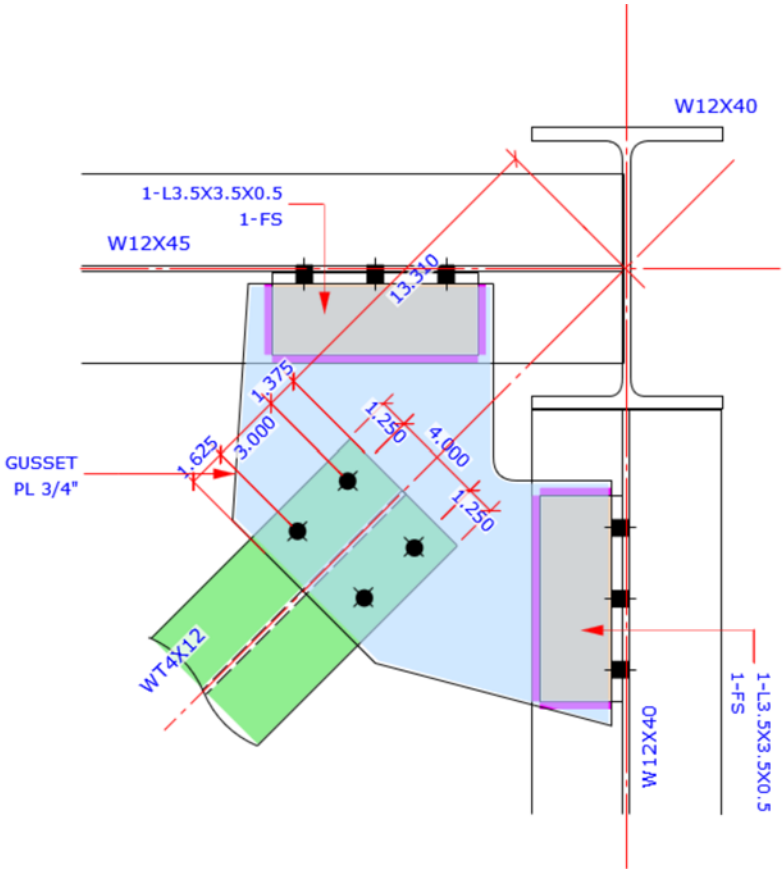
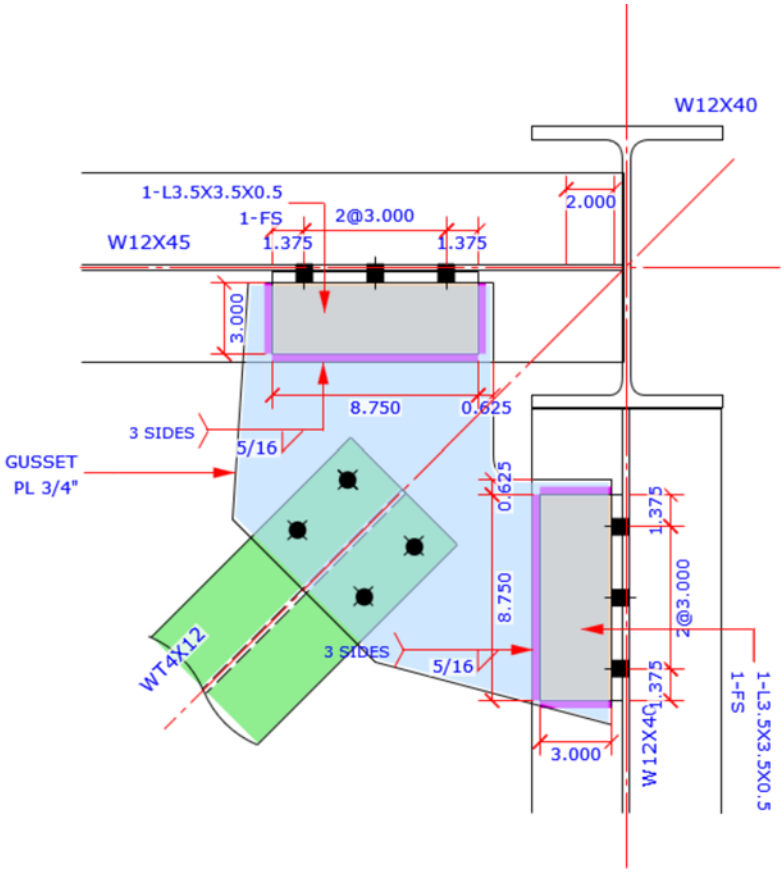
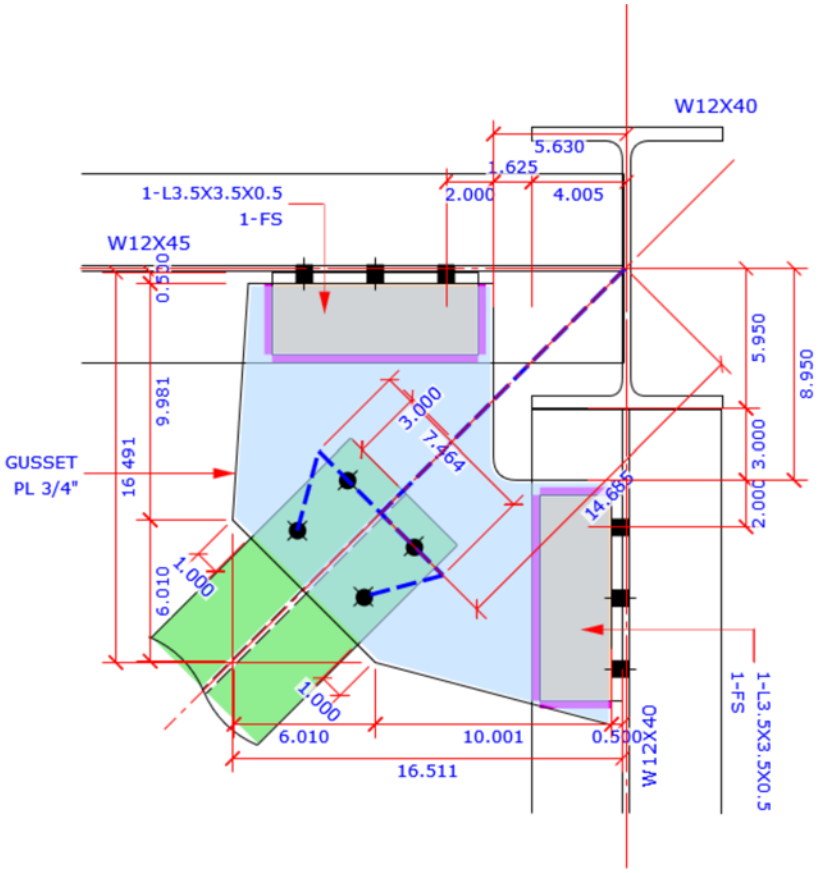
Result Summary - Overall	Horizontal Brace Connection	Code=AISC 360-10 LRFD

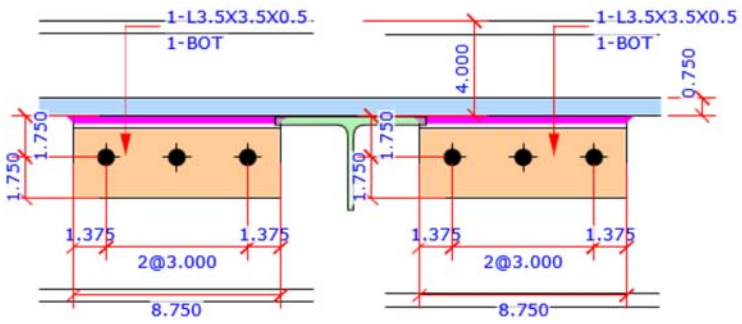
Result Summary - Overall	geometries & weld limitations = **PASS**	limit states max ratio = **0.85**	**PASS**
Brace to Gusset	geometries & weld limitations = **PASS**	limit states max ratio = **0.35**	**PASS**
Gusset to Ver Beam	geometries & weld limitations = **PASS**	limit states max ratio = **0.85**	**PASS**
Gusset to Hor Beam	geometries & weld limitations = **PASS**	limit states max ratio = **0.85**	**PASS**

Sketch	Horizontal Brace Connection	Code=AISC 360-10 LRFD




W12X40
1-L3.5X3.5X0.5
1-FS
2@3.000
W12X45
1.375
1.375
2.000
3.000
8.750
0.625
3 SIDES
5/16
GUSSET
PL 3/4"
0.625
1.375
8.750
2@3.000
WT4X12
3 SIDES
5/16
1.375
1-FS
1-L3.5X3.5X0.5
3.000
W12X40


W12X40
5.630
1.625
2.000
4.005
1-L3.5X3.5X0.5
1-FS
W12X45
0.500
9.981
16.491
5.950
8.950
3.000
7.464
3.000
2.000
14.685
GUSSET
PL 3/4"
1.000
6.010
1.000
6.010
10.001
0.500
16.511
1-FS
1-L3.5X3.5X0.5
W12X40

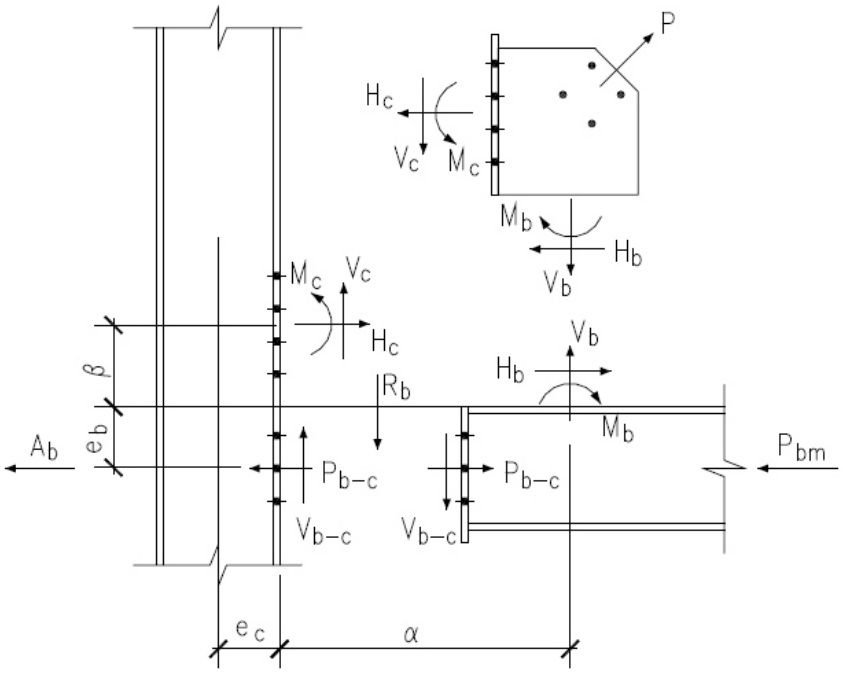


Ver Beam W12X40 Hor Beam W12X45

Members & Components Summary

Member	Brace Connection				Code=AISC 360-10 LRFD
Hor 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]	
Ver Beam 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

Brace force	P = -25.00	[kips] (T)			
Beam end shear & transfer force	Shear R_b = 25.00	[kips]	Transfer A_b = 15.00	[kips]	

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 = 10.483	[in]	β = 13.783	[in]	
	θ = 45.0	[°]			
	$K = e_b \tan\theta - e_c$		= 0.020	[in]	AISC 14th Eq. 13-16
	$D = \tan^2\theta + (\frac{\alpha}{\beta})^2$		= 1.578		AISC 14th Eq. 13-24
	$K' = \alpha (\tan\theta + \frac{\alpha}{\beta})$		= 18.455		AISC 14th Eq. 13-23
	$\bar{\alpha} = [K' \tan\theta + K (\frac{\alpha}{\beta})^2] / D$		= 11.699	[in]	AISC 14th Eq. 13-21
	$\bar{\beta} = (K' - K \tan\theta) / D$		= 11.679	[in]	AISC 14th Eq. 13-22
	$r = [(e_b + \bar{\beta})^2 + (e_c + \bar{\alpha})^2]^{0.5}$		= 16.754	[in]	AISC 14th Eq. 13-6
Brace axial force	P_u = from user input		= -25.00	[kips]	in tension
Gusset to Ver Beam Interface Forces					
Shear force	$V_c = (\bar{\beta} / r) P_u$		= **-17.43**	[kips]	AISC 14th Eq. 13-2
Axial force	$H_c = (e_c / r) P_u$		= **-0.22**	[kips]	AISC 14th Eq. 13-3
Moment	$M_c = H_c (\beta - \bar{\beta})$		= **0.04**	[kip-ft]	AISC 14th Eq. 13-19
Gusset to Hor Beam Interface Forces					
Shear force	$H_b = (\bar{\alpha} / r) P_u$		= **-17.46**	[kips]	AISC 14th Eq. 13-5
Axial force	$V_b = (e_b / r) P_u$		= **-0.25**	[kips]	AISC 14th Eq. 13-4
Moment	$M_b = V_b (\bar{\alpha} - \alpha)$		= **-0.03**	[kip-ft]	AISC 14th Eq. 13-17

Top Brace - Brace to Gusset | Sect=WT4X12 | P_{LC1} =-25.00 kips (T) | P_{LC2} =25.00 kips (C) | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.35**	**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 =-25.00 kips (T) | ratio = **0.35** | **PASS**

WT Shape Brace - Tensile Yield		ratio = 25.00 / 159.30	= **0.16**	**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 =	= **25.00**	[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 = **0.16**	> P_u	OK	

WT Shape Brace - Tensile Rupture			ratio = 25.00 / 106.38	= **0.24**	**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 =		= **25.00**	[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 = **0.24**		> P_u	OK	

WT Brace - Bolt Shear			ratio = 25.00 / 71.57	= **0.35**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750 [in]		bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 4.0		shear plane m = 1		
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **25.00**	[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 = **0.35**		> V_u	OK	

WT Brace - Bolt Bearing on WT Flange			ratio = 25.00 / 71.57	= **0.35**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.400	[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 =		= **25.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.35**		> V_u	OK	

WT Brace - Bolt Bearing on Gusset Plate					ratio = 25.00 / 71.57	= **0.35**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N			F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2	
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]		
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$			= 23.86	[kips]	AISC 14th Eq J3-1	
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3	
Bolt spacing & edge distance	spacing L_s = 3.000	[in]		edge distance L_e = 1.625	[in]		
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.750	[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	
	= 159.96 ≤ 109.69			= 109.69	[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	
	= 89.12 ≤ 109.69			= 89.12	[kips]		
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$			= 23.86	[kips]		
Number of bolt	interior n_{in} = 2			edge n_{ed} = 2			
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$			= 95.43	[kips]		
Required shear strength	V_u =			= **25.00**	[kips]		
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th J3-10	
	ϕR_n =			= **71.57**	[kips]		
	ratio = **0.35**			> V_u	OK		

WT Brace Flange - Block Shear - 1-Side Strip ratio = 12.50 / 51.68 = **0.24** **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 =	= **12.50**	[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 = **0.24**	> V_u	OK		

Gusset Plate - Tensile Yield (Whitmore) ratio = 25.00 / 251.91 = **0.10** **PASS**

Plate Tensile Yielding Check

Plate size	width b_p = 7.464 [in]	thickness t_p = 0.750	[in]		
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_g = b_p t_p$	= 5.598	[in^2]		
Tensile force required	P_u =	= **25.00**	[kips]		
Plate tensile yielding strength	$R_n = F_y A_g$	= 279.90	[kips]	AISC 14th	Eq J4-1
Resistance factor-LRFD	ϕ = 0.90			AISC 14th	Eq J4-1
	ϕR_n =	= **251.91**	[kips]		
	ratio = **0.10**	> P_u	OK		

Gusset Plate - Tensile Rupture (Whitmore) ratio = 25.00 / 208.92 = **0.12** **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 = 0.750	[in]		
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in tension	$A_{nt} = (b_p - n d_h) t_p$	= 4.286	[in^2]		
Tensile force required	P_u =	= **25.00**	[kips]		
Plate tensile rupture strength	$R_n = F_u A_{nt}$	= 278.56	[kips]	AISC 14th	Eq J4-2
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-2
	ϕR_n =	= **208.92**	[kips]	AISC 14th	Eq J4-2
	ratio = **0.12**	> P_u	OK		

Gusset Plate - Block Shear - Center Strip ratio = 25.00 / 259.59 = **0.10** **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 = 0.750 [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	= 6.938	[in^2]		
Net area subject to shear	A_{nv} = A_{gv} - [(n_h - 1)+ 0.5] d_h t_p x2	= 4.969	[in^2]		
Net area subject to tension when sheared out by center strip	A_{nt} = [W_{bs} - (n_v - 1) d_h] t_p	= 2.344	[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 ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 346.13	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕ R_n =	= **259.59**	[kips]		
	ratio = **0.10**	> V_u	OK		

Brace Force Load Case 2 Sect=WT4X12 P =25.00 kips (C) ratio = **0.35** **PASS**

WT Brace - Bolt Shear ratio = 25.00 / 71.57 = **0.35** **PASS**

Bolt shear stress	bolt grade = A325-N	F_{nv} = 54.0	[ksi]	AISC 14th	Table J3.2
	bolt dia d_b = 0.750 [in]	bolt area A_b = 0.442	[in^2]		
Number of bolt carried shear	n_s = 4.0	shear plane m = 1			
Bolt group eccentricity coefficient	C_{ec} =	= 1.000			
Required shear strength	V_u =	= **25.00**	[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
	ϕ R_n =	= **71.57**	[kips]		
	ratio = **0.35**	> V_u	OK		

WT Brace - Bolt Bearing on WT Flange					ratio = 25.00 / 71.57	= **0.35**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442		[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$				= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16		[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]					
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.400	[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 =				= **25.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕR_n =				= **71.57**	[kips]	
	ratio = **0.35**				> V_u	OK	

WT Brace - Bolt Bearing on Gusset Plate			ratio = 25.00 / 71.57	= **0.35**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.750	[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
	= 159.96 ≤ 109.69		= 109.69	[kips]	
Bolt strength at interior	$R_{n\text{-}in}$ = min ($R_{n\text{-}t\&b\text{-}in}$, $R_{n\text{-}bolt}$)		= 23.86	[kips]	
Number of bolt	interior n_{in} = 4				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 95.43	[kips]	
Required shear strength	V_u =		= **25.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **71.57**	[kips]	
	ratio = **0.35**		> V_u	OK	

Gusset Plate - Compression (Whitmore)

ratio = 25.00 / 231.59 = **0.11** **PASS**

Plate Compression Check

Plate size	width b_p = 7.464 [in]	thickness t_p = 0.750	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 5.598	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$	= 0.217	[in]	
Plate effective length factor	K =	= 0.50		
Plate unbraced length	L_u =	= 14.685	[in]	
Plate slenderness	$KL/r = 0.50 \times L_u / r$	= 33.91		
	when $\frac{KL}{r} > 25$, use Chapter E			AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$	= 248.86	[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	$F_{cr} = 0.658^{(F_y/F_e)} F_y$	= 45.97	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =	= **25.00**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$	= 257.32	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th E1
	ϕR_n =	= **231.59**	[kips]	
	ratio = **0.11**	> P_u	OK	

Gusset Plate - Block Shear - Center Strip

ratio = 25.00 / 259.59 = **0.10** **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 = 0.750 [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	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 6.938	[in^2]	
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 4.969	[in^2]	
Net area subject to tension when sheared out by center strip	$A_{nt} = [W_{bs} - (n_v - 1) d_h] t_p$	= 2.344	[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	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 346.13	[kips]	AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-5
	ϕR_n =	= **259.59**	[kips]	
	ratio = **0.10**	> V_u	OK	

Gusset to Ver Beam | 1L Clip Angle Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.85**	**PASS**

Weld Limitation Checks - Clip Angle to Gusset Plate — PASS

Min Fillet Weld Size

Thinner part joined thickness	t =	= 0.500	[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	

Max Fillet Weld Size

Along edge plate thickness	t =	= 0.500	[in]	
Max fillet weld size allowed	w_{max} = t - $^1/_{16}$" (2mm)	= **0.438**	[in]	AISC 14th J2.2b
Fillet weld size provided	w =	= **0.313**	[in]	
		< w_{max}	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 =	= **3.000**	[in]	
		> L_{min}	OK	

Geometry Restriction Checks - Clip Angle to Beam Web — PASS

Min Bolt Edge Distance - Clip Angle to Ver Beam WebWeb

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 Clip Angle to Ver Beam WebWeb	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - Clip Angle to Ver Beam WebWeb

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 Clip Angle to Ver Beam WebWeb	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Brace Force Load Case 1	Gusset plate t=0.750	P =-25.00 kips (T)	ratio = **0.85**	**PASS**

Gusset Plate - Shear Yielding ratio = 17.43 / 173.45 = **0.10** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 7.709	[in]	thickness t_p = 0.750	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 5.782	[in^2]	
Shear force required	V_u =		= **17.43**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 173.45	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **173.45**	[kips]	
	ratio = **0.10**		> V_u	OK	

Gusset Plate - Shear Rupture ratio = 17.43 / 169.12 = **0.10** **PASS**

Plate Shear Rupture Check

Plate size	width b_p = 7.709	[in]	thickness t_p = 0.750	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 5.782	[in^2]	
Shear force in demand	V_u =		= **17.43**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 225.49	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **169.12**	[kips]	
	ratio = **0.10**		> V_u	OK	

Gusset Plate Leg - Flexural Yielding ratio = 8.18 / 27.86 = **0.29** **PASS**

Refer to Bo Dowswell's paper 'Design of Wrap-Around Steel Gusset Plates' for more details on this limit state check

Shear on guseet leg & moment arm	shear V = 17.43	[kips]	ecc e = 5.630	[in]	
Moment on gusset plate leg	$M_u = V e$		= **8.18**	[kip-ft]	
Gusset plate leg size	width d = 7.709	[in]	thick t = 0.750	[in]	
Gusset plate steel strength	F_y = 50.0	[ksi]			
Moment on gusset plate leg	$R_n = F_y (t d^2 / 6)$		= 30.95	[kip-ft]	
Resistance factor-LRFD	ϕ = 0.90				
	ϕR_n =		= **27.86**	[kips]	
	ratio = **0.29**		> M_u	OK	

Gusset Plate Leg - Lateral Torsional Buckling ratio = 8.18 / 388.73 = **0.02** **PASS**

Refer to Bo Dowswell's paper 'Design of Wrap-Around Steel Gusset Plates' for more details on this limit state check

Shear on guseet leg & moment arm	shear P = 17.43	[kips]	ecc e = 5.630	[in]	
Moment on gusset plate leg	M_u = P e		= **8.18**	[kip-ft]	
Gusset plate leg size	width d = 7.709	[in]	thick t = 0.750	[in]	
Gusset plate steel strength	E = 29000	[ksi]	G = 11200	[ksi]	
	F_y = 50.0	[ksi]			
Gusset leg buckiling length	L = distance from gusset load CG to gusset-beam interface line		= 10.630	[in]	
Critical moment - gusset leg	$R_n = 0.94\sqrt{E\,G}\ \frac{d\,t^3}{L}$		= 431.92	[kip-ft]	Dowswell Paper Eq 9
Resistance factor-LRFD	ϕ = 0.90				
	ϕ R_n =		= **388.73**	[kip-ft]	
	ratio = **0.02**		> M_u	OK	

Clip Angle - Gusset Side - Shear Yielding ratio = 17.43 / 131.25 = **0.13** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.375	[in^2]	
Shear force required	V_u =		= **17.43**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 131.25	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕ R_n =		= **131.25**	[kips]	
	ratio = **0.13**		> V_u	OK	

Clip Angle - Gusset Side - Shear Rupture ratio = 17.43 / 127.97 = **0.14** **PASS**

Plate Shear Rupture Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 4.375	[in^2]	
Shear force in demand	V_u =		= **17.43**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 170.63	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **127.97**	[kips]	
	ratio = **0.14**		> V_u	OK	

Clip Angle / Gusset Plate - Fillet Weld Strength — ratio = 0.93 / 5.00 = **0.19** **PASS**

Eccentric C shape weld group strength check using IC analysis method

Weld Group Forces

shear V = 17.43 [kips] axial P = 0.22 [kips] in tension

C Shape Weld Group Geometry

C shape weld group size	width b = 3.000 [in]	depth d = 8.750	[in]	
Hor distance from ver shear load V to C shape weld group flange tip	e_v =	= 0.500	[in]	
Ver distance from hor axial load P to C shape weld group CG	e_p =	= 0.000	[in]	
Hor distance from weld group CG to C shape web	$x = \frac{2\ (b \times 0.5\ b)}{2\ b + d}$	= 0.610	[in]	
Ver shear hor ecc to weld group CG	$e_x = e_v + (b - x)$	= 2.890	[in]	
Hor axial ver ecc to weld group CG	$e_y = e_p$	= 0.000	[in]	
Twisting moment to CG of C shape weld group	$M = V\ e_x + P\ e_y$	= 4.20	[kip-ft]	
Weld group resultant force	$R = (V^2 + P^2)^{0.5}$	= 17.43	[kips]	
Resultant load angle to ver line	$\theta = \tan^{-1}(P / V)$	= 0.7	[°]	
Resultant hor ecc to weld group CG	$e_x = M / V$	= 2.890	[in]	
	$a = e_x / d$	= 0.330		
	$k = b / d$	= 0.343		
Weld group coefficient	C = from AISC manual Table 8-8	= 2.871		AISC 14th Table 8-8
Electrode strength	F_{EXX} = 70.0 [ksi]	strength coeff C_1 = 1.00		AISC 14th Table 8-3
Weld size provided	D =	= **5.00**	[1/16]	
Weld resistance factor-LRFD	ϕ = 0.75			AISC 14th Table 8-8
Weld size required	$D_{rqd} = \frac{R}{\phi\ C\ C_1\ d}$	= **0.93**	[1/16]	AISC 14th Table 8-8
	ratio = **0.19**	< D	OK	
Base metal - gusset plate	thickness t = 0.750 [in]	tensile F_u = 65.0	[ksi]	
Base metal thickness req'd to match weld shear rupture strength	$t_{rqd} = \frac{3.09\ D_{rqd}}{F_u}$	= **0.044**	[in]	AISC 14th Eq 9-2
	ratio = **0.06**	< t	OK	

Clip Angle - Beam Web Side - Shear Yielding — ratio = 17.43 / 131.25 = **0.13** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750 [in]	thickness t_p = 0.500	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p\ t_p$	= 4.375	[in^2]	
Shear force required	V_u =	= **17.43**	[kips]	
Plate shear yielding strength	$R_n = 0.6\ F_y\ A_{gv}$	= 131.25	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	$\phi\ R_n$ =	= **131.25**	[kips]	
	ratio = **0.13**	> V_u	OK	

Clip Angle - Beam Web Side - Shear Rupture	ratio = 17.43 / 89.58	= **0.19**	**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 = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	A_{nv} = (b_p - n d_h) t_p		= 3.063	[in^2]	
Shear force required	V_u =		= **17.43**	[kips]	
Plate shear rupture strength	R_n = 0.6 F_u A_{nv}		= 119.44	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **89.58**	[kips]	
	ratio = **0.19**		> V_u	OK	

Clip Angle - Beam Web Side - Outstanding Leg Flexural Yield	ratio = 2.54 / 35.89	= **0.07**	**PASS**

Shear on clip angle & moment arm	shear V = 17.43	[kips]	gage g = 1.750	[in]	
Moment on clip angle leg	M_u = V x g		= **2.54**	[kip-ft]	
Clip angle leg	length b_p = 8.750	[in]	thick t_p = 0.500	[in]	
	yield F_y = 50.0	[ksi]			
Flexural yield strength	R_n = F_y (b_p^2 x t_p) / 4		= 39.88	[kip-ft]	
Resistance factor-LRFD	ϕ = 0.90				
	ϕ R_n =		= **35.89**	[kips]	
	ratio = **0.07**		> M_u	OK	

Clip Angle - Beam Web Side - Outstanding Leg Flexural Rupture	ratio = 2.54 / 27.83	= **0.09**	**PASS**

Plate A_n and Z_{net} Calc

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 = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate net area	A_n = (b_p - n d_h) t_p		= 3.063	[in^2]	
Plate net plastic sect modulus	Z_{net} =		= 6.850	[in^3]	
Plate net elastic sect modulus	S_{net} =		= 4.561	[in^3]	
Shear on clip angle & moment arm	shear V = 17.43	[kips]	gage g = 1.750	[in]	
Moment on clip angle leg	M_u = V x g		= **2.54**	[kip-ft]	
Clip angle	length b_p = 8.750	[in]	thick t_p = 0.500	[in]	
	tensile F_u = 65.0	[ksi]			
Flexural rupture strength	R_n = F_u Z_{net}		= 37.10	[kip-ft]	AISC 14th Eq 9-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq 9-4
	ϕ R_n =		= **27.83**	[kips]	
	ratio = **0.09**		> M_u	OK	

Clip Angle - Beam Web Side - Bolt Bearing on Clip Angle	ratio = 17.43 / 53.68	= **0.32**	**PASS**

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.500	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 106.64 ≤ 73.13		= 73.13	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 47.23 ≤ 73.13		= 47.23	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 1		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 71.57	[kips]	
Required shear strength	V_u =		= **17.43**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **53.68**	[kips]	
	ratio = **0.32**		> V_u	OK	

Clip Angle - Beam Web Side - Block Shear - 1-Side Strip ratio = 17.43 / 107.86 = **0.16** **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 = 3			
Bolt spacing in hor dir	s_h = 3.000	[in]				
Bolt edge dist in ver & hor dir	e_v = 1.750	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 3.688	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 2.594	[in^2]		
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$		= 0.656	[in^2]		
Block shear strength required	V_u =		= **17.43**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 143.81	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **107.86**	[kips]		
	ratio = **0.16**		> V_u	OK		

Clip Angle / Beam Web - Bolt Group Eccentricity

Load eccentricity to bolt group CG	e_x =		= 2.125	[in]	
Load angle from the vertical line	θ =		= 0.00	[°]	
Bolt no in hor & ver direction	Bolt Col n_h = 3		Bolt Row n_v = 1		
Bolt spacing	Bolt Col s_h = 3.000	[in]			
Bolt group coefficient C	C = from AISC 14th Table 7-6 ~ 7-13		= 2.161		
Bolt group eccentricity coefficient	$C_{ec} = C / (n_v \times n_h)$		= **0.720**		

Clip Angle / Beam Web - Bolt Shear ratio = 17.43 / 38.65 = **0.45** **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 = 3.0		shear plane m = 1			
Bolt group eccentricity coefficient	C_{ec} = from 'Bolt Group Eccentricity' calc		= 0.720			
Required shear strength	V_u =		= **17.43**	[kips]		
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 51.53	[kips]	AISC 14th	Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J3-1
	ϕR_n =		= **38.65**	[kips]		
	ratio = **0.45**		> V_u	OK		

Clip Angle / Beam Web - Slip Critical			ratio = 17.43 / 20.46	= **0.85**	**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 = 3		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} = from 'Bolt Group Eccentricity' calc		= 0.720		
Required shear strength	V_u =		= **17.43**	[kips]	
Tension Reduction Factor					
Bolt group tensile load	T_u =		= 0.22	[kips]	
Number of bolt	$n_b = n_r \times n_c$		= 3		
Tension reduction factor	$k_{sc} = 1 - \frac{T_u}{D_u T_b n_b}$		= 1.00		AISC 14th Eq J3-5a
Slip resistance	$R_n = k_{sc} \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 20.46	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **20.46**	[kips]	
	ratio = **0.85**		> V_u	OK	

Clip Angle / Beam Web - Bolt Bearing on Beam Web			ratio = 17.43 / 53.68	= **0.32**	**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} = 3				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 71.57	[kips]	
Required shear strength	V_u =		= **17.43**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **53.68**	[kips]	
	ratio = **0.32**		> V_u	OK	

Clip Angle / Beam Web - Angle Leg Bending			ratio = 0.02 / 2.67	= **0.01**	**PASS**
Angle leg on beam	width b = 8.750	[in]	thickness t = 0.500	[in]	
	tensile F_u = 65.0	[ksi]	bolt gage g = 1.750	[in]	
Gusset plate thickness	t_p = 0.750	[in]			
1/2 beam span - distance from bolt center to gusset plate center	d = g + 0.5 t_p		= 2.125	[in]	
Axial tensile load on single angle	P =		= 0.22	[kips]	
Moment in demand	M_r = 0.5 P d		= **0.02**	[kip-ft]	
Moment capacity	M_n = (t^2 b) / 4 x F_u		= 2.96	[kip-ft]	AISC 14th Eq 15-21
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq 15-21
	ϕ M_n =		= **2.67**	[kip-ft]	
	ratio = **0.01**		> M_r	OK	

Brace Force Load Case 2 Gusset plate t=0.750 P =25.00 kips (C) ratio = **0.85** **PASS**

Gusset Plate - Shear Yielding			ratio = 17.43 / 173.45	= **0.10**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 7.709	[in]	thickness t_p = 0.750	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	A_{gv} = b_p t_p		= 5.782	[in^2]	
Shear force required	V_u =		= **17.43**	[kips]	
Plate shear yielding strength	R_n = 0.6 F_y A_{gv}		= 173.45	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕ R_n =		= **173.45**	[kips]	
	ratio = **0.10**		> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 17.43 / 169.12	= **0.10**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 7.709	[in]	thickness t_p = 0.750	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	A_{nv} = b_p t_p		= 5.782	[in^2]	
Shear force in demand	V_u =		= **17.43**	[kips]	
Plate shear rupture strength	R_n = 0.6 F_u A_{nv}		= 225.49	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **169.12**	[kips]	
	ratio = **0.10**		> V_u	OK	

Gusset Plate Leg - Flexural Yielding ratio = 8.18 / 27.86 = **0.29** **PASS**

Refer to Bo Dowswell's paper 'Design of Wrap-Around Steel Gusset Plates' for more details on this limit state check

Shear on guseet leg & moment arm	shear V = 17.43	[kips]	ecc e = 5.630	[in]	
Moment on gusset plate leg	M_u = V e		= **8.18**	[kip-ft]	
Gusset plate leg size	width d = 7.709	[in]	thick t = 0.750	[in]	
Gusset plate steel strength	F_y = 50.0	[ksi]			
Moment on gusset plate leg	$R_n = F_y (t d^2 / 6)$		= 30.95	[kip-ft]	
Resistance factor-LRFD	ϕ = 0.90				
	ϕR_n =		= **27.86**	[kips]	
	ratio = **0.29**		> M_u	OK	

Gusset Plate Leg - Lateral Torsional Buckling ratio = 8.18 / 388.73 = **0.02** **PASS**

Refer to Bo Dowswell's paper 'Design of Wrap-Around Steel Gusset Plates' for more details on this limit state check

Shear on guseet leg & moment arm	shear P = 17.43	[kips]	ecc e = 5.630	[in]	
Moment on gusset plate leg	M_u = P e		= **8.18**	[kip-ft]	
Gusset plate leg size	width d = 7.709	[in]	thick t = 0.750	[in]	
Gusset plate steel strength	E = 29000	[ksi]	G = 11200	[ksi]	
	F_y = 50.0	[ksi]			
Gusset leg buckiling length	L = distance from gusset load CG to gusset-beam interface line		= 10.630	[in]	
Critical moment - gusset leg	$R_n = 0.94 \sqrt{E G} \frac{d t^3}{L}$		= 431.92	[kip-ft]	Dowswell Paper Eq 9
Resistance factor-LRFD	ϕ = 0.90				
	ϕR_n =		= **388.73**	[kip-ft]	
	ratio = **0.02**		> M_u	OK	

Clip Angle - Gusset Side - Shear Yielding ratio = 17.43 / 131.25 = **0.13** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.375	[in^2]	
Shear force required	V_u =		= **17.43**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 131.25	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **131.25**	[kips]	
	ratio = **0.13**		> V_u	OK	

Clip Angle - Gusset Side - Shear Rupture — ratio = 17.43 / 127.97 = **0.14** **PASS**

Plate Shear Rupture Check

Plate size	width b_p = 8.750 [in]		thickness t_p = 0.500	[in]	
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = b_p t_p$		= 4.375	[in^2]	
Shear force in demand	V_u =		= **17.43**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 170.63	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **127.97**	[kips]	
	ratio = **0.14**		> V_u	OK	

Clip Angle / Gusset Plate - Fillet Weld Strength — ratio = 0.93 / 5.00 = **0.19** **PASS**

Eccentric C shape weld group strength check using IC analysis method

Weld Group Forces

	shear V = 17.43 [kips]		axial P = 0.22	[kips]	in compression

C Shape Weld Group Geometry

C shape weld group size	width b = 3.000 [in]		depth d = 8.750	[in]	
Hor distance from ver shear load V to C shape weld group flange tip	e_v =		= 0.500	[in]	
Ver distance from hor axial load P to C shape weld group CG	e_p =		= 0.000	[in]	
Hor distance from weld group CG to C shape web	$x = \frac{2 (b \times 0.5 b)}{2 b + d}$		= 0.610	[in]	
Ver shear hor ecc to weld group CG	$e_x = e_v + (b - x)$		= 2.890	[in]	
Hor axial ver ecc to weld group CG	$e_y = e_p$		= 0.000	[in]	
Twisting moment to CG of C shape weld group	$M = V e_x + P e_y$		= 4.20	[kip-ft]	
Weld group resultant force	$R = (V^2 + P^2)^{0.5}$		= 17.43	[kips]	
Resultant load angle to ver line	$\theta = \tan^{-1} (P / V)$		= 0.7	[°]	
Resultant hor ecc to weld group CG	$e_x = M / V$		= 2.890	[in]	
	$a = e_x / d$		= 0.330		
	$k = b / d$		= 0.343		
Weld group coefficient	C = from AISC manual Table 8-8		= 2.871		AISC 14th Table 8-8
Electrode strength	F_{EXX} = 70.0 [ksi]		strength coeff C_1 = 1.00		AISC 14th Table 8-3
Weld size provided	D =		= **5.00**	[1/16]	
Weld resistance factor-LRFD	ϕ = 0.75				AISC 14th Table 8-8
Weld size required	$D_{rqd} = \frac{R}{\phi C C_1 d}$		= **0.93**	[1/16]	AISC 14th Table 8-8
	ratio = **0.19**		< D	OK	
Base metal - gusset plate	thickness t = 0.750 [in]		tensile F_u = 65.0	[ksi]	
Base metal thickness req'd to match weld shear rupture strength	$t_{rqd} = \frac{3.09 D_{rqd}}{F_u}$		= **0.044**	[in]	AISC 14th Eq 9-2
	ratio = **0.06**		< t	OK	

Clip Angle - Gusset Side - Compression Buckling ratio = 0.22 / 196.88 = **0.00** **PASS**

Plate Compression Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.500	[in]	
	F_y = 50.0	[ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$		= 4.375	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$		= 0.144	[in]	
Plate effective length factor	K =		= 1.00		
Plate unbraced length	L_u =		= 1.750	[in]	
Plate slenderness	$KL/r = 1.00 \times L_u / r$		= 12.12		
Plate compression required	P_u =		= **0.22**	[kips]	
	when $\frac{KL}{r} \le 25$				AISC 14th J4.4 (a)
Plate compression provided	$R_n = F_y \times A_g$		= 218.75	[kips]	AISC 14th Eq J4-6
Bolt resistance factor-LRFD	ϕ = 0.90				AISC 14th J4.4 (a)
	ϕR_n =		= **196.88**	[kips]	
	ratio = **0.00**		> P_u	OK	

Clip Angle - Beam Web Side - Shear Yielding ratio = 17.43 / 131.25 = **0.13** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.375	[in^2]	
Shear force required	V_u =		= **17.43**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 131.25	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **131.25**	[kips]	
	ratio = **0.13**		> V_u	OK	

Clip Angle - Beam Web Side - Shear Rupture ratio = 17.43 / 89.58 = **0.19** **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 = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$		= 3.063	[in^2]	
Shear force required	V_u =		= **17.43**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 119.44	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **89.58**	[kips]	
	ratio = **0.19**		> V_u	OK	

Clip Angle - Beam Web Side - Outstanding Leg Flexural Yield	ratio = 2.54 / 35.89	= **0.07**	**PASS**
Shear on clip angle & moment arm	shear V = 17.43 [kips]	gage g = 1.750	[in]
Moment on clip angle leg	M_u = V x g	= **2.54**	[kip-ft]
Clip angle leg	length b_p = 8.750 [in]	thick t_p = 0.500	[in]
	yield F_y = 50.0 [ksi]		
Flexural yield strength	$R_n = F_y (b_p^2 \times t_p) / 4$	= 39.88	[kip-ft]
Resistance factor-LRFD	ϕ = 0.90		
	ϕR_n =	= **35.89**	[kips]
	ratio = **0.07**	> M_u	OK

Clip Angle - Beam Web Side - Outstanding Leg Flexural Rupture	ratio = 2.54 / 27.83	= **0.09**	**PASS**	
Plate A_n and Z_{net} Calc				
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 = 8.750 [in]	thickness t_p = 0.500	[in]	
Plate net area	$A_n = (b_p - n\, d_h)\, t_p$	= 3.063	[in^2]	
Plate net plastic sect modulus	Z_{net} =	= 6.850	[in^3]	
Plate net elastic sect modulus	S_{net} =	= 4.561	[in^3]	
Shear on clip angle & moment arm	shear V = 17.43 [kips]	gage g = 1.750	[in]	
Moment on clip angle leg	M_u = V x g	= **2.54**	[kip-ft]	
Clip angle	length b_p = 8.750 [in]	thick t_p = 0.500	[in]	
	tensile F_u = 65.0 [ksi]			
Flexural rupture strength	$R_n = F_u Z_{net}$	= 37.10	[kip-ft]	AISC 14th Eq 9-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq 9-4
	ϕR_n =	= **27.83**	[kips]	
	ratio = **0.09**	> M_u	OK	

Clip Angle - Beam Web Side - Bolt Bearing on Clip Angle	ratio = 17.43 / 53.68	= **0.32**	**PASS**

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.500	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 106.64 ≤ 73.13	= 73.13	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 47.23 ≤ 73.13	= 47.23	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 1		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 71.57	[kips]	
Required shear strength	V_u =		= **17.43**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **53.68**	[kips]	
	ratio = **0.32**		> V_u	OK	

Clip Angle - Beam Web Side - Block Shear - 1-Side Strip ratio = 17.43 / 107.86 = **0.16** **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 = 3			
Bolt spacing in hor dir	s_h = 3.000	[in]				
Bolt edge dist in ver & hor dir	e_v = 1.750	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 3.688	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 2.594	[in^2]		
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$		= 0.656	[in^2]		
Block shear strength required	V_u =		= **17.43**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 143.81	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **107.86**	[kips]		
	ratio = **0.16**		> V_u	OK		

Clip Angle / Beam Web - Bolt Group Eccentricity

Load eccentricity to bolt group CG	e_x =		= 2.125	[in]	
Load angle from the vertical line	θ =		= 0.00	[°]	
Bolt no in hor & ver direction	Bolt Col n_h = 3		Bolt Row n_v = 1		
Bolt spacing	Bolt Col s_h = 3.000	[in]			
Bolt group coefficient C	C = from AISC 14th Table 7-6 ~ 7-13		= 2.161		
Bolt group eccentricity coefficient	$C_{ec} = C / (n_v \times n_h)$		= **0.720**		

Clip Angle / Beam Web - Bolt Shear ratio = 17.43 / 38.65 = **0.45** **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 = 3.0		shear plane m = 1			
Bolt group eccentricity coefficient	C_{ec} = from 'Bolt Group Eccentricity' calc		= 0.720			
Required shear strength	V_u =		= **17.43**	[kips]		
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 51.53	[kips]	AISC 14th	Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J3-1
	ϕR_n =		= **38.65**	[kips]		
	ratio = **0.45**		> V_u	OK		

Clip Angle / Beam Web - Slip Critical			ratio = 17.43 / 20.50	= **0.85**	**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 = 3		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} = from 'Bolt Group Eccentricity' calc		= 0.720		
Required shear strength	V_u =		= **17.43**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 20.50	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **20.50**	[kips]	
	ratio = **0.85**		> V_u	OK	

Clip Angle / Beam Web - Bolt Bearing on Beam Web			ratio = 17.43 / 53.68	= **0.32**	**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} = 3				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 71.57	[kips]	
Required shear strength	V_u =		= **17.43**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **53.68**	[kips]	
	ratio = **0.32**		> V_u	OK	

Gusset to Hor Beam | 1L Clip Angle Connection | Code=AISC 360-10 LRFD

Result Summary geometries & weld limitations = **PASS** limit states max ratio = **0.85** **PASS**

Weld Limitation Checks - Clip Angle to Gusset Plate — PASS

Min Fillet Weld Size

Thinner part joined thickness	t =	= 0.500	[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	

Max Fillet Weld Size

Along edge plate thickness	t =	= 0.500	[in]	
Max fillet weld size allowed	w_{max} = t - $^1/_{16}$" (2mm)	= **0.438**	[in]	AISC 14th J2.2b
Fillet weld size provided	w =	= **0.313**	[in]	
		< w_{max}	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 =	= **3.000**	[in]	
		> L_{min}	OK	

Geometry Restriction Checks - Clip Angle to Beam Web — PASS

Min Bolt Edge Distance - Clip Angle to Hor Beam 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 Clip Angle to Hor Beam Web	L_e =	= **1.375**	[in]	
		> $L_{e\text{-}min}$	OK	

Min Bolt Spacing - Clip Angle to Hor Beam 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 Clip Angle to Hor Beam Web	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Brace Force Load Case 1 Gusset plate t=0.750 P =-25.00 kips (T) ratio = **0.85** **PASS**

Gusset Plate - Shear Yielding ratio = 17.46 / 248.15 = **0.07** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 11.029 [in]	thickness t_p = 0.750	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 8.272	[in^2]	
Shear force required	V_u =	= **17.46**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 248.15	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕR_n =	= **248.15**	[kips]	
	ratio = **0.07**	> V_u	OK	

Gusset Plate - Shear Rupture ratio = 17.46 / 241.95 = **0.07** **PASS**

Plate Shear Rupture Check

Plate size	width b_p = 11.029 [in]	thickness t_p = 0.750	[in]	
Plate tensile strength	F_u = 65.0 [ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$	= 8.272	[in^2]	
Shear force in demand	V_u =	= **17.46**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 322.60	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4
	ϕR_n =	= **241.95**	[kips]	
	ratio = **0.07**	> V_u	OK	

Gusset Plate Leg - Flexural Yielding ratio = 13.02 / 57.02 = **0.23** **PASS**

Refer to Bo Dowswell's paper 'Design of Wrap-Around Steel Gusset Plates' for more details on this limit state check

Shear on guseet leg & moment arm	shear V = 17.46 [kips]	ecc e = 8.950	[in]	
Moment on gusset plate leg	$M_u = V e$	= **13.02**	[kip-ft]	
Gusset plate leg size	width d = 11.029 [in]	thick t = 0.750	[in]	
Gusset plate steel strength	F_y = 50.0 [ksi]			
Moment on gusset plate leg	$R_n = F_y (t d^2 / 6)$	= 63.35	[kip-ft]	
Resistance factor-LRFD	ϕ = 0.90			
	ϕR_n =	= **57.02**	[kips]	
	ratio = **0.23**	> M_u	OK	

Gusset Plate Leg - Lateral Torsional Buckling ratio = 13.02 / 619.52 = **0.02** **PASS**

Refer to Bo Dowswell's paper 'Design of Wrap-Around Steel Gusset Plates' for more details on this limit state check

Shear on guseet leg & moment arm	shear P = 17.46 [kips]		ecc e = 8.950	[in]	
Moment on gusset plate leg	M_u = P e		= **13.02**	[kip-ft]	
Gusset plate leg size	width d = 11.029 [in]		thick t = 0.750	[in]	
Gusset plate steel strength	E = 29000 [ksi]		G = 11200	[ksi]	
	F_y = 50.0 [ksi]				
Gusset leg buckiling length	L = distance from gusset load CG to gusset-beam interface line		= 9.543	[in]	
Critical moment - gusset leg	$R_n = 0.94 \sqrt{E\,G}\ \frac{d\,t^3}{L}$		= 688.35	[kip-ft]	Dowswell Paper Eq 9
Resistance factor-LRFD	ϕ = 0.90				
	ϕ R_n =		= **619.52**	[kip-ft]	
	ratio = **0.02**		> M_u	OK	

Clip Angle - Gusset Side - Shear Yielding ratio = 17.46 / 131.25 = **0.13** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750 [in]		thickness t_p = 0.500	[in]	
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.375	[in^2]	
Shear force required	V_u =		= **17.46**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 131.25	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕ R_n =		= **131.25**	[kips]	
	ratio = **0.13**		> V_u	OK	

Clip Angle - Gusset Side - Shear Rupture ratio = 17.46 / 127.97 = **0.14** **PASS**

Plate Shear Rupture Check

Plate size	width b_p = 8.750 [in]		thickness t_p = 0.500	[in]	
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = b_p t_p$		= 4.375	[in^2]	
Shear force in demand	V_u =		= **17.46**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 170.63	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **127.97**	[kips]	
	ratio = **0.14**		> V_u	OK	

Clip Angle / Gusset Plate - Fillet Weld Strength — ratio = 0.93 / 5.00 = **0.19** **PASS**

Eccentric C shape weld group strength check using IC analysis method

Weld Group Forces

shear V = 17.46 [kips] axial P = 0.25 [kips] in tension

C Shape Weld Group Geometry

C shape weld group size	width b = 3.000 [in]	depth d = 8.750	[in]	
Hor distance from ver shear load V to C shape weld group flange tip	e_v =	= 0.500	[in]	
Ver distance from hor axial load P to C shape weld group CG	e_p =	= 0.000	[in]	
Hor distance from weld group CG to C shape web	$x = \frac{2\ (b \times 0.5\ b)}{2\ b + d}$	= 0.610	[in]	
Ver shear hor ecc to weld group CG	$e_x = e_v + (b - x)$	= 2.890	[in]	
Hor axial ver ecc to weld group CG	$e_y = e_p$	= 0.000	[in]	
Twisting moment to CG of C shape weld group	$M = V\ e_x + P\ e_y$	= 4.20	[kip-ft]	
Weld group resultant force	$R = (V^2 + P^2)^{0.5}$	= 17.46	[kips]	
Resultant load angle to ver line	$\theta = \tan^{-1}(P / V)$	= 0.8	[°]	
Resultant hor ecc to weld group CG	$e_x = M / V$	= 2.890	[in]	
	$a = e_x / d$	= 0.330		
	$k = b / d$	= 0.343		
Weld group coefficient	C = from AISC manual Table 8-8	= 2.871		AISC 14th Table 8-8
Electrode strength	F_{EXX} = 70.0 [ksi]	strength coeff C_1 = 1.00		AISC 14th Table 8-3
Weld size provided	D =	= **5.00**	[1/16]	
Weld resistance factor-LRFD	ϕ = 0.75			AISC 14th Table 8-8
Weld size required	$D_{rqd} = \frac{R}{\phi\ C\ C_1\ d}$	= **0.93**	[1/16]	AISC 14th Table 8-8
	ratio = **0.19**	< D	OK	
Base metal - gusset plate	thickness t = 0.750 [in]	tensile F_u = 65.0	[ksi]	
Base metal thickness req'd to match weld shear rupture strength	$t_{rqd} = \frac{3.09\ D_{rqd}}{F_u}$	= **0.044**	[in]	AISC 14th Eq 9-2
	ratio = **0.06**	< t	OK	

Clip Angle - Beam Web Side - Shear Yielding — ratio = 17.46 / 131.25 = **0.13** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750 [in]	thickness t_p = 0.500	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p\ t_p$	= 4.375	[in^2]	
Shear force required	V_u =	= **17.46**	[kips]	
Plate shear yielding strength	$R_n = 0.6\ F_y\ A_{gv}$	= 131.25	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	$\phi\ R_n$ =	= **131.25**	[kips]	
	ratio = **0.13**	> V_u	OK	

Clip Angle - Beam Web Side - Shear Rupture	ratio = 17.46 / 89.58	= **0.19**	**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 = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	A_{nv} = (b_p - n d_h) t_p		= 3.063	[in^2]	
Shear force required	V_u =		= **17.46**	[kips]	
Plate shear rupture strength	R_n = 0.6 F_u A_{nv}		= 119.44	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **89.58**	[kips]	
	ratio = **0.19**		> V_u	OK	

Clip Angle - Beam Web Side - Outstanding Leg Flexural Yield	ratio = 2.55 / 35.89	= **0.07**	**PASS**

Shear on clip angle & moment arm	shear V = 17.46	[kips]	gage g = 1.750	[in]	
Moment on clip angle leg	M_u = V x g		= **2.55**	[kip-ft]	
Clip angle leg	length b_p = 8.750	[in]	thick t_p = 0.500	[in]	
	yield F_y = 50.0	[ksi]			
Flexural yield strength	R_n = F_y (b_p^2 x t_p) / 4		= 39.88	[kip-ft]	
Resistance factor-LRFD	ϕ = 0.90				
	ϕ R_n =		= **35.89**	[kips]	
	ratio = **0.07**		> M_u	OK	

Clip Angle - Beam Web Side - Outstanding Leg Flexural Rupture	ratio = 2.55 / 27.83	= **0.09**	**PASS**

Plate A_n and Z_{net} Calc

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 = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate net area	A_n = (b_p - n d_h) t_p		= 3.063	[in^2]	
Plate net plastic sect modulus	Z_{net} =		= 6.850	[in^3]	
Plate net elastic sect modulus	S_{net} =		= 4.561	[in^3]	
Shear on clip angle & moment arm	shear V = 17.46	[kips]	gage g = 1.750	[in]	
Moment on clip angle leg	M_u = V x g		= **2.55**	[kip-ft]	
Clip angle	length b_p = 8.750	[in]	thick t_p = 0.500	[in]	
	tensile F_u = 65.0	[ksi]			
Flexural rupture strength	R_n = F_u Z_{net}		= 37.10	[kip-ft]	AISC 14th Eq 9-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq 9-4
	ϕ R_n =		= **27.83**	[kips]	
	ratio = **0.09**		> M_u	OK	

Clip Angle - Beam Web Side - Bolt Bearing on Clip Angle	ratio = 17.46 / 53.68	= **0.33**	**PASS**

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.500	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 106.64 ≤ 73.13	= 73.13	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$			AISC 14th Eq J3-6b
	= 47.23 ≤ 73.13	= 47.23	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 1		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 71.57	[kips]	
Required shear strength	V_u =		= **17.46**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **53.68**	[kips]	
	ratio = **0.33**		> V_u	OK	

Clip Angle - Beam Web Side - Block Shear - 1-Side Strip	ratio = 17.46 / 107.86	= **0.16**	**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 = 3			
Bolt spacing in hor dir	s_h = 3.000	[in]				
Bolt edge dist in ver & hor dir	e_v = 1.750	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 3.688	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 2.594	[in^2]		
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$		= 0.656	[in^2]		
Block shear strength required	V_u =		= **17.46**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 143.81	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **107.86**	[kips]		
	ratio = **0.16**		> V_u	OK		

Clip Angle / Beam Web - Bolt Group Eccentricity					
Load eccentricity to bolt group CG	e_x =		= 2.125	[in]	
Load angle from the vertical line	θ =		= 0.00	[°]	
Bolt no in hor & ver direction	Bolt Col n_h = 3		Bolt Row n_v = 1		
Bolt spacing	Bolt Col s_h = 3.000	[in]			
Bolt group coefficient C	C = from AISC 14th Table 7-6 ~ 7-13		= 2.161		
Bolt group eccentricity coefficient	$C_{ec} = C / (n_v \times n_h)$		= **0.720**		

Clip Angle / Beam Web - Bolt Shear	ratio = 17.46 / 38.65	= **0.45**	**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 = 3.0		shear plane m = 1			
Bolt group eccentricity coefficient	C_{ec} = from 'Bolt Group Eccentricity' calc		= 0.720			
Required shear strength	V_u =		= **17.46**	[kips]		
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 51.53	[kips]	AISC 14th	Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J3-1
	ϕR_n =		= **38.65**	[kips]		
	ratio = **0.45**		> V_u	OK		

Clip Angle / Beam Web - Slip Critical			ratio = 17.46 / 20.45	= **0.85**	**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 = 3		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} = from 'Bolt Group Eccentricity' calc		= 0.720		
Required shear strength	V_u =		= **17.46**	[kips]	
Tension Reduction Factor					
Bolt group tensile load	T_u =		= 0.25	[kips]	
Number of bolt	$n_b = n_r \times n_c$		= 3		
Tension reduction factor	$k_{sc} = 1 - \frac{T_u}{D_u T_b n_b}$		= 1.00		AISC 14th Eq J3-5a
Slip resistance	$R_n = k_{sc} \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 20.45	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **20.45**	[kips]	
	ratio = **0.85**		> V_u	OK	

Clip Angle / Beam Web - Bolt Bearing on Beam Web			ratio = 17.46 / 53.68	= **0.33**	**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 = 0.335	[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
	= 71.45 ≤ 48.99		= 48.99	[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} = 3				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 71.57	[kips]	
Required shear strength	V_u =		= **17.46**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **53.68**	[kips]	
	ratio = **0.33**		> V_u	OK	

Clip Angle / Beam Web - Angle Leg Bending			ratio = 0.02 / 2.67	= **0.01**	**PASS**
Angle leg on beam	width b = 8.750	[in]	thickness t = 0.500	[in]	
	tensile F_u = 65.0	[ksi]	bolt gage g = 1.750	[in]	
Gusset plate thickness	t_p = 0.750	[in]			
1/2 beam span - distance from bolt center to gusset plate center	d = g + 0.5 t_p		= 2.125	[in]	
Axial tensile load on single angle	P =		= 0.25	[kips]	
Moment in demand	M_r = 0.5 P d		= **0.02**	[kip-ft]	
Moment capacity	M_n = (t^2 b) / 4 x F_u		= 2.96	[kip-ft]	AISC 14th Eq 15-21
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq 15-21
	ϕ M_n =		= **2.67**	[kip-ft]	
	ratio = **0.01**		> M_r	OK	

Brace Force Load Case 2 Gusset plate t=0.750 P =25.00 kips (C) ratio = **0.85** **PASS**

Gusset Plate - Shear Yielding			ratio = 17.46 / 248.15	= **0.07**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 11.029	[in]	thickness t_p = 0.750	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	A_{gv} = b_p t_p		= 8.272	[in^2]	
Shear force required	V_u =		= **17.46**	[kips]	
Plate shear yielding strength	R_n = 0.6 F_y A_{gv}		= 248.15	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕ R_n =		= **248.15**	[kips]	
	ratio = **0.07**		> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 17.46 / 241.95	= **0.07**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 11.029	[in]	thickness t_p = 0.750	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	A_{nv} = b_p t_p		= 8.272	[in^2]	
Shear force in demand	V_u =		= **17.46**	[kips]	
Plate shear rupture strength	R_n = 0.6 F_u A_{nv}		= 322.60	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **241.95**	[kips]	
	ratio = **0.07**		> V_u	OK	

Gusset Plate Leg - Flexural Yielding ratio = 13.02 / 57.02 = **0.23** **PASS**

Refer to Bo Dowswell's paper 'Design of Wrap-Around Steel Gusset Plates' for more details on this limit state check

Shear on guseet leg & moment arm	shear V = 17.46	[kips]	ecc e = 8.950	[in]	
Moment on gusset plate leg	M_u = V e		= **13.02**	[kip-ft]	
Gusset plate leg size	width d = 11.029	[in]	thick t = 0.750	[in]	
Gusset plate steel strength	F_y = 50.0	[ksi]			
Moment on gusset plate leg	$R_n = F_y (t d^2 / 6)$		= 63.35	[kip-ft]	
Resistance factor-LRFD	ϕ = 0.90				
	ϕR_n =		= **57.02**	[kips]	
	ratio = **0.23**		> M_u	OK	

Gusset Plate Leg - Lateral Torsional Buckling ratio = 13.02 / 619.52 = **0.02** **PASS**

Refer to Bo Dowswell's paper 'Design of Wrap-Around Steel Gusset Plates' for more details on this limit state check

Shear on guseet leg & moment arm	shear P = 17.46	[kips]	ecc e = 8.950	[in]	
Moment on gusset plate leg	M_u = P e		= **13.02**	[kip-ft]	
Gusset plate leg size	width d = 11.029	[in]	thick t = 0.750	[in]	
Gusset plate steel strength	E = 29000	[ksi]	G = 11200	[ksi]	
	F_y = 50.0	[ksi]			
Gusset leg buckiling length	L = distance from gusset load CG to gusset-beam interface line		= 9.543	[in]	
Critical moment - gusset leg	$R_n = 0.94 \sqrt{E G} \frac{d t^3}{L}$		= 688.35	[kip-ft]	Dowswell Paper Eq 9
Resistance factor-LRFD	ϕ = 0.90				
	ϕR_n =		= **619.52**	[kip-ft]	
	ratio = **0.02**		> M_u	OK	

Clip Angle - Gusset Side - Shear Yielding ratio = 17.46 / 131.25 = **0.13** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.375	[in^2]	
Shear force required	V_u =		= **17.46**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 131.25	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **131.25**	[kips]	
	ratio = **0.13**		> V_u	OK	

Clip Angle - Gusset Side - Shear Rupture — ratio = 17.46 / 127.97 = **0.14** **PASS**

Plate Shear Rupture Check

Plate size	width b_p = 8.750 [in]	thickness t_p = 0.500	[in]		
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = b_p t_p$	= 4.375	[in^2]		
Shear force in demand	V_u =	= **17.46**	[kips]		
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 170.63	[kips]	AISC 14th Eq J4-4	
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4	
	ϕR_n =	= **127.97**	[kips]		
	ratio = **0.14**	> V_u	OK		

Clip Angle / Gusset Plate - Fillet Weld Strength — ratio = 0.93 / 5.00 = **0.19** **PASS**

Eccentric C shape weld group strength check using IC analysis method

Weld Group Forces

	shear V = 17.46 [kips]	axial P = 0.25	[kips]	in compression	

C Shape Weld Group Geometry

C shape weld group size	width b = 3.000 [in]	depth d = 8.750	[in]		
Hor distance from ver shear load V to C shape weld group flange tip	e_v =	= 0.500	[in]		
Ver distance from hor axial load P to C shape weld group CG	e_p =	= 0.000	[in]		
Hor distance from weld group CG to C shape web	$x = \frac{2 (b \times 0.5 b)}{2 b + d}$	= 0.610	[in]		
Ver shear hor ecc to weld group CG	$e_x = e_v + (b - x)$	= 2.890	[in]		
Hor axial ver ecc to weld group CG	$e_y = e_p$	= 0.000	[in]		
Twisting moment to CG of C shape weld group	$M = V e_x + P e_y$	= 4.20	[kip-ft]		
Weld group resultant force	$R = (V^2 + P^2)^{0.5}$	= 17.46	[kips]		
Resultant load angle to ver line	$\theta = \tan^{-1} (P / V)$	= 0.8	[°]		
Resultant hor ecc to weld group CG	$e_x = M / V$	= 2.890	[in]		
	$a = e_x / d$	= 0.330			
	$k = b / d$	= 0.343			
Weld group coefficient	C = from AISC manual Table 8-8	= 2.871		AISC 14th Table 8-8	
Electrode strength	F_{EXX} = 70.0 [ksi]	strength coeff C_1 = 1.00		AISC 14th Table 8-3	
Weld size provided	D =	= **5.00**	[1/16]		
Weld resistance factor-LRFD	ϕ = 0.75			AISC 14th Table 8-8	
Weld size required	$D_{rqd} = \frac{R}{\phi C C_1 d}$	= **0.93**	[1/16]	AISC 14th Table 8-8	
	ratio = **0.19**	< D	OK		
Base metal - gusset plate	thickness t = 0.750 [in]	tensile F_u = 65.0	[ksi]		
Base metal thickness req'd to match weld shear rupture strength	$t_{rqd} = \frac{3.09 D_{rqd}}{F_u}$	= **0.044**	[in]	AISC 14th Eq 9-2	
	ratio = **0.06**	< t	OK		

Clip Angle - Gusset Side - Compression Buckling

ratio = 0.25 / 196.88 = **0.00** **PASS**

Plate Compression Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.500	[in]	
	F_y = 50.0	[ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$		= 4.375	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$		= 0.144	[in]	
Plate effective length factor	K =		= 1.00		
Plate unbraced length	L_u =		= 1.750	[in]	
Plate slenderness	$KL/r = 1.00 \times L_u / r$		= 12.12		
Plate compression required	P_u =		= **0.25**	[kips]	
	when $\frac{KL}{r} \le 25$				AISC 14th J4.4 (a)
Plate compression provided	$R_n = F_y \times A_g$		= 218.75	[kips]	AISC 14th Eq J4-6
Bolt resistance factor-LRFD	ϕ = 0.90				AISC 14th J4.4 (a)
	ϕR_n =		= **196.88**	[kips]	
	ratio = **0.00**		> P_u	OK	

Clip Angle - Beam Web Side - Shear Yielding

ratio = 17.46 / 131.25 = **0.13** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 4.375	[in^2]	
Shear force required	V_u =		= **17.46**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 131.25	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **131.25**	[kips]	
	ratio = **0.13**		> V_u	OK	

Clip Angle - Beam Web Side - Shear Rupture

ratio = 17.46 / 89.58 = **0.19** **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 = 8.750	[in]	thickness t_p = 0.500	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$		= 3.063	[in^2]	
Shear force required	V_u =		= **17.46**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 119.44	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **89.58**	[kips]	
	ratio = **0.19**		> V_u	OK	

Clip Angle - Beam Web Side - Outstanding Leg Flexural Yield	ratio = 2.55 / 35.89	= **0.07**	**PASS**
Shear on clip angle & moment arm	shear V = 17.46 [kips]	gage g = 1.750	[in]
Moment on clip angle leg	M_u = V x g	= **2.55**	[kip-ft]
Clip angle leg	length b_p = 8.750 [in]	thick t_p = 0.500	[in]
	yield F_y = 50.0 [ksi]		
Flexural yield strength	$R_n = F_y (b_p^2 \times t_p) / 4$	= 39.88	[kip-ft]
Resistance factor-LRFD	ϕ = 0.90		
	ϕR_n =	= **35.89**	[kips]
	ratio = **0.07**	> M_u	OK

Clip Angle - Beam Web Side - Outstanding Leg Flexural Rupture	ratio = 2.55 / 27.83	= **0.09**	**PASS**	
Plate A_n and Z_{net} Calc				
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 = 8.750 [in]	thickness t_p = 0.500	[in]	
Plate net area	$A_n = (b_p - n\, d_h)\, t_p$	= 3.063	[in^2]	
Plate net plastic sect modulus	Z_{net} =	= 6.850	[in^3]	
Plate net elastic sect modulus	S_{net} =	= 4.561	[in^3]	
Shear on clip angle & moment arm	shear V = 17.46 [kips]	gage g = 1.750	[in]	
Moment on clip angle leg	M_u = V x g	= **2.55**	[kip-ft]	
Clip angle	length b_p = 8.750 [in]	thick t_p = 0.500	[in]	
	tensile F_u = 65.0 [ksi]			
Flexural rupture strength	$R_n = F_u Z_{net}$	= 37.10	[kip-ft]	AISC 14th Eq 9-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq 9-4
	ϕR_n =	= **27.83**	[kips]	
	ratio = **0.09**	> M_u	OK	

Clip Angle - Beam Web Side - Bolt Bearing on Clip Angle	ratio = 17.46 / 53.68	= **0.33**	**PASS**

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.500	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 106.64 ≤ 73.13		= 73.13	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 0.969	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 47.23 ≤ 73.13		= 47.23	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 1		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 71.57	[kips]	
Required shear strength	V_u =		= **17.46**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **53.68**	[kips]	
	ratio = **0.33**		> V_u	OK	

Clip Angle - Beam Web Side - Block Shear - 1-Side Strip ratio = 17.46 / 107.86 = **0.16** **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 = 3			
Bolt spacing in hor dir	s_h = 3.000	[in]				
Bolt edge dist in ver & hor dir	e_v = 1.750	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 3.688	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 2.594	[in^2]		
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$		= 0.656	[in^2]		
Block shear strength required	V_u =		= **17.46**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 143.81	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **107.86**	[kips]		
	ratio = **0.16**		> V_u	OK		

Clip Angle / Beam Web - Bolt Group Eccentricity

Load eccentricity to bolt group CG	e_x =		= 2.125	[in]	
Load angle from the vertical line	θ =		= 0.00	[°]	
Bolt no in hor & ver direction	Bolt Col n_h = 3		Bolt Row n_v = 1		
Bolt spacing	Bolt Col s_h = 3.000	[in]			
Bolt group coefficient C	C = from AISC 14th Table 7-6 ~ 7-13		= 2.161		
Bolt group eccentricity coefficient	$C_{ec} = C / (n_v \times n_h)$		= **0.720**		

Clip Angle / Beam Web - Bolt Shear ratio = 17.46 / 38.65 = **0.45** **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 = 3.0		shear plane m = 1			
Bolt group eccentricity coefficient	C_{ec} = from 'Bolt Group Eccentricity' calc		= 0.720			
Required shear strength	V_u =		= **17.46**	[kips]		
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 51.53	[kips]	AISC 14th	Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J3-1
	ϕR_n =		= **38.65**	[kips]		
	ratio = **0.45**		> V_u	OK		

Clip Angle / Beam Web - Slip Critical			ratio = 17.46 / 20.50	= **0.85**	**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 = 3		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} = from 'Bolt Group Eccentricity' calc		= 0.720		
Required shear strength	V_u =		= **17.46**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 20.50	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **20.50**	[kips]	
	ratio = **0.85**		> V_u	OK	

Clip Angle / Beam Web - Bolt Bearing on Beam Web			ratio = 17.46 / 53.68	= **0.33**	**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 = 0.335 [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
	= 71.45 ≤ 48.99		= 48.99	[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} = 3				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 71.57	[kips]	
Required shear strength	V_u =		= **17.46**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **53.68**	[kips]	
	ratio = **0.33**		> V_u	OK	