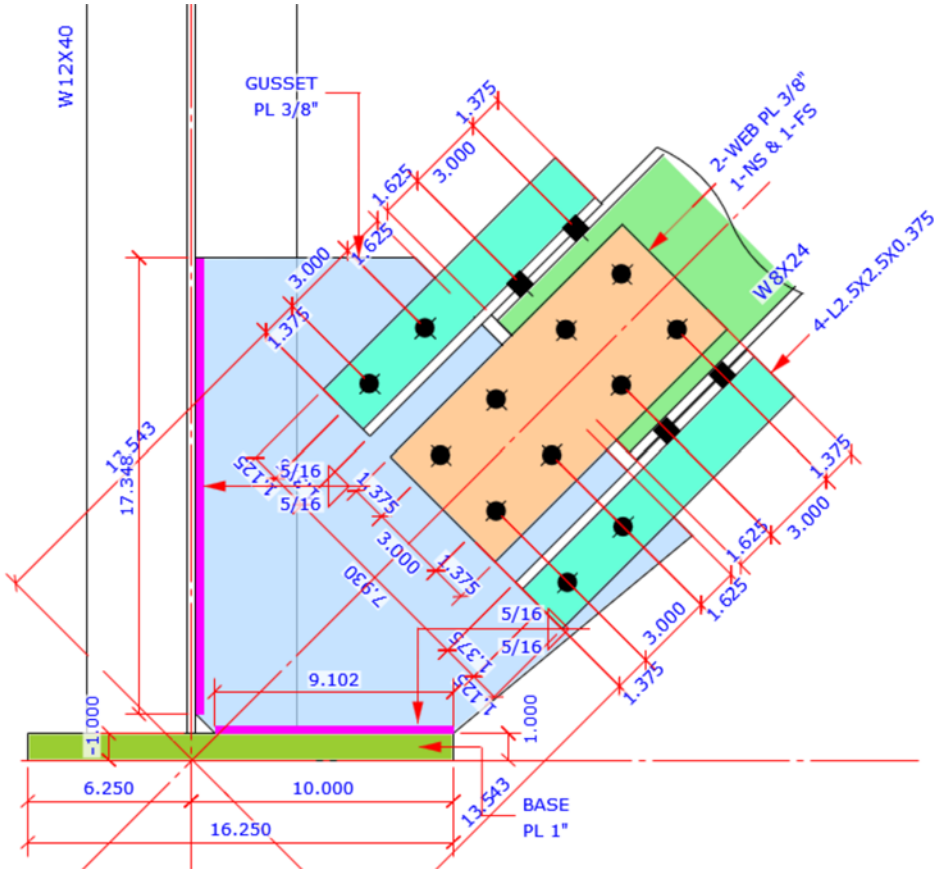
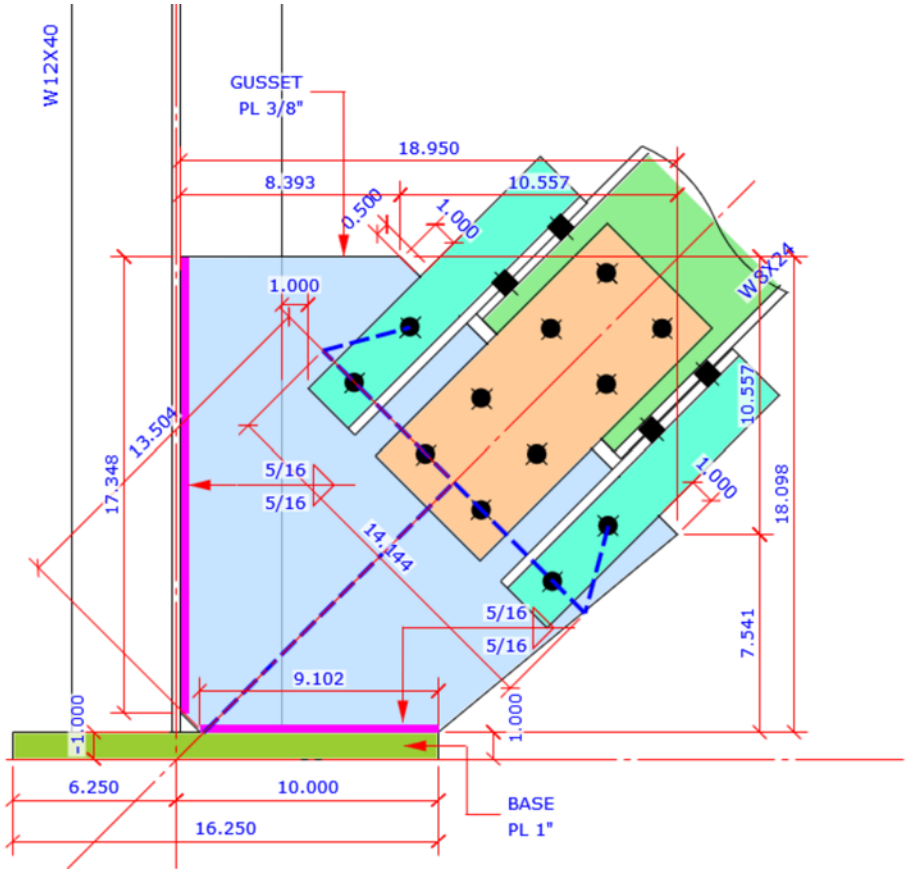
Result Summary - Overall | Vertical Brace Connection | Code=AISC 360-10 LRFD

Result Summary - Overall	geometries & weld limitations = **PASS**	limit states max ratio = **0.97**	**PASS**
Brace to Gusset	geometries & weld limitations = **PASS**	limit states max ratio = **0.97**	**PASS**
Gusset to Column	geometries & weld limitations = **PASS**	limit states max ratio = **0.47**	**PASS**
Gusset to Base Plate	geometries & weld limitations = **PASS**	limit states max ratio = **0.97**	**PASS**

Sketch | Vertical Brace Connection | Code=AISC 360-10 LRFD




W12X40
GUSSET
PL 3/8"
18.950
8.393
10.557
0.500
1.000
1.000
W8X24
13.504
17.348
5/16
5/16
14.144
10.557
1.000
18.098
5/16
5/16
7.541
9.102
1.000
1.000
6.250
10.000
16.250
BASE
PL 1"

Members & Components Summary

Member	Brace Connection				Code=AISC 360-10 LRFD
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

Refer to AISC DG29 Fig. 4-23 for all charts and definitions of variables and symbols shown in calculation below

Brace axial force	P = from user input	= -100.00	[kips]	in tension	
Brace to ver line angle	θ = from user input	= 45.0	[°]		
Brace force hor component	H = P sin θ	= -70.71	[kips]		
Brace force ver component	V = P cos θ	= -70.71	[kips]		
	L = 18.098 [in]	clip = 0.750	[in]	AISC DG29 Fig. 4-23	
	$\bar{\beta}$ = 0.5 (L - clip) + clip	= 9.424	[in]		
Brace work point eccentricity	e = -1.000 [in]	column e_c = 0.148	[in]	AISC DG29 Fig. 4-23	
Gusset - column shear	V = P cos θ	= **-70.71**	[kips]	AISC DG29 Fig. 4-23	
Gusset - column axial	$H_c = \frac{H\,e + V\,e_c}{\bar{\beta}}$	= **6.40**	[kips]	in compression	
Gusset - base plate shear	$H_b = \frac{H\,(\bar{\beta} - e) - V\,e_c}{\bar{\beta}}$	= **-77.11**	[kips]		

Brace Axial Force Load Case 2

Refer to AISC DG29 Fig. 4-23 for all charts and definitions of variables and symbols shown in calculation below

Brace axial force	P = from user input	= 100.00	[kips]	in compression	
Brace to ver line angle	θ = from user input	= 45.0	[°]		
Brace force hor component	H = P sin θ	= 70.71	[kips]		
Brace force ver component	V = P cos θ	= 70.71	[kips]		
	L = 18.098 [in]	clip = 0.750	[in]	AISC DG29 Fig. 4-23	
	$\bar{\beta}$ = 0.5 (L - clip) + clip	= 9.424	[in]		
Brace work point eccentricity	e = -1.000 [in]	column e_c = 0.148	[in]	AISC DG29 Fig. 4-23	
Gusset - column shear	V = P cos θ	= **70.71**	[kips]	AISC DG29 Fig. 4-23	
Gusset - column axial	$H_c = \frac{H\,e + V\,e_c}{\bar{\beta}}$	= **-6.40**	[kips]	in tension	
Gusset - base plate shear	$H_b = \frac{H\,(\bar{\beta} - e) - V\,e_c}{\bar{\beta}}$	= **77.11**	[kips]		

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

Result Summary geometries & weld limitations = **PASS** limit states max ratio = **0.97** **PASS**

Geometry Restriction Checks - Flange Angle to Gusset				PASS
Min Bolt Edge Distance - Flange Angle to Gusset				
Bolt diameter	d_b =	= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in Flange Angle to Gusset	L_e =	= **1.125**	[in]	
		> $L_{e\text{-}min}$	OK	
Min Bolt Spacing - Flange Angle to Gusset				
Bolt diameter	d_b =	= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in Flange Angle to Gusset	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

Geometry Restriction Checks - Flange Angle to Brace Flange				PASS
Min Bolt Edge Distance - Flange Angle to Brace Flange				
Bolt diameter	d_b =	= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =	= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in Flange Angle to Brace Flange	L_e =	= **1.125**	[in]	
		> $L_{e\text{-}min}$	OK	
Min Bolt Spacing - Flange Angle to Brace Flange				
Bolt diameter	d_b =	= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b	= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in Flange Angle to Brace Flange	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

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

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

Brace Force Load Case 1 Sect=W8X24 P =-100.00 kips (T) ratio = **0.97** **PASS**

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

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

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

Flange Angle - Tensile Yield			ratio = 36.72 / 155.70	= **0.24**	**PASS**
Gross area subject to tension	A_g =		= 3.460	[in^2]	
Steel yield strength	F_y =		= 50.0	[ksi]	
Tensile force required	P_u =		= **36.72**	[kips]	
Tensile yielding strength	$R_n = F_y A_g$		= 173.00	[kips]	AISC 14th Eq D2-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th D2 (a)
	ϕR_n =		= **155.70**	[kips]	AISC 14th Eq D2-1
	ratio = **0.24**		> P_u	OK	

Flange Angle - Tensile Rupture			ratio = 36.72 / 102.15	= **0.36**	**PASS**
Section gross area	A_g = 2 L2-1/2X2-1/2X3/8		= 3.460	[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 =	0.375	[in]	
Tensile net area	$A_n = A_g - n_v d_h t \times 2$		= 2.804	[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 L2$^1/_2$ x 2$^1/_2$ x $^3/_8$		= 0.758	[in]	
Shear lag factor	U = 1 - $\bar{x}$ / L		= 0.747		AISC 14th Table D3.1
Tensile force required	P_u =		= **36.72**	[kips]	
Tensile effective net area	$A_e = A_n U$		= 2.095	[in^2]	
Plate tensile strength	F_u =		= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$		= 136.20	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th D2 (b)
	ϕR_n =		= **102.15**	[kips]	AISC 14th Eq D2-2
	ratio = **0.36**		> P_u	OK	

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

Flange Angle - Brace Side - Slip Critical - Angle / Brace Flange			ratio = 36.72 / 37.97	= **0.97**	**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 =		= **36.72**	[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 = **0.97**		> V_u	OK	

Flange Angle - Brace Side - Bolt Bearing on Angle			ratio = 36.72 / 71.57	= **0.51**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[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 =		= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Brace Side - Bolt Bearing on Brace Flange ratio = 36.72 / 71.57 = **0.51** **PASS**

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.625	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.400	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 85.31 ≤ 58.50		= 58.50	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$		= 1.219	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$				AISC 14th Eq J3-6b
	= 47.53 ≤ 58.50		= 47.53	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$		= 23.86	[kips]	

Number of bolt	interior n_{in} = 2		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 95.43	[kips]	
Required shear strength	V_u =		= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Block Shear - 1-Side Strip ratio = 18.36 / 46.16 = **0.40** **PASS**

Plate Block Shear - Side Strip

Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 7/8	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.375	[in]				
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 1		n_h = 2			
Bolt spacing in hor dir	s_h = 3.000	[in]				
Bolt edge dist in ver & hor dir	e_v = 1.125	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 1.641	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 1.148	[in^2]		
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$		= 0.258	[in^2]		
Block shear strength required	V_u =		= **18.36**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$		= 61.55	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **46.16**	[kips]		
	ratio = **0.40**		> V_u	OK		

Brace Flange - Block Shear - 1-Side Strip ratio = 18.36 / 63.14 = **0.29** **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 = 1.688	[in]	e_h = 1.625	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$		= 1.850	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$		= 1.325	[in^2]		
Net area subject to tension	$A_{nt} = (e_v - 0.5 d_h) t_p$		= 0.500	[in^2]		
Block shear strength required	V_u =		= **18.36**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$		= 84.19	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **63.14**	[kips]		
	ratio = **0.29**		> V_u	OK		

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

Flange Angle - Gusset PL Side - Slip Critical - Angle / Gusset PL			ratio = 36.72 / 37.97	= **0.97**	**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 = 2				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **36.72**	[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
	ϕ R_n =		= **37.97**	[kips]	
	ratio = **0.97**		> V_u	OK	

Flange Angle - Gusset PL Side - Bolt Bearing on Angle			ratio = 18.36 / 35.78	= **0.51**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[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} = 1		edge n_{ed} = 1		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 47.71	[kips]	
Required shear strength	V_u =		= **18.36**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕ R_n =		= **35.78**	[kips]	
	ratio = **0.51**		> V_u	OK	

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

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

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

Interior Bolt

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

Edge Bolt

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

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

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

Plate Tensile Yielding Check

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

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

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

Web Plate - Brace Side - Slip Critical - Web Plate / Brace Web			ratio = 26.55 / 75.94	= **0.35**	**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 = 2				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **26.55**	[kips]	
Slip resistance	R_n = $\mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 75.94	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **75.94**	[kips]	
	ratio = **0.35**		> V_u	OK	

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

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

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

Interior Bolt

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

Edge Bolt

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

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

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

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

Plate Block Shear - Center Strip

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

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

Plate Block Shear - Side Strip

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

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

Plate Block Shear - 2 Side Strips

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.375	[in]				
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 2		n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000	[in]	s_h = 3.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$		= 3.281	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$		= 2.297	[in^2]		
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$		= 0.703	[in^2]		
Block shear strength required	V_u =		= **13.28**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 135.28	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **101.46**	[kips]		
	ratio = **0.13**		> V_u	OK		

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

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th	B4.3b
Plate thickness	t_p = 0.245	[in]				
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]		
Bolt no in ver & hor dir	n_v = 2		n_h = 2			
Bolt spacing in ver & hor dir	s_v = 3.000	[in]	s_h = 3.000	[in]		
Bolt edge dist in ver & hor dir	e_v = 2.465	[in]	e_h = 1.625	[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$		= 2.266	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$		= 1.623	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 0.521	[in^2]		
Block shear strength required	V_u =		= **26.55**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$		= 97.14	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th	Eq J4-5
	ϕR_n =		= **72.86**	[kips]		
	ratio = **0.36**		> V_u	OK		

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

Web Plate - Gusset PL Side - Slip Critical - Web Plate/Gusset PL			ratio = 26.55 / 75.94	= **0.35**	**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 = 2				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **26.55**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 75.94	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **75.94**	[kips]	
	ratio = **0.35**		> V_u	OK	

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

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

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

Interior Bolt

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

Edge Bolt

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

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

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

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

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

Interior Bolt

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

Edge Bolt

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

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

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

Plate Block Shear - Center Strip

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

Gusset Plate Overall - Block Shear - Center Strip ratio = 100.00 / 219.92 = **0.45** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th	B4.3b
Plate thickness	t_p = 0.375 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 4.0	n_h = 2			
Bolt spacing in hor dir	s_h = 3.000 [in]	edge dist e_h = 1.625 [in]			
Width of block shear strip	W_{bs} = 10.680 [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	$A_{nt} = [W_{bs} - (n_v - 1) d_h] t_p$	= 3.021	[in^2]		
Block shear strength required	V_u =	= **100.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00			AISC 14th	Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 293.23	[kips]	AISC 14th	Eq J4-5
Resistance factor-LRFD	ϕ = 0.75			AISC 14th	Eq J4-5
	ϕR_n =	= **219.92**	[kips]		
	ratio = **0.45**	> V_u	OK		

Gusset Plate - Tensile Yield (Whitmore)			ratio = 100.00 / 238.68	= **0.42**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 14.144	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 5.304	[in^2]	
Tensile force required	P_u =		= **100.00**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 265.20	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **238.68**	[kips]	
	ratio = **0.42**		> P_u	OK	

Gusset Plate - Tensile Rupture (Whitmore)			ratio = 100.00 / 194.59	= **0.51**	**PASS**
Plate Tensile Rupture Check					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 7/8	[in]	AISC 14th B4.3b
Number of bolt	n = 4				
Plate size	width b_p = 14.144	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	$A_{nt} = (b_p - n d_h) t_p$		= 3.992	[in^2]	
Tensile force required	P_u =		= **100.00**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 259.45	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕR_n =		= **194.59**	[kips]	AISC 14th Eq J4-2
	ratio = **0.51**		> P_u	OK	

Brace Force Load Case 2 Sect=W8X24 P =100.00 kips (C) ratio = **0.97** **PASS**

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

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

Flange Angle - Brace Side - Slip Critical - Angle / Brace Flange			ratio = 36.72 / 37.97	= **0.97**	**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 =		= **36.72**	[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 = **0.97**		> V_u	OK	

Flange Angle - Brace Side - Bolt Bearing on Angle			ratio = 36.72 / 71.57	= **0.51**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[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 =		= **36.72**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.51**		> V_u	OK	

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

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

Flange Angle - Gusset PL Side - Slip Critical - Angle / Gusset PL			ratio = 36.72 / 37.97	= **0.97**	**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 = 2				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **36.72**	[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 = **0.97**		> V_u	OK	

Flange Angle - Gusset PL Side - Bolt Bearing on Angle			ratio = 18.36 / 35.78	= **0.51**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[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 =		= **18.36**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **35.78**	[kips]	
	ratio = **0.51**		> V_u	OK	

Flange Angle - Gusset PL Side - Bolt Bearing on Gusset Plate	ratio = 36.72 / 71.57	= **0.51**	**PASS**

Single Bolt Shear Strength

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

Bolt Bearing / TearOut Strength on Plate

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

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]		
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, m\, F_u$			AISC 14th	Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]		
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 47.71	[kips]		
Number of bolt	interior n_{in} = 2				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$	= 95.43	[kips]		
Required shear strength	V_u =	= **36.72**	[kips]		
Bolt resistance factor-LRFD	ϕ = 0.75			AISC 14th	J3-10
	ϕ R_n =	= **71.57**	[kips]		
	ratio = **0.51**	> V_u	OK		

Web Plate - Brace Side - Bolt Shear	ratio = 26.55 / 143.14	= **0.19**	**PASS**

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

Web Plate - Brace Side - Slip Critical - Web Plate / Brace Web	ratio = 26.55 / 75.94	= **0.35**	**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 = 2		
Bolt group eccentricity coefficient	C_{ec} =	= 1.000	
Required shear strength	V_u =	= **26.55** [kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$	= 75.94 [kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00 for standard size or SSLT hole		AISC 14th J3.8
	ϕR_n =	= **75.94** [kips]	
	ratio = **0.35**	> V_u OK	

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

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

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

Web Plate - Gusset PL Side - Slip Critical - Web Plate / Gusset PL	ratio = 26.55 / 75.94	= **0.35**	**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 = 2		
Bolt group eccentricity coefficient	C_{ec} =	= 1.000	
Required shear strength	V_u =	= **26.55** [kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$	= 75.94 [kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00 for standard size or SSLT hole		AISC 14th J3.8
	ϕR_n =	= **75.94** [kips]	
	ratio = **0.35**	> V_u OK	

Web Plate - Gusset PL Side - Bolt Bearing on Web Plate	ratio = 13.28 / 71.57	= **0.19**	**PASS**
Single Bolt Shear Strength			
Bolt shear stress	bolt grade = A325-N	F_{nv} = 54.0 [ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750 [in]	bolt area A_b = 0.442 [in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$	= 23.86 [kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate			
Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^{13}/_{16}$ [in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000 [in]		
Plate tensile strength	F_u = 65.0 [ksi]		
Plate thickness	t = 0.375 [in]		
Interior Bolt			
Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188 [in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5 L_c t F_u \le 3.0 d_b t m F_u$		AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84 [kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min (R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 23.86 [kips]	
Number of bolt	interior n_{in} = 4		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$	= 95.43 [kips]	
Required shear strength	V_u =	= **13.28** [kips]	
Bolt resistance factor-LRFD	ϕ = 0.75		AISC 14th J3-10
	ϕR_n =	= **71.57** [kips]	
	ratio = **0.19**	> V_u OK	

Web Plate - Gusset PL Side - Bolt Bearing on Gusset Plate			ratio = 26.55 / 143.14	= **0.19**	**PASS**
Single Bolt Shear Strength					
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = 2 \times F_{nv} A_b$		= 47.71	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]			
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			
Interior Bolt					
Bolt hole edge clear distance	$L_c = L_s - d_h$		= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, m\, F_u$				AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84		= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$		= 47.71	[kips]	
Number of bolt	interior n_{in} = 4				
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$		= 190.85	[kips]	
Required shear strength	V_u =		= **26.55**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **143.14**	[kips]	
	ratio = **0.19**		> V_u	OK	

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

Plate Compression Check

Plate size	width b_p = 5.750 [in]	thickness t_p = 0.375	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 2.156	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$	= 0.108	[in]	
Plate effective length factor	K =	= 1.00		AISC DG29 Page 277
Plate unbraced length	L_u =	= 6.750	[in]	
Plate slenderness	$KL/r = 1.00 \times L_u / r$	= 62.35		
	when $\frac{KL}{r} > 25$, use Chapter E			AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$	= 73.62	[ksi]	AISC 14th Eq E3-4
	when $\frac{KL}{r} \le 4.71 \left(\frac{E}{F_y}\right)^{0.5} = 113.43$			AISC 14th E3 (a)
Critical stress	$F_{cr} = 0.658^{(F_y/F_e)} F_y$	= 37.63	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =	= **13.28**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$	= 81.13	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th E1
	ϕR_n =	= **73.02**	[kips]	
	ratio = **0.18**	> P_u	OK	

Gusset Plate - Compression (Whitmore) ratio = 100.00 / 158.46 = **0.63** **PASS**

Plate Compression Check

Plate size	width b_p = 14.144 [in]	thickness t_p = 0.375	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 5.304	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$	= 0.108	[in]	
Plate effective length factor	K =	= 0.60		AISC DG29 Page 277
Plate unbraced length	L_u =	= 13.504	[in]	
Plate slenderness	$KL/r = 0.60 \times L_u / r$	= 74.85		
	when $\frac{KL}{r} > 25$, use Chapter E			AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$	= 51.09	[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	$F_{cr} = 0.658^{(F_y/F_e)} F_y$	= 33.20	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =	= **100.00**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$	= 176.07	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th E1
	ϕR_n =	= **158.46**	[kips]	
	ratio = **0.63**	> P_u	OK	

Gusset to Column | Direct Weld Connection | Code=AISC 360-10 LRFD

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

Weld Limitation Checks - Gusset to Column — PASS

Min Fillet Weld Size

Thinner part joined thickness	t =	= 0.295	[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 =	= **17.348**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1

Gusset plate t=0.375 | P = -100.00 kips (T) | ratio = **0.46** | **PASS**

Gusset Plate - Shear Yielding — ratio = 70.71 / 195.17 = **0.36** — PASS

Plate Shear Yielding Check

Plate size	width b_p = 17.348	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 6.506	[in^2]	
Shear force required	V_u =		= **70.71**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 195.17	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **195.17**	[kips]	
	ratio = **0.36**		> V_u	OK	

Gusset Plate - Shear Rupture — ratio = 70.71 / 190.29 = **0.37** — PASS

Plate Shear Rupture Check

Plate size	width b_p = 17.348	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 6.506	[in^2]	
Shear force in demand	V_u =		= **70.71**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 253.71	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **190.29**	[kips]	
	ratio = **0.37**		> V_u	OK	

Gusset Plate - Axial Tensile Yield						ratio = 6.40 / 292.75	= **0.02**	**PASS**
Plate Tensile Yielding Check								
Plate size	width b_p = 17.348	[in]		thickness t_p = 0.375	[in]			
Plate yield strength	F_y = 50.0	[ksi]						
Plate gross area in shear	$A_g = b_p t_p$			= 6.506	[in^2]			
Tensile force required	P_u =			= **6.40**	[kips]			
Plate tensile yielding strength	$R_n = F_y A_g$			= 325.28	[kips]	AISC 14th Eq J4-1		
Resistance factor-LRFD	ϕ = 0.90					AISC 14th Eq J4-1		
	ϕR_n =			= **292.75**	[kips]			
	ratio = **0.02**			> P_u	OK			

Gusset to Column Weld Strength						ratio = 4.08 / 8.78	= **0.46**	**PASS**
Gusset to Column Interface - Forces								
	shear V_c = 70.71	[kips]		axial H_c = 6.40	[kips]	in compression		
	moment M_c = 0.00	[kip-ft]						
Gusset-column fillet weld length	L_{wc} =			= **17.348**	[in]			
Gusset to Column Interface - Combined Weld Stress								
Weld stress from axial force	$f_a = H_c / L_{wc}$			= 0.000	[kip/in]	in compression		
Weld stress from shear force	$f_v = V_c / L_{wc}$			= 4.076	[kip/in]			
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$			= 0.000	[kip/in]			
Weld stress combined - max	$f_{max} = f_v$			= **4.076**	[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	$\phi R_n = \phi R_n$ x (1/1.25)			= **8.775**	[kip/in]			
	ratio = **0.46**			> f_{max}	OK			

Column Web Strength to Carry H_c ratio = 6.40 / 30.08 = **0.21** **PASS**

Refer to AISC DG29 Fig. 4-23 for all charts and definitions of variables and symbols shown in calculation below

Gusset-column interface length	L = 18.098 [in]	clip = 0.750	[in]	AISC DG29 Fig. 4-23
	$\bar{\beta}$ = 0.5 (L - clip) + clip	= 9.424	[in]	
Column sect W12X40	t_w = 0.295 [in]	F_y = 50.0	[ksi]	
Gusset to column web normal force	H_c =	= **6.40**	[kips]	
Column web can take normal force	$R_n = (4 F_y t_w^2 L) / \bar{\beta}$	= 33.42	[kips]	AISC DG29 Eq 4-19
Resistance factor-LRFD	ϕ = 0.90			
	ϕR_n =	= **30.08**	[kips]	
	ratio = **0.21**	> H_c	OK	

Brace Force Load Case 2 Gusset plate t=0.375 P = 100.00 kips (C) ratio = **0.47** **PASS**

Gusset Plate - Shear Yielding ratio = 70.71 / 195.17 = **0.36** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 17.348 [in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 6.506	[in^2]	
Shear force required	V_u =	= **70.71**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 195.17	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕR_n =	= **195.17**	[kips]	
	ratio = **0.36**	> V_u	OK	

Gusset Plate - Shear Rupture ratio = 70.71 / 190.29 = **0.37** **PASS**

Plate Shear Rupture Check

Plate size	width b_p = 17.348 [in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0 [ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$	= 6.506	[in^2]	
Shear force in demand	V_u =	= **70.71**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 253.71	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4
	ϕR_n =	= **190.29**	[kips]	
	ratio = **0.37**	> V_u	OK	

Gusset Plate - Axial Tensile Yield			ratio = 6.40 / 292.75	= **0.02**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 17.348	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 6.506	[in^2]	
Tensile force required	P_u =		= **6.40**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 325.28	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **292.75**	[kips]	
	ratio = **0.02**		> P_u	OK	

Gusset Plate - Axial Tensile Rupture			ratio = 6.40 / 317.14	= **0.02**	**PASS**
Plate Tensile Rupture Check					
Plate size	width b_p = 17.348	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	$A_{nt} = b_p t_p$		= 6.506	[in^2]	
Tensile force required	P_u =		= **6.40**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 422.86	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕR_n =		= **317.14**	[kips]	AISC 14th Eq J4-2
	ratio = **0.02**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.13**	**PASS**
Gusset plate	width b_p = 17.348	[in]	thick t_p = 0.375	[in]	
	yield F_y = 50.0	[ksi]			
Shear plate - gross area	$A_g = b_p \times t_p$		= 6.506	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 28.214	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 105.80	[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		= 292.75	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 6.40	[kips]	
Shear strength available	V_c = from shear yielding check		= 195.17	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 70.71	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.13**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact					
	ratio =		= **0.14**	**PASS**	
Gusset plate	width b_p = 17.348 [in]	thick t_p = 0.375	[in]		
	tensile F_u = 65.0 [ksi]				
Net area of plate	$A_n = b_p \times t_p$	= 6.506	[in^2]		
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$	= 28.214	[in^3]		
Flexural strength available	$M_c = \phi F_u Z_{net}$ ϕ=0.75	= 114.62	[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	= 317.14	[kips]		
Axial strength required	P_r = from gusset interface forces calc	= 6.40	[kips]		
Shear strength available	V_c = from shear rupture check	= 190.29	[kips]		
Shear strength required	V_r = from gusset interface forces calc	= 70.71	[kips]		
Flexural rupture interaction	$\text{ratio} = (\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$	= **0.14**		AISC 14th Eq 10-5	
		< 1.0	OK		

Gusset to Column Weld Strength ratio = 4.09 / 8.78 = **0.47** **PASS**

Gusset to Column Interface - Forces

shear V_c = 70.71 [kips] axial H_c = -6.40 [kips] in tension

moment M_c = 0.00 [kip-ft]

Gusset-column fillet weld length L_{wc} = = **17.348** [in]

Gusset to Column Interface - Combined Weld Stress

Weld stress from axial force $f_a = H_c / L_{wc}$ = -0.369 [kip/in] in tension

Weld stress from shear force $f_v = V_c / L_{wc}$ = 4.076 [kip/in]

Weld stress from moment force $f_b = \frac{M}{L^2 / 6}$ = 0.000 [kip/in]

Weld stress combined - max $f_{max} = [(f_a - f_b)^2 + f_v^2]^{0.5}$ = **4.093** [kip/in] AISC 14th Eq 8-11

Weld resultant load angle $\theta = \tan^{-1} [(f_b - f_a) / f_v]$ = 5.2 [°]

Fillet Weld Strength Calc

Fillet weld leg size $w = {}^{5}/_{16}$ [in] load angle θ = 5.2 [°]

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 $C_2 = (1 + 0.5 \sin^{1.5} \theta)$ = 1.01 AISC 14th Page 8-9

Fillet weld shear strength $R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$ = 18.810 [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 = **0.47** > f_{max} OK

Column Web Strength to Carry H_c ratio = 6.40 / 30.08 = **0.21** **PASS**

Refer to AISC DG29 Fig. 4-23 for all charts and definitions of variables and symbols shown in calculation below

Gusset-column interface length L = 18.098 [in] clip = 0.750 [in] AISC DG29 Fig. 4-23

$\bar{\beta} = 0.5 (L - \text{clip}) + \text{clip}$ = 9.424 [in]

Column sect W12X40 t_w = 0.295 [in] F_y = 50.0 [ksi]

Gusset to column web normal force H_c = = **6.40** [kips]

Column web can take normal force $R_n = (4 F_y t_w^2 L) / \bar{\beta}$ = 33.42 [kips] AISC DG29 Eq 4-19

Resistance factor-LRFD ϕ = 0.90

ϕR_n = = **30.08** [kips]

ratio = **0.21** > H_c OK

Gusset to Base Plate | Direct Weld Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.97**	**PASS**

Weld Limitation Checks - Gusset to Base 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 =	= **9.102**	[in]		
		> L_{min}	OK		

Brace Force Load Case 1	Gusset plate t=0.375	P = -100.00 kips (T)	ratio = **0.97**	**PASS**

Gusset Plate - Shear Yielding					ratio = 77.11 / 102.40	= **0.75**	**PASS**
Plate Shear Yielding Check							
Plate size	width b_p = 9.103	[in]	thickness t_p = 0.375	[in]			
Plate yield strength	F_y = 50.0	[ksi]					
Plate gross area in shear	$A_{gv} = b_p t_p$		= 3.413	[in^2]			
Shear force required	V_u =		= **77.11**	[kips]			
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 102.40	[kips]	AISC 14th Eq J4-3		
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3		
	ϕR_n =		= **102.40**	[kips]			
	ratio = **0.75**		> V_u	OK			

Gusset Plate - Shear Rupture					ratio = 77.11 / 99.84	= **0.77**	**PASS**
Plate Shear Rupture Check							
Plate size	width b_p = 9.103	[in]	thickness t_p = 0.375	[in]			
Plate tensile strength	F_u = 65.0	[ksi]					
Plate net area in shear	$A_{nv} = b_p t_p$		= 3.413	[in^2]			
Shear force in demand	V_u =		= **77.11**	[kips]			
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 133.12	[kips]	AISC 14th Eq J4-4		
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4		
	ϕR_n =		= **99.84**	[kips]			
	ratio = **0.77**		> V_u	OK			

Gusset to Base Plate Weld Strength ratio = 8.47 / 8.78 = **0.97** **PASS**

Gusset to Beam Interface - Forces

shear H_b = 77.11 [kips] axial V_b = 0.00 [kips]

moment M_b = 0.00 [kip-ft]

Gusset-beam fillet weld length	L_w =	= 9.103	[in]	

Gusset to Beam Interface - Combined Weld Stress

Weld stress from axial force	$f_a = V_b / L_{wb}$	= 0.000	[kip/in]	
Weld stress from shear force	$f_v = H_b / L_{wb}$	= 8.471	[kip/in]	
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$	= 0.000	[kip/in]	
Weld stress combined - max	$f_{max} = f_v$	= **8.471**	[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 = **0.97**	> f_{max}	OK	

Brace Force Load Case 2 Gusset plate t=0.375 P = 100.00 kips (C) ratio = **0.97** **PASS**

Gusset Plate - Shear Yielding ratio = 77.11 / 102.40 = **0.75** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 9.103 [in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 3.413	[in^2]	
Shear force required	V_u =	= **77.11**	[kips]	
Plate shear yielding strength	R_n = 0.6 $F_y A_{gv}$	= 102.40	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕ R_n =	= **102.40**	[kips]	
	ratio = **0.75**	> V_u	OK	

Gusset Plate - Shear Rupture					ratio = 77.11 / 99.84	= **0.77**	**PASS**
Plate Shear Rupture Check							
Plate size	width b_p = 9.103	[in]		thickness t_p = 0.375	[in]		
Plate tensile strength	F_u = 65.0	[ksi]					
Plate net area in shear	$A_{nv} = b_p t_p$			= 3.413	[in^2]		
Shear force in demand	V_u =			= **77.11**	[kips]		
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$			= 133.12	[kips]	AISC 14th	Eq J4-4
Resistance factor-LRFD	ϕ = 0.75					AISC 14th	Eq J4-4
	ϕR_n =			= **99.84**	[kips]		
	ratio = **0.77**			> V_u	OK		

Gusset to Base Plate Weld Strength					ratio = 8.47 / 8.78	= **0.97**	**PASS**
Gusset to Beam Interface - Forces							
	shear H_b = 77.11	[kips]		axial V_b = 0.00	[kips]		
	moment M_b = 0.00	[kip-ft]					
Gusset-beam fillet weld length	L_w =			= 9.103	[in]		
Gusset to Beam Interface - Combined Weld Stress							
Weld stress from axial force	$f_a = V_b / L_{wb}$			= 0.000	[kip/in]		
Weld stress from shear force	$f_v = H_b / L_{wb}$			= 8.471	[kip/in]		
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$			= 0.000	[kip/in]		
Weld stress combined - max	$f_{max} = f_v$			= **8.471**	[kip/in]	AISC 14th	Eq 8-11
Weld resultant load angle	θ = weld only has shear component			= 0.0	[°]		
Fillet Weld Strength Calc							
Fillet weld leg size	w = 5/16	[in]		load angle θ = 0.0	[°]		
Electrode strength	F_{EXX} = 70.0	[ksi]		strength coeff C_1 = 1.00		AISC 14th	Table 8-3
Number of weld line	n = 2 for double fillet						
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$			= 1.00		AISC 14th	Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$			= 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 = **0.97**			> f_{max}	OK		