

Result Summary - Overall

Moment Connection - Beam to Column

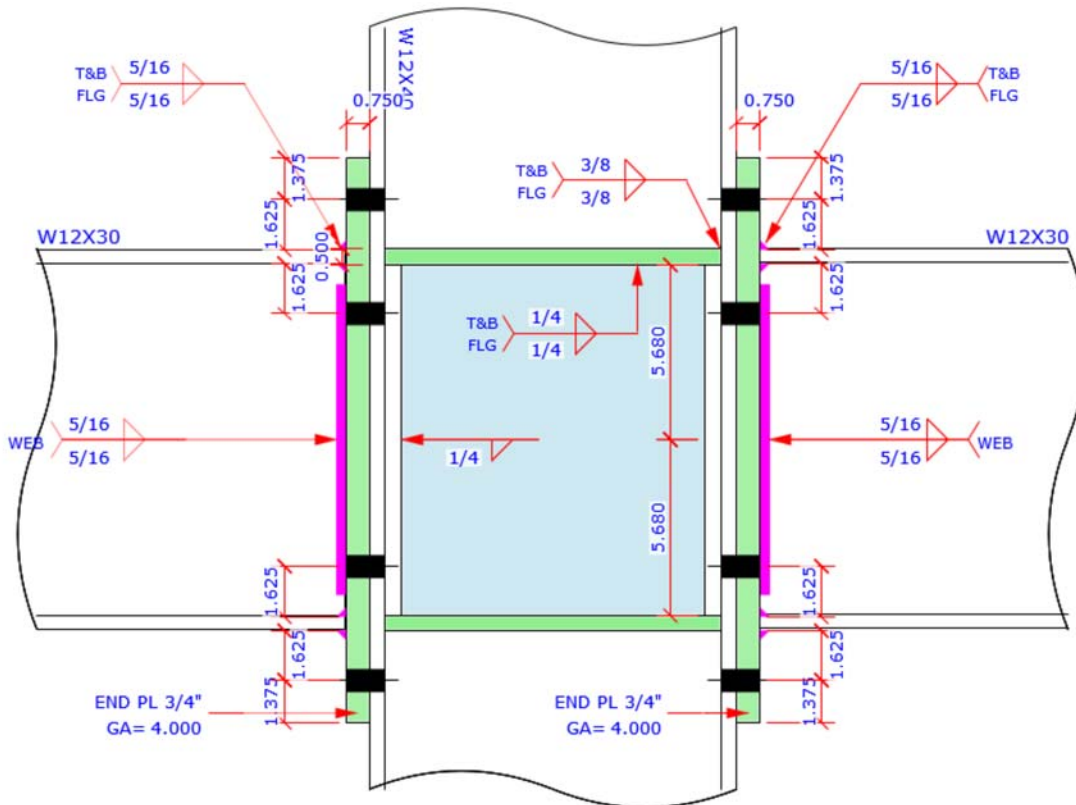
Code=AISC 360-10 LRFD

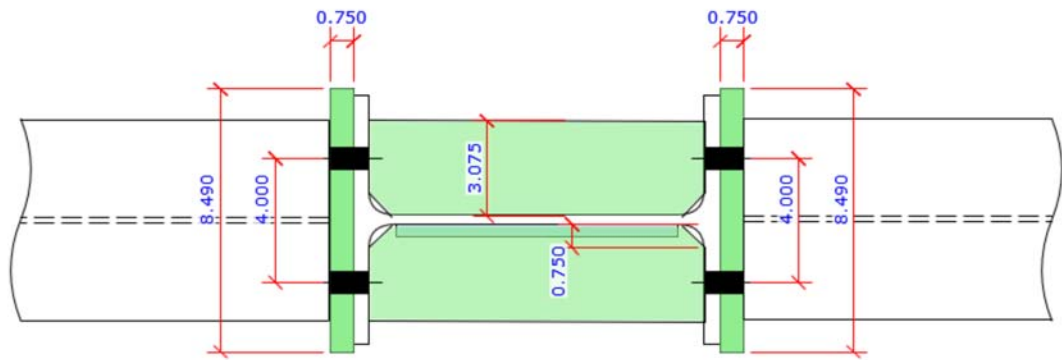
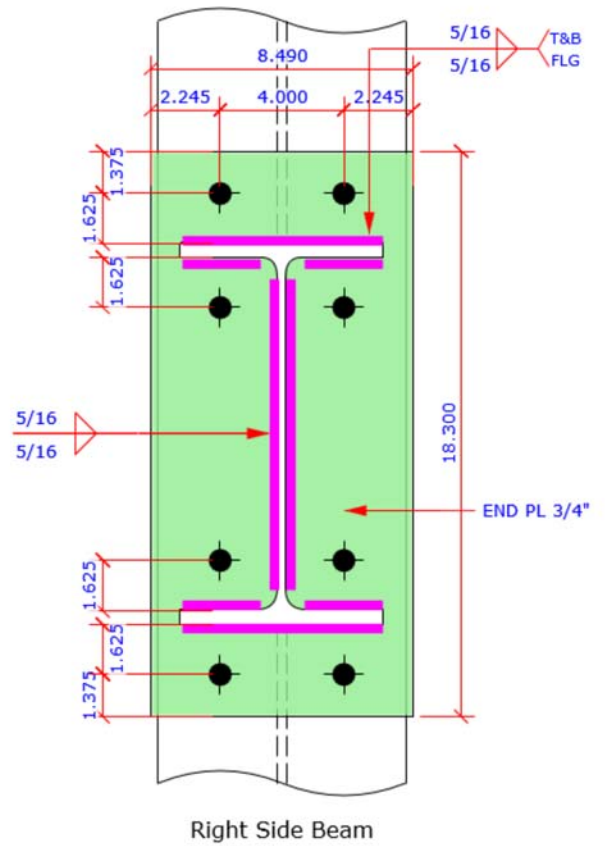
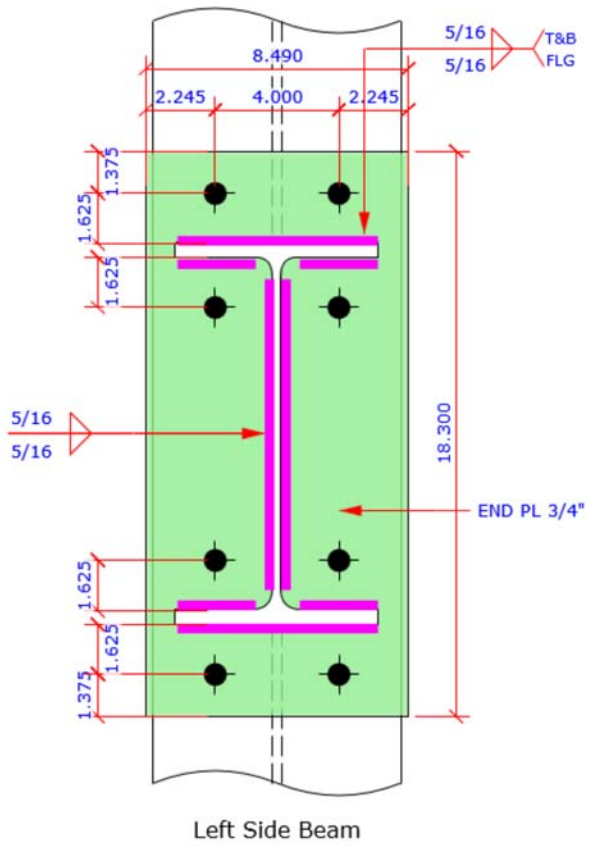
Result Summary - Overall	geometries & weld limitations = PASS	limit states max ratio = 0.95	PASS
Right Beam to Column	geometries & weld limitations = PASS	limit states max ratio = 0.95	PASS
Left Beam to Column	geometries & weld limitations = PASS	limit states max ratio = 0.95	PASS

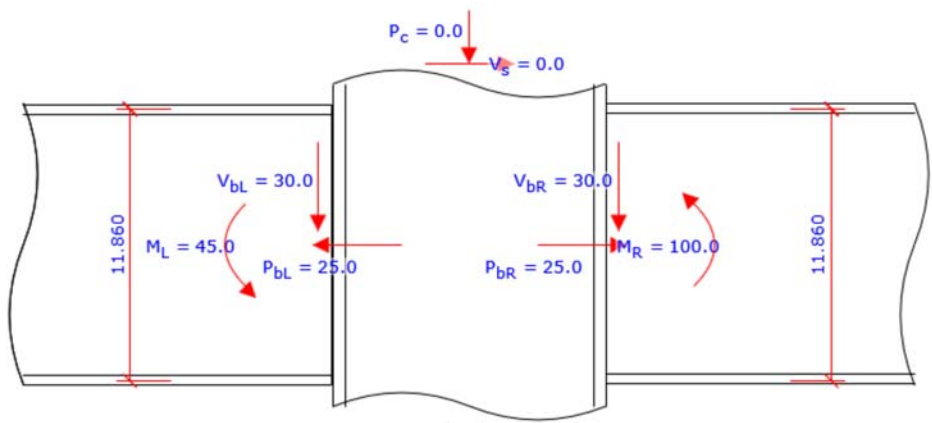
Sketch

Moment Connection - Beam to Column

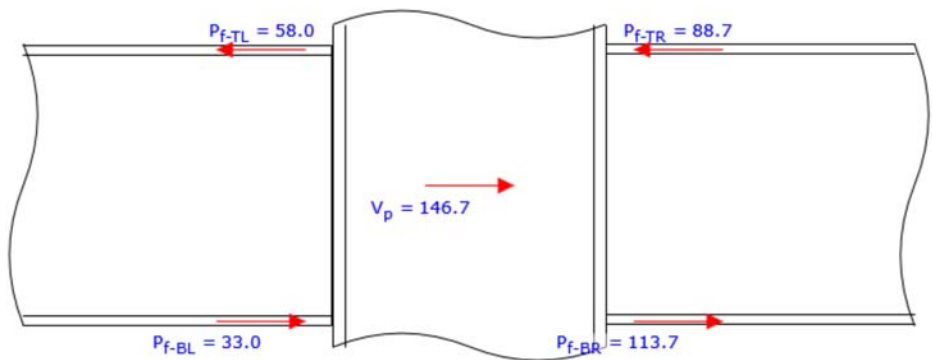
Code=AISC 360-10 LRFD







Design Load



Beam Flange Force & Panel Zone Shear V_p

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]
Left 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] in tension	moment $M_R = 100.00$ [kip-ft]
Beam flange force - top	$P_{f-TR} = P_{bR} / 2 + M_R / d_m$	$= 88.68$ [kips]
Beam flange force - bottom	$P_{f-BR} = P_{bR} / 2 - M_R / d_m$	$= -113.68$ [kips]

Beam Flange Force - Left 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 $P_{bL} = -25.00$ [kips] in tension	moment $M_L = 45.00$ [kip-ft]
Beam flange force - top	$P_{f-TL} = P_{bL} / 2 - M_L / d_m$	$= -58.03$ [kips]
Beam flange force - bottom	$P_{f-BL} = P_{bL} / 2 + M_L / d_m$	$= 33.03$ [kips]

Panel Zone Shear Force Calc

Column story shear	$V_s =$ from user input	$= 0.00$ [kips]
Panel zone shear force	$V_p = P_{f-TR} - P_{f-TL} - V_s$	$= 146.71$ [kips]

Right Beam to Column

MC Connection

Code=AISC 360-10 LRFD

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

Geometry Restriction Checks			PASS
Min Bolt Edge Distance - Column Flange			
Bolt diameter	$d_b =$	= 0.750 [in]	
Min edge distance allowed	$L_{e-min} =$	= 1.000 [in]	AISC 14 th Table J3.4
Min edge distance in Column Flange	$L_e =$	= 2.005 [in]	
		> L_{e-min}	OK
Min Bolt Spacing - End Plate			
Bolt diameter	$d_b =$	= 0.750 [in]	
Min bolt spacing allowed	$L_{s-min} = 2.667 d_b$	= 2.000 [in]	AISC 14 th J3.3
Min Bolt spacing in End Plate	$L_s =$	= 3.690 [in]	
		> L_{s-min}	OK
Min Bolt Edge Distance - End Plate			
Bolt diameter	$d_b =$	= 0.750 [in]	
Min edge distance allowed	$L_{e-min} =$	= 1.000 [in]	AISC 14 th Table J3.4
Min edge distance in End Plate	$L_e =$	= 1.375 [in]	
		> L_{e-min}	OK
Max Bolt Edge Distance - End Plate			
Connecting plate thickness	$t_p =$	= 0.750 [in]	
Max edge distance allowed	$L_{e-max} = \min (12t , 6")$	= 6.000 [in]	AISC 14 th J3.5
Max edge distance in End Plate	$L_e =$	= 2.245 [in]	
		< L_{e-max}	OK
Beam Flange Fillet Weld Limitation			PASS
Min Fillet Weld Size			
Thinner part joined thickness	$t =$	= 0.440 [in]	
Min fillet weld size allowed	$w_{min} =$	= 0.188 [in]	AISC 14 th 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	$L_{min} = 4 \times w$	= 1.250 [in]	AISC 14 th J2.2b
Min fillet weld length	$L = 0.5 b_{fb} - k_{1b}$	= 2.510 [in]	
		> L_{min}	OK

Beam Web Fillet Weld Limitation			PASS
Min Fillet Weld Size			
<hr/>			
Thinner part joined thickness	$t =$	$= 0.260$ [in]	
Min fillet weld size allowed	$w_{min} =$	$= 0.188$ [in]	AISC 14 th Table J2.4
Fillet weld size provided	$w =$	$= 0.313$ [in]	
		$> w_{min}$	OK
Min Fillet Weld Length			
<hr/>			
Fillet weld size provided	$w =$	$= 0.313$ [in]	
Min fillet weld length allowed	$L_{min} = 4 \times w$	$= 1.250$ [in]	AISC 14 th J2.2b
Min fillet weld length	$L = 0.5 d_b - k_b$	$= 5.025$ [in]	
		$> L_{min}$	OK
Min Beam Web to End Plate Fillet Weld Size			
<hr/>			
Beam web to end-plate fillet weld in the tension-bolt region to develop the yield strength of the beam web			AISC DG4 Page 9 Item 7
Shear resistance factor-LRFD	$\phi_v = 0.90$		AISC 14 th G1
Fillet weld shear strength	$\phi R_{n-w} =$	$= 1.392$ [kip/in]	AISC 14 th Eq 8-2a
Fillet weld strength $\phi R_{n-w} \times 1.5 \times 2$ to account for 90° load angle when it's in tension and double fillet			
Min double fillet weld size to match beam web yield strength	$D_{min} = \phi_v F_{yb} t_{wb} / (\phi R_{n-w} \times 1.5 \times 2)$	$= 2.802$ [1/16 "]	
Fillet weld size provided	$D =$	$= 5.000$ [1/16 "]	
		$> D_{min}$	OK

Verify AISC DG4 Bolt No Prying Assumption			AISC DG4 Is Used
Bolt Moment Strength (No Prying)			
	bolt grade = A325-N	$F_t = 90.0$ [ksi]	AISC 14 th Table J3.2
	bolt dia $d_b = 0.750$ [in]	bolt area $A_b = 0.442$ [in ²]	
Bolt nominal tensile strength	$P_t = F_t A_b$	$= 39.76$ [kips]	AISC 14 th Eq J3-1
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]	
Bolt moment strength (no prying)	$M_{np} = 2 P_t (h_0 + h_1)$	$= 157.19$ [kip-ft]	AISC DG4 Eq 3.7
Bolt resistance factor-LRFD	$\phi = 0.75$		AISC 14 th Eq J3-1
	$\phi M_{np} =$	$= 117.89$ [kip-ft]	
End Plate Bending Strength			
End plate width	$b_{plate} = 8.490$ [in]	thickness $t_p = 0.750$ [in]	
Beam flange width	$b_{fb} = 6.520$ [in]		
Effective end plate width	$b_p = \min (b_{plate}, b_{fb} + 1")$	$= 7.520$ [in]	AISC DG4 Page 9 item 5
End plate yield strength	$F_{yp} = 50.0$ [ksi]		
See AISC DG4 Table 3.1 for all formulas to derive the following parameters			AISC DG4 Table 3.1
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]	
	$g = 4.000$ [in]		
	$p_{fi} = 1.625$ [in]	$p_{fo} = 1.625$ [in]	
	$s = 2.742$ [in]	$Y_p = 88.61$ [in]	
Flexure resistance factor-LRFD	$\phi_b = 0.90$		AISC 14 th F1 (1)
End plate bending strength	$\phi_b M_{pl} = \phi_b F_{yp} t_p^2 Y_p$	$= 186.90$ [kip-ft]	AISC DG4 Table 3.1
Check thick end plate condition	$\phi_b M_{pl} \geq 1.11 \times \phi M_{np}$		AISC DG4 Eq 3.33
	ratio = 0.70 thick plate		
Column Flange Bending Strength			
See AISC DG4 Table 3.4 for all formulas to derive the following parameters			AISC DG4 Table 3.4
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]	
*** Stiffened Column Flange Case ***			
Column section	$b_{fc} = 8.010$ [in]	$t_{fc} = 0.515$ [in]	
	$F_{yc} = 50.0$ [ksi]	bolt gage $g = 4.000$ [in]	
	$s = 2.830$ [in]	$c = 3.690$ [in]	
Stiffener plate thickness	$t_s = 0.500$ [in]		
	$p_{si} = 1.595$ [in]	$p_{so} = 1.595$ [in]	
	$Y_c = 145.6$ [in]		
Flexure resistance factor-LRFD	$\phi_b = 0.90$		AISC 14 th F1 (1)
Column flange bending strength	$\phi_b M_{cf} = \phi_b F_{yc} t_{fc}^2 Y_c$	$= 144.82$ [kip-ft]	AISC DG4 Table 3.4
Check thick column flange condition	$\phi_b M_{cf} \geq 1.11 \times \phi M_{np}$		AISC DG4 Eq 3.35
	ratio = 0.90 thick plate		
The thick end plate and column flange conditions are met. AISC DG4 is used and no bolt prying is considered			AISC DG4 Eq 3.33 & 3.35

Bolt Moment Strength (No Prying)		ratio = 113.68 / 119.28 = 0.95	PASS
	bolt grade = A325-N	$F_t = 90.0$ [ksi]	AISC 14 th Table J3.2
	bolt dia $d_b = 0.750$ [in]	bolt area $A_b = 0.442$ [in ²]	
Bolt nominal tensile strength	$P_t = F_t A_b$	= 39.76 [kips]	AISC 14 th Eq J3-1
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]	
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860 [in]	
Flange force required in tension	$P_{uf_t} = P_u / 2 - M_u / d_m$	= 113.68 [kips]	
Flange force resistance by bolt	$F_n = 2 P_t (h_0 + h_1) / d_m$	= 159.04 [kips]	AISC DG4 Eq 3.7
Bolt resistance factor-LRFD	$\phi = 0.75$		AISC 14 th Eq J3-1
	$\phi F_n =$	= 119.28 [kips]	AISC DG4 Eq 3.7
	ratio = 0.95	> P_{uf_t}	OK
Bolt Shear Strength		ratio = 30.00 / 71.57 = 0.42	PASS
Bolt shear stress	bolt grade = A325-N	$F_{nv} = 54.0$ [ksi]	AISC 14 th 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	$V_u =$	= 30.00 [kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$	= 95.43 [kips]	AISC 14 th Eq J3-1
Bolt resistance factor-LRFD	$\phi = 0.75$		AISC 14 th Eq J3-1
	$\phi R_n =$	= 71.57 [kips]	
	ratio = 0.42	> V_u	OK

Bolt Bearing/TearOut Strength on End Plate		ratio = 30.00 / 71.57	= 0.42	PASS
Single Bolt Shear Strength				
Bolt shear stress	bolt grade = A325-N	$F_{nv} = 54.0$	[ksi]	AISC 14 th Table J3.2
	bolt dia $d_b = 0.750$	[in]	bolt area $A_b = 0.442$	[in ²]
Single bolt shear strength	$R_{n-bolt} = F_{nv} A_b$	= 23.86	[kips]	AISC 14 th 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 14 th Table J3.3
Bolt spacing & edge distance	spacing $L_s = 3.690$	[in]	edge distance $L_e = 1.375$	[in]
Plate tensile strength	$F_u = 65.0$	[ksi]		
Plate thickness	$t = 0.750$	[in]		
Interior Bolt				
Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.878	[in]	
Bolt tear out/bearing strength	$R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$	= 109.69	[kips]	AISC 14 th Eq J3-6b
	= 210.42 ≤ 109.69			
Bolt strength at interior	$R_{n-in} = \min (R_{n-t\&b-in}, R_{n-bolt})$	= 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	$R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$	= 70.84	[kips]	AISC 14 th Eq J3-6b
	= 70.84 ≤ 109.69			
Bolt strength at edge	$R_{n-ed} = \min (R_{n-t\&b-ed}, R_{n-bolt})$	= 23.86	[kips]	
Number of bolt	interior $n_{in} = 2$	edge $n_{ed} = 2$		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$	= 95.43	[kips]	
Required shear strength	$V_u =$	= 30.00	[kips]	
Bolt resistance factor-LRFD	$\phi = 0.75$			AISC 14 th J3-10
	$\phi R_n =$	= 71.57	[kips]	
	ratio = 0.42	> V_u	OK	

Bolt Bearing/TearOut Strength on Column Flange		ratio = 30.00 / 71.57	= 0.42	PASS
Single Bolt Shear Strength				
Bolt shear stress	bolt grade = A325-N	$F_{nv} = 54.0$	[ksi]	AISC 14 th Table J3.2
	bolt dia $d_b = 0.750$	[in]	bolt area $A_b = 0.442$	[in ²]
Single bolt shear strength	$R_{n-bolt} = F_{nv} A_b$	= 23.86	[kips]	AISC 14 th 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 14 th Table J3.3
Bolt spacing	spacing $L_s = 3.690$	[in]		
Plate tensile strength	$F_u = 65.0$	[ksi]		
Plate thickness	$t = 0.515$	[in]		
Interior Bolt				
Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.878	[in]	
Bolt tear out/bearing strength	$R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$	= 75.32	[kips]	AISC 14 th Eq J3-6b
	= 144.49 \leq 75.32			
Bolt strength at interior	$R_{n-in} = \min (R_{n-t\&b-in}, R_{n-bolt})$	= 23.86	[kips]	
Number of bolt	interior $n_{in} = 4$			
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n-in}$	= 95.43	[kips]	
Required shear strength	$V_u =$	= 30.00	[kips]	
Bolt resistance factor-LRFD	$\phi = 0.75$			AISC 14 th J3-10
	$\phi R_n =$	= 71.57	[kips]	
	ratio = 0.42	> V_u		OK

End Plate Flexural Yielding		ratio = 113.68 / 189.11 = 0.60		PASS
End Plate Bending Strength				
End plate width	$b_{plate} = 8.490$ [in]	thickness $t_p = 0.750$ [in]		
Beam flange width	$b_{fb} = 6.520$ [in]			
Effective end plate width	$b_p = \min (b_{plate}, b_{fb} + 1")$	$= 7.520$ [in]		AISC DG4 Page 9 item 5
End plate yield strength	$F_{yp} = 50.0$ [ksi]			
See AISC DG4 Table 3.1 for all formulas to derive the following parameters				AISC DG4 Table 3.1
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]		
	$g = 4.000$ [in]			
	$p_{fi} = 1.625$ [in]	$p_{fo} = 1.625$ [in]		
	$s = 2.742$ [in]	$Y_p = 88.61$ [in]		
Flexure resistance factor-LRFD	$\phi_b = 0.90$			AISC 14 th F1 (1)
End plate bending strength	$\phi_b M_{pl} = \phi_b F_{yp} t_p^2 Y_p$	$= 186.90$ [kip-ft]		AISC DG4 Table 3.1
Flange force moment arm	$d_m = d_b - t_{fb}$	$= 11.860$ [in]		
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	$= 113.68$ [kips]		
Flange force provided by end plate bending	$\phi R_{pl} = \phi M_{pl} / d_m$	$= 189.11$ [kips]		AISC DG4 Eq 3.10
	ratio = 0.60	$> P_{uf,t}$	OK	
End Plate Shear Yielding		ratio = 56.84 / 169.20 = 0.34		PASS
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	$= 56.84$ [kips]		
End plate width	$b_{plate} = 8.490$ [in]	thickness $t_p = 0.750$ [in]		
Beam flange width	$b_{fb} = 6.520$ [in]			
Effective end plate width	$b_p = \min (b_{plate}, b_{fb} + 1")$	$= 7.520$ [in]		AISC DG4 Page 9 item 5
Plate Shear Yielding Check				
Plate size	width $b_p = 7.520$ [in]	thickness $t_p = 0.750$ [in]		
Plate yield strength	$F_y = 50.0$ [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	$= 5.640$ [in ²]		
Shear force required	$0.5 P_{uf,t} =$	$= 56.84$ [kips]		
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	$= 169.20$ [kips]		AISC 14 th Eq J4-3
Resistance factor-LRFD	$\phi = 1.00$			AISC 14 th Eq J4-3
	$\phi R_n =$	$= 169.20$ [kips]		
	ratio = 0.34	$> 0.5 P_{uf,t}$	OK	

End Plate Shear Rupture		ratio = 56.84 / 126.58	= 0.45	PASS
Flange force required in tension	$P_{uf_t} = P_u / 2 - M_u / d_m$	= 56.84	[kips]	
End plate width	$b_{plate} = 8.490$ [in]	thickness $t_p = 0.750$	[in]	
Beam flange width	$b_{fb} = 6.520$ [in]			
Effective end plate width	$b_p = \min (b_{plate}, b_{fb} + 1")$	= 7.520	[in]	AISC DG4 Page 9 item 5
Plate Shear Rupture Check				
Bolt hole diameter	bolt dia $d_b = 3/4$ [in]	bolt hole dia $d_h = 7/8$	[in]	AISC 14 th B4.3b
Number of bolt	$n = 2$			
Plate size	width $b_p = 7.520$ [in]	thickness $t_p = 0.750$	[in]	
Plate tensile strength	$F_u = 65.0$ [ksi]			
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$	= 4.328	[in ²]	
Shear force required	$0.5 P_{uf_t} =$	= 56.84	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 168.77	[kips]	AISC 14 th Eq J4-4
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq J4-4
	$\phi R_n =$	= 126.58	[kips]	
	ratio = 0.45	> 0.5 P_{uf_t}	OK	

Beam Flange Weld Strength		ratio = 113.68 / 120.47	= 0.94	PASS
Flange force required in tension	$P_{uf_t} = P_u / 2 - M_u / d_m$	= 113.68	[kips]	
Fillet weld length - double fillet	$L = [b_{fb} + (b_{fb} - 2k_{1b})] / 2$ as dbl fillet	= 5.770	[in]	
Fillet Weld Strength Check				
Fillet weld leg size	$w = 5/16$ [in]	load angle $\theta = 90.0$	[°]	
Electrode strength	$F_{EXX} = 70.0$ [ksi]	strength coeff $C_1 = 1.00$		AISC 14 th 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 14 th 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 14 th Eq 8-1
Base metal - beam flange	thickness $t = 0.440$ [in]	tensile $F_u = 65.0$	[ksi]	
Base metal - beam flange is in tension, <u>tensile</u> rupture as per AISC 14 th Eq J4-2 is checked				
Base metal tensile rupture	$R_{n-b} = F_u t$	= 28.600	[kip/in]	AISC 14 th Eq J4-2
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	= 27.838	[kip/in]	AISC 14 th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq 8-1
	$\phi R_n =$	= 20.879	[kip/in]	
Shear resistance required	$P_{uf_t} =$	= 113.68	[kips]	
Fillet weld length - double fillet	$L =$	= 5.770	[in]	
Shear resistance provided	$\phi F_n = \phi R_n \times L$	= 120.47	[kips]	
	ratio = 0.94	> P_{uf_t}	OK	

Beam Web Weld Strength		ratio = 30.00 / 38.22	= 0.79	PASS
Beam Web Effective Weld Length Calc				
Beam section	$d_b = 12.300$ [in]	$t_{fb} = 0.440$ [in]		
	$k_b = 1.125$ [in]			
Bolt diameter	$d_{bolt} = 0.750$ [in]	bolt inner pitch $p_{fi} = 1.625$ [in]		
Effective weld length case 1	$L_1 = 0.5 d_b - k_b$	= 5.025 [in]		AISC DG4 Page 38
Effective weld length case 2	$L_2 = d_b - 2t_{fb} - p_{fi} - 2 d_{bolt}$	= 8.295 [in]		AISC DG4 Page 38
Fillet weld length - double fillet	$L = \min(L_1, L_2)$	= 5.025 [in]		
Fillet Weld Strength Check				
Fillet weld leg size	$w = 5/16$ [in]	load angle $\theta = 0.0$ [°]		
Electrode strength	$F_{EXX} = 70.0$ [ksi]	strength coeff $C_1 = 1.00$		AISC 14 th 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 14 th 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 14 th Eq 8-1
Base metal - beam web	thickness $t = 0.260$ [in]	tensile $F_u = 65.0$ [ksi]		
Base metal - beam web is in shear, <u>shear</u> rupture as per AISC 14 th Eq J4-4 is checked				AISC 14 th J2.4
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	= 10.140 [kip/in]		AISC 14 th Eq J4-4
Double fillet linear shear strength	$R_n = \min(R_{n-w}, R_{n-b})$	= 10.140 [kip/in]		AISC 14 th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq 8-1
	$\phi R_n =$	= 7.605 [kip/in]		
Shear resistance required	$V_u =$	= 30.00 [kips]		
Fillet weld length - double fillet	$L =$	= 5.025 [in]		
Shear resistance provided	$\phi F_n = \phi R_n \times L$	= 38.22 [kips]		
	ratio = 0.79	> V_u	OK	

Column Flexural Yielding		ratio = 113.68 / 146.53 = 0.78	PASS
Column Flange Bending Strength			
See AISC DG4 Table 3.4 for all formulas to derive the following parameters		AISC DG4 Table 3.4	
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]	
*** Stiffened Column Flange Case ***			
Column section	$b_{fc} = 8.010$ [in]	$t_{fc} = 0.515$ [in]	
	$F_{yc} = 50.0$ [ksi]	bolt gage $g = 4.000$ [in]	
	$s = 2.830$ [in]	$c = 3.690$ [in]	
Stiffener plate thickness	$t_s = 0.500$ [in]		
	$p_{si} = 1.595$ [in]	$p_{so} = 1.595$ [in]	
	$Y_c = 145.6$ [in]		
Flexure resistance factor-LRFD	$\phi_b = 0.90$		AISC 14 th F1 (1)
Column flange bending strength	$\phi_b M_{cf} = \phi_b F_{yc} t_{fc}^2 Y_c$	= 144.82 [kip-ft]	AISC DG4 Table 3.4
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860 [in]	
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	= 113.68 [kips]	
Flange force provided by column flange bending	$\phi R_{cf} = \phi M_{cf} / d_m$	= 146.53 [kips]	AISC DG4 Eq 3.21
	ratio = 0.78	> $P_{uf,t}$	OK
Column Web Yielding		ratio = 113.68 / 290.95 = 0.39	PASS
Column web thickness	$t_{wc} = 0.295$ [in]	yield $F_y = 50.0$ [ksi]	
Doubler plate thickness	$t_{dp} = 0.375$ [in]	yield $F_{ydp} = 50.0$ [ksi]	
Equivalent web thickness when considering doubler plate	$t_{w-eq} = t_{wc} + t_{dp} \times F_{ydp} / F_y$	= 0.670 [in]	
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860 [in]	
Flange force in demand	$P_{uf} = \max (P_{uf,t} , P_{uf,c})$	= 113.68 [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	$C_t = 1.0$	AISC DG4 Eq 3.24
Beam flange fillet weld size	$w = 0.313$ [in]	beam flange $t_{fb} = 0.440$ [in]	
Length of bearing	$N = t_{fb} + 2 w$	= 1.065 [in]	AISC DG4 Eq 3.24
End plate thickness	$t_p = 0.750$ [in]		
Column web yielding strength	$R_n = C_t (6 k_c + N + 2 t_p) F_{yc} t_{w-eq}$	= 290.95 [kips]	AISC DG4 Eq 3.24
Resistance factor-LRFD	$\phi = 1.00$		AISC 14 th J10.2
	$\phi R_n =$	= 290.95 [kips]	
	ratio = 0.39	> P_{uf}	OK

Column Web Buckling		ratio = 88.68 / 206.83	= 0.43	PASS
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860	[in]	
Flange force required in compression	$P_{uf_c} = P_u / 2 - M_u / d_m$	= 88.68	[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 14 th J10.5
Column web buckling strength	$R_{n1} = \frac{C_t 24 t_{wc}^3 \sqrt{E_c F_{yc}}}{h}$	= 75.25	[kips]	AISC 14 th Eq J10-8
Doubler plate thickness	$t_{dp} = 0.375$ [in]	yield $F_{ydp} = 50.0$	[ksi]	
Doubler plate buckling strength	$R_{n2} = \frac{C_t 24 t_{dp}^3 \sqrt{E_c F_{ydp}}}{h}$	= 154.57	[kips]	AISC 14 th Eq J10-8
Total buckling strength	$R_n = R_{n1} + R_{n2}$	= 229.81	[kips]	
Resistance factor-LRFD	$\phi = 0.90$			AISC 14 th J10.5
	$\phi R_n =$	= 206.83	[kips]	
	ratio = 0.43	> P_{uf_c}	OK	

Column Web Crippling		ratio = 88.68 / 273.27	= 0.32	PASS
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860	[in]	
Flange force required in compression	$P_{uf_c} = P_u / 2 - M_u / d_m$	= 88.68	[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]	
Beam flange fillet weld size	$w = 0.313$ [in]	beam flange $t_{fb} = 0.440$	[in]	
End plate thickness	$t_p = 0.750$ [in]			
Length of bearing	$l_b = t_{fb} + 2 w + 2 t_p$	= 2.565	[in]	
Distance from top of column to top of beam flange	$d_{end-flg} =$	= 4.000	[in]	
Top column condition	it's not a top column case, use Eq J10-4			AISC 14 th J10.3 (a)
Column web crippling strength	$R_{n1} = 0.8 t_{wc}^2 [1 + 3 \frac{l_b}{d_c} (\frac{t_{wc}}{t_{fc}})^{1.5}] \times (\frac{E_c F_{yc} t_{fc}}{t_{wc}})^{0.5}$	= 141.82	[kips]	AISC 14 th Eq J10-4
Doubler plate thickness	$t_{dp} = 0.375$ [in]	yield $F_{ydp} = 50.0$	[ksi]	
Doubler plate crippling strength	$R_{n2} = 0.8 t_{dp}^2 [1 + 3 \frac{l_b}{d_c} (\frac{t_{dp}}{t_{fc}})^{1.5}] \times (\frac{E_c F_{ydp} t_{fc}}{t_{dp}})^{0.5}$	= 222.54	[kips]	AISC 14 th Eq J10-4
Total crippling strength	$R_n = R_{n1} + R_{n2}$	= 364.36	[kips]	
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th J10.3
	$\phi R_n =$	= 273.27	[kips]	
	ratio = 0.32	> P_{uf_c}	OK	

Column Panel Zone Shear		146.71 / 94.78	N/A
Panel zone shear force	$V_p = P_{f-TR} - P_{f-TL} - V_s$	= 146.71	[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]
	$P_r \leq 0.4 P_c$, use Eq J10-9		AISC 14 th Eq J10-9
Web panel zone capacity	$R_n = 0.6 F_{yc} d_c t_{wc}$	= 105.32	[kips]
Resistance factor-LRFD	$\phi = 0.90$		AISC 14 th J10.6
	$\phi R_n =$	= 94.78	[kips]
Unbalanced force to be resisted by doubler plate	$V_{dp} = R_p - \phi R_n$	= 51.93	[kips]

Doubler Geometry Restriction		PASS	
Min Doubler Thickness to Allow for Proper Beveling of Plate		AISC DG13 Eq 4.4-4	
Column section	$t_{fc} = 0.515$ [in]	$k_c = 1.020$ [in]	
Allowed fillet encroachment	$r_e = 0.250$ [in]		AISC 14 th Fig 10-3
Min doubler plate thickness	$t_{pmin} = k_c - t_{fc} - r_e$	= 0.255 [in]	AISC DG13 Eq 4.4-4
Doubler plate thickness	$t_{dp} =$	= 0.375 [in]	
		> t_{pmin}	OK
Min Doubler Thickness to Avoid Shear Buckling of Plate		AISC DG13 Eq 4.4-5	
Column section	$d_c = 11.900$ [in]	$k_c = 1.020$ [in]	
	$h = d_c - 2 k_c$	= 9.860 [in]	
Doubler plate steel	$F_y = 50.0$ [ksi]	$E = 29000$ [ksi]	
Min doubler plate thickness	$t_{pmin} = h / 2.24 \sqrt{E / F_y}$	= 0.183 [in]	AISC 14 th G2.1 (a)
Doubler plate thickness	$t_{dp} =$	= 0.375 [in]	
		> t_{pmin}	OK
Doubler Plate Shear Yield		ratio = 51.93 / 133.88	= 0.39 PASS
Doubler plate thickness	$t_{dp} = 0.375$ [in]	yield strength $F_y = 50.0$ [ksi]	
Number of doubler	$N_{dbl} = 1$ for one side		
Column depth	$d_c = 11.900$ [in]		
Area of web	$A_w = t_{dp} \times d_c$	= 4.463 [in ²]	AISC DG13 Eq 4.4-1
Shear coefficient	$C_v = 1.0$		AISC 14 th Eq G2-2
Doubler plate shear in demand	$R_{dp} =$ unbalanced force from column panel zone shear calc	= 51.93 [kips]	
Doubler plate shear strength	$R_n = N_{dbl} 0.6 F_y A_w C_v$	= 133.88 [kips]	AISC 14 th Eq G2-1
Resistance factor-LRFD	$\phi = 1.00$		AISC 14 th G2.1 (a)
	$\phi R_n =$	= 133.88 [kips]	
	ratio = 0.39	> R_{dp}	OK
Doubler to Column Flange Fillet Weld Limitation		PASS	
Min Fillet Weld Size			
Thinner part joined thickness	$t =$	= 0.375 [in]	
Min fillet weld size allowed	$w_{min} =$	= 0.188 [in]	AISC 14 th Table J2.4
Fillet weld size provided	$w =$	= 0.250 [in]	
		> w_{min}	OK
Min Fillet Weld Length			
Fillet weld size provided	$w =$	= 0.250 [in]	
Min fillet weld length allowed	$L_{min} = 4 \times w$	= 1.000 [in]	AISC 14 th J2.2b
Min fillet weld length	$L = d_b + (3 k_c + t_p) \times 2$ Ends	= 19.920 [in]	
		> L_{min}	OK

Doubler to Column Web Fillet Weld Limitation		PASS	
Min Fillet Weld Size			
Thinner part joined thickness	$t =$	$= 0.295$ [in]	
Min fillet weld size allowed	$w_{min} =$	$= 0.188$ [in]	AISC 14 th Table J2.4
Fillet weld size provided	$w =$	$= 0.250$ [in]	
		$> w_{min}$	OK
Min Fillet Weld Length			
Fillet weld size provided	$w =$	$= 0.250$ [in]	
Min fillet weld length allowed	$L_{min} = 4 \times w$	$= 1.000$ [in]	AISC 14 th J2.2b
Min fillet weld length	$L = d_c - 2 \times k_c$	$= 9.860$ [in]	
		$> L_{min}$	OK
Doubler Weld Strength at Column Flange		ratio = 51.93 / 110.91 = 0.47	PASS
Doubler Plate to Column Flange Weld Length Calc			
Beam section	$d_b = 12.300$ [in]	column section $k_c = 1.020$ [in]	
End plate thickness	$t_p = 0.750$ [in]		
Doubler plate to column flange weld length - single fillet	$L = d_b + (3 k_c + t_p) \times 2$ ends	$= 19.920$ [in]	AISC DG13 Fig 4-3
Fillet Weld Strength Check			
Fillet weld leg size	$w = 1/4$ [in]	load angle $\theta = 0.0$ [°]	
Electrode strength	$F_{EXX} = 70.0$ [ksi]	strength coeff $C_1 = 1.00$	AISC 14 th Table 8-3
Number of weld line	$n = 1$ for single fillet		
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$	$= 1.00$	AISC 14 th Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$	$= 7.424$ [kip/in]	AISC 14 th Eq 8-1
Base metal - doubler plate	thickness $t = 0.375$ [in]	tensile $F_u = 65.0$ [ksi]	
Base metal - doubler plate is in shear, <u>shear</u> rupture as per AISC 14 th Eq J4-4 is checked			AISC 14 th J2.4
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	$= 14.625$ [kip/in]	AISC 14 th Eq J4-4
Single fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	$= 7.424$ [kip/in]	AISC 14 th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$		AISC 14 th Eq 8-1
	$\phi R_n =$	$= 5.568$ [kip/in]	
Shear resistance required	$R_{dp} =$	$= 51.93$ [kips]	
Fillet weld length - single fillet	$L =$	$= 19.920$ [in]	
Shear resistance provided	$\phi F_n = \phi R_n \times L$	$= 110.91$ [kips]	
	ratio = 0.47	$> R_{dp}$	OK

Doubler Weld Strength at Column Web		ratio = 51.93 / 54.90	= 0.95	PASS
Doubler Plate to Column Web Weld Length Calc				
Column section	$d_c = 11.900$ [in]	$k_c = 1.020$ [in]		
Doubler plate to column web weld length - single fillet	$L = d_c - 2 \times k_c$		= 9.860 [in]	
Fillet Weld Strength Check				
Fillet weld leg size	$w = 1/4$ [in]	load angle $\theta = 0.0$ [°]		
Electrode strength	$F_{EXX} = 70.0$ [ksi]	strength coeff $C_1 = 1.00$		AISC 14 th Table 8-3
Number of weld line	$n = 1$ for single fillet			
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$	= 1.00		AISC 14 th Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$	= 7.424 [kip/in]		AISC 14 th Eq 8-1
Base metal - doubler plate thickness $t = 0.375$ [in]		tensile $F_u = 65.0$ [ksi]		
Base metal - doubler plate is in shear, <u>shear</u> rupture as per AISC 14 th Eq J4-4 is checked				AISC 14 th J2.4
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	= 14.625 [kip/in]		AISC 14 th Eq J4-4
Single fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	= 7.424 [kip/in]		AISC 14 th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq 8-1
	$\phi R_n =$	= 5.568 [kip/in]		
Shear resistance required	$R_{dp} =$	= 51.93 [kips]		
Fillet weld length - single fillet	$L =$	= 9.860 [in]		
Shear resistance provided	$\phi F_n = \phi R_n \times L$	= 54.90 [kips]		
	ratio = 0.95	> R_{dp}	OK	

Left Beam to Column

MC Connection

Code=AISC 360-10 LRFD

Result Summarygeometries & weld limitations = **PASS**limit states max ratio = **0.95** **PASS****Geometry Restriction Checks****PASS****Min Bolt Edge Distance - Column Flange**

Bolt diameter	$d_b =$	= 0.750 [in]	
Min edge distance allowed	$L_{e-min} =$	= 1.000 [in]	AISC 14 th Table J3.4
Min edge distance in Column Flange	$L_e =$	= 2.005 [in]	
		> L_{e-min}	OK

Min Bolt Spacing - End Plate

Bolt diameter	$d_b =$	= 0.750 [in]	
Min bolt spacing allowed	$L_{s-min} = 2.667 d_b$	= 2.000 [in]	AISC 14 th J3.3
Min Bolt spacing in End Plate	$L_s =$	= 3.690 [in]	
		> L_{s-min}	OK

Min Bolt Edge Distance - End Plate

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

Max Bolt Edge Distance - End Plate

Connecting plate thickness	$t_p =$	= 0.750 [in]	
Max edge distance allowed	$L_{e-max} = \min (12t , 6")$	= 6.000 [in]	AISC 14 th J3.5
Max edge distance in End Plate	$L_e =$	= 2.245 [in]	
		< L_{e-max}	OK

Beam Flange Fillet Weld Limitation**PASS****Min Fillet Weld Size**

Thinner part joined thickness	$t =$	= 0.440 [in]	
Min fillet weld size allowed	$w_{min} =$	= 0.188 [in]	AISC 14 th 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	$L_{min} = 4 \times w$	= 1.250 [in]	AISC 14 th J2.2b
Min fillet weld length	$L = 0.5 b_{fb} - k_{1b}$	= 2.510 [in]	
		> L_{min}	OK

Beam Web Fillet Weld Limitation			PASS
Min Fillet Weld Size			
<hr/>			
Thinner part joined thickness	$t =$	$= 0.260$ [in]	
Min fillet weld size allowed	$w_{min} =$	$= 0.188$ [in]	AISC 14 th Table J2.4
Fillet weld size provided	$w =$	$= 0.313$ [in]	
		$> w_{min}$	OK
Min Fillet Weld Length			
<hr/>			
Fillet weld size provided	$w =$	$= 0.313$ [in]	
Min fillet weld length allowed	$L_{min} = 4 \times w$	$= 1.250$ [in]	AISC 14 th J2.2b
Min fillet weld length	$L = 0.5 d_b - k_b$	$= 5.025$ [in]	
		$> L_{min}$	OK
Min Beam Web to End Plate Fillet Weld Size			
<hr/>			
Beam web to end-plate fillet weld in the tension-bolt region to develop the yield strength of the beam web			AISC DG4 Page 9 Item 7
Shear resistance factor-LRFD	$\phi_v = 0.90$		AISC 14 th G1
Fillet weld shear strength	$\phi R_{n-w} =$	$= 1.392$ [kip/in]	AISC 14 th Eq 8-2a
Fillet weld strength $\phi R_{n-w} \times 1.5 \times 2$ to account for 90° load angle when it's in tension and double fillet			
Min double fillet weld size to match beam web yield strength	$D_{min} = \phi_v F_{yb} t_{wb} / (\phi R_{n-w} \times 1.5 \times 2)$	$= 2.802$ [1/16 "]	
Fillet weld size provided	$D =$	$= 5.000$ [1/16 "]	
		$> D_{min}$	OK

Verify AISC DG4 Bolt No Prying Assumption			AISC DG4 Is Used
Bolt Moment Strength (No Prying)			
	bolt grade = A325-N	$F_t = 90.0$ [ksi]	AISC 14 th Table J3.2
	bolt dia $d_b = 0.750$ [in]	bolt area $A_b = 0.442$ [in ²]	
Bolt nominal tensile strength	$P_t = F_t A_b$	$= 39.76$ [kips]	AISC 14 th Eq J3-1
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]	
Bolt moment strength (no prying)	$M_{np} = 2 P_t (h_0 + h_1)$	$= 157.19$ [kip-ft]	AISC DG4 Eq 3.7
Bolt resistance factor-LRFD	$\phi = 0.75$		AISC 14 th Eq J3-1
	$\phi M_{np} =$	$= 117.89$ [kip-ft]	
End Plate Bending Strength			
End plate width	$b_{plate} = 8.490$ [in]	thickness $t_p = 0.750$ [in]	
Beam flange width	$b_{fb} = 6.520$ [in]		
Effective end plate width	$b_p = \min (b_{plate}, b_{fb} + 1")$	$= 7.520$ [in]	AISC DG4 Page 9 item 5
End plate yield strength	$F_{yp} = 50.0$ [ksi]		
See AISC DG4 Table 3.1 for all formulas to derive the following parameters			AISC DG4 Table 3.1
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]	
	$g = 4.000$ [in]		
	$p_{fi} = 1.625$ [in]	$p_{fo} = 1.625$ [in]	
	$s = 2.742$ [in]	$Y_p = 88.61$ [in]	
Flexure resistance factor-LRFD	$\phi_b = 0.90$		AISC 14 th F1 (1)
End plate bending strength	$\phi_b M_{pl} = \phi_b F_{yp} t_p^2 Y_p$	$= 186.90$ [kip-ft]	AISC DG4 Table 3.1
Check thick end plate condition	$\phi_b M_{pl} \geq 1.11 \times \phi M_{np}$		AISC DG4 Eq 3.33
	ratio = 0.70 thick plate		
Column Flange Bending Strength			
See AISC DG4 Table 3.4 for all formulas to derive the following parameters			AISC DG4 Table 3.4
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]	
*** Stiffened Column Flange Case ***			
Column section	$b_{fc} = 8.010$ [in]	$t_{fc} = 0.515$ [in]	
	$F_{yc} = 50.0$ [ksi]	bolt gage $g = 4.000$ [in]	
	$s = 2.830$ [in]	$c = 3.690$ [in]	
Stiffener plate thickness	$t_s = 0.500$ [in]		
	$p_{si} = 1.595$ [in]	$p_{so} = 1.595$ [in]	
	$Y_c = 145.6$ [in]		
Flexure resistance factor-LRFD	$\phi_b = 0.90$		AISC 14 th F1 (1)
Column flange bending strength	$\phi_b M_{cf} = \phi_b F_{yc} t_{fc}^2 Y_c$	$= 144.82$ [kip-ft]	AISC DG4 Table 3.4
Check thick column flange condition	$\phi_b M_{cf} \geq 1.11 \times \phi M_{np}$		AISC DG4 Eq 3.35
	ratio = 0.90 thick plate		
The thick end plate and column flange conditions are met. AISC DG4 is used and no bolt prying is considered			AISC DG4 Eq 3.33 & 3.35

Bolt Moment Strength (No Prying)		ratio = 58.03 / 119.28	= 0.49	PASS
	bolt grade = A325-N	$F_t = 90.0$	[ksi]	AISC 14 th Table J3.2
	bolt dia $d_b = 0.750$ [in]	bolt area $A_b = 0.442$	[in ²]	
Bolt nominal tensile strength	$P_t = F_t A_b$	= 39.76	[kips]	AISC 14 th Eq J3-1
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$	[in]	
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860	[in]	
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	= 58.03	[kips]	
Flange force resistance by bolt	$F_n = 2 P_t (h_0 + h_1) / d_m$	= 159.04	[kips]	AISC DG4 Eq 3.7
Bolt resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq J3-1
	$\phi F_n =$	= 119.28	[kips]	AISC DG4 Eq 3.7
	ratio = 0.49	> $P_{uf,t}$	OK	
Bolt Shear Strength		ratio = 30.00 / 71.57	= 0.42	PASS
Bolt shear stress	bolt grade = A325-N	$F_{nv} = 54.0$	[ksi]	AISC 14 th 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	$V_u =$	= 30.00	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$	= 95.43	[kips]	AISC 14 th Eq J3-1
Bolt resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq J3-1
	$\phi R_n =$	= 71.57	[kips]	
	ratio = 0.42	> V_u	OK	

Bolt Bearing/TearOut Strength on End Plate		ratio = 30.00 / 71.57	= 0.42	PASS
Single Bolt Shear Strength				
Bolt shear stress	bolt grade = A325-N	$F_{nv} = 54.0$	[ksi]	AISC 14 th Table J3.2
	bolt dia $d_b = 0.750$	$A_b = 0.442$	[in] [in ²]	
Single bolt shear strength	$R_{n-bolt} = F_{nv} A_b$	= 23.86	[kips]	AISC 14 th Eq J3-1
Bolt Bearing/TearOut Strength on Plate				
Bolt hole diameter	bolt dia $d_b = 3/4$	$d_h = 13/16$	[in]	AISC 14 th Table J3.3
Bolt spacing & edge distance	spacing $L_s = 3.690$	edge distance $L_e = 1.375$	[in]	
Plate tensile strength	$F_u = 65.0$		[ksi]	
Plate thickness	$t = 0.750$		[in]	
Interior Bolt				
Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.878	[in]	
Bolt tear out/bearing strength	$R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$	= 109.69	[kips]	AISC 14 th Eq J3-6b
	= 210.42 ≤ 109.69			
Bolt strength at interior	$R_{n-in} = \min (R_{n-t\&b-in}, R_{n-bolt})$	= 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	$R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$	= 70.84	[kips]	AISC 14 th Eq J3-6b
	= 70.84 ≤ 109.69			
Bolt strength at edge	$R_{n-ed} = \min (R_{n-t\&b-ed}, R_{n-bolt})$	= 23.86	[kips]	
Number of bolt	interior $n_{in} = 2$	edge $n_{ed} = 2$		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$	= 95.43	[kips]	
Required shear strength	$V_u =$	= 30.00	[kips]	
Bolt resistance factor-LRFD	$\phi = 0.75$			AISC 14 th J3-10
	$\phi R_n =$	= 71.57	[kips]	
	ratio = 0.42	> V_u	OK	

Bolt Bearing/TearOut Strength on Column Flange		ratio = 30.00 / 71.57	= 0.42	PASS
Single Bolt Shear Strength				
Bolt shear stress	bolt grade = A325-N	$F_{nv} = 54.0$	[ksi]	AISC 14 th Table J3.2
	bolt dia $d_b = 0.750$	[in]	bolt area $A_b = 0.442$	[in ²]
Single bolt shear strength	$R_{n-bolt} = F_{nv} A_b$	= 23.86	[kips]	AISC 14 th 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 14 th Table J3.3
Bolt spacing	spacing $L_s = 3.690$	[in]		
Plate tensile strength	$F_u = 65.0$	[ksi]		
Plate thickness	$t = 0.515$	[in]		
Interior Bolt				
Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.878	[in]	
Bolt tear out/bearing strength	$R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$	= 75.32	[kips]	AISC 14 th Eq J3-6b
	= 144.49 \leq 75.32			
Bolt strength at interior	$R_{n-in} = \min (R_{n-t\&b-in}, R_{n-bolt})$	= 23.86	[kips]	
Number of bolt	interior $n_{in} = 4$			
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n-in}$	= 95.43	[kips]	
Required shear strength	$V_u =$	= 30.00	[kips]	
Bolt resistance factor-LRFD	$\phi = 0.75$			AISC 14 th J3-10
	$\phi R_n =$	= 71.57	[kips]	
	ratio = 0.42	> V_u		OK

End Plate Flexural Yielding		ratio = 58.03 / 189.11 = 0.31		PASS
End Plate Bending Strength				
End plate width	$b_{plate} = 8.490$ [in]	thickness $t_p = 0.750$ [in]		
Beam flange width	$b_{fb} = 6.520$ [in]			
Effective end plate width	$b_p = \min (b_{plate}, b_{fb} + 1")$	= 7.520 [in]		AISC DG4 Page 9 item 5
End plate yield strength	$F_{yp} = 50.0$ [ksi]			
See AISC DG4 Table 3.1 for all formulas to derive the following parameters AISC DG4 Table 3.1				
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]		
	$g = 4.000$ [in]			
	$p_{fi} = 1.625$ [in]	$p_{fo} = 1.625$ [in]		
	$s = 2.742$ [in]	$Y_p = 88.61$ [in]		
Flexure resistance factor-LRFD	$\phi_b = 0.90$			AISC 14 th F1 (1)
End plate bending strength	$\phi_b M_{pl} = \phi_b F_{yp} t_p^2 Y_p$	= 186.90 [kip-ft]		AISC DG4 Table 3.1
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860 [in]		
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	= 58.03 [kips]		
Flange force provided by end plate bending	$\phi R_{pl} = \phi M_{pl} / d_m$	= 189.11 [kips]		AISC DG4 Eq 3.10
	ratio = 0.31	> $P_{uf,t}$	OK	
End Plate Shear Yielding		ratio = 29.02 / 169.20 = 0.17		PASS
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	= 29.02 [kips]		
End plate width	$b_{plate} = 8.490$ [in]	thickness $t_p = 0.750$ [in]		
Beam flange width	$b_{fb} = 6.520$ [in]			
Effective end plate width	$b_p = \min (b_{plate}, b_{fb} + 1")$	= 7.520 [in]		AISC DG4 Page 9 item 5
Plate Shear Yielding Check				
Plate size	width $b_p = 7.520$ [in]	thickness $t_p = 0.750$ [in]		
Plate yield strength	$F_y = 50.0$ [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 5.640 [in ²]		
Shear force required	$0.5 P_{uf,t}$	= 29.02 [kips]		
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 169.20 [kips]		AISC 14 th Eq J4-3
Resistance factor-LRFD	$\phi = 1.00$			AISC 14 th Eq J4-3
	$\phi R_n =$	= 169.20 [kips]		
	ratio = 0.17	> $0.5 P_{uf,t}$	OK	

End Plate Shear Rupture		ratio = 29.02 / 126.58	= 0.23	PASS
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	= 29.02	[kips]	
End plate width	$b_{plate} = 8.490$ [in]	thickness $t_p = 0.750$	[in]	
Beam flange width	$b_{fb} = 6.520$ [in]			
Effective end plate width	$b_p = \min (b_{plate}, b_{fb} + 1")$	= 7.520	[in]	AISC DG4 Page 9 item 5
Plate Shear Rupture Check				
Bolt hole diameter	bolt dia $d_b = 3/4$ [in]	bolt hole dia $d_h = 7/8$	[in]	AISC 14 th B4.3b
Number of bolt	$n = 2$			
Plate size	width $b_p = 7.520$ [in]	thickness $t_p = 0.750$	[in]	
Plate tensile strength	$F_u = 65.0$ [ksi]			
Plate net area in shear	$A_{nv} = (b_p - n d_h) t_p$	= 4.328	[in ²]	
Shear force required	$0.5 P_{uf,t} =$	= 29.02	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 168.77	[kips]	AISC 14 th Eq J4-4
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq J4-4
	$\phi R_n =$	= 126.58	[kips]	
	ratio = 0.23	> 0.5 $P_{uf,t}$	OK	

Beam Flange Weld Strength		ratio = 58.03 / 120.47	= 0.48	PASS
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	= 58.03	[kips]	
Fillet weld length - double fillet	$L = [b_{fb} + (b_{fb} - 2k_{1b})] / 2$ as dbl fillet	= 5.770	[in]	
Fillet Weld Strength Check				
Fillet weld leg size	$w = 5/16$ [in]	load angle $\theta = 90.0$	[°]	
Electrode strength	$F_{EXX} = 70.0$ [ksi]	strength coeff $C_1 = 1.00$		AISC 14 th 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 14 th 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 14 th Eq 8-1
Base metal - beam flange	thickness $t = 0.440$ [in]	tensile $F_u = 65.0$	[ksi]	
Base metal - beam flange is in tension, <u>tensile</u> rupture as per AISC 14 th Eq J4-2 is checked				
Base metal tensile rupture	$R_{n-b} = F_u t$	= 28.600	[kip/in]	AISC 14 th Eq J4-2
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	= 27.838	[kip/in]	AISC 14 th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq 8-1
	$\phi R_n =$	= 20.879	[kip/in]	
Shear resistance required	$P_{uf,t} =$	= 58.03	[kips]	
Fillet weld length - double fillet	$L =$	= 5.770	[in]	
Shear resistance provided	$\phi F_n = \phi R_n \times L$	= 120.47	[kips]	
	ratio = 0.48	> $P_{uf,t}$	OK	

Beam Web Weld Strength		ratio = 30.00 / 38.22	= 0.79	PASS
Beam Web Effective Weld Length Calc				
Beam section	$d_b = 12.300$ [in]	$t_{fb} = 0.440$ [in]		
	$k_b = 1.125$ [in]			
Bolt diameter	$d_{bolt} = 0.750$ [in]	bolt inner pitch $p_{fi} = 1.625$ [in]		
Effective weld length case 1	$L_1 = 0.5 d_b - k_b$	$= 5.025$ [in]		AISC DG4 Page 38
Effective weld length case 2	$L_2 = d_b - 2t_{fb} - p_{fi} - 2 d_{bolt}$	$= 8.295$ [in]		AISC DG4 Page 38
Fillet weld length - double fillet	$L = \min(L_1, L_2)$	$= 5.025$ [in]		
Fillet Weld Strength Check				
Fillet weld leg size	$w = 5/16$ [in]	load angle $\theta = 0.0$ [°]		
Electrode strength	$F_{EXX} = 70.0$ [ksi]	strength coeff $C_1 = 1.00$		AISC 14 th 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 14 th 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 14 th Eq 8-1
Base metal - beam web	thickness $t = 0.260$ [in]	tensile $F_u = 65.0$ [ksi]		
Base metal - beam web is in shear, <u>shear</u> rupture as per AISC 14 th Eq J4-4 is checked				AISC 14 th J2.4
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	$= 10.140$ [kip/in]		AISC 14 th Eq J4-4
Double fillet linear shear strength	$R_n = \min(R_{n-w}, R_{n-b})$	$= 10.140$ [kip/in]		AISC 14 th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq 8-1
	$\phi R_n =$	$= 7.605$ [kip/in]		
Shear resistance required	$V_u =$	$= 30.00$ [kips]		
Fillet weld length - double fillet	$L =$	$= 5.025$ [in]		
Shear resistance provided	$\phi F_n = \phi R_n \times L$	$= 38.22$ [kips]		
	ratio = 0.79	$> V_u$	OK	

Column Flexural Yielding		ratio = 58.03 / 146.53	= 0.40	PASS
Column Flange Bending Strength				
See AISC DG4 Table 3.4 for all formulas to derive the following parameters				AISC DG4 Table 3.4
Tension bolt moment arm	$h_0 = 13.705$ [in]	$h_1 = 10.015$ [in]		
*** Stiffened Column Flange Case ***				
Column section	$b_{fc} = 8.010$ [in]	$t_{fc} = 0.515$ [in]		
	$F_{yc} = 50.0$ [ksi]	bolt gage $g = 4.000$ [in]		
	$s = 2.830$ [in]	$c = 3.690$ [in]		
Stiffener plate thickness	$t_s = 0.500$ [in]			
	$p_{si} = 1.595$ [in]	$p_{so} = 1.595$ [in]		
	$Y_c = 145.6$ [in]			
Flexure resistance factor-LRFD	$\phi_b = 0.90$			AISC 14 th F1 (1)
Column flange bending strength	$\phi_b M_{cf} = \phi_b F_{yc} t_{fc}^2 Y_c$	= 144.82 [kip-ft]		AISC DG4 Table 3.4
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860 [in]		
Flange force required in tension	$P_{uf,t} = P_u / 2 - M_u / d_m$	= 58.03 [kips]		
Flange force provided by column flange bending	$\phi R_{cf} = \phi M_{cf} / d_m$	= 146.53 [kips]		AISC DG4 Eq 3.21
	ratio = 0.40	> $P_{uf,t}$	OK	
Column Web Yielding		ratio = 58.03 / 290.95	= 0.20	PASS
Column web thickness	$t_{wc} = 0.295$ [in]	yield $F_y = 50.0$ [ksi]		
Doubler plate thickness	$t_{dp} = 0.375$ [in]	yield $F_{ydp} = 50.0$ [ksi]		
Equivalent web thickness when considering doubler plate	$t_{w-eq} = t_{wc} + t_{dp} \times F_{ydp} / F_y$	= 0.670 [in]		
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860 [in]		
Flange force in demand	$P_{uf} = \max (P_{uf,t} , P_{uf,c})$	= 58.03 [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	$C_t = 1.0$		AISC DG4 Eq 3.24
Beam flange fillet weld size	$w = 0.313$ [in]	beam flange $t_{fb} = 0.440$ [in]		
Length of bearing	$N = t_{fb} + 2 w$	= 1.065 [in]		AISC DG4 Eq 3.24
End plate thickness	$t_p = 0.750$ [in]			
Column web yielding strength	$R_n = C_t (6 k_c + N + 2 t_p) F_{yc} t_{w-eq}$	= 290.95 [kips]		AISC DG4 Eq 3.24
Resistance factor-LRFD	$\phi = 1.00$			AISC 14 th J10.2
	$\phi R_n =$	= 290.95 [kips]		
	ratio = 0.20	> P_{uf}	OK	

Column Web Buckling		ratio = 33.03 / 206.83	= 0.16	PASS
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860	[in]	
Flange force required in compression	$P_{uf_c} = P_u / 2 - M_u / d_m$	= 33.03	[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 14 th J10.5
Column web buckling strength	$R_{n1} = \frac{C_t 24 t_{wc}^3 \sqrt{E_c F_{yc}}}{h}$	= 75.25	[kips]	AISC 14 th Eq J10-8
Doubler plate thickness	$t_{dp} = 0.375$ [in]	yield $F_{ydp} = 50.0$	[ksi]	
Doubler plate buckling strength	$R_{n2} = \frac{C_t 24 t_{dp}^3 \sqrt{E_c F_{ydp}}}{h}$	= 154.57	[kips]	AISC 14 th Eq J10-8
Total buckling strength	$R_n = R_{n1} + R_{n2}$	= 229.81	[kips]	
Resistance factor-LRFD	$\phi = 0.90$			AISC 14 th J10.5
	$\phi R_n =$	= 206.83	[kips]	
	ratio = 0.16	> P_{uf_c}	OK	

Column Web Crippling		ratio = 33.03 / 273.27	= 0.12	PASS
Flange force moment arm	$d_m = d_b - t_{fb}$	= 11.860	[in]	
Flange force required in compression	$P_{uf_c} = P_u / 2 - M_u / d_m$	= 33.03	[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]	
Beam flange fillet weld size	$w = 0.313$ [in]	beam flange $t_{fb} = 0.440$	[in]	
End plate thickness	$t_p = 0.750$ [in]			
Length of bearing	$l_b = t_{fb} + 2 w + 2 t_p$	= 2.565	[in]	
Distance from top of column to top of beam flange	$d_{end-flg} =$	= 4.000	[in]	
Top column condition	it's not a top column case, use Eq J10-4			AISC 14 th J10.3 (a)
Column web crippling strength	$R_{n1} = 0.8 t_{wc}^2 [1 + 3 \frac{l_b}{d_c} (\frac{t_{wc}}{t_{fc}})^{1.5}] \times (\frac{E_c F_{yc} t_{fc}}{t_{wc}})^{0.5}$	= 141.82	[kips]	AISC 14 th Eq J10-4
Doubler plate thickness	$t_{dp} = 0.375$ [in]	yield $F_{ydp} = 50.0$	[ksi]	
Doubler plate crippling strength	$R_{n2} = 0.8 t_{dp}^2 [1 + 3 \frac{l_b}{d_c} (\frac{t_{dp}}{t_{fc}})^{1.5}] \times (\frac{E_c F_{ydp} t_{fc}}{t_{dp}})^{0.5}$	= 222.54	[kips]	AISC 14 th Eq J10-4
Total crippling strength	$R_n = R_{n1} + R_{n2}$	= 364.36	[kips]	
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th J10.3
	$\phi R_n =$	= 273.27	[kips]	
	ratio = 0.12	> P_{uf_c}	OK	
Column Panel Zone Shear		146.71 / 94.78		N/A
Panel zone shear force	$V_p = P_{f-TR} - P_{f-TL} - V_s$	= 146.71	[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 14 th J10.6
	$P_r \leq 0.4 P_c$, use Eq J10-9			AISC 14 th Eq J10-9
Web panel zone capacity	$R_n = 0.6 F_{yc} d_c t_{wc}$	= 105.32	[kips]	AISC 14 th Eq J10-9
Resistance factor-LRFD	$\phi = 0.90$			AISC 14 th J10.6
	$\phi R_n =$	= 94.78	[kips]	
Unbalanced force to be resisted by doubler plate	$V_{dp} = R_p - \phi R_n$	= 51.93	[kips]	

Doubler Geometry Restriction			PASS
Min Doubler Thickness to Allow for Proper Beveling of Plate			AISC DG13 Eq 4.4-4
Column section	$t_{fc} = 0.515$ [in]	$k_c = 1.020$ [in]	
Allowed fillet encroachment	$r_e = 0.250$ [in]		AISC 14 th Fig 10-3
Min doubler plate thickness	$t_{pmin} = k_c - t_{fc} - r_e$	= 0.255 [in]	AISC DG13 Eq 4.4-4
Doubler plate thickness	$t_{dp} =$	= 0.375 [in]	
		> t_{pmin}	OK
Min Doubler Thickness to Avoid Shear Buckling of Plate			AISC DG13 Eq 4.4-5
Column section	$d_c = 11.900$ [in]	$k_c = 1.020$ [in]	
	$h = d_c - 2 k_c$	= 9.860 [in]	
Doubler plate steel	$F_y = 50.0$ [ksi]	$E = 29000$ [ksi]	
Min doubler plate thickness	$t_{pmin} = h / 2.24 \sqrt{E / F_y}$	= 0.183 [in]	AISC 14 th G2.1 (a)
Doubler plate thickness	$t_{dp} =$	= 0.375 [in]	
		> t_{pmin}	OK
Doubler Plate Shear Yield			ratio = 51.93 / 133.88 = 0.39 PASS
Doubler plate thickness	$t_{dp} = 0.375$ [in]	yield strength $F_y = 50.0$ [ksi]	
Number of doubler	$N_{dbl} = 1$ for one side		
Column depth	$d_c = 11.900$ [in]		
Area of web	$A_w = t_{dp} \times d_c$	= 4.463 [in ²]	AISC DG13 Eq 4.4-1
Shear coefficient	$C_v = 1.0$		AISC 14 th Eq G2-2
Doubler plate shear in demand	$R_{dp} =$ unbalanced force from column panel zone shear calc	= 51.93 [kips]	
Doubler plate shear strength	$R_n = N_{dbl} 0.6 F_y A_w C_v$	= 133.88 [kips]	AISC 14 th Eq G2-1
Resistance factor-LRFD	$\phi = 1.00$		AISC 14 th G2.1 (a)
	$\phi R_n =$	= 133.88 [kips]	
	ratio = 0.39	> R_{dp}	OK
Doubler to Column Flange Fillet Weld Limitation			PASS
Min Fillet Weld Size			
Thinner part joined thickness	$t =$	= 0.375 [in]	
Min fillet weld size allowed	$w_{min} =$	= 0.188 [in]	AISC 14 th Table J2.4
Fillet weld size provided	$w =$	= 0.250 [in]	
		> w_{min}	OK
Min Fillet Weld Length			
Fillet weld size provided	$w =$	= 0.250 [in]	
Min fillet weld length allowed	$L_{min} = 4 \times w$	= 1.000 [in]	AISC 14 th J2.2b
Min fillet weld length	$L = d_b + (3 k_c + t_p) \times 2$ Ends	= 19.920 [in]	
		> L_{min}	OK

Doubler to Column Web Fillet Weld Limitation			PASS
Min Fillet Weld Size			
Thinner part joined thickness	$t =$	$= 0.295$ [in]	
Min fillet weld size allowed	$w_{min} =$	$= 0.188$ [in]	AISC 14 th Table J2.4
Fillet weld size provided	$w =$	$= 0.250$ [in]	
		$> w_{min}$	OK
Min Fillet Weld Length			
Fillet weld size provided	$w =$	$= 0.250$ [in]	
Min fillet weld length allowed	$L_{min} = 4 \times w$	$= 1.000$ [in]	AISC 14 th J2.2b
Min fillet weld length	$L = d_c - 2 \times k_c$	$= 9.860$ [in]	
		$> L_{min}$	OK
Doubler Weld Strength at Column Flange			ratio = 51.93 / 110.91 = 0.47 PASS
Doubler Plate to Column Flange Weld Length Calc			
Beam section	$d_b = 12.300$ [in]	column section $k_c = 1.020$ [in]	
End plate thickness	$t_p = 0.750$ [in]		
Doubler plate to column flange weld length - single fillet	$L = d_b + (3 k_c + t_p) \times 2$ ends	$= 19.920$ [in]	AISC DG13 Fig 4-3
Fillet Weld Strength Check			
Fillet weld leg size	$w = 1/4$ [in]	load angle $\theta = 0.0$ [°]	
Electrode strength	$F_{EXX} = 70.0$ [ksi]	strength coeff $C_1 = 1.00$	AISC 14 th Table 8-3
Number of weld line	$n = 1$ for single fillet		
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$	$= 1.00$	AISC 14 th Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$	$= 7.424$ [kip/in]	AISC 14 th Eq 8-1
Base metal - doubler plate	thickness $t = 0.375$ [in]	tensile $F_u = 65.0$ [ksi]	
Base metal - doubler plate is in shear, shear rupture as per AISC 14 th Eq J4-4 is checked			AISC 14 th J2.4
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	$= 14.625$ [kip/in]	AISC 14 th Eq J4-4
Single fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	$= 7.424$ [kip/in]	AISC 14 th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$		AISC 14 th Eq 8-1
	$\phi R_n =$	$= 5.568$ [kip/in]	
Shear resistance required	$R_{dp} =$	$= 51.93$ [kips]	
Fillet weld length - single fillet	$L =$	$= 19.920$ [in]	
Shear resistance provided	$\phi F_n = \phi R_n \times L$	$= 110.91$ [kips]	
	ratio = 0.47	$> R_{dp}$	OK

Doubler Weld Strength at Column Web		ratio = 51.93 / 54.90	= 0.95	PASS
Doubler Plate to Column Web Weld Length Calc				
Column section	$d_c = 11.900$ [in]	$k_c = 1.020$ [in]		
Doubler plate to column web weld length - single fillet	$L = d_c - 2 \times k_c$		= 9.860 [in]	
Fillet Weld Strength Check				
Fillet weld leg size	$w = 1/4$ [in]	load angle $\theta = 0.0$ [°]		
Electrode strength	$F_{EXX} = 70.0$ [ksi]	strength coeff $C_1 = 1.00$		AISC 14 th Table 8-3
Number of weld line	$n = 1$ for single fillet			
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$	= 1.00		AISC 14 th Page 8-9
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$	= 7.424 [kip/in]		AISC 14 th Eq 8-1
Base metal - doubler plate thickness $t = 0.375$ [in]		tensile $F_u = 65.0$ [ksi]		
Base metal - doubler plate is in shear, <u>shear</u> rupture as per AISC 14 th Eq J4-4 is checked				AISC 14 th J2.4
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$	= 14.625 [kip/in]		AISC 14 th Eq J4-4
Single fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$	= 7.424 [kip/in]		AISC 14 th Eq 9-2
Resistance factor-LRFD	$\phi = 0.75$			AISC 14 th Eq 8-1
	$\phi R_n =$	= 5.568 [kip/in]		
Shear resistance required	$R_{dp} =$	= 51.93 [kips]		
Fillet weld length - single fillet	$L =$	= 9.860 [in]		
Shear resistance provided	$\phi F_n = \phi R_n \times L$	= 54.90 [kips]		
	ratio = 0.95	> R_{dp}	OK	