 4.358	[in]	AISC 14th Page 9-6
Beam end shear force	V_u =		= **25.00**	[kips]	
Beam end shear resistance	$R_n = F_u S_{net} / e$		= 76.75	[kips]	AISC 14th Eq 9-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq 9-4
	ϕ R_n =		= **57.56**	[kips]	
	ratio = **0.43**		> V_u	OK	

Coped Beam - Local Web Buckling					ratio = 25.00 / 53.13	= **0.47**	**PASS**
Beam section & cope side	sect = W12X45				cope side = double cope		
Beam top flange cope	depth d_{ct} = 1.250	[in]			length L_{ct} = 3.983	[in]	
Beam bottom flange cope	depth d_{cb} = 1.250	[in]			length L_{cb} = 3.983	[in]	
Beam section elastic modulus	S_{net} =				= 5.146	[in^3]	
Distance from face of cope to the point of inflection of beam	e =				= 4.358	[in]	AISC 14th Page 9-6
Beam section	depth d = 12.100	[in]			web t_w = 0.335	[in]	
	F_y = 50.0	[ksi]			E = 29000	[ksi]	
	f_d = 3.5 - 7.5 (d_{ct} / d)				= 2.725		AISC 14th Eq 9-13
Reduced beam depth	h_0 = d - d_{ct} - d_{cb}				= 9.600	[in]	
Plate local buckling stress	$F_{cr} = 0.62 \pi E \frac{t_w^2}{L_{ct} h_0} f_d$				= 451.8	[ksi]	AISC 14th Eq 9-12
	$F_{cr} = F_{cr} \leq F_y$				= 50.0	[ksi]	AISC 14th Eq 9-12
Beam end shear force	V_u =				= **25.00**	[kips]	
Beam end shear resistance	$R_n = F_{cr} S_{net} / e$				= 59.04	[kips]	AISC 14th Eq 9-6
Resistance factor-LRFD	ϕ = 0.90						AISC 14th Eq 9-6
	ϕR_n =				= **53.13**	[kips]	
	ratio = **0.47**				> V_u	OK	

End Plate - Bolt Bearing on End Plate - Vy Vz Combined ratio = 36.18 / 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 = 25.00 [kips]	shear V_z = 26.16	[kips]		
Bolt group resultant force	$R = (V_y^2 + V_z^2)^{0.5}$	= **36.18**	[kips]		
Resultant force/hor line load angle	$\theta = \tan^{-1} (V_y / V_z)$	= 43.70	[°]		
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 = 3.500 [in]	hor s_h = 4.000	[in]		
Bolt edge distance	ver e_v = 1.375 [in]	hor e_h = 1.375	[in]		
Bolt clear dist - bot right corner bolt	$L_{cA} = \min (\frac{e_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.496	[in]		
Bolt clear dist - right side edge bolt	$L_{cB} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.496	[in]		
Bolt clear dist - bot side edge bolt	$L_{cC} = \min (\frac{e_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 1.584	[in]		
Bolt clear dist - inner edge bolt	$L_{cD} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 4.072	[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	$R_{n\text{-}tA} = 1.5\, L_{cA}\, t\, F_u$	= 54.69	[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	$R_{n\text{-}tB} = 1.5\, L_{cB}\, t\, F_u$	= 54.69	[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	$R_{n\text{-}tC} = 1.5\, L_{cC}\, t\, F_u$	= 57.91	[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	$R_{n\text{-}tD} = 1.5\, L_{cD}\, t\, F_u$	= 148.87	[kips]	AISC 14th	Eq J3-6b

End Plate - Bolt Bearing on Column Web - Vy Vz Combined ratio = 36.18 / 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 = 25.00 [kips]	shear V_z = 26.16	[kips]	
Bolt group resultant force	$R = (V_y^2 + V_z^2)^{0.5}$	= **36.18**	[kips]	
Resultant force/hor line load angle	$\theta = \tan^{-1} (V_y / V_z)$	= 43.70	[°]	
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 = 3.500 [in]	hor s_h = 4.000	[in]	
Bolt edge distance	ver e_v = 1.375 [in]	hor e_h = 1.375	[in]	
Bolt clear dist - bot right corner bolt	$L_{cA} = \min (\frac{e_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.496	[in]	
Bolt clear dist - right side edge bolt	$L_{cB} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{e_h}{\cos\theta}) - d_c$	= 1.496	[in]	
Bolt clear dist - bot side edge bolt	$L_{cC} = \min (\frac{e_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 1.584	[in]	
Bolt clear dist - inner edge bolt	$L_{cD} = \min (\frac{s_v - 0.5d_v}{\sin\theta}, \frac{s_h - 0.5d_v}{\cos\theta}) - d_c$	= 4.072	[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 = 0.295 [in]	tensile F_u = 65.0	[ksi]	
Bolt bearing strength	$R_{n\text{-}br} = 3.0\, d_b\, t\, F_u$	= 43.14	[kips]	AISC 14th Eq J3-6b
Type A - Bolt Group Bottom Right Corner Bolt				
Number of bolt	n_A = 1			
Bolt tear out strength	$R_{n\text{-}tA} = 1.5\, L_{cA}\, t\, F_u$	= 43.02	[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	$R_{n\text{-}tB} = 1.5\, L_{cB}\, t\, F_u$	= 43.02	[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	$R_{n\text{-}tC} = 1.5\, L_{cC}\, t\, F_u$	= 45.56	[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	$R_{n\text{-}tD} = 1.5\, L_{cD}\, t\, F_u$	= 117.11	[kips]	AISC 14th Eq J3-6b

End Plate - Shear in Vy - Block Shear - Center Strip ratio = 25.00 / 192.87 = **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 = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.500	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 6.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 4.641	[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 =	= **25.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 257.16	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **192.87**	[kips]		
	ratio = **0.13**	> V_u	OK		

End Plate - Shear in Vy - Block Shear - 2-Side Strip ratio = 25.00 / 170.02 = **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 = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.500	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375 [in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 6.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 4.641	[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 ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 226.69	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **170.02**	[kips]		
	ratio = **0.15**	> V_u	OK		

End Plate - Shear in Vz - Block Shear - Center Strip ratio = 26.16 / 185.10 = **0.14** **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 = 3.500	[in]	s_h = 4.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$		= 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	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 1.969	[in^2]		
Block shear strength required	V_u =		= **26.16**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 246.80	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **185.10**	[kips]		
	ratio = **0.14**		> V_u	OK		

End Plate - Shear in Vz - Block Shear - 2-Side Strip ratio = 26.16 / 123.40 = **0.21** **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 = 3.500	[in]	s_h = 4.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$		= 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	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$		= 0.703	[in^2]		
Block shear strength required	V_u =		= **26.16**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 164.53	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **123.40**	[kips]		
	ratio = **0.21**		> V_u	OK		

End Plate / Column Web - Bolt Shear					ratio = 36.18 / 107.35	= **0.34**	**PASS**
Bolt group forces	shear V_y = 25.00	[kips]			shear V_z = 26.16	[kips]	
Shear resultant force	$R = (V_y^2 + V_z^2)^{0.5}$				= **36.18**	[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 =				= **36.18**	[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 = 2.50 / 8.03	= **0.31**	**PASS**
Bolt group forces	shear V = 36.18	[kips]		axial P = -15.00	[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 = 36.18	[kips]		no of bolt n = 6			
Shear stress required	$f_{rv} = V / (n A_b)$			= 13.65	[ksi]		
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.7
Modified nominal tensile stress	$F'_{nt} = 1.3 F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{rv} \le F_{nt}$			= **86.66**	[ksi]	AISC 14th	Eq J3-3a
Bolt norminal tensile strength	$r_n = F'_{nt} A_b$			= 38.29	[kips]	AISC 14th	Eq J3-1
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	J3.6
Single bolt tensile capacity	ϕr_n =			= **28.72**	[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 = 3.500						
Bolt tributary length	$p = s_v$ $p \le 2b$ and $p \le s_v$			= 3.250	[in]	AISC 14th	Page 9-11
	$\rho = b' / a'$			= 0.833		AISC 14th	Eq 9-26
	$\delta = 1 - d_h / p$			= 0.750		AISC 14th	Eq 9-24
Tensile capacity per bolt before considering prying	B = from calc shown in above section			= 28.72	[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	$t_c = (\frac{4 B b'}{\phi p F_u})^{0.5}$			= 0.938	[in]	AISC 14th	Eq 9-30a
	$\alpha' = \frac{1}{\delta (1 + \rho)} [(\frac{t_c}{t})^2 - 1]$			= 3.828		AISC 14th	Eq 9-35
when $\alpha' > 1$	$Q = (\frac{t}{t_c})^2 (1 + \delta)$			= 0.279		AISC 14th	Eq 9-34
Bolt tensile force per bolt in demand	T = from calc shown below			= **2.50**	[kips]		
Tensile strength per bolt after considering prying	$\phi r_n = B \times Q$			= **8.03**	[kips]	AISC 14th	Eq 9-31
	ratio = **0.31**			> T	OK		
Calculate Max Single Bolt Tensile Load							
Bolt group force	axial P = 15.00	[kips]					
Bolt number	Bolt Row n_h = 2			Bolt Col n_v = 3			
Bolt tensile force per bolt	$T = P / (n_v n_h)$			= **2.50**	[kips]		

Beam Web Weld Strength			ratio = 4.19 / 9.80	= **0.43**	**PASS**
Weld Group Forces					
Web weld shear force	$V_u = (V_y^2 + V_z^2)^{0.5}$		= 36.18	[kips]	
Weld group forces	shear V = 36.18 [kips]		axial P = -15.00	[kips]	in tension
Beam web-end plate weld length	L =		= 9.350	[in]	
Beam web-end plate fillet weld size	w =		= 0.375	[in]	
Combined Weld Stress					
Weld stress from axial force	$f_a = P / L$		= -1.604	[kip/in]	in tension
Weld stress from shear force	$f_v = V / L$		= 3.870	[kip/in]	
Weld stress combined - max	$f_{max} = (f_a^2 + f_v^2)^{0.5}$		= **4.189**	[kip/in]	AISC 14th Eq 8-11
Weld stress load angle	$\theta = \tan^{-1} (\frac{f_a}{f_v})$		= 22.5	[°]	
Fillet Weld Strength Calc					
Fillet weld leg size	w = 3/8 [in]	load angle θ = 22.5		[°]	
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	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$		= 1.12		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		= 24.909	[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
	ϕR_n =		= **9.799**	[kip/in]	
	ratio = **0.43**		> f_{max}	OK	