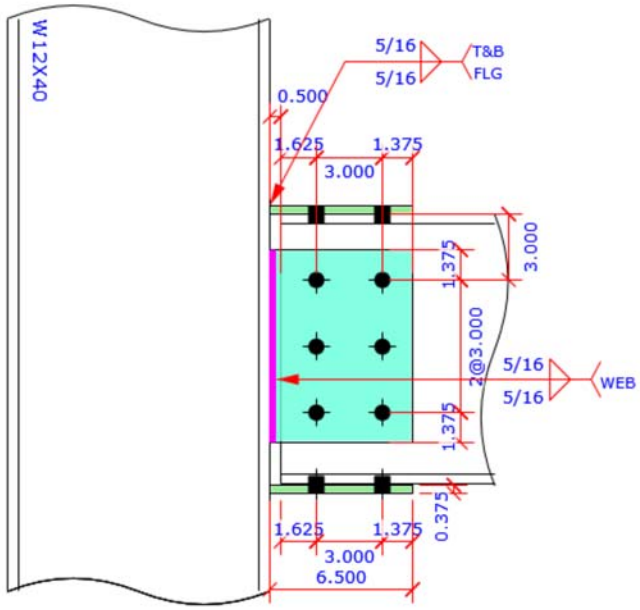
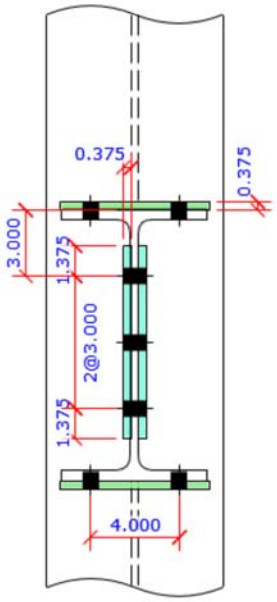
Result Summary - Overall	Moment Connection - Beam to Column	Code=AISC 360-10 LRFD

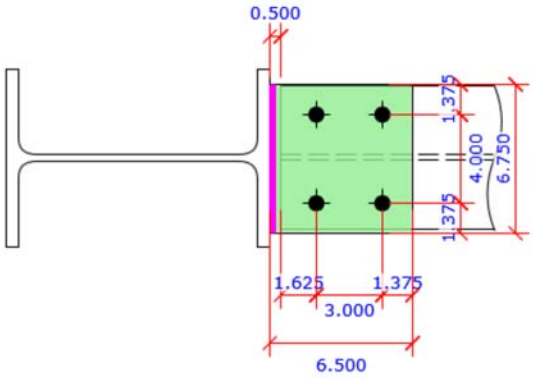
Result Summary - Overall	geometries & weld limitations = **PASS**	limit states max ratio = **0.95**	**PASS**
Right Beam to Column	geometries & weld limitations = **PASS**	limit states max ratio = **0.95**	**PASS**

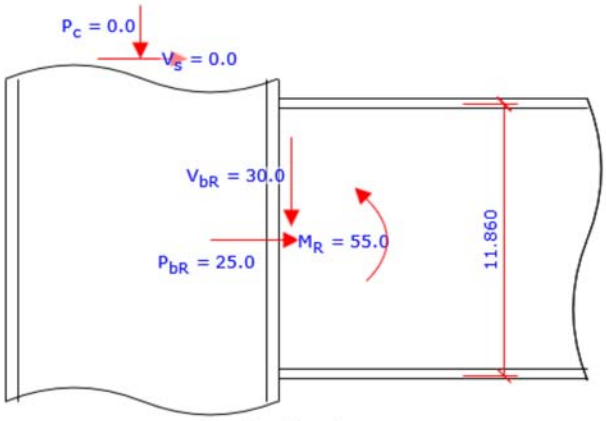
Sketch	Moment Connection - Beam to Column	Code=AISC 360-10 LRFD



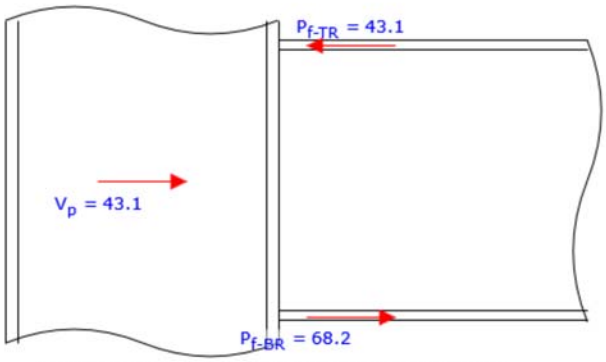


Right Side Beam





Design Load



Beam Flange Force & Panel Zone Shear Vp

Members & Components Summary

Member	Moment 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]	
Right Side Beam Section					
W12X30	d = 12.300	[in]	b_f = 6.520	[in]	
	t_f = 0.440	[in]	t_w = 0.260	[in]	
	k_{des} = 0.740	[in]	k_{det} = 1.125	[in]	
	k_1 = 0.750	[in]	A = 8.790	[in^2]	
	S_x = 38.60	[in^3]	Z_x = 43.10	[in^3]	
Steel Grade A992	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]	

Beam Flange Force Calc

Beam Flange Force - Right Side Beam

Beam section	d_b = 12.300	[in]	t_{fb} = 0.440	[in]
Flange force moment arm	$d_m = d_b - t_{fb}$		= 11.860	[in]
User input load	axial P_{bR} = -25.00	[kips]	moment M_R = 55.00	[kip-ft]
	in tension			
Beam flange force - top	$P_{f\text{-}TR} = P_{bR}/2 + M_R/d_m$		= **43.15**	[kips]
Beam flange force - bottom	$P_{f\text{-}BR} = P_{bR}/2 - M_R/d_m$		= **-68.15**	[kips]

Panel Zone Shear Force Calc

Column story shear	V_s = from user input		= 0.00	[kips]
Panel zone shear force	$V_p = P_{f\text{-}TR} - P_{f\text{-}TL} - V_s$		= **43.15**	[kips]

Right Beam to Column	MC Connection	Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.95** **PASS**

Geometry Restriction Checks - Flange Plate				PASS
Min Bolt Edge Distance - Flange Plate				
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 Plate	L_e =	= **1.260**	[in]	
		> $L_{e\text{-}min}$	OK	
Min Bolt Spacing - Flange Plate				
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 Plate	L_s =	= **3.000**	[in]	
		> $L_{s\text{-}min}$	OK	

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

Fillet Weld Limitation Checks - Flange 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 =	= **6.750**	[in]	
		> L_{min}	OK	

Fillet Weld Limitation Checks - Web 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 =	= **8.750**	[in]		
		> L_{min}	OK		

Flange Plate Weld Strength					ratio = 68.15 / 123.40	= **0.55**	**PASS**
Flange force required in tension	$P_{uf\_t} = P_u / 2 - M_u / d_m$			= **68.15**	[kips]		
Fillet weld length - double fillet	L =			= 6.750	[in]		
Fillet Weld Strength Check							
Fillet weld leg size	w = 5/16	[in]	load angle θ = 90.0		[°]		
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	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$			= 1.50		AISC 14th Page 8-9	
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$			= 27.838	[kip/in]	AISC 14th Eq 8-1	
Base metal - flange_plate	thickness t = 0.375	[in]	tensile F_u = 65.0		[ksi]		
Base metal - flange_plate is in tension, tensile rupture as per AISC 14th Eq J4-2 is checked						AISC 14th J2.4	
Base metal tensile rupture	$R_{n-b} = F_u t$			= 24.375	[kip/in]	AISC 14th Eq J4-2	
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$			= **24.375**	[kip/in]	AISC 14th Eq 9-2	
Resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq 8-1	
	ϕR_n =			= **18.281**	[kip/in]		
Shear resistance required	P_{uf_t} =			= **68.15**	[kips]		
Fillet weld length - double fillet	L =			= 6.750	[in]		
Shear resistance provided	$\phi F_n = \phi R_n \times L$			= **123.40**	[kips]		
	ratio = **0.55**			> P_{uf_t}	OK		

Web Plate Weld Strength				ratio = 30.00 / 95.98	= **0.31**	**PASS**
Shear force in demand	V_u =			= **30.00**	[kips]	
Fillet weld length - double fillet	L =			= 8.750	[in]	
Fillet Weld Strength Check						
Fillet weld leg size	w = $^5/_{16}$	[in]	load angle θ = 0.0		[°]	
Electrode strength	F_{EXX} = 70.0	[ksi]	strength coeff C_1 = 1.00			AISC 14th Table 8-3
Number of weld line	n = 2 for double fillet					
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$			= 1.00		AISC 14th Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 \text{ w n } C_2$			= 18.559	[kip/in]	AISC 14th Eq 8-1
Base metal - web plate	thickness t = 0.375	[in]	tensile F_u = 65.0		[ksi]	
Base metal - web 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]	
Shear resistance required	V_u =			= **30.00**	[kips]	
Fillet weld length - double fillet	L =			= 8.750	[in]	
Shear resistance provided	$\phi F_n = \phi R_n \times L$			= **95.98**	[kips]	
	ratio = **0.31**			> V_u	OK	

Flange Plate - Bolt Shear				ratio = 33.08 / 71.57	= **0.46**	**PASS**
Flange force moment arm	$d_m = d_b$			= 12.300	[in]	
Beam flange force as shear	$V_u = P_b / 2 + M / d_m$			= 66.16	[kips]	
Shear on single flange plate	$V_u = V_u \times 0.5$ (2 shear plane)			= **33.08**	[kips]	
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 =			= **33.08**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$			= 95.43	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq J3-1
	ϕR_n =			= **71.57**	[kips]	
	ratio = **0.46**			> V_u	OK	

Flange Plate - Bolt Bearing							ratio = 34.07 / 71.57	= **0.48**	**PASS**
Flange force moment arm	$d_m = d_b - t_f$						= 11.860	[in]	
Beam flange force as shear	$V_u = P_b / 2 + M / d_m$						= 68.15	[kips]	
Shear on single flange plate	$V_u = V_u$ x 0.5 (double shear plane)						= **34.07**	[kips]	
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 =						= **34.07**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75								AISC 14th J3-10
	ϕ R_n =						= **71.57**	[kips]	
	ratio = **0.48**						> V_u	OK	

Flange Plate - Block Shear - 2 Side Strips			ratio = 68.15 / 101.46	= **0.67**	**PASS**
Flange force moment arm	$d_m = d_b - t_f$		= 11.860	[in]	
Flange force - tension	$P_u = P_b / 2 + M / d_m$		= **68.15**	[kips]	
Plate Block Shear - 2 Side Strips					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 7/8	[in]	AISC 14th B4.3b
Plate thickness	t_p = 0.375	[in]			
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]	
Bolt no in ver & hor dir	n_v = 2		n_h = 2		
Bolt spacing in ver & hor dir	s_v = 4.000	[in]	s_h = 3.000	[in]	
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]	
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2		= 3.281	[in^2]	
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2		= 2.297	[in^2]	
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p$ x 2		= 0.703	[in^2]	
Block shear strength required	V_u =		= **68.15**	[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 = **0.67**		> V_u	OK	

Flange Plate - Block Shear - Center Strip			ratio = 68.15 / 95.75	= **0.71**	**PASS**
Flange force moment arm	$d_m = d_b - t_f$		= 11.860	[in]	
Flange force - tension	$P_u = P_b / 2 + M / d_m$		= **68.15**	[kips]	
Plate Block Shear - Center Strip					
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 7/8	[in]	AISC 14th B4.3b
Plate thickness	t_p = 0.375	[in]			
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]	
Bolt no in ver & hor dir	n_v = 2		n_h = 2		
Bolt spacing in ver & hor dir	s_v = 4.000	[in]	s_h = 3.000	[in]	
Bolt edge dist in ver & hor dir	e_v = 1.375	[in]	e_h = 1.375	[in]	
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p$ x 2		= 3.281	[in^2]	
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$ x2		= 2.297	[in^2]	
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 1.172	[in^2]	
Block shear strength required	V_u =		= **68.15**	[kips]	
Uniform tension stress factor	U_{bs} = 0.50				AISC 14th Fig C-J4.2
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$		= 127.66	[kips]	AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5
	ϕR_n =		= **95.75**	[kips]	
	ratio = **0.71**		> V_u	OK	

Flange Plate - Tensile Yielding					ratio = 68.15 / 113.91	= **0.60**	**PASS**
Flange force moment arm	$d_m = d_b - t_f$				= 11.860	[in]	
Flange force - tension	$P_u = P_b / 2 + M / d_m$				= **68.15**	[kips]	
Plate Tensile Yielding Check							
Plate size	width b_p = 6.750	[in]	thickness t_p = 0.375	[in]			
Plate yield strength	F_y = 50.0	[ksi]					
Plate gross area in shear	$A_g = b_p t_p$				= 2.531	[in^2]	
Tensile force required	P_u =				= **68.15**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$				= 126.56	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90						AISC 14th Eq J4-1
	ϕR_n =				= **113.91**	[kips]	
	ratio = **0.60**				> P_u	OK	

Flange Plate - Tensile Rupture					ratio = 68.15 / 91.41	= **0.75**	**PASS**
Flange force moment arm	$d_m = d_b - t_f$				= 11.860	[in]	
Flange force - tension	$P_u = P_b / 2 + M / d_m$				= **68.15**	[kips]	
Plate Tensile Rupture Check							
Bolt hole diameter	bolt dia d_b = 3/4	[in]	bolt hole dia d_h = 7/8	[in]			AISC 14th B4.3b
Number of bolt	n = 2						
Plate size	width b_p = 6.750	[in]	thickness t_p = 0.375	[in]			
Plate tensile strength	F_u = 65.0	[ksi]					
Plate net area in tension	$A_{nt} = (b_p - n d_h) t_p$				= 1.875	[in^2]	
Tensile force required	P_u =				= **68.15**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$				= 121.88	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75						AISC 14th Eq J4-2
	ϕR_n =				= **91.41**	[kips]	AISC 14th Eq J4-2
	ratio = **0.75**				> P_u	OK	

Flange Plate - Compression					ratio = 43.15 / 113.91	= **0.38**	**PASS**
Flange force moment arm	$d_m = d_b - t_f$				= 11.860	[in]	
Flange force - compression	$P_u = P_b / 2 + M / d_m$				= **43.15**	[kips]	
Plate Compression Check							
Plate size	width b_p = 6.750	[in]			thickness t_p = 0.375	[in]	
	F_y = 50.0	[ksi]			E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$				= 2.531	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$				= 0.108	[in]	
Plate effective length factor	K =				= 0.65		
Plate unbraced length	L_u =				= 2.125	[in]	
Plate slenderness	KL/r = 0.65 x L_u / r				= 12.76		
Plate compression required	P_u =				= **43.15**	[kips]	
	when $\frac{KL}{r} \leq 25$						AISC 14th J4.4 (a)
Plate compression provided	$R_n = F_y$ x A_g				= 126.56	[kips]	AISC 14th Eq J4-6
Bolt resistance factor-LRFD	ϕ = 0.90						AISC 14th J4.4 (a)
	ϕR_n =				= **113.91**	[kips]	
	ratio = **0.38**				> P_u	OK	

Web Plate - Bolt Bearing

ratio = 15.00 / 107.35 = **0.14** **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} = 4	edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$	= 143.14	[kips]	
Required shear strength	V_u =	= **15.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75			AISC 14th J3-10
	ϕ R_n =	= **107.35**	[kips]	
	ratio = **0.14**	> V_u	OK	

Web Plate - Shear Yielding

ratio = 15.00 / 98.44 = **0.15** **PASS**

Plate Shear Yielding Check

Plate size	width b_p = 8.750	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 3.281	[in^2]	
Shear force required	V_u =		= **15.00**	[kips]	
Plate shear yielding strength	$R_n = 0.6\, F_y A_{gv}$		= 98.44	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕ R_n =		= **98.44**	[kips]	
	ratio = **0.15**		> V_u	OK	

Web Plate - Shear Rupture ratio = 15.00 / 67.18 = **0.22** **PASS**

Plate Shear Rupture Check

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]		AISC 14th B4.3b	
Number of bolt	n = 3				
Plate size	width b_p = 8.750 [in]	thickness t_p = 0.375 [in]			
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in shear	$A_{nv} = (b_p - n\, d_h)\, t_p$	= 2.297	[in^2]		
Shear force required	V_u =	= **15.00**	[kips]		
Plate shear rupture strength	$R_n = 0.6\, F_u\, A_{nv}$	= 89.58	[kips]	AISC 14th Eq J4-4	
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4	
	$\phi\, R_n$ =	= **67.18**	[kips]		
	ratio = **0.22**	> V_u	OK		

Web Plate - Block Shear - 1-Side Strip ratio = 15.00 / 84.89 = **0.18** **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 = 3			
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	$A_{gv} = [(n_h - 1)\, s_h + e_h]\, t_p$	= 2.766	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5]\, d_h\, t_p$	= 1.945	[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 =	= **15.00**	[kips]		
Uniform tension stress factor	U_{bs} = 0.50			AISC 14th Fig C-J4.2	
Bolt shear resistance provided	R_n = min $(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$	= 113.19	[kips]	AISC 14th Eq J4-5	
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-5	
	$\phi\, R_n$ =	= **84.89**	[kips]		
	ratio = **0.18**	> V_u	OK		

Beam Flange - Bolt Shear			ratio = 66.16 / 71.57	= **0.92**	**PASS**
Flange force moment arm	$d_m = d_b$		= 12.300	[in]	
Beam flange force as shear	$V_u = P_b / 2 + M / d_m$		= **66.16**	[kips]	
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 =		= **66.16**	[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 = **0.92**		> V_u	OK	

Beam Flange - Bolt Bearing			ratio = 68.15 / 71.57	= **0.95**	**PASS**
Flange force moment arm	$d_m = d_b - t_{fb}$		= 11.860	[in]	
Beam flange force as shear	$V_u = P_b / 2 + M / d_m$		= **68.15**	[kips]	
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 = 0.440 [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
	= 93.84 ≤ 64.35		= 64.35	[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
	= 52.28 ≤ 64.35		= 52.28	[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 =		= **68.15**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **71.57**	[kips]	
	ratio = **0.95**		> V_u	OK	

Beam Flange - Block Shear - 2 Side Strips					ratio = 68.15 / 120.55	= **0.57**	**PASS**
Flange force moment arm	$d_m = d_b - t_{fb}$				= 11.860	[in]	
Beam flange force - tension	$V_u = P_b / 2 + M / d_m$				= **68.15**	[kips]	
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 = 0.440	[in]					
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0		[ksi]		
Bolt no in ver & hor dir	n_v = 2		n_h = 2				
Bolt spacing in ver & hor dir	s_v = 4.000	[in]	s_h = 3.000		[in]		
Bolt edge dist in ver & hor dir	e_v = 1.260	[in]	e_h = 1.625		[in]		
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$				= 4.070	[in^2]	
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$				= 2.915	[in^2]	
Net area subject to tension when sheared out by 2 side strips	$A_{nt} = (e_v - 0.5 d_h) t_p \times 2$				= 0.724	[in^2]	
Block shear strength required	V_u =				= **68.15**	[kips]	
Uniform tension stress factor	U_{bs} = 1.00					AISC 14th Fig C-J4.2	
Bolt shear resistance provided	$R_n = \min(0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$				= 160.73	[kips]	AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq J4-5	
	ϕR_n =				= **120.55**	[kips]	
	ratio = **0.57**				> V_u	OK	

Beam Web - Bolt Shear					ratio = 30.00 / 214.71	= **0.14**	**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 = 6.0			shear plane m = 2			
Required shear strength	V_u =			= **30.00**	[kips]		
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$			= 286.28	[kips]	AISC 14th Eq J3-1	
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq J3-1	
	ϕR_n =			= **214.71**	[kips]		
	ratio = **0.14**			> V_u	OK		

Beam Web - Bolt Bearing					ratio = 30.00 / 171.11	= **0.18**	**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 = 0.260	[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
	= 55.45 ≤ 38.03				= 38.03	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$				= 38.03	[kips]	
Number of bolt	interior n_{in} = 6						
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$				= 228.15	[kips]	
Required shear strength	V_u =				= **30.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕ R_n =				= **171.11**	[kips]	
	ratio = **0.18**				> V_u	OK	

Beam Web - Shear Yielding					ratio = 30.00 / 95.94	= **0.31**	**PASS**
Plate Shear Yielding Check							
Plate size	width b_p = 12.300	[in]			thickness t_p = 0.260	[in]	
Plate yield strength	F_y = 50.0	[ksi]					
Plate gross area in shear	$A_{gv} = b_p t_p$				= 3.198	[in^2]	
Shear force required	V_u =				= **30.00**	[kips]	
Plate shear yielding strength	$R_n = 0.6\, F_y A_{gv}$				= 95.94	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00						AISC 14th Eq J4-3
	ϕ R_n =				= **95.94**	[kips]	
	ratio = **0.31**				> V_u	OK	

Beam Web - Shear Rupture			ratio = 30.00 / 73.58	= **0.41**	**PASS**
Plate Shear Rupture Check					
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th B4.3b
Number of bolt	n = 3				
Plate size	width b_p = 12.300	[in]	thickness t_p = 0.260	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	A_{nv} = (b_p - n d_h) t_p		= 2.516	[in^2]	
Shear force required	V_u =		= **30.00**	[kips]	
Plate shear rupture strength	R_n = 0.6 F_u A_{nv}		= 98.10	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕ R_n =		= **73.58**	[kips]	
	ratio = **0.41**		> V_u	OK	

Column Flange Bending			ratio = 68.15 / 74.59	= **0.91**	**PASS**
Flange force moment arm	d_m = d_b + t_p		= 11.860	[in]	
Flange force required - tension	P_{uf_t} = P_u / 2 - M_u / d_m		= **68.15**	[kips]	
Column flange thickness	t_{fc} = 0.515	[in]	yield F_{yc} = 50.0	[ksi]	
Top column condition	it's not a top column case		C_t = 1.0		AISC 14th J10.1
Column flange tensile resistance	R_n = C_t 6.25 F_{yc} t_{fc}^2		= 82.88	[kips]	AISC 14th Eq J10-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th J10.1
	ϕ R_n =		= **74.59**	[kips]	
	ratio = **0.91**		> P_{uf_t}	OK	

Column Web Yielding			ratio = 68.15 / 89.97	= **0.76**	**PASS**
Flange force moment arm	d_m = d_b + t_p		= 11.860	[in]	
Flange force in demand	P_{uf} = max (P_{uf_t} , P_{uf_c})		= **68.15**	[kips]	AISC DG13 Eq 4.2-1
Column section	d_c = 11.900	[in]	t_{fc} = 0.515	[in]	
	t_{wc} = 0.295	[in]	k_c = 1.020	[in]	
Column yield strength	F_{yc} = 50.0	[ksi]			
Top column condition	it's not a top column case				AISC 14th J10.2 (a)
Flange plate fillet weld size	w = 0.313	[in]	flange plate t_p = 0.375	[in]	
Length of bearing	N = t_p + 2 w		= 1.000	[in]	AISC DG4 Eq 3.24
Column web yielding strength	R_n = (5 k_c + N) F_{yc} t_{wc}		= 89.97	[kips]	AISC 14th Eq J10-2
Resistance factor-LRFD	ϕ = 1.00				AISC 14th J10.2
	ϕ R_n =		= **89.97**	[kips]	
	ratio = **0.76**		> P_{uf}	OK	

Column Web Buckling				ratio = 43.15 / 67.72	= **0.64**	**PASS**
Flange force moment arm	$d_m = d_b + t_p$			= 11.860	[in]	
Flange force required in compression	$P_{uf\_c} = P_u / 2 - M_u / d_m$			= **43.15**	[kips]	
Column section	d_c = 11.900	[in]		t_{fc} = 0.515	[in]	
	t_{wc} = 0.295	[in]		k_c = 1.020	[in]	
	$h = d_c - 2 k_c$			= 9.860	[in]	
Column yield strength	F_{yc} = 50.0	[ksi]		E_c = 29000	[ksi]	
Top column condition	it's not a top column case			C_t = 1.0		AISC 14th J10.5
Column web buckling strength	$R_n = \frac{C_t 24 t_{wc}^3 \sqrt{E_c F_{yc}}}{h}$			= 75.25	[kips]	AISC 14th Eq J10-8
Resistance factor-LRFD	ϕ = 0.90					AISC 14th J10.5
	ϕR_n =			= **67.72**	[kips]	
	ratio = **0.64**			> P_{uf_c}	OK	

Column Web Crippling				ratio = 43.15 / 92.15	= **0.47**	**PASS**
Flange force moment arm	$d_m = d_b + t_p$			= 11.860	[in]	
Flange force required in compression	$P_{uf\_c} = P_u / 2 - M_u / d_m$			= **43.15**	[kips]	
Column section	d_c = 11.900	[in]		t_{fc} = 0.515	[in]	
	t_{wc} = 0.295	[in]		k_c = 1.020	[in]	
Column yield strength	F_{yc} = 50.0	[ksi]		E_c = 29000	[ksi]	
Flange plate fillet weld size	w = 0.313	[in]		flange plate t_p = 0.375	[in]	
Length of bearing	$l_b = t_p + 2 w$			= 1.000	[in]	
Distance from top of column to top of beam flange	$d_{end\text{-}flg}$ =			= 4.000	[in]	
Top column condition	it's not a top column case, use Eq J10-4					AISC 14th J10.3 (a)
Column web crippling strength	$R_n = 0.8 t_{wc}^2 [1+3\frac{l_b}{d_c}(\frac{t_{wc}}{t_{fc}})^{1.5}] x (\frac{E_c F_{yc} t_{fc}}{t_{wc}})^{0.5}$			= 122.87	[kips]	AISC 14th Eq J10-4
Resistance factor-LRFD	ϕ = 0.75					AISC 14th J10.3
	ϕR_n =			= **92.15**	[kips]	
	ratio = **0.47**			> P_{uf_c}	OK	

Column Panel Zone Shear		ratio = 43.15 / 94.78	= **0.46**	**PASS**
Panel zone shear force	$V_p = P_{f\text{-}TR} - P_{f\text{-}TL} - V_s$	= **43.15**	[kips]	
Column section	d_c = 11.900 [in]	t_{wc} = 0.295	[in]	
	A_c = 11.700 [in^2]	F_{yc} = 50.0	[ksi]	
Column axial compression - user input	P_r =	= 0.00	[kips]	
	$P_c = P_y = F_{yc} A_c$	= 585.00	[kips]	AISC 14th J10.6
	$P_r \le 0.4\ P_c$, use Eq J10-9			AISC 14th Eq J10-9
Web panel zone capacity	$R_n = 0.6\ F_{yc}\ d_c\ t_{wc}$	= 105.32	[kips]	AISC 14th Eq J10-9
Resistance factor-LRFD	ϕ = 0.90			AISC 14th J10.6
	$\phi\ R_n$ =	= **94.78**	[kips]	
	ratio = **0.46**	> V_p	OK	