

Validation Record for

# ${\rm HB001AM10}$

Double Angle Horozontal Bracing Connection

(March 27, 2025)

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# 1 Introduction

Osoconn is a free and open source connection design application. The Osoconn project is a personal project developed by Roshn Noronha for educational purposes and licensed under the MIT Open Source license. For more information visit https://osoconn.com.

#### 1.1 Purpose and scope

The purpose of this document is to validate the results of the connection code HB001AM10 for the Osoconn project.

# 1.2 Methodology

To validate the results of the program a set of sample calculations are prepared and the results are compared with the output from the program. If the results obtained are equal within a tolerance of one percent, the validation is deemed successful.

The connection code HB001AM10 refers to the double angle horozontal bracing connection, and the design of this connection type is checked against the requirements of AISC 360-2010 [1]. The detailed calculation and a summary of the comparison with the program output is provided in section 2. The full output of the program is provided in section 3.

To minimize the chance of errors the selected validation problems tries to cover as many different options and connections configurations available in the program as possible. However, while every attempt is made to ensure the accuracy of the program, it should be noted that, not every aspect of the program can be tested, and the user shall independently verify the output of the program before using it.

#### References

[1] AISC. Specification for Structural Steel Buildings. 360. American Institute of Steel Construction, Chicago, IL, 2010.

# 2 Validation Calculation

# 2.1 Executive summary

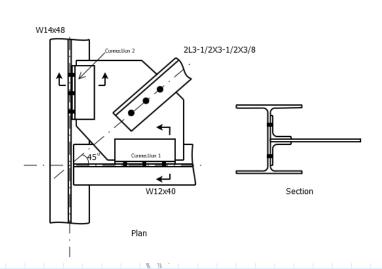
Table 1: Executive Summary

Table 1. Executive 5u	mmary
	Result
Validation problem 1	OK
Validation problem 2	OK
Validation problem 3	OK
Validation problem 4	OK
Validation problem 5	OK
Validation problem 6	OK

#### 2.2 Validation Problem 1

#### Problem Statement

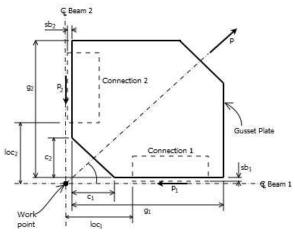
Design a horizontal brace connection for a double angle 2L3-1/2X3-1/2X3/8 brace, with their back to back leg horizontal, framing into the junction between a W12X40 and a W14X48 using the LRFD method. The brace has an angle of 45 degrees with the W12 beam. The brace has an axial force of 35kip. The beams, angles and plates are of grade ASTM A36. The bolts are ASTM 3125 A325 slip critical type.



# Design Inputs

Material Properties	4,
Material grade for plate	ASTM A36
Yield strength	$F_{yp} = 36 \ ksi$
Tensile strength	$F_{up} = 58 \; ksi$
Material grade of beam	ASTM A36
Yield strength	$F_{yb} = 36$ ksi
Tensile strength	$F_{ub} \coloneqq 58 \; ksi$
	· C
Material grade of angles	ASTM A36
Yield strength	$F_{ya} = 36$ ksi
Tensile strength	$F_{ua} = 58$ ksi
Matanial anada San naldalastrada	E70XX
Material grade for weld electrode Tensile strength	$F_{EXX} = 70 \; ksi$
Tensile sciengen	F EXX 10 KSt
Material specification for bolts	ASTM 3125 A325
Tensile strength	$F_{nt} = 90 \; m{ksi}$
Shear strength	$F_{nv}^{ni} \coloneqq 54 \ ksi$
	ne de la companya de
Young's modulus for steel	$E \coloneqq 29000 \; ksi$
	94.
Design Forces	
Axial force in brace	P = 35  kip

Connection Geometry	
Brace section	2L3-1/2X3-1/2X3/8
Thickness	$t_{br}\!\coloneqq\!0.375$ $m{in}$
Outstanding leg length	$l_{obr} \coloneqq 3.5$ in
Back-to-back leg length	$l_{ibr} \coloneqq 3.5$ in
Gross cross section area	$A_{br} \coloneqq 5$ $in^2$
Centroid of brace outstanding leg	$x'_{br} \coloneqq 1$ in
Brace angle with horizontal	$\theta_{br}^{\text{s.i.}} = 45  oldsymbol{deg}$
Beam section at connection 1	W12X40
Section depth	$d_{xb1}\!\coloneqq\!11.9$ $m{in}$
Flange width	$b_{fb1} = 8.01 \; in$
Flange thickness	$t_{fb1}^{"}\!\coloneqq\!0.515$ $m{in}$
Web thickness	$t_{wb1} \coloneqq 0.295$ in
Distance from outer face to fillet edge	$k_{bdet1} = 1.375$ in
Beam section at connection 2	W14X48
Section depth	$d_{xb2}\!\coloneqq\!13.8$ $m{in}$
Flange width	$b_{fb2} = 8.03$ $in$
Flange thickness	$t_{fb2}\!\coloneqq\!0.595$ $in$
Web thickness	$t_{wb2} \coloneqq 0.34$ in
Distance from outer face to fillet edge	$k_{bdet2} = 1.4375$ in
Clip angle section	L3-1/2X3X3/8
Thickness	$t_a = 0.375 \; in$
Outstanding leg length	$l_{oa}^{\circ}$ := $3.5$ $in$
Welded leg length	$l_{ia} \coloneqq 3$ in
€ Beam 2	
sb <sub>2</sub> ! <sub>11-</sub>	



Gusset plate thickness	$t_g\!\coloneqq\!0.5$ in
Gusset dimension along connection 1	$g_1 \coloneqq 15$ <b>in</b>
Gusset dimension along connection 2	$g_2\!\coloneqq\!15$ <b>in</b>
Gusset cutout at connection 1	$c_1 \coloneqq 4$ in
Gusset cutout at connection 2	$c_2 \coloneqq 4$ in

Bolt diameter	$d_b \!\coloneqq\! rac{7}{8}  oldsymbol{in} \ d_{bh} \!\coloneqq\! rac{15}{16}  oldsymbol{in}$
	15
Bolt hole diameter	$d_{bh}$ := $\stackrel{13}{-}$ $in$
	16
Slip coefficient (class A surface)	$\mu := 0.3$
Bolt pretension	$T_{pre} = 39 \ kip$
Number of bolts per row on brace	$n_{br}\!\coloneqq\!3$
Number of bolts at clip at beam 1	$n_1 \coloneqq 3$
Number of bolts at clip at beam 2	$n_2 = 3$
Bolt spacing	s = 2.5 in
Bolt gage on brace	$g_{br} \coloneqq 1.75$ in
Bolt gage on clip	$g \coloneqq 1.75$ in
Location of brace edge from the work point	$loc_{br} \coloneqq 16$ $m{in}$
Location of connection 1 from work point	$loc_1 = 6$ in
Location of connection 2 from work point	$loc_2 \coloneqq 6$ in
Bolt edge distance on brace	$ed_1 \coloneqq 1.25$ in
Bolt edge distance on gusset	$ed_2 = 1.25$ in
Bolt edge distance on clip	
Bort edge distance on Cirp	$ed_3\!\coloneqq\!1.125$ $\emph{in}$
Clip to gusset weld thickness	$w \coloneqq 0.25$ in
Connection setback at connection 1	$sb_1 \coloneqq 0.5$ in
Connection setback at connection 2	$sb_2 = 0.5$ in
Connection forces Shear per bolt at brace connection	3
p P	D 11 007 1
$P_b$ := $rac{1}{n_{br}}$	$P_b$ =11.667 $kip$
$r_{br}$	
Component of brace force along connection 1	40-
$P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$	$P_1 = 24.749 \ \textit{kip}$
Force per bolt along connection 1	$P_{b}$ = 11.667 <b>kip</b> $P_{1}$ = 24.749 <b>kip</b> $P_{b1}$ = 4.125 <b>kip</b> $P_{2}$ = 24.749 <b>kip</b>
$P_{b1} \coloneqq rac{P_1}{2 \cdot n_1}$	$P_{b_1} = 4.125 \ kip$
$2 \cdot n_1$	5
Component of brace force along connection 2	2
D. D.:/A	D 204 740 1
$P_2 = P \cdot \sin\left(\theta_{br}\right)$	$P_2 = 24.749 \text{ kip}$
Force per bolt along connection 2	
	D 4 107 16 m
$D_{\mathbf{D}} = \mathbf{I}_{\mathbf{D}}$	
$P_{b2}\!\coloneqq\!rac{P_2}{2\!\cdot\! n_2}$	$P_{b2} = 4.125$ ktp
$P_{b2}$ : $\equiv {2 \cdot n_2}$	$P_{b2} = 4.125$ ktp
$P_{b2}\coloneqqrac{F_2}{2m{\cdot}n_2}$ Bolt shear at brace to gusset connection	$P_{b2} = 4.125$ kip
$P_{b2}\coloneqq \overline{2 \cdot n_2}$	$P_{b2}\!=\!4.125$ $m{kip}$
$P_{b2} \coloneqq rac{}{2 \cdot n_2}$ Bolt shear at brace to gusset connection	$R_{b2}$ =4.125 $kip$

Ĉ.	$I_0 \coloneqq \frac{P_b}{R_m}$	$I_0 = 0.441$
O.	${}^{\circ}$ ${}^{\kappa_n}$	0
Bolt bearing on bra		
Minimum clear dista	nce for bearing check	1 0.00
70	$l_{c1}\!\coloneqq\!min\left(s\!-\!d_{bh},ed_{1}\!-\!0.5\!ullet\!d_{bh} ight)$	$l_{c1}\!=\!0.02$ $m$
Nominal strength in		
	$R_n := min\left(1.2 \cdot l_{c1} \cdot t_{br} \cdot F_{ua}, 2.4 \cdot d_b \cdot t_{br} \cdot F_{ua}\right)$	$R_n = 20.391 \ kip$
Interaction ratio in	n bolt bearing at brace	
10	$I_1 \coloneqq \frac{0.5 \ P_b}{0.75 \cdot R_n}$	$I_{1} = 0.381$
	$\frac{1}{1} = 0.75 \cdot R_n$	1 -0.301
Bolt bearing on gus:	set check	
	nce for bearing on gusset	
	$l_{c2}\!\coloneqq\!min\left(s\!-\!d_{bh},ed_{2}\!-\!0.5\!ullet d_{bh} ight)$	$l_{c1}\!=\!0.02$ $m$
Nominal strength in		
	$R_n := min\left(1.2 \cdot l_{c2} \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 27.188 \ kip$
Interaction ratio i	n bolt bearing at gusset	
	$P_b$	1 -0 570
	n bolt bearing at gusset $I:=rac{P_b}{0.75 \cdot R_n}$ re check rea of brace	$I_{_2} = 0.572$
Brace tension ruptu:	re check	
Net cross section a	rea of brace	
	re check $ ext{rea of brace} \ A_{nbr} \coloneqq A_{br} - 2 \cdot d_{bh} \cdot t_{br}$	$A_{nbr} = 4.297 \; in^2$
Length of connection	n 705	
	$l_{br}\!\coloneqq\!s\!\cdot\!\left(n_{br}\!-\!1\right)$	$l_{br}\!=\!5$ $in$
Shear lag factor		
	$l_{br}\!\coloneqq\!s\!\cdot\!\left(n_{br}\!-\!1 ight)$ $U\!\coloneqq\!1\!-\!rac{x_{br}'}{l_{br}}$	U = 0.8
Brace strength in to	ension rupture	
	$P_n \coloneqq F_{ua} \cdot U \cdot A_{nbr}$	$P_n = 199.375 \ kip$
Interaction ratio fo	or brace tension rupture	20.
	$I_3 = \frac{P}{0.75 \cdot P_n}$	$I_{3} = 0.234$
Brace block shear cl	heck	16
Gross area in shear		72
	$A_{gv}\!\coloneqq\!2\boldsymbol{\cdot} \big(\big(n_{br}\!-\!1\big)\boldsymbol{\cdot} s\!+\!ed_1\big)\boldsymbol{\cdot} t_{br}$	$A_{gv}\!=\!4.688$ $in^2$
Net area in shear		6
wee area in shear	$A_{nv}\!\coloneqq\!A_{gv}\!-2\boldsymbol{\cdot} \left(n_{br}\!-\!0.5\right)\boldsymbol{\cdot} d_{bh}\boldsymbol{\cdot} t_{br}$	$A_{nv}$ = $2.93~in^2$

)	1	$A_{nt} = 0.961 \; in^2$
Ź.	$A_{nt}\!\coloneqq\!2ullet ig(l_{ibr}\!-g_{br}\!-0.5ullet d_{bh}ig)ullet t_{br}$	$A_{nt} = 0.961 \ m$
Nominal strength bl		
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
4		
9-:	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
105		
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 156.984 \; kip$
	( 1027   1027	
Interaction ratio i	in block shear	
	$I_4 = \frac{P}{0.75 \cdot R_n}$	$I_{A} = 0.297$
9	$14 0.75 \cdot R_n$	4 0.231
Cugaet tangian	ding shock	
Gusset tension yiel	Grig Cileck	
	YO	
	30,5	
	lw V	
	Wa.	
Length of Whitmore	section	
	$l_w = 2 \cdot l_{br} \cdot \tan \left( 30   oldsymbol{deg}  ight)$	$l_w = 5.774 \; in$
		w
Nominal strength of	gusset in yielding	
	$P_n \coloneqq F_{up} \cdot l_w \cdot t_q$	$P_n = 103.923 \ kip$
	$I_n = I_{yp} \cdot \iota_w \cdot \iota_g$	n = 100.323 kep
Internation matic i	in tension violding	
Interaction ratio i	in tension yielding	
	, P	1 0 274
	$I_{5} = \frac{P}{0.9 \cdot P_{n}}$	$I_{\frac{5}{5}} = 0.374$
Gusset tension rupt	ure check	
Net area of gusset	in tension	
	$A_{ng}\coloneqq ig(l_w-d_{bh}ig)ullet t_g$	$A_{ng} = 2.418 \; m{in}^2$
		$I_{5}\!=\!0.374$ $A_{ng}\!=\!2.418~in^{2}$ $P_{n}\!=\!140.244~kip$
Nominal strength of	f gusset in rupture	92
	$P_n \coloneqq F_{up} \cdot A_{nq}$	$P_n = 140.244 \; kip$
		4
	n ap neg	
Interaction ratio i		
Interaction ratio i		0
Interaction ratio i	in tension rupture	0
Interaction ratio i		$I_6 = 0.333$
	in tension rupture $I_6 \coloneqq \frac{P}{0.75 \cdot P_n}$	0
Bolt shear at conne	in tension rupture $I_6 \coloneqq \frac{P}{0.75 \cdot P_n}$ ection 1	0
Bolt shear at conne	in tension rupture $I_6 \coloneqq \frac{P}{0.75 \cdot P_n}$ ection $1$	$I_6 = 0.333$
Interaction ratio i  Bolt shear at connection in the connection ratio in the connectin ratio in the connection ratio in the connection ratio in the co	in tension rupture $I_6 \coloneqq \frac{P}{0.75 \cdot P_n}$ ection 1	0

	$I_7 \coloneqq \frac{P_{b1}}{R_m}$	$I_7 = 0.312$
	71	
TO WILL STATE OF THE STATE OF T	angle at connection 1	
Clear distance between	en bolt holes/ hole and edge	1 0 676 in
25	$l_c\!\coloneqq\!min\left(\!s\!-\!d_{bh},ed_3\!-\!0.5\!ullet\!d_{bh}\! ight)$	$l_c\!=\!0.656$ $in$
Nominal strength in 1		
	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_a \cdot F_{ua}, 2.4 \cdot d_b \cdot t_a \cdot F_{ua}\right)$	$R_n = 17.128 \; kip$
Interaction ratio in	bolt bearing	
	$P_{h_1}$	
	$I_{8} = \frac{P_{b1}}{0.75 \ R_{n}}$	$I_{8} = 0.321$
Bolt bearing at beam		
Nominal strength in b		D = 20 001 1.5
	$R_n \coloneqq min\left(1.2 \cdot \left(s - d_{bh}\right) \cdot t_{wb1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{wb1} \cdot F_{ub}\right)$	$R_n = 32.081 \; kip$
Interaction ratio in	bolt bearing	
	$I_{g} \coloneqq \frac{P_{b1}}{0.75 \ R_{m}}$	$I_{0} = 0.171$
	$^{9}$ 0.75 $R_{n}$	9
Gusset shear yieldin	g at connection 1	
Nominal shear streng	th of gusset in yielding	
	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot (g_1 - c_1) \cdot t_g$	$R_n = 118.8 \; kip$
	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot (g_1 - e_1) \cdot t_g$	
Interaction ratio in	gusset yieldling	
	$I = P_1$	I -0.208
	$I_{10} \coloneqq \frac{P_1}{R_n}$	$I_{_{10}} = 0.208$
Gusset plate block s	hear at connection 1	
Length of gusset to		
	$L_1 := (n_1 - 1) \cdot s + 2 \ ed_3$	$L_1\!=\!7.25 {m in}$
		1
Distance of gusset o	uter edge from work point	
	$loc_{go} \coloneqq g_1 + sb_2 + 0.5 \cdot t_{wb2}$	$loc_{go} = 15.67$ in
Distance of gusset i	nner edge from work point	3
$loc_g$	$i \coloneqq c_1 + sb_2 + 0.5 \cdot t_{wb2} - \mathbf{if} \left( c_2 = 0 , 0 , \left( l_{ia} - sb_1 \right) \cdot \frac{c_1}{c_2} \right)$	$loc_{gi} = 2.17$ $in$
Outer edge distance		
	$ed_{go} \coloneqq loc_{go} - loc_1 - L_1$	$ed_{go}\!=\!2.42$ $in$
Inner edge distance	for clip on gusset $ed_{gi} \coloneqq loc_1 - loc_{gi}$	$ed_{gi}$ $=$ $3.83$ $in$

Minimum edge distance for clip on gusset	
$ed_{g} \coloneqq min\left(ed_{go}, ed_{gi}\right)$	$ed_q$ =2.42 $in$
$cag$ . Here $(cag_{\delta}, cag_{i})$	
Gross area subjected to block shear	
$A_{qv} \coloneqq (L_1 + ed_q) ullet t_q$	$A_{qv} = 4.835 \; in^2$
	ge
Net area subjected to tension	
$A_{nt}\!\coloneqq\!(l_{ia}\!-\!sb_1)\!\cdot\!t_g$	$A_{nt}$ $=$ $1.25$ $oldsymbol{in}^2$
Nominal strength in block shear	
$R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	$R_n = 176.936 \ kip$
Interaction ratio in block shear	
$I_{11} \coloneqq \frac{P_1}{0.75 \ R_n}$	
$I_{11} = \frac{1}{0.75 R}$	$I_{11} = 0.186$
Gusset flexure yielding at connection 1	
Eccentricity of force at connection 1	10101
$ec_1 = c_2 + sb_1 + 0.5 \ t_{wb1}$	$ec_1 = 4.648$ in
Nominal moment strength of gusset	
$M_n\!\coloneqq\!rac{F_{yp}\!\cdot\! t_g\!\cdot\! {g_1}^2}{4}$	$M_n = 84.375 \; kip \cdot ft$
$N_n$ $         -$	$m_n = 64.373 \text{ ktp} \cdot \text{jt}$
Interaction ratio in gusset flexure	
$I_{12} \coloneqq rac{P_1 \! \cdot \! ec_1}{0.9 \! \cdot \! M_n}$	$I_{12} = 0.126$
$^{12}$ $0.9 \cdot M_n$	12
Clip angle shear yielding at connection 1	
Gross area in shear	
$A_{gv}\!\coloneqq\!2m{\cdot} L_1m{\cdot} t_a$	$A_{gv} = 5.438 \; in^2$
Nominal strength in shear yielding	
$R_n\!\coloneqq\!0.6\!ullet\!F_{ya}\!ullet\!A_{gv}$	$R_n = 117.45 \ kip$
Interaction ratio in shear yielding	
$r$ $P_1$	T 0.011
$I_{13} = \frac{P_1}{R_n}$	$I_{13} = 0.211$
Clip angle shear rupture at connection 1	2
$A_{gv}\coloneqq 2\cdot L_1\cdot t_a$ Nominal strength in shear yielding $R_n\coloneqq 0.6\cdot F_{ya}\cdot A_{gv}$ Interaction ratio in shear yielding $I_{13}\coloneqq \frac{P_1}{R_n}$ Clip angle shear rupture at connection 1 Net area in shear	10
$A_{nv}\!\coloneqq\!A_{qv}\!-2ullet\!n_1\!ullet\!d_{bh}\!ullet\!t_a$	$A_{nv} = 3.328 \; in^2$
	nv
Nominal strength in shear rupture	16
$R_n\!\coloneqq\!0.6\!\cdot\!F_{ua}\!\cdot\!A_{nv}$	$R_n = 115.819 \; kip$
Interaction ratio in shear rupture	97.
P.	0.
$I_{14} \coloneqq rac{P_1}{0.75 \; R_n}$	$I_{14} = 0.285$
$14  0.73 \; R_n$	* 1

	cted to block shear	
0	$A_{gv} \coloneqq 2 \boldsymbol{\cdot} \left( L_1 - ed_3 \right) \boldsymbol{\cdot} t_a$	$A_{gv}\!=\!4.594$ $in^2$
O.e		
Net area subject	ed to block shear	
Ç.	$A_{nv}\!\coloneqq\!A_{qv}\!-\!2\boldsymbol{\cdot} (n_1\!-\!0.5)\boldsymbol{\cdot} d_{bh}\boldsymbol{\cdot} t_a$	$A_{nv} = 2.836 \; in^2$
9		
Net area subject		
103	$A_{nt} \coloneqq ig( 2 ullet l_{oa} + t_g - 2 ullet g - d_{bh} ig) ullet t_a$	$A_{nt} = 1.148 \; m{in}^2$
Nominal strength	in block shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$	$R_n = 165.3$ kip
Interaction rati	o in block shear	
	$I_{15} \coloneqq \frac{P_1}{0.75 R_n}$	$I_{_{15}}\!=\!0.2$
	$^{15}$ 0.75 $R_n$	15
Weld check at co	nnection 1	
	sb,   b <sub>w</sub>	
	P <sub>1</sub>	
Length of horizo	ntal run of weld $b_w\!\coloneqq\! l_{ia}\!-\!sb_1$	$b_w$ = 2.5 $in$
Controld of wold	group	Ö.
Centroid of weld	$c_w \coloneqq \frac{b_w^{\ 2}}{2 \cdot b_w + L_1}$	e = 0.51 im
	$c_w$ $\overline{}$	$e_w$ $=$ 0.31 $m$
Eccentricity of		9
	$e_w \coloneqq l_{ia} - c_w$	$oldsymbol{e}_w\!=\!0.51$ $oldsymbol{in}$ $e_w\!=\!2.49$ $oldsymbol{in}$
Polar moment of	inertia of weld group	10,
	$I_w\!\coloneqq\!rac{ig(2\!\cdot\!b_w\!+\!L_1ig)^3}{12}\!-\!rac{b_w^{-2}\!\cdot\!ig(b_w\!+\!L_1ig)^2}{2\!\cdot\!b_w\!+\!L_1}$	$I_w = 104.688 \; in^3$

	$P_1 \cdot e_w \cdot L_1$	kip
	$f_{wx}\!\coloneqq\!rac{P_1\!\cdot\! e_w\!\cdot\! L_1}{4\!\cdot\! I_w}$	$f_{wx} = 1.067 \frac{kip}{in}$
Co	w w	616
Component of weld	stress along y	
Y i	$P_1 \qquad P_1 \cdot e_m \cdot (b_m - c_m)$	kin
9	$f_{wy}\!\coloneqq\!rac{P_1}{2ullet(2ullet b_w\!+\!L_1)}\!+\!rac{P_1ullet e_wullet \left(b_w\!-\!c_w ight)}{2\;I_w}$	$f_{wy} = 1.596 \frac{kip}{in}$
(2)		TIL .
Resultant weld str		kin
	$f_w \coloneqq \sqrt{f_{wx}^2 + f_{wy}^2}$	$f_w = 1.92 \; rac{m{kip}}{m{in}}$
		TH .
Nominal weld stren	gth $R_n\!\coloneqq\!0.6\!\cdot\!F_{E\!X\!X}\!\cdot\!rac{\sqrt{2}}{2}\!\cdot\!w$	kin
	$R_n = 0.6 \cdot F_{EXX} \cdot \frac{\sqrt{2}}{2} \cdot w$	$R_n = 7.425 \frac{kip}{in}$
7	2	in
Interaction ratio	for weld check	
	$I_{16} \coloneqq \frac{f_w}{0.75 \ R_w}$	$I_{16} = 0.345$
	$0.75 R_n$	10
Gusset rupture at	weld at connection 1	
	ess to match weld strength	
	$t_{g.min} \coloneqq rac{2 \cdot f_w}{0.75 \cdot 0.6 \cdot F_{wn}}$	$t_{q.min}\!=\!0.147$ <b>in</b>
	$0.75 \cdot 0.6 \cdot F_{up}$	g.men
Interaction ratio	in web rupture	
	$I := \frac{t_{g.min}}{}$	$I_{17} = 0.294$
	$t_g$	17
Bolt shear at conn	ection 2	
Nominal slip resis	tance of bolt	
	$t_{g.min} \coloneqq \frac{t_{g.min}}{0.75 \cdot 0.6 \cdot F_{up}}$ in web rupture $I_{17} \coloneqq \frac{t_{g.min}}{t_g}$ ection 2 tance of bolt $R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$	$R_n = 13.221 \ kip$
	Ton Later pre	100
Interaction ratio		
Interaction ratio	in bolt shear	
Interaction ratio	in bolt shear	I -0.312
Interaction ratio		$I_{18} = 0.312$
	in bolt shear $I_{18} \coloneqq \frac{P_{b2}}{R_n}$	$I_{18} = 0.312$
Bolt bearing at cl	in bolt shear $I_{18} \coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2	
	in bolt shear $I_{18} \coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2	
Bolt bearing at cl	in bolt shear $I_{18} \coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2	
Bolt bearing at cl	in bolt shear $I_{18} \coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2 n bearing $R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_a \cdot F_{ua}, 2.4 \cdot d_b \cdot t_a \cdot F_{ua}\right)$	$I_{_{18}} = 0.312$ $R_n = 17.128 \ \textit{kip}$
Bolt bearing at cl	in bolt shear $I_{18} \coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2 n bearing $R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_a \cdot F_{ua}, 2.4 \cdot d_b \cdot t_a \cdot F_{ua}\right)$	$R_n = 17.128 \ kip$
Bolt bearing at cl	in bolt shear $I_{18} \coloneqq \frac{P_{b2}}{R_n}$ $\textbf{ip angle at connection 2}$ $n \ \text{bearing}$ $R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_a \cdot F_{ua}, 2.4 \cdot d_b \cdot t_a \cdot F_{ua}\right)$ in bolt bearing	$R_n = 17.128 \ kip$
Bolt bearing at cl	in bolt shear $I_{18} \coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2 n bearing $R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_a \cdot F_{ua}, 2.4 \cdot d_b \cdot t_a \cdot F_{ua}\right)$	
Bolt bearing at cl Nominal strength i	in bolt shear $I_{18}\coloneqq \frac{P_{b2}}{R_n}$ $\mathbf{ip \ angle \ at \ connection \ 2}$ $n \ bearing$ $R_n\coloneqq min\left(1.2\cdot l_c\cdot t_a\cdot F_{ua},2.4\cdot d_b\cdot t_a\cdot F_{ua}\right)$ $\mathbf{in \ bolt \ bearing}$ $I_{19}\coloneqq \frac{P_{b2}}{0.75\ R_n}$	$R_n = 17.128 \ kip$
Bolt bearing at cl Nominal strength i Interaction ratio	in bolt shear $I_{18}\coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2 n bearing $R_n\coloneqq min\left(1.2\cdot l_c\cdot t_a\cdot F_{ua},2.4\cdot d_b\cdot t_a\cdot F_{ua}\right)$ in bolt bearing $I_{19}\coloneqq \frac{P_{b2}}{0.75R_n}$ am web at connection 2	$R_n = 17.128 \ kip$
Bolt bearing at cl Nominal strength i	in bolt shear $I_{18}\coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2 n bearing $R_n\coloneqq min\left(1.2\cdot l_c\cdot t_a\cdot F_{ua},2.4\cdot d_b\cdot t_a\cdot F_{ua}\right)$ in bolt bearing $I_{19}\coloneqq \frac{P_{b2}}{0.75R_n}$ am web at connection 2 n bearing	$R_n = 17.128 \ \textit{kip}$ $I_{_{19}} = 0.321$
Bolt bearing at cl Nominal strength i Interaction ratio	in bolt shear $I_{18}\coloneqq \frac{P_{b2}}{R_n}$ ip angle at connection 2 n bearing $R_n\coloneqq min\left(1.2\cdot l_c\cdot t_a\cdot F_{ua},2.4\cdot d_b\cdot t_a\cdot F_{ua}\right)$ in bolt bearing $I_{19}\coloneqq \frac{P_{b2}}{0.75R_n}$ am web at connection 2	$R_n = 17.128 \ \textit{kip}$ $I_{19} = 0.321$

Interaction ratio i		
Ĉ	$I_{20} = \frac{P_{b2}}{0.75 R_n}$	$I_{20} = 0.149$
Ca		
Gusset shear yieldi	gth of gusset in yielding	
Nominal Shear Scren	$R_n\!\coloneqq\!0.6\!\cdot\!F_{yp}\!\cdot\!(g_2\!-\!c_2)\!\cdot\!t_q$	$R_n = 118.8 \; kip$
	$R_n = 0.0$ $r_{yp}$ $(g_2 = c_2)$ $r_g$	$n_n$ =116.6 $n_p$
Interaction ratio i	n gusset vieldling	
	$I_{21} \coloneqq \frac{P_2}{R_n}$	$I_{21} = 0.208$
	$^{21}$ $R_n$	21
Gusset plate block	shear at connection 2	
Distance of gusset	outer edge from work point	
	$loc_{go}\coloneqq g_2+sb_1+0.5m{\cdot} t_{wb1}$	$loc_{go}$ = $15.648$ $in$
	Y/V	
Distance of gusset	inner edge from work point	
		$ c_2\rangle$
loo	$c_{gi}\!:=\!c_{2}\!+\!s\!b_{1}\!+\!0.5\cdot t_{wb1}\!-\! ext{if}\!\left(c_{1}\!=\!0,0,\left(l_{ia}\!-\!sb_{2} ight)\!\cdot\!$	$loc_{gi} = 2.148 \ in$
		01)
Length of gusset to	Column Clip	7.25 3-2
	$L_2 \coloneqq (n_2 - 1) \cdot s + 2 \ ed_3$	$L_2 = 7.25 \; in$
Outer edge distance	for clip on gusset	
	ed := loc = loc = I	$ed_{go} = 2.398$ <b>in</b>
	$ed_{go} \coloneqq loc_{go} - loc_2 - L_2$	3 go 2 3 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
Inner edge distance	for clip on gusset $ed_{gi} \coloneqq loc_2 - loc_{gi}$	
	$ed_{qi} = loc_2 - loc_{qi}$	$ed_{qi}\!=\!3.853$ $in$
Minimum edge distan	ce for clip on gusset	
	$ed_g \coloneqq min\left(ed_{go}, ed_{gi} ight)$	$ed_g$ = $2.398$ $in$
Gross area subjecte		
	$A_{gv} \coloneqq (L_2 + ed_g) \cdot t_g$	$A_{gv}\!=\!4.824\; {\it in}^2$
NT   1   1		2
Net area subjected		$A_{nt}$ = 1.25 $in^2$
	$A_{nt} \coloneqq (l_{ia} - sb_2) \cdot t_g$	$A_{nt}$ = 1.25 $t n$
Nominal strength in	block shear	
	$R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{av} + F_{ua} \cdot A_{nt}$	$R_n = 176.693 \; kip$
Interaction ratio i	n block shear	(),
	$I_{22} = \frac{P_2}{0.75 \ R_{m}}$	$I_{22} = 0.187$
	$^{22}$ 0.75 $R_n$	22
	ding at connection 2	
Eccentricity of for	ce at connection 2	
_	$ec_2 := c_1 + sb_2 + 0.5 \ t_{wb2}$	$ec_2 = 4.67 \ in$

Interaction ratio in gusset flexure $I_{23} \coloneqq \frac{P_2 \cdot ec_2}{0.9 \cdot M_n} \qquad I_{23} = 0.127$ Clip angle shear yielding at connection 2 Gross area in shear $A_{gv} \coloneqq 2 \cdot L_2 \cdot t_a \qquad A_{gv} = 5.438 \; \text{in}^2$ Nominal strength in shear yielding $R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} \qquad R_n = 117.45 \; \text{kip}$ Interaction ratio in Shear yielding $I_{24} = \frac{P_2}{R_n} \qquad I_{24} = 0.211$ Clip angle shear rupture at connection 2 Net area in shear $A_{nv} \coloneqq A_{gv} \mp 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad A_{nv} = 3.328 \; \text{in}^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{wa} \cdot A_{nv} \qquad R_n = 115.819 \; \text{kip}$ Interaction ratio in shear rupture $I_{25} \coloneqq \frac{P_2}{0.75 \; R_n} \qquad I_{25} = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad A_{gv} = 4.594 \; \text{in}^2$ Net area subjected to block shear $A_{mv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \; \text{in}^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad A_{nt} = 1.148 \; \text{in}^2$	Ô	$M_n \coloneqq rac{F_{yp} \! \cdot \! t_g \! \cdot \! g_2^{\ 2}}{4}$	$M_n = 84.375 \; kip \cdot ft$
Clip angle shear yielding at connection 2 Gross area in shear $A_{gv} \coloneqq 2 \cdot L_2 \cdot t_a \qquad A_{gv} \equiv 5.438 \; in^2$ Nominal strength in shear yielding $R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} \qquad R_n = 117.45 \; kip$ Interaction ratio in shear yielding $I_{2i} \vDash \frac{P_2}{R_n} \qquad I_{2i} = 0.211$ Clip angle shear rupture at connection 2 Net area in shear $A_{nv} \coloneqq A_{gv} = 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad A_{nv} = 3.328 \; in^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad R_n = 115.819 \; kip$ Interaction ratio in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad R_n = 115.849 \; kip$ Interaction ratio in shear rupture $I_{2b} \coloneqq \frac{P_2}{0.75 \; R_n} \qquad I_{25} = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - cd_3) \cdot t_a \qquad A_{gv} = 4.594 \; in^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \; in^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot t_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad A_{nt} = 1.148 \; in^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ya} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	Ø,	4	
Clip angle shear yielding at connection 2 Gross area in shear $A_{gv} \coloneqq 2 \cdot L_2 \cdot t_a \qquad \qquad A_{gv} \equiv 5.438 \ in^2$ Nominal strength in shear yielding $R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} \qquad \qquad R_n = 117.45 \ kip$ Interaction ratio in shear yielding $I_2 \coloneqq \frac{P_2}{R_n} \qquad \qquad I_2 \equiv 0.211$ Clip angle shear rupture at connection 2 Net area in shear $A_{nv} \coloneqq A_{gv} = 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad \qquad A_{nv} \equiv 3.328 \ in^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad \qquad R_n = 115.819 \ kip$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{0.75 \ R_n} \qquad \qquad I_2 \equiv 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad \qquad A_{gv} \equiv 4.594 \ in^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} = 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad \qquad A_{nv} \equiv 2.836 \ in^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot t_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad \qquad A_{nt} \equiv 1.148 \ in^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ya} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	Interaction ratio	in gusset flexure	
Clip angle shear yielding at connection 2 Gross area in shear $A_{gv} \coloneqq 2 \cdot L_2 \cdot t_a \qquad A_{gv} \equiv 5.438 \ in^2$ Nominal strength in shear yielding $R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} \qquad R_n = 117.45 \ kip$ Interaction ratio in shear yielding $I_2 \coloneqq \frac{P_2}{R_n} \qquad I_2 \equiv 0.211$ Clip angle shear rupture at connection 2 Net area in shear $A_{nv} \coloneqq A_{gv} = 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad A_{nv} \equiv 3.328 \ in^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad R_n = 115.819 \ kip$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{0.75 \ R_n} \qquad I_2 \equiv 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad A_{gv} \equiv 4.594 \ in^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} = 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} \equiv 2.836 \ in^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot t_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad A_{nt} \equiv 1.148 \ in^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ya} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	Ġ.	$P_2 {ullet} ec_2$	T 0.10F
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For same and the shear $A_{gv}\coloneqq 2\cdot L_2\cdot t_a$ and $A_{gv}=5.438$ in $A_{gv}=5.438$ i			
Nominal strength in shear yielding $R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} \qquad \qquad R_n = 117.45 \text{ $kip}$ Interaction ratio in Shear yielding $I_{2i} \coloneqq \frac{P_2}{R_n} \qquad \qquad I_{2i} = 0.211$ Clip angle shear rupture at connection 2 Net area in shear $A_{nv} \coloneqq A_{gv} - 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad \qquad A_{nv} = 3.328 \text{ $in}^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad \qquad R_n = 115.819 \text{ $kip}$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{0.75 R_n} \qquad \qquad I_{25} = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad \qquad A_{gv} = 4.594 \text{ $in}^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad \qquad A_{nv} = 2.836 \text{ $in}^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad \qquad A_{nt} = 1.148 \text{ $in}^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$			_
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Clip angle shear rupture at connection 2 Net area in shear $A_{nv} \coloneqq A_{gv} = 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad A_{nv} = 3.328 \ in^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad R_n = 115.819 \ kip$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{0.75 \ R_n} \qquad I_2 = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad A_{gv} = 4.594 \ in^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} = 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \ in^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad A_{nt} = 1.148 \ in^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$		n gu gi	16
Clip angle shear rupture at connection 2 Net area in shear $A_{nv} \coloneqq A_{gv} = 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad A_{nv} = 3.328 \ in^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad R_n = 115.819 \ kip$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{25} = \frac{P_2}{0.75 \ R_n} \qquad I_2 = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad A_{gv} = 4.594 \ in^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \ in^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad A_{nt} = 1.148 \ in^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	Interaction ratio	in shear yielding	
Clip angle shear rupture at connection 2 Net area in shear $A_{nv} \coloneqq A_{gv} = 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad A_{nv} = 3.328 \ in^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad R_n = 115.819 \ kip$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{25} = \frac{P_2}{0.75 \ R_n} \qquad I_2 = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad A_{gv} = 4.594 \ in^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \ in^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad A_{nt} = 1.148 \ in^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$		$P_2$	I = 0.211
Net area in shear $A_{nv} \coloneqq A_{gv} + 2 \cdot n_2 \cdot d_{bh} \cdot t_a \qquad A_{nv} = 3.328 \ in^2$ Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad R_n = 115.819 \ kip$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{0.75 \ R_n} \qquad I_2 = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad A_{gv} = 4.594 \ in^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \ in^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad A_{nt} = 1.148 \ in^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$		$rac{I_{24}}{R_n}$	$\frac{1}{24}$ $-0.211$
Nominal strength in shear rupture $R_n\coloneqq 0.6\cdot F_{ua}\cdot A_{nv} \qquad \qquad R_n=115.819 \ \textit{kip}$ Interaction ratio in shear rupture $I_2\coloneqq \frac{P_2}{0.75 \ R_n} \qquad \qquad I_2=0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv}\coloneqq 2\cdot (L_2-ed_3)\cdot t_a \qquad \qquad A_{gv}=4.594 \ \textit{in}^2$ Net area subjected to block shear $A_{nv}\coloneqq A_{gv}=2\cdot (n_2-0.5)\cdot d_{bh}\cdot t_a \qquad \qquad A_{nv}=2.836 \ \textit{in}^2$ Net area subjected to tension $A_{nt}\coloneqq (2\cdot l_{oa}+t_g-2\cdot g-d_{bh})\cdot t_a \qquad \qquad A_{nt}=1.148 \ \textit{in}^2$ Nominal strength in block shear $R_{n1}\coloneqq 0.6\cdot F_{ua}\cdot A_{nv}+F_{ua}\cdot A_{nt} \qquad \qquad R_{n2}\coloneqq 0.6\cdot F_{ya}\cdot A_{gv}+F_{ua}\cdot A_{nt}$	Clip angle shear :	rupture at connection 2	
Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad \qquad R_n = 115.819 \ \textit{kip}$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{0.75 \ R_n} \qquad \qquad I_2 = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad \qquad A_{gv} = 4.594 \ \textit{in}^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad \qquad A_{nv} = 2.836 \ \textit{in}^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad \qquad A_{nt} = 1.148 \ \textit{in}^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	Net area in shear		
Nominal strength in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} \qquad \qquad R_n = 115.819 \ \textit{kip}$ Interaction ratio in shear rupture $I_2 \coloneqq \frac{P_2}{0.75 \ R_n} \qquad \qquad I_2 = 0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad \qquad A_{gv} = 4.594 \ \textit{in}^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad \qquad A_{nv} = 2.836 \ \textit{in}^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad \qquad A_{nt} = 1.148 \ \textit{in}^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$		$A_{nv}\!\coloneqq\!A_{gv}\!-\!2ullet n_2\!\cdot\!d_{bh}\!\cdot\!t_a$	$A_{nv} = 3.328 \; in^2$
$I_{25}\coloneqq\frac{P_2}{0.75R_n} \qquad \qquad I_{25}=0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv}\coloneqq 2\cdot (L_2-ed_3)\cdot t_a \qquad \qquad A_{gv}=4.594~\text{in}^2$ Net area subjected to block shear $A_{nv}\coloneqq A_{gv}-2\cdot (n_2-0.5)\cdot d_{bh}\cdot t_a \qquad \qquad A_{nv}=2.836~\text{in}^2$ Net area subjected to tension $A_{nt}\coloneqq \left(2\cdot l_{oa}+t_g-2\cdot g-d_{bh}\right)\cdot t_a \qquad \qquad A_{nt}=1.148~\text{in}^2$ Nominal strength in block shear $R_{n1}\coloneqq 0.6\cdot F_{ua}\cdot A_{nv}+F_{ua}\cdot A_{nt}$ $R_{n2}\coloneqq 0.6\cdot F_{ya}\cdot A_{gv}+F_{ua}\cdot A_{nt}$	Nominal strength	n shear rupture	
$I_{25}\coloneqq\frac{P_2}{0.75R_n} \qquad \qquad I_{25}=0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv}\coloneqq 2\cdot (L_2-ed_3)\cdot t_a \qquad \qquad A_{gv}=4.594~\text{in}^2$ Net area subjected to block shear $A_{nv}\coloneqq A_{gv}-2\cdot (n_2-0.5)\cdot d_{bh}\cdot t_a \qquad \qquad A_{nv}=2.836~\text{in}^2$ Net area subjected to tension $A_{nt}\coloneqq \left(2\cdot l_{oa}+t_g-2\cdot g-d_{bh}\right)\cdot t_a \qquad \qquad A_{nt}=1.148~\text{in}^2$ Nominal strength in block shear $R_{n1}\coloneqq 0.6\cdot F_{ua}\cdot A_{nv}+F_{ua}\cdot A_{nt}$ $R_{n2}\coloneqq 0.6\cdot F_{ya}\cdot A_{gv}+F_{ua}\cdot A_{nt}$		$R_n\!\coloneqq\!0.6\!\cdot\!F_{ua}\!\cdot\!A_{nv}$	$R_n = 115.819 \ kip$
$I_{25}\coloneqq\frac{P_2}{0.75R_n} \qquad \qquad I_{25}=0.285$ Clip angle block shear at connection 2 Gross area subjected to block shear $A_{gv}\coloneqq 2\cdot (L_2-ed_3)\cdot t_a \qquad \qquad A_{gv}=4.594~\text{in}^2$ Net area subjected to block shear $A_{nv}\coloneqq A_{gv}-2\cdot (n_2-0.5)\cdot d_{bh}\cdot t_a \qquad \qquad A_{nv}=2.836~\text{in}^2$ Net area subjected to tension $A_{nt}\coloneqq \left(2\cdot l_{oa}+t_g-2\cdot g-d_{bh}\right)\cdot t_a \qquad \qquad A_{nt}=1.148~\text{in}^2$ Nominal strength in block shear $R_{n1}\coloneqq 0.6\cdot F_{ua}\cdot A_{nv}+F_{ua}\cdot A_{nt}$ $R_{n2}\coloneqq 0.6\cdot F_{ya}\cdot A_{gv}+F_{ua}\cdot A_{nt}$		2	
Gross area subjected to block shear $A_{gv}\coloneqq 2\boldsymbol{\cdot} (L_2-ed_3)\boldsymbol{\cdot} t_a \qquad \qquad A_{gv}=4.594 \ \boldsymbol{in}^2$ Net area subjected to block shear $A_{nv}\coloneqq A_{gv}-2\boldsymbol{\cdot} (n_2-0.5)\boldsymbol{\cdot} d_{bh}\boldsymbol{\cdot} t_a \qquad \qquad A_{nv}=2.836 \ \boldsymbol{in}^2$ Net area subjected to tension $A_{nt}\coloneqq \left(2\boldsymbol{\cdot} l_{oa}+t_g-2\boldsymbol{\cdot} g-d_{bh}\right)\boldsymbol{\cdot} t_a \qquad \qquad A_{nt}=1.148 \ \boldsymbol{in}^2$ Nominal strength in block shear $R_{n1}\coloneqq 0.6\boldsymbol{\cdot} F_{ua}\boldsymbol{\cdot} A_{nv}+F_{ua}\boldsymbol{\cdot} A_{nt}$ $R_{n2}\coloneqq 0.6\boldsymbol{\cdot} F_{ya}\boldsymbol{\cdot} A_{gv}+F_{ua}\boldsymbol{\cdot} A_{nt}$	Interaction ratio	in shear rupture	
Gross area subjected to block shear $A_{gv}\coloneqq 2\boldsymbol{\cdot} (L_2-ed_3)\boldsymbol{\cdot} t_a \qquad \qquad A_{gv}=4.594 \ \boldsymbol{in}^2$ Net area subjected to block shear $A_{nv}\coloneqq A_{gv}-2\boldsymbol{\cdot} (n_2-0.5)\boldsymbol{\cdot} d_{bh}\boldsymbol{\cdot} t_a \qquad \qquad A_{nv}=2.836 \ \boldsymbol{in}^2$ Net area subjected to tension $A_{nt}\coloneqq \left(2\boldsymbol{\cdot} l_{oa}+t_g-2\boldsymbol{\cdot} g-d_{bh}\right)\boldsymbol{\cdot} t_a \qquad \qquad A_{nt}=1.148 \ \boldsymbol{in}^2$ Nominal strength in block shear $R_{n1}\coloneqq 0.6\boldsymbol{\cdot} F_{ua}\boldsymbol{\cdot} A_{nv}+F_{ua}\boldsymbol{\cdot} A_{nt}$ $R_{n2}\coloneqq 0.6\boldsymbol{\cdot} F_{ya}\boldsymbol{\cdot} A_{gv}+F_{ua}\boldsymbol{\cdot} A_{nt}$		$I := P_2$	I = 0.285
Gross area subjected to block shear $A_{gv} \coloneqq 2 \cdot (L_2 - ed_3) \cdot t_a \qquad \qquad A_{gv} = 4.594 \; \textbf{i} n^2$ Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad \qquad A_{nv} = 2.836 \; \textbf{i} n^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad \qquad A_{nt} = 1.148 \; \textbf{i} n^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$		$^{25}$ 0.75 $R_n$	25
$A_{gv}\coloneqq 2 \cdot (L_2-ed_3) \cdot t_a \qquad \qquad A_{gv}=4.594 \; in^2$ Net area subjected to block shear $A_{nv}\coloneqq A_{gv}-2 \cdot (n_2-0.5) \cdot d_{bh} \cdot t_a \qquad \qquad A_{nv}=2.836 \; in^2$ Net area subjected to tension $A_{nt}\coloneqq \left(2 \cdot l_{oa}+t_g-2 \cdot g-d_{bh}\right) \cdot t_a \qquad \qquad A_{nt}=1.148 \; in^2$ Nominal strength in block shear $R_{n1}\coloneqq 0.6 \cdot F_{ua} \cdot A_{nv}+F_{ua} \cdot A_{nt} \qquad \qquad R_{n2}\coloneqq 0.6 \cdot F_{ya} \cdot A_{gv}+F_{ua} \cdot A_{nt}$			
Net area subjected to block shear $A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \ in^2$ Net area subjected to tension $A_{nt} \coloneqq \left(2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}\right) \cdot t_a \qquad A_{nt} = 1.148 \ in^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	Gross area subject		4 4 504 : 2
$A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \ \textbf{in}^2$ Net area subjected to tension $A_{nt} \coloneqq \left(2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}\right) \cdot t_a \qquad A_{nt} = 1.148 \ \textbf{in}^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$		$A_{gv} \coloneqq 2 \cdot (L_2 - ea_3) \cdot t_a$	$A_{gv} = 4.594 \ \textit{in}$
$A_{nv} \coloneqq A_{gv} - 2 \cdot (n_2 - 0.5) \cdot d_{bh} \cdot t_a \qquad A_{nv} = 2.836 \ \textbf{in}^2$ Net area subjected to tension $A_{nt} \coloneqq (2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}) \cdot t_a \qquad A_{nt} = 1.148 \ \textbf{in}^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	Net area subjected	d to block shear	
$A_{nt} \coloneqq \left(2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}\right) \cdot t_a \qquad \qquad A_{nt} \equiv 1.148 \; \textbf{in}^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$		$A_{nv}\!\coloneqq\!A_{gv}\!-\!2ullet(n_2\!-\!0.5)ullet d_{bh}ullet t_a$	$A_{nv} = 2.836 \; in^2$
$A_{nt} \coloneqq \left(2 \cdot l_{oa} + t_g - 2 \cdot g - d_{bh}\right) \cdot t_a \qquad \qquad A_{nt} \equiv 1.148 \; \textbf{in}^2$ Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	Net area subjects	to tension	Ô,
Nominal strength in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	wet area subjected		$A_{mt} = 1.148 \; im^2$
$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$		m - (m - g - g - on) - a	2111
$R_{n2}\!\coloneqq\!0.6\!\cdot\!F_{ya}\!\cdot\!A_{gv}\!+\!F_{ua}\!\cdot\!A_{nt}$	Nominal strength		
		$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
$R_n\!\coloneqq\!min\left(\!R_{n1},R_{n2}\! ight)$ $R_n\!=\!165.3$ $m{kip}$		$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	Ô
161 7 162)		$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 165.3 \ $ <b>kip</b>
		161 / 162/	

Ŝ.	$I_{26}\coloneqq rac{P_2}{0.75\;R_n}$	$I_{26} = 0.2$
	$^{26}$ 0.75 $R_n$	26
Weld check at connecti	on 2	
Ç.		
9-:	sb.   b.w	
105		
	P <sub>2</sub>	
4		
19 <sub>x</sub>	L <sub>2</sub> /2	
Length of horizontal m	cup of wold	
nengen of horizontal i		$b_w\!=\!2.5~m{in}$
	$b_w \coloneqq l_{ia} - sb_2$	$\sigma_w = 2.5$ th
Centroid of weld group		
	$c_w \coloneqq rac{{b_w}^2}{2 \cdot b_w + L_2}$ force	
	$c_w \coloneqq \frac{o_w}{c_w}$	$c_w = 0.51 \; in$
	$2 \cdot b_w + L_2$	
Eccentricity of shear	force	
	$e_w \coloneqq l_{ia} - c_w$	$e_w\!=\!2.49$ $in$
	7,	
Polar moment of inerti	a of weld group	
	$(2 \cdot b_w + L_1)^3  b_w^2 \cdot (b_w + L_1)^2$	7 404 000 4 3
	$I_w\!\coloneqq\!rac{\left(2m{\cdot}b_w\!+\!L_1 ight)^3}{12}\!-\!rac{{b_w}^2m{\cdot}\left(\!b_w\!+\!L_1\! ight)^2}{2m{\cdot}b_w\!+\!L_1}$	$I_w = 104.688 \ in^{\circ}$
	7	
Component of weld stre	ess along x	
	$_{f}$ $P_{2} \cdot e_{w} \cdot L_{2}$	f = 1.067 $kip$
	$J_{wx}$ $-\frac{1}{4 \cdot I_w}$	$\int wx - 1.007 {in}$
Component of weld stre	In a off weld group $I_w\coloneqq rac{\left(2\cdot b_w+L_1 ight)^3}{12}-rac{b_w^2\cdot (b_w+L_1)^2}{2\cdot b_w+L_1}$ as along x $f_{wx}\coloneqq rac{P_2\cdot e_w\cdot L_2}{4\cdot I_w}$ as along y $f_{wy}\coloneqq rac{P_2}{2\cdot \left(2\cdot b_w+L_2 ight)}+rac{P_2\cdot e_w\cdot (b_w-c_w)}{2\;I_w}$	2
		75
	$f_{vw} := P_2 + P_2 \cdot e_w \cdot (b_w - c_w)$	$f_{\text{max}} = 1.596 \frac{kip}{}$
	$2 \cdot (2 \cdot b_w + L_2)$ 2 $I_w$	in
Resultant weld stress		2
	$f_w = \sqrt{f_{wx}^2 + f_{wu}^2}$	$f_w = 1.92 \frac{\boldsymbol{kip}}{\cdot}$
		in
Nominal weld strength	$\sqrt{2}$	$f_w$ =1.92 $\frac{kip}{in}$ $R_n$ =7.425 $\frac{kip}{in}$
	$R_n = 0.6 \cdot F_{EXX} \cdot \frac{\sqrt{2}}{2} \cdot w$	$R_n = 7.425 \frac{\kappa \iota p}{200}$
		- un
Interaction ratio for	weld check	
	$I_{^{27}} \coloneqq \frac{f_w}{0.75 \; R_n}$	

Minimum web thickne	ss to match weld strength	
A L		
O. I	$t_{\cdots} := \frac{2 \cdot f_w}{}$	$t_{g.min}\!=\!0.147$ $in$
TITIHUM WED CHICKHE	$t_{g.min} \coloneqq rac{2 \cdot f_w}{0.75 \cdot 0.6 \cdot F_{up}}$ n web rupture $I_{28} \coloneqq rac{t_{g.min}}{t_g}$	<i>g.min</i> = 0.141
Interesting matic i	n trab mintuna	
Interaction ratio i	n web rupture	
TX.	$_{ au}$ $t_{a.min}$	T 0001
	$I_{28} := \frac{3}{t}$	$I_{28} = 0.294$
	$c_g$	
1		
9	K,	
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	YO	
	10	
	<u>O</u> '	
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	i i i i i i i i i i i i i i i i i i i	
	49	
	12	
	(S)_	
	10.	
	- QV	
		2
		4
		15
		12
		Call
		2.
		O.

# Validation Results

The calculated ratios are compared with the output of Osoconn and if it is within a tolerance of 1% the result is deemed to be OK.

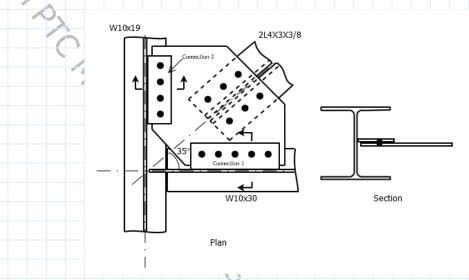
Table 2: Validation problem 1 results

Table 2: Validation problem 1 results					
	Interactio	n Ratio			
Check	Calculated	Osoconn	Result		
Bolt shear at brace check	0.441	0.441	OK		
Bolt bearing at brace check	0.381	0.381	OK		
Bolt bearing at gusset check	0.572	0.572	OK		
Brace tension rupture check	0.234	0.234	OK		
Brace block shear check	0.297	0.297	OK		
Gusset tension yielding check	0.374	0.374	OK		
Gusset tension rupture check	0.333	0.333	OK		
Bolt shear at connection 1	0.312	0.312	OK		
Bolt bearing at clip angle at connection 1	0.321	0.321	OK		
Bolt bearing at beam web at connection 1	0.171	0.171	OK		
Gusset shear yielding at connection 1	0.208	0.208	OK		
Gusset plate block shear at connection 1	0.186	0.186	OK		
Gusset flexure yielding at connection 1	0.126	0.126	OK		
Clip angle shear yielding at connection 1	0.211	0.211	OK		
Clip angle shear rupture at connection 1	0.285	0.285	OK		
Clip angle block shear at connection 1	0.2	0.2	OK		
Weld check at connection 1	0.345	0.345	OK		
Gusset rupture at weld at connection 1	0.294	0.294	OK		
Bolt shear at connection 2	0.312	0.312	OK		
Bolt bearing at clip angle at connection 2	0.321	0.321	OK		
Bolt bearing at beam web at connection 2	0.149	0.149	OK		
Gusset shear yielding at connection 2	0.208	0.208	OK		
Gusset plate block shear at connection 2	0.187	0.187	OK		
Gusset flexure yielding at connection 2	0.127	0.127	OK		
Clip angle shear yielding at connection 2	0.211	0.211	OK		
Clip angle shear rupture at connection 2	0.285	0.285	OK		
Clip angle block shear at connection 2	0.2	0.2	OK		
Weld check at connection 2	0.345	0.345	OK		
Gusset rupture at weld at connection 2	0.294	0.294	OK		

#### 2.3 Validation Problem 2

#### Problem Statement

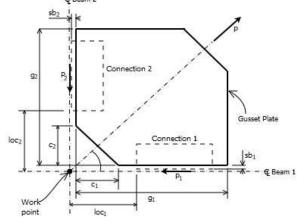
Design a horizontal brace connection for a double angle 2L4X3X3/8 brace, with their short leg back to back and vertical, framing into the junction between a W10X19 and a W10X30 using the LRFD method. The brace has an angle of 35 degrees with the W10X30 beam. The brace has an axial force of 45kip. The beams, angles and plates are of grade ASTM A36. The bolts are ASTM 3125 A325 bearing type.



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Material grade for plate	ASTM A36
Yield strength	$F_{up} = 36$ ksi
Tensile strength	$F_{up} = 58 \ ksi$
Material grade of beam	ASTM A36
Yield strength	$F_{yb} \coloneqq 36$ <b>ksi</b>
Tensile strength	$F_{ub}$ := 58 $ksi$
Material grade of angles	ASTM A36
Yield strength	$F_{ya}\!\coloneqq\!36$ <b>ksi</b>
Tensile strength	$F_{ua}$ := 58 $m{ksi}$
Material grade for weld electrode	E70XX
Tensile strength	$F_{EXX}$ := 70 $m{ksi}$
Material specification for bolts	ASTM 3125 A325
Tensile strength	$F_{nt} = 90 \; ksi$
Shear strength	$F_{nv} \coloneqq 54 \ \textit{ksi}$
Young's modulus for steel	$E \coloneqq 29000 \; \textit{ksi}$
Design Forces	94.
Axial force in brace	P = 45  kip

Connection Geometry  Brace section  Thickness	
Thickness	2L4X3X3/8
	$t_{br}\!\coloneqq\!0.375$ $m{in}$
Outstanding leg length	$l_{obr}\!\coloneqq\!3$ $m{in}$
Horizontal leg length	$l_{ibr}\!\coloneqq\!4$ $m{in}$
Gross cross section area	$A_{br}\!\coloneqq\!4.98~m{in}^2$
Centroid of brace back to back leg	$x'_{br} \coloneqq 0.775$ in
Brace angle with from beam at connection 1	$\theta_{br} = 35   deg$
Back to back leg spacing	$s_{br} \coloneqq 0.25$ $m{in}$
Beam section at connection 1	W10X30
Section depth	$d_{xb1}\!\coloneqq\!10.5$ $m{in}$
Flange width	$b_{fb1} = 5.81$ in
Flange thickness	$t_{fb1} \coloneqq 0.51$ in
Web thickness	$\overset{\circ}{t_{wb1}} \coloneqq 0.3 \; \emph{in}$
Distance from outer face to fillet edge	$k_{bdet1}\!\coloneqq\!1.125$ $in$
Beam section at connection 2	W10X19
Section depth	$d_{xb2}$ := $10.2$ $oldsymbol{in}$
Flange width	$b_{fb2}$ := $4.02$ $m{in}$
Flange thickness	$t_{fb2}\!\coloneqq\!0.395$ $in$
Web thickness	$t_{wb2}\!\coloneqq\!0.25$ $m{in}$
Distance from outer face to fillet edge	$k_{bdet2}\!\coloneqq\!0.695$ in
Shear tab thickness	$t_s\!\coloneqq\!0.5$ $in$
Shear tab width	$w_s$ := 3.5 $in$



Gusset plate thickness		$t_q \coloneqq 0.5 \; in$	ľô.
Gusset dimension along connection	1	$g_1 = 20$ <b>in</b>	72
Gusset dimension along connection	2	$g_2 \coloneqq 20$ <b>in</b>	
Gusset cutout at connection 1		$c_1 \coloneqq 4$ in	<u> </u>
Gusset cutout at connection 2		$c_2 \coloneqq 4$ in	

Bolt diameter	$d_b \!\coloneqq\! rac{7}{8}  i n \ d_{bh} \!\coloneqq\! rac{15}{16}  i n$
	8
Bolt hole diameter	$d = \frac{15}{m}$
Bolt note diameter	16
Number of bolts per row on brace	$n_{br}\!\coloneqq\!3$
Number of bolts at clip at beam 1	
	$n_1 := 5$
Number of bolts at clip at beam 2	$n_2 \coloneqq 4$
Bolt spacing	$s \coloneqq 2.5$ in
Bolt gage on brace	$g_{br} \coloneqq 1.75$ in
Bolt gage on shear tab	$g_s = 1.75$ in
Shear tab location for connection 1	$loc_1 \coloneqq 6$ in
Shear tab location for connection 2	$loc_2 \coloneqq 6$ in
Bolt edge distance on brace	$ed_1 \coloneqq 1.25$ in
Bolt edge distance on gusset	$ed_2$ := 1.25 $in$
Bolt edge distance on shear tab	$ed_3$ := 1.125 $\emph{in}$
Shear tab to beam weld thickness	$w\!\coloneqq\!0.25$ in
Connection setback at connection 1	$sb_1\!\coloneqq\!0.5$ $in$
Connection setback at connection 2	$sb_2\!\coloneqq\!0.5$ $in$
Shear per bolt at brace connection P	
$P_b$ := $rac{P}{2 \cdot n_{base}}$	$P_b = 7.5  kip$
	-3.
Component of brace force along connection	
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(  heta_{br}  ight)$	
Component of brace force along connection	
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1	
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1	$P_1$ = $36.862~kip$ $P_{b1}$ = $7.372~kip$
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$	$P_1$ = $36.862~m{kip}$ $P_{b1}$ = $7.372~m{kip}$
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection	$P_1$ = $36.862~kip$ $P_{b1}$ = $7.372~kip$
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$	$P_1$ = $36.862~kip$ $P_{b1}$ = $7.372~kip$
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left(\theta_{br}\right)$	$P_1$ = $36.862~kip$ $P_{b1}$ = $7.372~kip$
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection	$P_{1}\!=\!36.862~{\it kip}$ $P_{b1}\!=\!7.372~{\it kip}$
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left(\theta_{br}\right)$ Force per bolt along connection 2	$P_{1}$ = 36.862 <b>kip</b> $P_{b1}$ = 7.372 <b>kip</b> $P_{2}$ = 25.811 <b>kip</b>
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left(\theta_{br}\right)$ Force per bolt along connection 2	$P_1$ = $36.862~kip$ $P_{b1}$ = $7.372~kip$
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left(\theta_{br}\right)$ Force per bolt along connection 2 $P_{b2} \coloneqq \frac{P_2}{n_2}$	$P_{1}$ = 36.862 <b>kip</b> $P_{b1}$ = 7.372 <b>kip</b> $P_{2}$ = 25.811 <b>kip</b>
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left(\theta_{br}\right)$ Force per bolt along connection 2 $P_{b2} \coloneqq \frac{P_2}{n_2}$ Bolt shear at brace to gusset connection	$P_{1}$ = 36.862 <b>kip</b> $P_{b1}$ = 7.372 <b>kip</b> $P_{2}$ = 25.811 <b>kip</b>
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left(\theta_{br}\right)$ Force per bolt along connection 2 $P_{b2} \coloneqq \frac{P_2}{n_2}$ Bolt shear at brace to gusset connection	$P_{1}$ = 36.862 <b>kip</b> $P_{b1}$ = 7.372 <b>kip</b> $P_{2}$ = 25.811 <b>kip</b> $P_{b2}$ = 6.453 <b>kip</b>
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left(\theta_{br}\right)$ Force per bolt along connection 2 $P_{b2} \coloneqq \frac{P_2}{n_2}$ Bolt shear at brace to gusset connection	$P_{1}$ = 36.862 <b>kip</b> $P_{b1}$ = 7.372 <b>kip</b> $P_{2}$ = 25.811 <b>kip</b>
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left( \theta_{br} \right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left( \theta_{br} \right)$ Force per bolt along connection 2 $P_{b2} \coloneqq \frac{P_2}{n_2}$ Bolt shear at brace to gusset connection Area of bolt $A_b \coloneqq \frac{\pi \cdot d_b^2}{4}$	$P_{1}$ = 36.862 $kip$ $P_{b1}$ = 7.372 $kip$ $P_{2}$ = 25.811 $kip$ $P_{b2}$ = 6.453 $kip$
Component of brace force along connection $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{n_1}$ Component of brace force along connection $P_2 \coloneqq P \cdot \sin \left(\theta_{br}\right)$ Force per bolt along connection 2 $P_{b2} \coloneqq \frac{P_2}{n_2}$ Bolt shear at brace to gusset connection	$P_{1}$ = 36.862 <b>kip</b> $P_{b1}$ = 7.372 <b>kip</b> $P_{2}$ = 25.811 <b>kip</b> $P_{b2}$ = 6.453 <b>kip</b>

	$_{ au}$ $P_b$	T 0005
(A)	$I_0 = \frac{P_b}{0.75 \ R_n}$	$I_0 = 0.308$
Bolt bearing on brace	check	
Minimum clear distance		
9 *Ök	$l_{c1}\!\coloneqq\!min\left(s\!-\!d_{bh},ed_{1}\!-\!0.5\!ullet d_{bh} ight)$	$l_{c1}\!=\!0.02\; m{m}$
Nominal strength in be	earing $R_n\!\coloneqq\!min\left(1.2\!\cdot\! l_{c1}\!\cdot\! t_{br}\!\cdot\! F_{ua},2.4\!\cdot\! d_b\!\cdot\! t_{br}\!\cdot\! F_{ua} ight)$	$R_n = 20.391 \; kip$
Interaction ratio in 1	oolt bearing at brace	
	$I_1 \coloneqq \frac{P_b}{0.75 \cdot R_n}$	$I_1 = 0.49$
Bolt bearing on gusse Minimum clear distance	e for bearing on gusset	
	$l_{c2} = min\left(s - d_{bh}, ed_2 - 0.5 oldsymbol{\cdot} d_{bh} ight)$	$l_{c1}\!=\!0.02~m{m}$
Nominal strength in be		
	$R_n \coloneqq min\left(1.2 \cdot l_{c2} \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 27.188 \; kip$
Interaction ratio in l	bolt bearing at gusset	
	poolt bearing at gusset $I_2 \coloneqq \frac{P_b}{0.75 \cdot R_n}$ check a of brace	$I_2 = 0.368$
Brace tension rupture	check	
Net cross section area	a of brace	
	check a of brace $A_{nbr}\!\coloneqq\!A_{br}\!-\!2\!\cdot\!d_{bh}\!\cdot\!t_{br}$	$A_{nbr} \!=\! 4.277 \; m{in}^2$
Length of connection		
	$l_{br} \coloneqq s \cdot (n_{br} - 1)$	$l_{br}\!=\!5$ $in$
Shear lag factor	$l_{br}\!\coloneqq\!s\!\cdot\!\left(n_{br}\!-\!1 ight)$ $U\!\coloneqq\!1\!-\!rac{x'_{br}}{l_{br}}$ sion rupture	$U\!=\!0.845$
Brace strength in ten	sion rupture $P_n\!\coloneqq\!F_{ua}\!\cdot\!U\!\cdot\!A_{nbr}$	$P_n = 209.61 \ kip$
Interaction ratio for	brace tension rupture	20.
	7 P	$I_{3} = 0.286$
	$I_3 := \frac{P}{0.75 \cdot P_n}$	$\frac{1}{3} = 0.280$
Brace block shear che	ck	10.
Gross area in shear		73
	$A_{gv}\!\coloneqq\!2m{\cdot}ig(ig(n_{br}\!-\!1ig)m{\cdot} s\!+\!ed_1ig)m{\cdot} t_{br}$	$A_{gv} = 4.688 \; in^2$
Net area in shear		YO.

	$A_{nt} \coloneqq 2 ullet (l_{ibr} - g_{br} - 0.5 ullet d_{bh}) ullet t_{br}$	$A_{nt} = 1.336 \; in^2$
â	$A_{nt} = 2 \cdot (\iota_{ibr} - g_{br} - 0.3 \cdot a_{bh}) \cdot \iota_{br}$	$A_{nt}$ – 1.330 $tr$
Nominal strength bl	ock shear	
Nomitial Schengen bi	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
CY	$R_{n1} = 0.0$ T $ua$ A $nv + T$ $ua$ A $nt$	
4	$R_{n2} \coloneqq 0.6 \cdot F_{ua} \cdot A_{qv} + F_{ua} \cdot A_{nt}$	
	$n_{n2}$ - 0.0 · $r_{ya}$ · $A_{gv}$ + $r_{ua}$ · $A_{nt}$	
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	D = 179 794 him
ZÔ,	$\mathbf{R}_n \coloneqq min\left(\mathbf{R}_{n1}, \mathbf{R}_{n2}\right)$	$R_n = 178.734 \ kip$
Interaction ratio i	n block shear	
	II DIOCK SHEAT	
	$I_4 := \frac{P}{0.75 \cdot R_n}$	$I_{_{4}} = 0.336$
9	$4 0.75 \cdot R_n$	4 0.000
Gusset tension yiel	ding check	
	3	
	<u> </u>	
	• • •	
	<b>`•</b> ∕•/	
	I <sub>W</sub>	
Length of Whitmore	section	
	$l_w \coloneqq 2 \cdot l_{br} \cdot \tan \left( 30 \ \textit{deg} \right) + 2 \cdot g_{br} + s_{br}$	$l_w = 9.524 \; in$
	w - 107 1111 (3 23) 1 3 307 1 307	
Nominal strength of	gusset in yielding	
	$P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$	$P_n = 171.423 \ kip$
	n gp w g	
Interaction ratio i	n tension yielding	
	705	
	$I_{5} = \frac{P}{0.9 \cdot P_{n}}$	$I_{_{5}} = 0.292$
	$^{5}$ $0.9 \cdot P_{n}$	5
Gusset tension rupt	cure check	
Net area of gusset	in tension	
	$A_{ng} \coloneqq (l_w - 2 \cdot d_{bh}) \cdot t_g$	$A_{ng} = 3.824 \; in^2$
	If tension yielding $I_{5} \coloneqq \frac{P}{0.9 \cdot P_{n}}$ Sure check in tension $A_{ng} \coloneqq (l_{w} - 2 \cdot d_{bh}) \cdot t_{g}$	X
		(),
Nominal strength of	gusset in rupture	7
Nominal strength of		$P_n = 221.807 \; kip$
Nominal strength of	$P_n \coloneqq F_{up} \cdot A_{ng}$	$P_n = 221.807 \; kip$
	$P_n \coloneqq F_{up} \cdot A_{ng}$	$P_n = 221.807 \; kip$
Nominal strength of  Interaction ratio i	$P_n\!\coloneqq\! F_{up}\!\cdot\! A_{ng}$ n tension rupture	
	$P_n\!\coloneqq\! F_{up}\!\cdot\! A_{ng}$ n tension rupture	
	$P_n \coloneqq F_{up} \cdot A_{ng}$	$P_n = 221.807 \ {m kip}$
Interaction ratio i	$P_n\!\coloneqq\!F_{up}\!\cdot\!A_{ng}$ n tension rupture $I_6\!\coloneqq\!rac{P}{0.75\!\cdot\!P_n}$	$I_6 = 0.271$
Interaction ratio i  Gusset block shear	$P_n\!\coloneqq\!F_{up}\!\cdot\!A_{ng}$ n tension rupture $I_6\!\coloneqq\!\frac{P}{0.75\!\cdot\!P_n}$ check	$I_6 = 0.271$
Interaction ratio i	$P_n\!\coloneqq\!F_{up}\!\cdot\!A_{ng}$ n tension rupture $I_6\!\coloneqq\!\frac{P}{0.75\!\cdot\!P_n}$ check	$I_6 = 0.271$
Interaction ratio i  Gusset block shear	$P_n\!\coloneqq\!F_{up}\!\cdot\!A_{ng}$ n tension rupture $I_6\!\coloneqq\!\frac{P}{0.75\!\cdot\!P_n}$ check	

	$A_{nv} \coloneqq A_{gv} - (2 \cdot n_{br} - 1) \cdot d_{bh} \cdot t_g$	$A_{nv} = 3.906 \ in^2$
8	$(2 \text{ repr} 1)^{-1} \text{ who } g$	$n_v = 0.500$ Viv
Net area in tension		
Net area III telision	$A \sim 2 \circ A + 1$	$A_{nt}$ = 1.406 $m{in}^2$
CY	$A_{nt} \coloneqq \begin{pmatrix} 2 & g_{br} + s_{br} - d_{bh} \end{pmatrix} \cdot t_g$	$A_{nt} = 1.400 \ n$
Ż		
	—	
1		
Y.*2		
Nominal strength bloc	k shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{up} \cdot A_{nv} + F_{up} \cdot A_{nt}$	
	$R_{n2}\coloneqq 0.6 \cdot F_{yp} \cdot A_{gv} + F_{up} \cdot A_{nt}$	
	$R_{n2}$ -0.0 ° $P_{yp}$ ° $A_{gv}$ $+ P_{up}$ ° $A_{nt}$	
	D (viv./D D)	D 010 700 1.1.
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 216.563 \ kip$
Interaction ratio in	olock shear	
	P	
	$I_7 \coloneqq \frac{P}{0.75 \ R_n}$	$I_{7} = 0.277$
	$0.75 R_n$	•
Bolt shear at connect	ion 1	
Polar moment of inert	ia of bolt group	
	47	
	$0.5 (n_1 - 1)$	
	$I_{no} \coloneqq 2 \cdot \sum_{i=0}^{0.5} (i \cdot s)^2$	
	$I_{po}\!\coloneqq\!2ullet \sum_{i=1}^{0.5} \stackrel{(n_1-1)}{(i\!\cdot\!s)^2}$	
	ia of bolt group $I_{po}\!\coloneqq\!2\!ullet\sum_{i=1}^{0.5} (i\!\cdot\!s)^2$	
	$I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} \stackrel{(n_1-1)}{(i \cdot s)^2}$ $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} \stackrel{(i-1)}{(i-0.5) \cdot s}$	
	$egin{align} I_{po} \coloneqq 2 m{\cdot} \sum_{i=1}^{0.5} rac{(n_1-1)}{(i m{\cdot} s)^2} \ I_{pe} \coloneqq 2 m{\cdot} \sum_{i=1}^{0.5} rac{((i-0.5) m{\cdot} s)^2}{(i-0.5) m{\cdot} s)^2} \ \end{array}$	
	$egin{align} I_{po} \coloneqq 2 m{\cdot} \sum_{i=1}^{0.5} \binom{n_1-1}{(i m{\cdot} s)^2} \ & I_{pe} \coloneqq 2 m{\cdot} \sum_{i=1}^{0.5  n_1} ((i-0.5) m{\cdot} s)^2 \ & \end{array}$	
	$I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} \binom{n_1-1}{(i \cdot s)^2}$ $I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5} ((i-0.5) \cdot s)^2$	
	$egin{aligned} I_{po} &\coloneqq 2 ullet \sum_{i=1}^{0.5} \binom{n_1-1}{(i ullet s)^2} \ &I_{pe} &\coloneqq 2 ullet \sum_{i=1}^{0.5} ((i-0.5) ullet s)^2 \ &I_p &\coloneqq \mathbf{if} \left( mod \left( n_1, 2  ight) \equiv 1, I_{po}, I_{pe}  ight) \end{aligned}$	$I_p\!=\!62.5~in^2$
	$egin{aligned} I_{po} &\coloneqq 2 ullet \sum_{i=1}^{0.5} \binom{n_1-1}{(i ullet s)^2} \ &I_{pe} &\coloneqq 2 ullet \sum_{i=1}^{0.5  n_1} ((i-0.5) ullet s)^2 \ &I_p &\coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2  ight) \equiv 1, I_{po}, I_{pe}  ight) \end{aligned}$	$I_p\!=\!62.5~{m in}^2$
Distance of most remo	$I_{po}\coloneqq 2\boldsymbol{\cdot}\sum_{i=1}^{0.5}\binom{n_1-1}{(i\boldsymbol{\cdot}s)^2}$ $I_{pe}\coloneqq 2\boldsymbol{\cdot}\sum_{i=1}^{0.5n_1}((i-0.5)\boldsymbol{\cdot}s)^2$ $I_p\coloneqq \mathbf{if}\left(\mathrm{mod}\left(n_1,2\right)=1,I_{po},I_{pe}\right)$ te bolt from CG	$I_p{=}62.5~m{in}^2$
Distance of most remo	$I_{po}\!:=\!2\!ullet \sum_{i=1}^{0.5} (i\!\cdot\! s)^2$ $I_{pe}\!:=\!2\!ullet \sum_{i=1}^{0.5n_1} ((i\!-\!0.5)\!\cdot\! s)^2$ $I_p\!:=\!\mathbf{if} (\mathrm{mod}(n_1,2)\!=\!1,I_{po},I_{pe})$ te bolt from CG $c\!:=\!0.5\;(n_1\!-\!1)\!\cdot\! s$	$I_p = 62.5 \; m{in}^2$ $c = 5 \; m{in}$
	$I_{po}\!\coloneqq\!2\!ullet \sum_{i=1}^{0.5} (i\!\cdot\!s)^2$ $I_{pe}\!\coloneqq\!2ullet \sum_{i=1}^{0.5n_1} ((i\!-\!0.5)\!\cdot\!s)^2$ $I_p\!\coloneqq\!\mathbf{if} (\mathrm{mod}(n_1,2)\!\equiv\!1,I_{po},I_{pe})$ te bolt from CG $c\!\coloneqq\!0.5\;(n_1\!-\!1)\!\cdot\!s$	$I_p = 62.5 \; in^2$ $c = 5 \; in$
Distance of most remo	$I_{po}\coloneqq 2ullet \sum_{i=1}^{0.5} (iullet s)^2$ $I_{pe}\coloneqq 2ullet \sum_{i=1}^{0.5n_1} ((i-0.5)ullet s)^2$ $I_p\coloneqq \mathbf{if} \left(\mathrm{mod}\left(n_1,2\right)\equiv 1, I_{po}, I_{pe}\right)$ the bolt from CG $c\coloneqq 0.5\ (n_1-1)ullet s$	$I_p{=}62.5~in^2$ $c{=}5~in$
	$I_{pe}\!\coloneqq\!2ullet\sum_{i=1}^{0.5n_1}((i\!-\!0.5)ullet s)^2$ $I_p\!\coloneqq\!\mathbf{if}\left(\mathrm{mod}\left(n_1,2\right)\!=\!1,I_{po},I_{pe}\right)$ te bolt from CG $c\!\coloneqq\!0.5\;(n_1\!-\!1)\!\cdot\!s$	$I_p = 62.5 \; in^2$
	$I_{pe}\!\coloneqq\!2ullet\sum_{i=1}^{0.5n_1}((i\!-\!0.5)ullet s)^2$ $I_p\!\coloneqq\!\mathbf{if}\left(\mathrm{mod}\left(n_1,2\right)\!=\!1,I_{po},I_{pe}\right)$ te bolt from CG $c\!\coloneqq\!0.5\;(n_1\!-\!1)\!\cdot\!s$	$I_p = 62.5 \; in^2$ $c = 5 \; in$ $P_s = 8.999 \; kip$
	$I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} \binom{n_1-1}{(i \cdot s)^2}$ $I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5} ((i-0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2 \right) = 1, I_{po}, I_{pe} \right)$ the bolt from CG $c \coloneqq 0.5 \left( n_1 - 1 \right) \cdot s$ $P_s \coloneqq \sqrt{\left( \frac{P_1}{n_1} \right)^2 + \left( \frac{P_1 \cdot g_s \cdot c}{I_p} \right)^2}$	$I_p{=}62.5~in^2$ $c{=}5~in$ $P_s{=}8.999~kip$
Maximum shear in bolt	$I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5  n_1} ((i-0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2 \right) = 1, I_{po}, I_{pe} \right)$ the bolt from CG $c \coloneqq 0.5  \left( n_1 - 1 \right) \cdot s$ $P_s \coloneqq \sqrt{\left( \frac{P_1}{n_1} \right)^2 + \left( \frac{P_1 \cdot g_s \cdot c}{I_p} \right)^2}$	$I_p = 62.5 \; in^2$ $c = 5 \; in$ $P_s = 8.999 \; kip$
	$I_{pe} \coloneqq 2 ullet \sum_{i=1}^{0.5  n_1} ((i-0.5) ullet s)^2$ $I_p \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2  ight) \equiv 1, I_{po}, I_{pe}  ight)$ the bolt from CG $c \coloneqq 0.5  \left( n_1 - 1  ight) ullet s$ $P_s \coloneqq \sqrt{\left( \frac{P_1}{n_1} \right)^2 + \left( \frac{P_1 ullet g_s ullet c}{I_p} \right)^2}$ The of bolt	$P_s$ =8.999 $m{kip}$
Maximum shear in bolt	$I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5  n_1} ((i-0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2 \right) = 1, I_{po}, I_{pe} \right)$ the bolt from CG $c \coloneqq 0.5  \left( n_1 - 1 \right) \cdot s$ $P_s \coloneqq \sqrt{\left( \frac{P_1}{n_1} \right)^2 + \left( \frac{P_1 \cdot g_s \cdot c}{I_p} \right)^2}$	$I_{p}\!=\!62.5\; i\!n^{2}$ $c\!=\!5\; i\!n$ $P_{s}\!=\!8.999\; k\!i\!p$ $R_{n}\!=\!32.471\; k\!i\!p$
Maximum shear in bolt  Nominal shear strengt	$I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5  n_1} ((i-0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2 \right) = 1, I_{po}, I_{pe} \right)$ the bolt from CG $c \coloneqq 0.5 \left( n_1 - 1 \right) \cdot s$ $P_s \coloneqq \sqrt{\left( \frac{P_1}{n_1} \right)^2 + \left( \frac{P_1 \cdot g_s \cdot c}{I_p} \right)^2}$ The of bolt $R_n \coloneqq F_{nv} \cdot A_b$	$P_s$ =8.999 $m{kip}$
Maximum shear in bolt	$I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5  n_1} ((i-0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2 \right) = 1, I_{po}, I_{pe} \right)$ the bolt from CG $c \coloneqq 0.5 \left( n_1 - 1 \right) \cdot s$ $P_s \coloneqq \sqrt{\left( \frac{P_1}{n_1} \right)^2 + \left( \frac{P_1 \cdot g_s \cdot c}{I_p} \right)^2}$ The of bolt $R_n \coloneqq F_{nv} \cdot A_b$	$P_s$ =8.999 $m{kip}$
Maximum shear in bolt  Nominal shear strengt	$I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5  n_1} ((i-0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2 \right) = 1, I_{po}, I_{pe} \right)$ the bolt from CG $c \coloneqq 0.5 \left( n_1 - 1 \right) \cdot s$ $P_s \coloneqq \sqrt{\left( \frac{P_1}{n_1} \right)^2 + \left( \frac{P_1 \cdot g_s \cdot c}{I_p} \right)^2}$ The of bolt $R_n \coloneqq F_{nv} \cdot A_b$	$P_s$ =8.999 $m{kip}$

Bolt bearing at shea	r tab at connection 1	
Clear distance betwe	en bolt holes/ hole and edge	1 ocre :-
CO.	$l_c \coloneqq min\left(s - d_{bh}, ed_3 - 0.5 \cdot d_{bh}\right)$	$l_c\!=\!0.656$ $in$
Nominal strength in		
4	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_s \cdot F_{up}, 2.4 \cdot d_b \cdot t_s \cdot F_{up}\right)$	$R_n = 22.838 \; kip$
Interaction ratio in	bolt bearing	
<b>5</b> 0.	$P_{b1}$	
	$I_9 \coloneqq \frac{P_{b1}}{0.75 \; R_n}$	$I_{9} = 0.43$
Bolt bearing at guss	et at connection 1	
Length of shear tah		
	$L_1 \coloneqq ig(n_1 - 1ig) \cdot s + 2 \ ed_3$	$L_1 = 12.25$ in
Distance of gusset o	outer edge from work point	
	$loc_{go} \coloneqq g_1 + sb_2 + 0.5 \cdot t_{wb2}$	$loc_{go}\!=\!20.625$ $in$
D	7.	
	nner edge from work point	
$loc_{g}$	$c_{gi} \coloneqq c_1 + sb_2 + 0.5 \cdot t_{wb2} - \mathbf{if} \left( c_2 = 0 , 0 , \left( g_s - sb_1 \right) \cdot \frac{c_1}{c_2} \right)$	$loc_{gi}\!=\!3.375$ $in$
Outer edge distance	for bolt on gusset	
	$ed_{go} \coloneqq loc_{go} - loc_1 - L_1 + ed_3$	$ed_{go}$ = 3.5 $in$
Inner edge distance	for bolt on gusset	
	$ed_{gi}\!\coloneqq\!loc_1\!-\!loc_{gi}\!+\!ed_3$	$ed_{gi}$ $=$ $3.75$ $in$
Minimum edge distanc	e for clip on gusset	
	$ed_g \coloneqq min\left(ed_{go}, ed_{gi} ight)$	$ed_g$ = $3.5$ $in$
Clear distance betwe	en bolt holes/ hole and edge	
	$l_c\!\coloneqq\!min\left(\!s\!-\!d_{bh},ed_g\!-\!0.5\!ullet d_{bh}\! ight)$	$l_c\!=\!1.563$ $in$
Nominal strength in	bearing	
	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 54.375 \ kip$
Interaction ratio in	bolt bearing	2
	$P_{h_1}$	
	$I_{10} \coloneqq \frac{P_{b1}}{0.75 \; R_{p}}$	$I_{10} = 0.181$
Gusset shear yieldin	g at connection 1	
Gross area in shear		
	$A_g\!\coloneqq\! \big(g_1\!-\!c_1\big)\!\cdot\! t_g$	$A_g=8$ $in^2$
Nominal shear streng	th of gusset in yielding	2
	$R_n\!\coloneqq\!0.6\!ullet\!F_{yp}\!ullet\!A_g$	$R_n = 172.8$ kip
		U.

Ô	$I_{11} \coloneqq \frac{P_1}{R_n}$	$I_{_{11}} = 0.213$
Gusset shear rupture	at connection 1	
Net area in shear		
9-:	$A_n \coloneqq A_g - n_1 \cdot d_{bh} \cdot t_g$	$A_n = 5.656 \ in^2$
105		
Nominal shear strengt	h of gusset in rupture	
	$R_n \coloneqq 0.6 \cdot F_{up} \cdot A_n$	$R_n = 196.838 \ kip$
Internation maticalin	ahaan muutuus	
Interaction ratio in		
Qx,	$I_{12} \coloneqq \frac{P_1}{0.75 \ R_n}$	$I_{_{12}} = 0.25$
	$^{1}_{12}$ $^{-}_{0.75}$ $R_n$	12 - 0.29
Gusset plate block sh		
Gross area subjected		
	$A_{gv}\!\coloneqq\! \big(L_1\!-\!2\;ed_3\!+\!ed_g\big)\!\cdot\! t_g$	$A_{gv}\!=\!6.75$ $in^2$
Net area subjected to		
	$A_{nv}\!:=\!A_{gv}\!-\!\left(n_1\!-\!0.5\right)\!\cdot\!d_{bh}\!\cdot\!t_g$	$A_{nv} = 4.641 \; in^2$
NT - +	10	
Net area subjected to	tension $A := (a \cdot ab \cdot 0.5 \cdot d) \cdot t$	$A_{nt} = 0.391 \; in^2$
	$A_{nt} \coloneqq ig(g_s - sb_1 - 0.5 \ d_{bh}ig) \cdot t_g$	$A_{nt}$ =0.391 $th$
Nominal strength in b	lock shear	
	lock shear $R_{n1}\!\coloneqq\!0.6\!\cdot\!F_{ua}\!\cdot\!A_{nv}\!+\!F_{ua}\!\cdot\!A_{nt}$	
	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
	$R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$	$R_n = 168.456 \ kip$
Interaction ratio in	block shear	
	$I_{13} \coloneqq \frac{P_1}{0.75 R_n}$	$I_{_{13}}\!=\!0.292$
	$^{1_{13}}$ 0.75 $R_n$	13
Gusset flexure yieldi:	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$ block shear $I_{13} \coloneqq rac{P_1}{0.75R_n}$ ng at connection 1	
Eccentricity of force	at connection 1	<b>A</b>
	$ec_1 \coloneqq c_2 + sb_1 + 0.5 \ t_{wb1}$	$ec_1 = 4.65$ in
		$ec_1 = 4.65$ in
Nominal moment streng	ht of gusset	
	$M_n \coloneqq rac{{F_{yp} \cdot t_g \cdot {g_1}^2}}{4}$	36 360 1: 0
	$NI_n := \frac{1}{1}$	$M_n = 150 \; kip \cdot ft$
		10
Interaction ratio in		9,
Interaction ratio in	gusset flexure	
Interaction ratio in		$I_{14} = 0.106$

<b>Shear tab shear yield</b> Gross area in shear		
N.	$A_{gv}\!\coloneqq\!L_1\!\cdot\!t_s$	$A_{gv}\!=\!6.125\; {\it in}^2$
Nominal strength in sh	near vielding	
Nominal Sciengen in Si	$R_n \coloneqq 0.6 \cdot F_{uv} \cdot A_{av}$	$R_n = 132.3 \; kip$
4	$yp \mid yy \mid$	
Interaction ratio in s	shear yielding	
79,	$I_{II} := \frac{F_{II}}{F_{II}}$	$I_{15} = 0.279$
	$^{15}$ $R_n$	15
1		
Shear tab shear ruptu:	re at connection 1	
Net area in shear		
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!n_1\!ullet\!d_{bh}\!ullet\!t_s$	$A_{nv} = 3.781 \; in^2$
Nominal strength in sh		D _ 191 500 lain
	$R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv}$	$R_n = 131.588 \ kip$
Interaction ratio in s	shear runture	
	$I_{16} \coloneqq \frac{P_1}{0.75 \; R_n}$	$I_{16} = 0.374$
	$^{16}$ 0.75 $R_n$	16
Shear tab block shear	at connection 1	
Gross area subjected t	to block shear	
	$A_{gv}\!\coloneqq\! \big(L_1\!-\!ed_3\big)\boldsymbol{\cdot} t_s$	$A_{gv} = 5.563 \; in^2$
	to block shear $A_{gv}\!\coloneqq\! ig(L_1\!-\!ed_3ig)\!\cdot\! t_s$	
Net area subjected to	block shear	4 2 472 : 2
	block shear $A_{nv}\!\coloneqq\!A_{gv}\!-\!\left(n_1\!-\!0.5 ight)\!\cdot\!d_{bh}\!\cdot\!t_s$	$A_{nv} = 3.453 \; in^2$
Net area subjected to		
Net area subjected to	$A_{nt} \coloneqq \left(w_s - g_s - 0.5 \ d_{bh}\right) \cdot t_s$	$A_{nt} \! = \! 0.641 \; m{in}^2$
	$A_{nt} = (w_s - g_s - 0.5 \ u_{bh}) \cdot v_s$	$A_{nt}$ = 0.041 $t$
Nominal strength in bl	lock shear	
	tension $A_{nt} \coloneqq \left(w_s - g_s - 0.5 \ d_{bh}\right) \cdot t_s$ ock shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
	Tel de les de les	
	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
		4
	$R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$	$R_n = 157.306 \ kip$
		0.
Interaction ratio in k	olock shear	6
	$P_1$	1 -0.212
	$I_{17} \coloneqq \frac{P_1}{0.75 \ R_n}$	$I_{17} = 0.312$
	ding at connection 1	42
Shear tab flexure viel		
Shear tab flexure yiel		
Shear tab flexure yiel	ght of shear tab	P.
		$M_n\!=\!56.273\;  extbf{kip ft}$

	$I := P_1 \cdot g_s$	I -0.106
Ĉ.	$I_{18} \coloneqq \frac{P_1 \cdot g_s}{0.9 \ M_n}$	$I_{18} = 0.106$
Weld check at connect:	ion 1	
Polar moment of inert:	ia of weld group	
9-:	$L_1^{-3}$	
Ċs	$I_w = \frac{-1}{12}$	$I_w = 153.189 \ in^3$
(1)	12	
Weld stress along weld		
	$f_{wx} \coloneqq \frac{P_1}{2 \cdot L_1}$	$f_{wx} = 1.505 \frac{kip}{in}$
	$\int wx \cdot = 2 \cdot L_1$	in
Max weld stress trans	verse to weld	
	$P_{\cdot \cdot \cdot q} \cdot I_{\cdot \cdot \cdot}$	laim
	$f_{wy} = \frac{1 + g_s \cdot B_1}{4 \cdot I}$	$f_{wy} = 1.29 \frac{kip}{ip}$
	$4 I_w$	TH .
Resultant weld stress	$c = \sqrt{\frac{c}{c} + \frac{2}{c} + \frac{2}{c}}$	c 1 000 kip
	$J_w = V J_{wx} + J_{wy}$	$f_w = 1.982 \frac{kip}{in}$
Nominal weld strength		
Wolfa berengen	$R_n := 0.6 \cdot F_{EVV} \cdot \frac{\sqrt{2}}{} \cdot w$	$R_n = 7.425 \frac{kip}{in}$
		" in
Interaction ratio for	Verse to Weld $f_{wy} \coloneqq rac{P_1 \cdot g_s \cdot L_1}{4 \ I_w}$ $f_w \coloneqq \sqrt{f_{wx}}^2 + f_{wy}^2$ $R_n \coloneqq 0.6 \cdot F_{EXX} \cdot rac{\sqrt{2}}{2} \cdot w$ Weld check $f_w$	
	weld check $I_{19}\!\coloneqq\!rac{f_w}{0.75R_n}$	
	$I_{19} = 0.75 R_{\odot}$	$I_{_{19}} = 0.356$
Shear tah runture at s	weld at connection 17	
	ckness to match weld strength	
	2 4	
	$t_{s.min} = \frac{2 f_w}{2 \pi r_s}$	$t_{s.min}\!=\!0.152$ $in$
	$t_{s.min} \coloneqq rac{2 \ f_w}{0.75 \cdot 0.6 \cdot F_{up}}$	$t_{s.min}$ $=$ $0.152$ $m{in}$
Interaction ratio in v	$t_{s.min} \coloneqq rac{2 \ f_w}{0.75 \cdot 0.6 \cdot F_{up}}$ web rupture	$t_{s.min}\!=\!0.152$ $in$
Interaction ratio in v	$t_{s.min} \coloneqq rac{2 \ f_w}{0.75 \cdot 0.6 \cdot F_{up}}$ web rupture $t_{s.min}$	$t_{s.min} = 0.152 \; in$
Interaction ratio in v	$t_{s.min} \coloneqq rac{2 \ f_w}{0.75 \cdot 0.6 \cdot F_{up}}$ web rupture $I_{20} \coloneqq rac{t_{s.min}}{t_s}$	$t_{s.min}\!=\!0.152$ $in$
	$t_{s.min} \coloneqq rac{2 \ f_w}{0.75 \cdot 0.6 \cdot F_{up}}$ web rupture $I_{20} \coloneqq rac{t_{s.min}}{t_s}$ at connection 1	$t_{s.min}\!=\!0.152\; {m in}$ $I_{20}\!=\!0.304$
Web rupture at weld a	$t_{s.min} \coloneqq rac{2 \ f_w}{0.75 \cdot 0.6 \cdot F_{up}}$ web rupture $I_{20} \coloneqq rac{t_{s.min}}{t_s}$ at connection 1 to match weld strength	$t_{s.min} = 0.152$ in $I_{20} = 0.304$
Web rupture at weld a	$t_{s.min}\coloneqq\overline{0.75\cdot0.6\cdot F_{up}}$ web rupture $I_{20}\coloneqq \frac{t_{s.min}}{t_s}$ at connection 1 to match weld strength	$t_{s.min}\!=\!0.152$ in $I_{20}\!=\!0.304$
Web rupture at weld a	$t_{s.min} \coloneqq rac{2 \ f_w}{0.75 \cdot 0.6 \cdot F_{up}}$ Web rupture $I_{20} \coloneqq rac{t_{s.min}}{t_s}$ At connection 1  to match weld strength $t_{w.min} \coloneqq rac{f_w}{0.75 \cdot 0.6 \cdot F_{s.min}}$	$t_{s.min}\!=\!0.152\; m{in}$ $I_{20}\!=\!0.304$ $t_{w.min}\!=\!0.076\; m{in}$
<b>Web rupture at weld a</b> Minimum web thickness	$t_{w.min} \coloneqq \frac{\int w}{0.75 \cdot 0.6 \cdot F_{ub}}$	$t_{w.min}$ $=$ $0.076$ $in$
Web rupture at weld a	$t_{w.min} \coloneqq \frac{\int w}{0.75 \cdot 0.6 \cdot F_{ub}}$	$t_{w.min}$ $=$ $0.076$ $in$
<b>Web rupture at weld a</b> Minimum web thickness	$t_{w.min} \coloneqq rac{Jw}{0.75 \cdot 0.6 \cdot F_{ub}}$ web rupture	$t_{w.min}$ $=$ $0.076$ $in$
<b>Web rupture at weld a</b> Minimum web thickness	$t_{w.min} \coloneqq \frac{\int w}{0.75 \cdot 0.6 \cdot F_{ub}}$	$t_{w.min}$ $=$ $0.076$ $in$
<b>Web rupture at weld a</b> Minimum web thickness	$t_{w.min} \coloneqq rac{Jw}{0.75 \cdot 0.6 \cdot F_{ub}}$ web rupture $I_{21} \coloneqq rac{t_{w.min}}{t_{wb1}}$	$t_{w.min}$ $=$ $0.076$ $in$
Web rupture at weld a Minimum web thickness  Interaction ratio in t	$t_{w.min}\coloneqqrac{Jw}{0.75\cdot0.6\cdot F_{ub}}$ web rupture $I_{21}\coloneqqrac{t_{w.min}}{t_{wb1}}$ ion 2	$t_{s.min} = 0.152 \; in$ $I_{20} = 0.304$ $t_{w.min} = 0.076 \; in$ $I_{21} = 0.253$

$I_{pe} \coloneqq 2 ullet \sum_{i=1}^{0.5  n_2} ig( (i-0.5) ullet s ig)^2$	
$I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{pe} ((i - 0.3) \cdot s)$ $I_{p} \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_{2}, 2 \right) = 1, I_{po}, I_{pe} \right)$	$I_p{=}31.25$ $in^2$
Distance of most remote bolt from CG $c\!\coloneqq\!0.5\; \left(n_2\!-\!1\right)\!\cdot\!s$	c = 3.75 in
Maximum shear in bolt $P_s \coloneqq \sqrt{\left(\frac{P_2}{n_2}\right)^2 + \left(\frac{P_2 \cdot g_s \cdot c}{I_p}\right)^2}$	$P_s$ =8.427 $m{kip}$
Nominal shear strength of bolt $R_n\!\coloneqq\! F_{nv}\!\cdot\! A_b$	$R_n = 32.471 \; kip$
Interaction ratio in bolt shear	
$I \coloneqq \frac{P_{b2}}{0.75 \; R_n}$	$I_{22} = 0.265$
Bolt bearing at shear tab at connection 2 Clear distance between bolt holes/ hole and edge $l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_3\!-\!0.5\!\cdot\!d_{bh}\right)$	$l_c\!=\!0.656$ $in$
Nominal strength in bearing $R_n \!\coloneqq\! min\left(1.2 \cdot l_c \cdot t_s \cdot F_{up}, 2.4 \cdot d_b \cdot t_s \cdot F_{up}\right)$	$R_n = 22.838 \; kip$
Interaction ratio in bolt bearing	
$I_{23}\!\coloneqq\!rac{P_{b2}}{0.75\;R_n}$	$I_{23} = 0.377$
Bolt bearing at gusset at connection 2  Length of shear tab	I 0 77
$L_2 \coloneqq ig(n_2 - 1ig) \cdot s + 2\ ed_3$ Distance of gusset outer edge from work point	$L_2 = 9.75 \ in$
$loc_{qo} \coloneqq g_2 + sb_1 + 0.5 \cdot t_{wb1}$	$loc_{go}\!=\!20.65$ $in$
Distance of gusset inner edge from work point	20
Distance of gusset inner edge from work point $loc_{gi} \coloneqq c_2 + sb_1 + 0.5 \cdot t_{wb1} - \mathbf{if} \left( c_1 = 0 , 0 , \left( g_s - sb_2 \right) \cdot \frac{c_2}{c_1} \right)$	$loc_{gi}=3.4$ in
	$loc_{gi}$ = $3.4 \; m{in}$ $ed_{go}$ = $6.025 \; m{in}$

Minimum edge distance for clip on gusset	
$ed_g \coloneqq min\left(ed_{go}, ed_{gi} ight)$	$ed_g$ $=$ $3.725$ $in$
Clear distance between bolt holes/ hole and edge	
$l_c \!\coloneqq\! min\left(s\!-\!d_{bh}, ed_g\!-\!0.5\!\cdot\!d_{bh} ight)$	$l_c\!=\!1.563$ $in$
Nominal strength in bearing	
$R_n\!\coloneqq\!min\left(1.2\!\cdot\! l_c\!\cdot\! t_g\!\cdot\! F_{up},2.4\!\cdot\! d_b\!\cdot\! t_g\!\cdot\! F_{up}\right)$	$R_n = 54.375 \ kip$
Interaction ratio in bolt bearing	
$I_{24} \coloneqq \frac{P_{b2}}{0.75 \; R_n}$	$I_{24} = 0.158$
Gusset shear yielding at connection 2 Gross area in shear	
$A_g\!\coloneqq\!ig(g_2\!-\!c_2ig)\!\cdot\!t_g$	$A_g$ =8 $m{in}^2$
Nominal shear strength of gusset in yielding	
$R_n\coloneqq 0.6 \cdot F_{yp} \cdot A_g$	$R_n = 172.8 \; kip$
Interaction ratio in gusset yieldling	
$I_{25}\!\coloneqq\!rac{P_2}{R_n}$	$I_{25} = 0.149$
Gusset shear rupture at connection 2	
Not area in shear	
Net area in shear $A_n\!\coloneqq\! A_g\!-\!n_2\!\cdot\!d_{bh}\!\cdot\!t_g$	$A_n = 6.125 \; in^2$
Nominal shear strength of gusset in rupture	
$R_n\!\coloneqq\!0.6{m\cdot} F_{up}{m\cdot} A_n$	$R_n = 213.15 \ \textit{kip}$
Interaction ratio in shear rupture	
$P_{2}$	
$I_{26} \coloneqq rac{P_2}{0.75 \; R_n}$	$I_{26} = 0.161$
Gusset plate block shear at connection 2	
Cross area subjected to block above	
$A_{gv}\!\coloneqq\! \left(L_2\!-\!2\;ed_3\!+\!ed_g\right)\!\cdot\! t_g$	$A_{gv} = 5.613 \; in^2$
Net area subjected to block shear	2
$A_{nv}\!\coloneqq\!A_{gv}\!-\!\left(n_2\!-\!0.5 ight)\!ullet\!d_{bh}\!ullet\!t_g$	$A_{gv} = 5.613 \; m{in}^2$ $A_{nv} = 3.972 \; m{in}^2$
Net area subjected to tension	$A_{nt}$ $=$ $0.391$ $m{in}^2$
$A_{nt}\!\coloneqq\!\left(g_s\!-\!sb_2\!-\!0.5\;d_{bh}\! ight)\!\cdot\!t_g$	$A_{nt}\!=\!0.391~in^2$
Nominal strength in block shear	
$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	6.
$R_{n2}\coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	

2	$R_n\!\coloneqq\!min\left(\!R_{n1},R_{n2}\! ight)$	$R_n = 143.886 \; kip$
Interaction ratio	in block shear	
	$I_{27} = \frac{P_2}{0.75 R_n}$	$I_{27} = 0.239$
, Ch	$^{27}$ $0.75$ $R_n$	27
Gusset flexure yie	elding at connection 2	
Eccentricity of fo	orce at connection 2	
	$ec_2 \coloneqq c_1 + sb_2 + 0.5 \cdot t_{wb2}$	$ec_2$ = $4.625$ $in$
Nominal moment st	renght of gusset	
-	$F_{nn} \cdot t_a \cdot q_2^{-2}$	
	$M_n \coloneqq rac{F_{yp} \! \cdot \! t_g \! \cdot \! g_2^{\ 2}}{4}$	$M_n = 150 \; kip \cdot ft$
Interaction ratio	in gusset flexure	
	$I_{28} \coloneqq \frac{P_2 \cdot ec_2}{0.9 \cdot M_n}$	I = 0.074
	$\frac{1}{28} = \frac{1}{0.9 \cdot M_n}$	$I_{28} = 0.074$
Shear tab shear w	ielding at connection 2	
Gross area in shear		
Gloss alea in shee	$A_{gv}\!\coloneqq\!L_2\!\cdot\!t_{\mathrm{s}}$	$A_{gv}\!=\!4.875$ $in^2$
	11gv - 22 gs	$g_{v} = 1.013$
Nominal strength	in shear vielding	
		$R_n = 105.3$ $kip$
	gp gg	
Interaction ratio	$R_n\!\coloneqq\!0.6\!\cdot\!F_{yp}\!\cdot\!A_{gv}$ in shear yielding $I_{29}\!\coloneqq\!rac{P_2}{R_n}$ upture at connection 2	
	Po	
	$I_{20} := \frac{1}{D}$	$I_{29} = 0.245$
	$R_n$	23
Shear tab shear ru	upture at connection 2	
Net area in shear		
	$A_{nv} \coloneqq A_{gv} - n_2 \cdot d_{bh} \cdot t_s$	$A_{nv} = 3 i n^2$
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!n_2\!\cdot\!d_{bh}\!\cdot\!t_s$ in shear rupture $R_n\!\coloneqq\!0.6\!\cdot\!F_{ua}\!\cdot\!A_{nv}$	
Nominal strength	in shear rupture	D 101111
	$R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv}$	$R_n = 104.4 \text{ kip}$
T.L		
Interaction ratio	in snear rupture	Ö.
	$I_{30} \coloneqq \frac{P_2}{0.75 \ R_n}$	V -0.33
	$rac{1}{30}$ $rac{0.75 R_n}{1}$	$I_{30} = 0.33$
Shear tab block sh	hear at connection 2	9
	ted to block shear	Q.
		$A_{gv}\!=\!4.313\;m{in}^2$
oloss area subject	$A_{aa} := (L_2 - ea_2) \cdot \iota_e$	A 4.310 til
dioss area subject	$A_{gv}\coloneqq (L_2\!-\!ed_3)\cdot t_s$	$A_{gv}$ $=$ 4.515 $tit$
Net area subjected		$A_{gv}$ – 4.315 $tt$
	d to block shear	95
		$A_{nv}$ = 2.672 $in^2$
	d to block shear $A_{nv}\!\coloneqq\!A_{gv}\!-\!\left(n_2\!-\!0.5\right)\!\cdot\!d_{bh}\!\cdot\!t_s$	95

Ż.	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
CO	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
CY		
L.	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 130.138 \ kip$
-/x		
Interaction ratio	in block shear	
ÍZÔ,	$P_2$	T 0001
	$I_{_{31}} \coloneqq \frac{P_2}{0.75 \; R_n}$	$I_{31} = 0.264$
	yielding at connection 2	
Nominal moment str	enght of gusset	
	$F_{uv} \cdot t_s \cdot L_2^2$	
	$M_n \! \coloneqq \! rac{F_{yp}\! \cdot \! t_s\! \cdot \! L_2^{\;2}}{4}$	$M_n = 48.333 \text{ kN} \cdot \text{m}$
	YO'Y	
Interaction ratio	in gusset flexure	
	$P_2 \cdot q_s$	
	$I_{32} = \frac{P_2 \cdot g_s}{0.9 \ M_n}$	$I_{32} = 0.117$
Weld check at conn	ection 2	
Polar moment of in	ection 2 ertia of weld group $I_w \coloneqq rac{L_2^3}{12}$ weld $f_{wx} \coloneqq rac{P_2}{2 \cdot L_2}$ ansverse to weld $f_{wy} \coloneqq rac{P_2 \cdot g_s \cdot L_2}{4 \cdot L_2}$	
	$L_2^{-3}$	
	$I_w := \frac{2}{12}$	$I_w = 77.238 \; in^3$
Weld stress along	weld <sup>12</sup>	
	Pa	kin
	$f_{wx} := \frac{2}{2}$	$f_{wx} = 1.324 \frac{kip}{im}$
	$2 \cdot L_2$	· · · · · · · · · · · · · · · · · · ·
Max weld stress tr	ansverse to weld	
	$P_2 \cdot q_2 \cdot L_2$	kin
	$f_{wy}$ := $rac{P_2 \cdot g_s \cdot L_2}{4 \; I_w}$	$f_{wy} = 1.425 \frac{kip}{ip}$
	$4I_w$	****
Resultant weld str	ess	kin
	$f_w \coloneqq \sqrt{{f_{wx}}^2 + {f_{wy}}^2}$	$f_w = 1.945 \frac{mp}{im}$
		· C
Nominal weld stren	gth $R_n\!\coloneqq\!0.6\!\cdot\!F_{E\!X\!X}\!\cdot\!rac{\sqrt{2}}{2}\!\cdot\!w$	kin
	$R_n = 0.6 \cdot F_{EXX} \cdot \frac{\sqrt{2}}{2} \cdot w$	$R_n = 7.425 \frac{nep}{im}$
		th.
Interaction ratio	for weld check	$f_{wy} = 1.425 \frac{1}{in}$ $f_w = 1.945 \frac{kip}{in}$ $R_n = 7.425 \frac{kip}{in}$
	f	6.
	$I_{33} \coloneqq \frac{f_w}{0.75 R_n}$	$I_{33} = 0.349$
		00
Shear tab rupture	at weld at connection 2	
Minimum shear tab	thickness to match weld strength	TO <sub>2</sub>
	2 f.	3
	$t_{s.min}$ := $\dfrac{2 \ f_w}{0.75 \cdot 0.6 \cdot F_{up}}$	$t_{s,min} = 0.149 \; in$
		The state of the s
	$0.75 \cdot 0.6 \cdot F_{up}$	$t_{s.min}\!=\!0.149{m in}$

Ö,	$I_{34}\!\coloneqq\!rac{t_{s.min}}{t_s}$	$I_{34} = 0.298$
Web rupture at weld	d at connection 2	
Minimum web thickne	ess to match weld strength $t_{w.min}\coloneqq \frac{f_w}{f_w}$	
	$f_w$	4 0.075 in
	$t_{w.min} \coloneqq rac{f_w}{0.75 \cdot 0.6 \cdot F_{ub}}$	$t_{w.min}$ = 0.075 $in$
Interaction ratio	n web runture	
	in wes rapeare	
1	$I:=\frac{t_{w.min}}{}$	I = 0.298
	$t_{wb2}$	35
9	$t_{w.min} \coloneqq \frac{v_w}{0.75 \cdot 0.6 \cdot F_{ub}}$ n web rupture $I_{35} \coloneqq \frac{t_{w.min}}{t_{wb2}}$	
	0	
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# Validation Results

The calculated ratios are compared with the output of Osoconn and if it is within a tolerance of 1% the result is deemed to be OK.

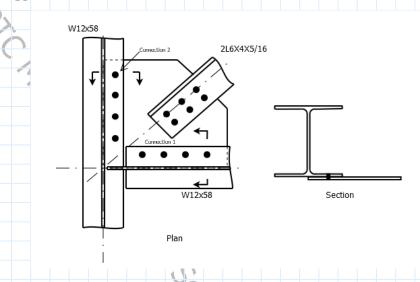
Table 3: Validation problem 2 results

Table 3: Validation prob			
	Interactio		
Check	Calculated	Osoconn	Result
Bolt shear at brace to gusset connection	0.308	0.308	OK
Bolt bearing on brace check	0.49	0.49	OK
Bolt bearing on gusset check	0.368	0.368	OK
Brace tension rupture check	0.286	0.286	OK
Brace block shear check	0.336	0.336	OK
Gusset tension yielding check	0.292	0.292	OK
Gusset tension rupture check	0.271	0.271	OK
Gusset block shear check	0.277	0.277	OK
Bolt shear at connection 1	0.303	0.303	OK
Bolt bearing at shear tab at connection 1	0.43	0.43	OK
Bolt bearing at gusset at connection 1	0.181	0.181	OK
Gusset shear yielding at connection 1	0.213	0.213	OK
Gusset shear rupture at connection 1	0.25	0.25	OK
Gusset plate block shear at connection 1	0.292	0.292	OK
Gusset flexure yieldsing at connection 1	0.106	0.106	OK
Shear tab shear yielding at connection 1	0.279	0.279	OK
Shear tab shear rupture at connection 1	0.374	0.374	OK
Shear tab block shear at connection 1	0.312	0.312	OK
Shear tab flexure yielding at connection 1	0.106	0.106	OK
Weld check at connection 1	0.356	0.356	OK
Shear tab rupture at weld at connection 1	0.304	0.304	OK
Web rupture at weld at connection 1	0.253	0.253	OK
Bolt shear at connection 2	0.265	0.265	OK
Bolt bearing at shear tab at connection 2	0.377	0.377	OK
Bolt bearing at gusset at connection 2	0.158	0.158	OK
Gusset shear yielding at connection 2	0.149	0.149	OK
Gusset shear rupture at connection 2	0.161	0.161	OK
Gusset plate block shear at connection 2	0.239	0.239	OK
Gusset flexure yielding at connection 2	0.074	0.074	OK
Shear tab shear yielding at connection 2	0.245	0.245	OK
Shear tab shear rupture at connection 2	0.33	0.33	OK
Shear tab block shear at connection 2	0.264	0.264	OK
Shear tab flexure yielding at connection 2	0.117	0.117	OK
Weld check at connection 2	0.349	0.349	OK
Shear tab rupture at weld at connection 2	0.298	0.298	OK
Web rupture at weld at connection 2	0.298	0.298	OK

#### 2.4 Validation Problem 3

# Problem Statement

Design a horizontal brace connection for a double angle 2L6X4X5/16 brace, with their back to back leg horizontal, framing into the junction between two W12X58 and a W12X58 using the LRFD method. The brace has an angle of 55 degrees. The brace has an axial force of 65kip. The beams are of grad ASTM A992, angles and plates are of grade ASTM A36. The bolts are ASTM 3125 A490 slip critical type.



#### Design Inputs

Material Properties	
Material grade for plate	ASTM A36
Yield strength	$F_{yp} = 36 \ ksi$
Tensile strength	$F_{up} = 58 \ ksi$
Material grade of beam	ASTM A992
Yield strength	$F_{yb} = 50$ ksi
Tensile strength	$F_{yb} = 65  ksi$
Tensite defengen	1 110 1-00 1100
Material grade of angles	ASTM A36
Yield strength	$F_{ua} \coloneqq 36$ ksi
Tensile strength	$F_{ua}$ := 58 $m{ksi}$
Material grade for weld electrode	E70XX
Tensile strength	$F_{EXX}$ := 70 $m{ksi}$
Material specification for bolts	ASTM 3125 A490
Tensile strength	
	$F_{nt} = 113 \ ksi$
Shear strength	$F_{nv} \coloneqq 68 \ \textit{ksi}$
Young's modulus for steel	$E \coloneqq 29000 \; ksi$
Design Forces	
Axial force in brace	$P = 65 \ kip$

Connection Geometry	
Brace section	2L6X4X5/16
Thickness	$t_{br}\!\coloneqq\!0.313$ in
Outstanding leg length	$l_{obr}\!\coloneqq\!4$ $m{in}$
Back-to-back leg length	$l_{ibr} \coloneqq 6$ in
Gross cross section area	$A_{br} \coloneqq 6.06 \; oldsymbol{in}^2$
Centroid of brace outstanding leg	$x'_{br} = 0.908 \; in$
Brace angle with horizontal	$\theta_{br} = 55  deg$
Beam section at connection 1	W12X58
Section depth	$d_{xb1}\!\coloneqq\!12.2$ $in$
Flange width	$b_{fb1} \coloneqq 10$ in
Flange thickness	$t_{fb1}\!\coloneqq\!0.64$ $in$
Web thickness	$t_{wb1}\!\coloneqq\!0.36$ in
Distance from outer face to fillet edge	$k_{bdet1}\!\coloneqq\!1.5$ in
Beam section at connection 2	W12X58
Section depth	$d_{xb2}\!\coloneqq\!12.2$ $m{in}$
Flange width	$b_{fb2} \coloneqq 10$ in
Flange thickness	$t_{fb2}\!\coloneqq\!0.64$ $in$
Web thickness	$t_{wb2}\!\coloneqq\!0.36$ in
Distance from outer face to fillet edge	$k_{bdet2}\!\coloneqq\!1.5$ in
Connection 2    Connection 2   Conne	Gusset Plate  n 1 (1)  Pex1  Pex1  Pex1  Ream 1
Gusset plate thickness	$t_q \coloneqq 0.5$ in
Gusset dimension along connection 1	$g_1 \coloneqq 15$ in
Gusset dimension along connection 2	$g_2 = 15$ in
Gusset cutout at connection 1	$g_2\!\coloneqq\!15\textbf{in}\\c_1\!\coloneqq\!0\textbf{in}$
Gusset cutout at connection 1 Gusset cutout at connection 2	$g_2 := 15 \ \emph{in}$ $c_1 := 0 \ \emph{in}$ $c_2 := 0 \ \emph{in}$
Gusset cutout at connection 1 Gusset cutout at connection 2 Gusset extension at connection 1	$g_2 := 15 \ \emph{in}$ $c_1 := 0 \ \emph{in}$ $c_2 := 0 \ \emph{in}$ $ex_1 := 0.5 \ \emph{in}$
Gusset cutout at connection 1 Gusset cutout at connection 2	$g_2 := 15 \ in$ $c_1 := 0 \ in$ $c_2 := 0 \ in$ $ex_1 := 0.5 \ in$ $ex_2 := 0.5 \ in$
Gusset cutout at connection 1 Gusset cutout at connection 2 Gusset extension at connection 1 Gusset extension at connection 2	$g_2 := 15 \ in$ $c_1 := 0 \ in$ $c_2 := 0 \ in$ $ex_1 := 0.5 \ in$ $ex_2 := 0.5 \ in$
Gusset cutout at connection 1 Gusset cutout at connection 2 Gusset extension at connection 1	$c_1 := 0$ in $c_2 := 0$ in $ex_1 := 0.5$ in

Number of bolts per row on brace Number of bolts at beam 1 flange Number of bolts at beam 2 flange Bolt spacing Bolt row spacing Bolt gage on brace	$T_{pre} \coloneqq 64 \ \textit{kip}$ $n_{br} \coloneqq 3$ $n_1 \coloneqq 3$ $n_2 \coloneqq 3$ $s \coloneqq 3 \ \textit{in}$
Number of bolts at beam 1 flange Number of bolts at beam 2 flange Bolt spacing Bolt row spacing	$n_{br} := 3$ $n_1 := 3$ $n_2 := 3$
Number of bolts at beam 1 flange Number of bolts at beam 2 flange Bolt spacing Bolt row spacing	$n_1 \coloneqq 3$ $n_2 \coloneqq 3$
Number of bolts at beam 1 flange Number of bolts at beam 2 flange Bolt spacing Bolt row spacing	$n_1 \coloneqq 3$ $n_2 \coloneqq 3$
Number of bolts at beam 2 flange  Bolt spacing Bolt row spacing	$n_2 \coloneqq 3$
Bolt spacing Bolt row spacing	
Bolt row spacing	s:=3 <b>in</b>
Bolt row spacing	s = 3 in
Bolt gage on brace	$s_r \coloneqq 1.75$ in
	$g_{br} \coloneqq 2$ in
Bolt gage on beam 1	$g_{bm1} \coloneqq 3$ in
Bolt gage on beam 2	
SOIL gage on Deam 2	$g_{bm2} = 3$ in
Bolt location for connection 1	$loc_1 := 6$ in
Bolt location for connection 2	$loc_2 = 6$ in
	2
Bolt edge distance on brace	$ed_1 \coloneqq 1.5$ in
Bolt edge distance on gusset	$ed_2 = 1.5$ in
Bolt edge distance on gusset at connection 1	$ed_3 = 1.5$ in
Bolt edge distance on gusset at connection 2	$ed_4 = 1.5 \; in$
Beam bottom flange cope length at connection 1	$cp_1 \coloneqq 4$ $in$
Beam bottom flange cope length at connection 2	$cp_1 = 1$ in $cp_2 = 0$ in
Setback of beam at connection 1	$cp_2 = 0$ th
Setback of Deall at Connection 1	$sbb_1 = 0.5$ in
Setback of beam at connection 2	$sbb_2 \coloneqq 0$ in
Setback of beam at connection 1 Setback of beam at connection 2  sign Calculations Connection forces Shear per bolt at brace connection	
Connection forces	
Shear per bolt at brace connection	
	为
$P_b\!\coloneqq\!rac{P}{2\;n_{br}}$	$P_b = 10.833 \ kip$
$^{1}$ $^{b}$ $^{-}$ $^{2}$ $n_{br}$	1 b=10.000 lulp
Component of brace force along connection 1	D 97,000 1
$P_1\!\coloneqq\!P\!\cdot\!\cos\left( heta_{br} ight)$	$P_b$ =10.833 ${m kip}$ $P_1$ =37.282 ${m kip}$
Force per bolt along connection 1	
P.	42
$P_{b1}\!\coloneqq\!rac{P_1}{n_1}$	$P_{b1}$ = 12.427 $m{kip}$
$n_1$	
Component of brace force along connection 2	
$P_2 = P \cdot \sin\left( heta_{br} ight)$	$P_2 = 53.245 \; kip$
	2 33.213 100
Force per bolt along connection 2	
orde per bord arong connection z	
$P_2$	$P_{b2}\!=\!17.748~{m kip}$
$P_{b2}\!\coloneqq\!rac{P_2}{n_2}$	$P_{b2} = 17.748 \; kip$

Nominal slip resist	$R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre} \cdot 2$	$R_n = 43.392 \ kip$
Interaction ratio	in bolt shear	
Ch		
9-:	$I_0 = \frac{P_b}{R_n}$	$I_0 = 0.25$
Bolt bearing on bra	ance for bearing check	
TITTIMUM CICUI AISCO	$l_{c1} \coloneqq min\left(s - d_{bh}, ed_1 - 0.5 \cdot d_{bh} ight)$	$l_{c1} = 0.969 \ in$
1		CI
Nominal strength in		
	$R_n \coloneqq min\left(1.2 \cdot l_{c1} \cdot t_{br} \cdot F_{ua}, 2.4 \cdot d_b \cdot t_{br} \cdot F_{ua}\right)$	$R_n = 21.099 \ kip$
Interaction ratio	in bolt bearing at brace	
Inceraction facto		
	$I_1 \coloneqq \frac{0.5 \ P_b}{0.75 \cdot R_n}$	$I_{1} = 0.342$
	$0.75 \cdot R_n$	1
Bolt bearing on gus		
Minimum clear dista	ance for bearing on gusset	$l_{c1} = 0.969 \; in$
	$l_{c2} \coloneqq min\left(s - d_{bh}, ed_2 - 0.5 \cdot d_{bh}\right)$	$t_{c1} = 0.909 \ m$
Nominal strength in	n bearing	
	$R_n \coloneqq min\left(1.2 \cdot l_{c2} \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 33.704 \ kip$
	Z Z	
Interaction ratio	in bolt bearing at gusset	
	$I_{2} = \frac{P_{b}}{0.75 \cdot R}$	$I_{2} = 0.429$
	$0.13^{\circ}10^{\circ}$	2
Brace tension ruptu	ire check	
Net cross section a	area of brace	4 4 500 1 2
	$A_{nbr}\!\coloneqq\!A_{br}\!-4m{\cdot}d_{bh}m{\cdot}t_{br}$	$A_{nbr} = 4.729 \; in^2$
Length of connection	on S.	
	are check area of brace $A_{nbr} \!\coloneqq\! A_{br} \!-\! 4 \!\cdot\! d_{bh} \!\cdot\! t_{br}$ on $l_{br} \!\coloneqq\! s \!\cdot\! (n_{br} \!-\! 1)$	$l_{br} = 6$ $in$
Shear lag factor	$x_{br}$	
	$U\!\coloneqq\!1\!-\!rac{x^{'}_{br}}{l_{br}}$	U = 0.849
Brace strength in t	tension rupture	9
	$P_n \coloneqq F_{ua} \cdot U \cdot A_{nbr}$	$P_n = 232.78 \ kip$
		$P_n = 232.78 \text{ kip}$ $I_3 = 0.372$
Interaction ratio	for brace tension rupture	
	7 P	$I_{3} = 0.372$
	$I_3 = \frac{P}{0.75 \cdot P_n}$	$\frac{1}{3} = 0.372$

	$A_{gv} \coloneqq 2 ullet ig( ig( n_{br} - 1 ig) ullet s + ed_1 ig) ullet t_{br}$	$A_{gv} = 4.695 \; in^2$
Net area in sheam		
Net alea III Shear	$A_{nv}\!\coloneqq\!A_{qv}\!-\!2ullet(n_{br}\!-\!0.5)ullet d_{bh}\!ullet t_{br}$	$A_{nv} = 3.031 \; in^2$
4	$11_{nv} - 11_{gv} = 2$ (100r 0.0) $a_{bh} = b_{br}$	11 <sub>nv</sub> = 3.031 414
Net area in tens	ion	
<b>3</b>	$A_{nt} \coloneqq 2 ullet \left( l_{ibr} - g_{br} - 1.5 ullet d_{bh}  ight) ullet t_{br}$	$A_{nt} = 1.506 \; in^2$
Nominal strength		
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
	$R_{n2} := 0.6 \cdot F_{na} \cdot A_{av} + F_{na} \cdot A_{nt}$	
	-n2 - ga go aa nt	
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 188.751 \ kip$
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$	
Interaction ratio	o in block shear	
	P P	1 -0 450
	$I_4 \coloneqq \frac{P}{0.75 \cdot R_n}$	$I_4 = 0.459$
Gusset tension y	ielding check	
	30.5	
	1 <sub>w</sub>	
Length of Whitmon		$l_w\!=\!8.678$ $in$
Length of Whitmon		$l_w\!=\!8.678~in$
Length of Whitmon		$l_w$ = $8.678~in$ $P_n$ = $156.208~kip$
Length of Whitmon	The section $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$	$l_w$ $=$ $8.678~in$ $P_n$ $=$ $156.208~kip$
Length of Whitmon	re section $l_w\!\coloneqq\!2\!\cdot\!l_{br}\!\cdot\! an(30\;deg)\!+\!s_r$ of gusset in yielding	$l_w$ $= 8.678 \ m{in}$ $P_n$ $= 156.208 \ m{kip}$
Length of Whitmon	The section $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg) + s_r$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ on in tension yielding	0,
Length of Whitmon	The section $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$	0,
Length of Whitmon	The section $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg) + s_r$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ on in tension yielding $I_s \coloneqq \frac{P}{0.9 \cdot P_n}$	I = 0.462
Length of Whitmon	The section $l_w \coloneqq 2 \cdot l_{br} \cdot \tan(30 \ deg) + s_r$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ of in tension yielding $I_{\overline{5}} \coloneqq \frac{P}{0.9 \cdot P_n}$ upture check et in tension	I = 0.462
Length of Whitmon Nominal strength Interaction ratio	The section $l_w \coloneqq 2 \cdot l_{br} \cdot \tan(30 \ deg) + s_r$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ of in tension yielding $I_s \coloneqq \frac{P}{0.9 \cdot P_n}$ apture check	I = 0.462
Length of Whitmon Nominal strength Interaction ratio Gusset tension ru Net area of gusse	The section $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg) + s_r$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ of in tension yielding $I_5 \coloneqq \frac{P}{0.9 \cdot P_n}$ apture check et in tension $A_{ng} \coloneqq (l_w - 2 \ d_{bh}) \cdot t_g$	I = 0.462
Length of Whitmon Nominal strength Interaction ratio Gusset tension ru Net area of gusse	The section $l_w \coloneqq 2 \cdot l_{br} \cdot \tan(30 \ deg) + s_r$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ of in tension yielding $I_{\overline{5}} \coloneqq \frac{P}{0.9 \cdot P_n}$ upture check et in tension	0,

Ź,	P P	7 0 450
8	$I_6 = \frac{P}{0.75 \cdot P_n}$	$I_{6} = 0.456$
Gusset block shear	16	
Gross area in shea		
GIOSS area III Silea	$A_{qv} \coloneqq 2 \; \left( (n_{br} - 1) \cdot s + ed_2 \right) \cdot t_q$	$A_{qv} = 7.5   m{in}^2$
	$r_{gv} = 2 \left( (n_{br} - 1)^{-\epsilon} S + c \omega_2 \right)^{-\epsilon} v_g$	21gv = 1.0 010
Net area in shear		
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!\left(2\boldsymbol{\cdot}n_{br}\!-\!1\right)\boldsymbol{\cdot}d_{bh}\boldsymbol{\cdot}t_{g}$	$A_{nv} = 4.843 \; in^2$
	, , ,	
Net area in tensio	on ,	
	$A_{nt} \coloneqq (s_r - d_{bh}) \cdot t_g$	$A_{nt} = 0.344 \; in^2$
	3	
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!(2\!\cdot\!n_{br}\!-\!1)\!\cdot\!d_{bh}\!\cdot\!t_g$	
	7	
	9 6	
Nominal strength b	plock shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{up} \cdot A_{nv} + F_{up} \cdot A_{nt}$	
	P := 06.F . A 4.F . A	
	$n_{n2} = 0.0 \cdot r_{yp} \cdot A_{gv} + r_{up} \cdot A_{nt}$	
	plock shear $R_{n1}\!\coloneqq\!0.6m{\cdot}F_{up}m{\cdot}A_{nv}\!+\!F_{up}m{\cdot}A_{nt}$ $R_{n2}\!\coloneqq\!0.6m{\cdot}F_{yp}m{\cdot}A_{gv}\!+\!F_{up}m{\cdot}A_{nt}$ $R_n\!\coloneqq\!min\left(R_{n1},R_{n2}\right)$	$R_n = 181.923 \; kip$
	16 (161) 162)	
Interaction ratio	in block shear	
INCOLUCTION LUCIO		
1110010001011 10010	P	
	$I_7 = \frac{P}{0.75 R}$	$I_{_{7}} = 0.476$
	$I_{7} = \frac{P}{0.75 R_{n}}$	$I_{_{7}} = 0.476$
Bolt shear at conn	ection 1	$I_{7} = 0.476$
Bolt shear at conn	mection 1	
Bolt shear at conn	ection 1	$I_{7} = 0.476$ $R_{n} = 21.696 \; kip$
Bolt shear at conn	Rection 1 Stance of bolt $R_n\!\coloneqq\!\mu\!\cdot\!1.13\!\cdot\!T_{pre}$	
Bolt shear at conn	Hection 1 stance of bolt $R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$ in bolt shear	$R_n$ =21.696 $kip$
Bolt shear at conn	Hection 1 stance of bolt $R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$ in bolt shear	$R_n$ = 21.696 $kip$
Bolt shear at conn	Rection 1 Stance of bolt $R_n\!\coloneqq\!\mu\!\cdot\!1.13\!\cdot\!T_{pre}$	
Bolt shear at conn Nominal slip resis	Hection 1 stance of bolt $R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$ in bolt shear	$R_n$ = 21.696 $kip$
Bolt shear at conn Nominal slip resis	pection 1  Stance of bolt $R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$ in bolt shear $I_8 \coloneqq \frac{P_{b1}}{R_n}$ Asset plate at connection 1	$R_n = 21.696 \ \textit{kip}$
Bolt shear at conn Nominal slip resis Interaction ratio Bolt bearing at gu	pection 1  Stance of bolt $R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$ in bolt shear $I_8 \coloneqq \frac{P_{b1}}{R_n}$ Asset plate at connection 1	$R_n$ =21.696 $kip$
Bolt shear at connounce Nominal slip resistant Interaction ratio  Bolt bearing at guilding the state of connection connection is shown as a superior of connection in the state of connection is shown as a superior of connection is sho	Hection 1 Stance of bolt $R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$ Sin bolt shear $I_8 \coloneqq \frac{P_{b1}}{R_n}$ Usset plate at connection 1 Since $1$ Since	$R_n = 21.696 \ \textit{kip}$
Bolt shear at connounce Nominal slip resistant Interaction ratio  Bolt bearing at guilding the state of connection connection is shown as a superior of connection in the state of connection is shown as a superior of connection is sho	pection 1  Stance of bolt $R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$ in bolt shear $I_8 \coloneqq \frac{P_{b1}}{R_n}$ Asset plate at connection 1	$R_n = 21.696 \ \textit{kip}$

$loc_{gi} = c_1 - cx_2 - \text{if}\left(c_2 = 0, 0, (g_{low1} + cx_1) \cdot \frac{c_1}{c_2}\right) \qquad loc_{gi} = -0.5 \ \text{in}$ Outer edge distance for clip on gusset $cd_{gi} = loc_{gi} - loc_{gi}$ $cd_{gi} = loc_{gi} - loc_{gi}$ $cd_{gi} = loc_{gi} - loc_{gi}$ $cd_{gi} = 6.5 \ \text{in}$ Inner edge distance for clip on gusset $cd_{gi} = min\left(cd_{gi}, cd_{gi}\right) \qquad cd_{gi} = 6.5 \ \text{in}$ Minimum edge distance for clip on gusset $cd_{gi} = min\left(cd_{gi}, cd_{gi}\right) \qquad cd_{gi} = 2.5 \ \text{in}$ Clear distance between bolt holes/ hole and edge $l_c = min\left(s - d_{bh}, cd_g - 0.5 \cdot d_{bh}\right) \qquad l_c = 1.937 \ \text{in}$ Nominal strength in bearing $R_{a} = min\left(1.2 \cdot l_c \cdot l_g \cdot F_{up}, 2.4 \cdot d_b \cdot l_g \cdot F_{up}\right) \qquad R_a = 67.408 \ \text{kip}$ Interaction ratio in bolt bearing $I_{gi} = \frac{P_{hh}}{0.75 \ R_{n}} \qquad I_{gi} = 0.246$ Bolt bearing at beam flange at connection 1 and edge $l_c = min\left(s - d_{bh}, cd_b - 0.5 \cdot d_{bh}\right) \qquad l_c = 0.788 \ \text{in}$ Clear distance between bolt holes/ hole and edge $l_c = min\left(s - d_{bh}, cd_b - 0.5 \cdot d_{bh}\right) \qquad l_c = 0.788 \ \text{in}$ Nominal strength in bearing $R_{ni} = min\left(1.2 \cdot l_c \cdot t_{gh} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{gh} \cdot F_{ub}\right) \qquad R_n = 39.362 \ \text{kip}$ Interaction ratio in bolt bearing $I_{10} := \frac{P_{b1}}{0.75 \ R_{n}} \qquad I_{10} = 0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_{gi} := (g_1 - c_1) \cdot t_g \qquad A_{gi} = 7.5 \ \text{in}^2$ Nominal shear strength of gusset in shear yielding $R_{ni} := 0.6 \cdot F_{yp} \cdot A_g \qquad R_{ni} = 162 \ \text{kip}$ Interaction ratio in shear yielding $R_{ni} := \frac{P_{11}}{R_{ni}} \qquad I_{10} = 0.23$	Distance of gusset inner edge from work point	
Inner edge distance for clip on gusset $cd_{gi} \coloneqq loc_1 - loc_{gi} \qquad cd_{gi} \equiv 6.5 \text{ in}$ Minimum edge distance for clip on gusset $cd_{gi} \coloneqq loc_1 - loc_{gi} \qquad cd_{gi} \equiv 6.5 \text{ in}$ Minimum edge distance for clip on gusset $cd_{gi} = min (ed_{go}, ed_{gi}) \qquad ed_{gi} \equiv 2.5 \text{ in}$ Clear distance between bolt holes/ hole and edge $l_c \coloneqq min (s - d_{bh}, ed_g - 0.5 \cdot d_{bh}) \qquad l_c \equiv 1.937 \text{ in}$ Nominal strength in bearing $R_n \coloneqq min (1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}) \qquad R_n = 67.408 \text{ kip}$ Interaction ratio in bolt bearing $I_c \coloneqq \frac{P_{bh}}{0.75 R_n} \qquad I_c = 0.246$ Bolt bearing at beam flange acque $cd_b \coloneqq loc_1 - cp_1 - sbb_1 - 0.5 \ t_{ab2} \qquad cd_b \equiv 1.32 \ \text{in}$ Clear distance between bolt holes/ hole and edge $l_c \coloneqq min (s - d_{bh}, cd_b - 0.5 \cdot d_{bh}) \qquad l_c \equiv 0.788 \ \text{in}$ Nominal strength in bearing $R_n \coloneqq min (1.2 \cdot l_c \cdot t_{fh}, F_{ub}, 2.4 \cdot d_h \cdot t_{fh}, F_{ub}) \qquad R_n \equiv 39.362 \ \text{kip}$ Interaction ratio in bolt bearing $R_n \coloneqq min (1.2 \cdot l_c \cdot t_{fh}, F_{ub}, 2.4 \cdot d_h \cdot t_{fh}, F_{ub}) \qquad R_n \equiv 39.362 \ \text{kip}$ Cusset shear yielding at connection 1 Gross area in shear $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad A_g = 7.5 \ \text{in}^2$ Nominal shear strength of gusset in shear yielding $R_n \equiv 0.6 \cdot F_{gp} \cdot A_g \qquad R_n \equiv 162 \ \text{kip}$	$loc_{gi} \coloneqq c_1 - ex_2 - \mathbf{if} \left( c_2 = 0 , 0 , \left( g_{bm1} + ex_1 \right) \cdot \frac{c_1}{c_2} \right)$	$loc_{gi}\!=\!-0.5$ in
$cd_{gi} = loc_1 - loc_{gi}$ $cd_{gi} = 6.5 \ in$ Minimum edge distance for clip on gusset $cd_{g} = min \left(cd_{go}, ed_{gi}\right)$ $cd_{g} = 2.5 \ in$ Clear distance between bolt holes/ hole and edge $l_c = min \left(s - d_{gh}, ed_g - 0.5 \cdot d_{gh}\right)$ $l_c = 1.937 \ in$ Nominal strength in bearing $R_n = min \left(1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$ $R_n = 67.408 \ kip$ Interaction ratio in bolt bearing $I_o = \frac{P_{hh}}{0.75 \ R_n}$ $I_o = 0.246$ Bolt bearing at beam flange at connection 1 Edge distance of bolt to beam flange edge $cd_b = l_{ci} - cp_1 - sbb_1 - 0.5 \ t_{ub2}$ $cd_b = 1.32 \ in$ Clear distance between bolt holes/ hole and edge $l_c = min \left(s - d_{hh}, ed_b - 0.5 \cdot d_{hh}\right)$ $l_c = 0.788 \ in$ Nominal strength in bearing $R_n = min \left(1.2 \cdot l_c \cdot t_{fh1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fh1} \cdot F_{ub}\right)$ $R_n = 39.362 \ kip$ Interaction ratio in bolt bearing $I_{10} = \frac{P_{h1}}{0.75 \ R_n}$ $I_{10} = 0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_g = \left(g_1 - c_1\right) \cdot t_g$ Nominal shear strength of gusset in shear yielding $R_n = 162 \ kip$		$ed_{go}\!=\!2.5$ $in$
Clear distance between bolt holes/ hole and edge $l_c \coloneqq \min(s-d_{bh}, ed_g-0.5 \cdot d_{bh}) \qquad l_c = 1.937 \ in$ Nominal strength in bearing $R_n \equiv \min(1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}) \qquad R_n = 67.408 \ kip$ Interaction ratio in bolt bearing $I_g \coloneqq \frac{P_{bb}}{0.75 \ R_n} \qquad I_g = 0.246$ Bolt bearing at beam flange at connection 1 Edge distance of bolt to beam flange edge $ed_b \coloneqq loc_1 - cp_1 - sbb_1 - 0.5 \ t_{wb2} \qquad ed_b = 1.32 \ in$ Clear distance between bolt holes/ hole and edge $l_c \coloneqq \min(s-d_{bh}, ed_b - 0.5 \cdot d_{bh}) \qquad l_c = 0.788 \ in$ Nominal strength in bearing $R_n \coloneqq \min(1.2 \cdot l_c \cdot t_{fb1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb1} \cdot F_{ub}) \qquad R_n = 39.362 \ kip$ Interaction ratio in bolt bearing $I_{10} \coloneqq \frac{P_{b1}}{0.75 \ R_n} \qquad I_{10} = 0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad A_g = 7.5 \ in^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad R_n = 162 \ kip$		$ed_{gi}{=}6.5$ $m{in}$
$l_c \coloneqq \min \left( s - d_{bh}, ed_g - 0.5 \cdot d_{bh} \right) \qquad l_c = 1.937 \ in$ Nominal strength in bearing $R_n \coloneqq \min \left( 1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up} \right) \qquad R_n = 67.408 \ kip$ Interaction ratio in bolt bearing $I_g \coloneqq \frac{P_{bh}}{0.75 \ R_n} \qquad I_g = 0.246$ Bolt bearing at beam flange at connection 1 Edge distance of bolt to beam flange edge $ed_b \coloneqq loc_1 - cp_1 - sbb_1 - 0.5 \ t_{ub2} \qquad ed_b = 1.32 \ in$ Clear distance between bolt holes/ hole and edge $l_c \coloneqq \min \left( s - d_{bh}, ed_b - 0.5 \cdot d_{bh} \right) \qquad l_c = 0.788 \ in$ Nominal strength in bearing $R_n \coloneqq \min \left( 1.2 \cdot l_c \cdot t_{fb1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb1} \cdot F_{ub} \right) \qquad R_n = 39.362 \ kip$ Interaction ratio in bolt bearing $I_{10} \coloneqq \frac{P_{b1}}{0.75 \ R_n} \qquad I_{10} = 0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad A_g = 7.5 \ in^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad R_n = 162 \ kip$		$ed_g$ = $2.5$ $m{in}$
$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right) \qquad R_n = 67.408 \; kip$ Interaction ratio in bolt bearing $I_g \coloneqq \frac{P_{b1}}{0.75 \; R_n} \qquad \qquad I_g = 0.246$ Bolt bearing at beam flange at connection 1 Edge distance of bolt to beam flange edge $ed_b \coloneqq loc_1 - cp_1 - sbb_1 - 0.5 \; t_{wb2} \qquad ed_b = 1.32 \; in$ Clear distance between bolt holes hole and edge $l_c \coloneqq min\left(s - d_{bh}, ed_b - 0.5 \cdot d_{bh}\right) \qquad l_c = 0.788 \; in$ Nominal strength in bearing $R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_{fb1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb1} \cdot F_{ub}\right) \qquad R_n = 39.362 \; kip$ Interaction ratio in bolt bearing $I_0 \coloneqq \frac{P_{b1}}{0.75 \; R_n} \qquad I_0 = 0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad A_g = 7.5 \; in^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad R_n = 162 \; kip$		$l_c\!=\!1.937$ $in$
Bolt bearing at beam flange at connection 1 Edge distance of bolt to beam flange edge $ed_b \coloneqq loc_1 - cp_1 - sbb_1 - 0.5 \ t_{wb2} \qquad ed_b = 1.32 \ in$ Clear distance between bolt holes/ hole and edge $l_c \coloneqq min \left(s - d_{bh}, ed_b - 0.5 \cdot d_{bh}\right) \qquad l_c = 0.788 \ in$ Nominal strength in bearing $R_n \coloneqq min \left(1.2 \cdot l_c \cdot t_{fb1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb1} \cdot F_{ub}\right) \qquad R_n = 39.362 \ kip$ Interaction ratio in bolt bearing $I_{10} \coloneqq \frac{P_{b1}}{0.75 \ R_n} \qquad I_{10} = 0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad A_g = 7.5 \ in^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad R_n = 162 \ kip$		$R_n \! = \! 67.408 \; kip$
Bolt bearing at beam flange at connection 1 Edge distance of bolt to beam flange edge $ed_b\coloneqq loc_1-cp_1-sbb_1-0.5\ t_{wb2} \qquad ed_b=1.32\ in$ Clear distance between bolt holes/ hole and edge $l_c\coloneqq min\left(s-d_{bh},ed_b-0.5\cdot d_{bh}\right) \qquad l_c=0.788\ in$ Nominal strength in bearing $R_n\coloneqq min\left(1.2\cdot l_c\cdot t_{fb1}\cdot F_{ub},2.4\cdot d_b\cdot t_{fb1}\cdot F_{ub}\right) \qquad R_n=39.362\ kip$ Interaction ratio in bolt bearing $I_{10}\coloneqq \frac{P_{b1}}{0.75\ R_n} \qquad \qquad I_{10}=0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_g\coloneqq (g_1-c_1)\cdot t_g \qquad \qquad A_g=7.5\ in^2$ Nominal shear strength of gusset in shear yielding $R_n\coloneqq 0.6\cdot F_{yp}\cdot A_g \qquad \qquad R_n=162\ kip$		
Clear distance between bolt holes/ hole and edge $l_c \coloneqq min \left(s - d_{bh}, ed_b - 0.5 \cdot d_{bh}\right) \qquad l_c = 0.788 \ in$ Nominal strength in bearing $R_n \coloneqq min \left(1.2 \cdot l_c \cdot t_{fb1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb1} \cdot F_{ub}\right) \qquad R_n = 39.362 \ kip$ Interaction ratio in bolt bearing $I_{10} \coloneqq \frac{P_{b1}}{0.75 \ R_n} \qquad I_{10} = 0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad A_g = 7.5 \ in^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad R_n = 162 \ kip$		$I_{9} = 0.246$
$l_c \coloneqq min\left(s-d_{bh}, ed_b-0.5 \cdot d_{bh}\right) \qquad l_c = 0.788 \; in$ Nominal strength in bearing $R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_{fb1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb1} \cdot F_{ub}\right) \qquad R_n = 39.362 \; kip$ Interaction ratio in bolt bearing $I_{10} \coloneqq \frac{P_{b1}}{0.75 \; R_n} \qquad \qquad I_{10} = 0.421$ Gusset shear yielding at connection 1 Gross area in shear $A_g \coloneqq (g_1-c_1) \cdot t_g \qquad \qquad A_g = 7.5 \; in^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad \qquad R_n = 162 \; kip$		$ed_b$ =1.32 $m{in}$
Gusset shear yielding at connection 1 $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad \qquad A_g = 7.5 \ \textit{in}^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad \qquad R_n = 162 \ \textit{kip}$	Clear distance between bolt holes/ hole and edge $l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_b\!-\!0.5\!\cdot\!d_{bh}\right)$	$l_c\!=\!0.788$ $in$
Gusset shear yielding at connection 1 $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad \qquad A_g = 7.5 \ \textit{in}^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad \qquad R_n = 162 \ \textit{kip}$	Nominal strength in bearing $R := min(1.2 \cdot l_1 \cdot t_{g_1} \cdot F_{g_2} \cdot 2.4 \cdot d_4 \cdot t_{g_3} \cdot F_{g_4})$	$R_{\rm s} = 39.362 \ kin$
Gusset shear yielding at connection 1 $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad \qquad A_g = 7.5 \ \textit{in}^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad \qquad R_n = 162 \ \textit{kip}$	Interaction ratio in bolt bearing	
Gross area in shear $A_g \coloneqq (g_1 - c_1) \cdot t_g \qquad \qquad A_g = 7.5 \; in^2$ Nominal shear strength of gusset in shear yielding $R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g \qquad \qquad R_n = 162 \; kip$	$I_{10} \coloneqq \frac{P_{b1}}{0.75 \ R_n}$	$I_{10} = 0.421$
Nominal shear strength of gusset in shear yielding $R_n\!\coloneqq\!0.6\!\cdot\!F_{yp}\!\cdot\!A_g \qquad \qquad R_n\!=\!162\textit{kip}$	Gross area in shear	$A_q$ =7.5 $in^2$
	Nominal shear strength of gusset in shear yielding	
$I_{_{11}} := \frac{I_{_{11}}}{R_n}$ $I_{_{11}} = 0.23$	Interaction ratio in shear yieldling	
	$I_{_{11}}\coloneqqrac{1}{R_{n}}$	$I_{11} = 0.23$

	$A_n\!\coloneqq\!A_g\!-\!n_1\!\cdot\!d_{bh}\!\cdot\!t_g$	$A_n = 5.906 \; in^2$
Nominal shoar strop	ngth of gusset in rupture	
Nominal Shear Screen	$R_n \coloneqq 0.6 \cdot F_{uv} \cdot A_n$	$R_n = 205.511 \; kip$
4.	$Te_n = 0.0$ $T_{up}$ $T_n$	$n_n$ = 200.011 $n_i p$
Interaction ratio	in shear runture	
Interaction ratio	In Shear Papeare	
70 <sub>2</sub>	$I_{12} \coloneqq \frac{P_1}{0.75 \ R_n}$	$I_{12} = 0.242$
	$^{-12}$ $0.75~R_n$	12
Gusset plate block	shear at connection 1	
Gross area subject		
9	$A_{gv} \coloneqq (L_1 + ed_g) \cdot t_g$	$A_{qv}\!=\!4.25$ $m{in}^2$
	ge ( 1 g) g	ge
Net area subjected	to block shear	
	$A_{nv} \coloneqq A_{gv} - (n_1 - 0.5) \cdot d_{bh} \cdot t_g$	$A_{nv}\!=\!2.921$ $m{in}^2$
	3 ( ) / 3	
Net area subjected		
	$A_{nt} \coloneqq \left(g_{bm1} + ex_1 - 0.5 \ d_{bh}\right) \cdot t_g$	$A_{nt} = 1.484 \; in^2$
Nominal strength in		
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
	8	
	$R_{n2}\!\coloneqq\!0.6\boldsymbol{\cdot} F_{ya}\boldsymbol{\cdot} A_{gv}\!+\!F_{ua}\boldsymbol{\cdot} A_{nt}$	
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 177.887 \ kip$
Interaction ratio	in block shear $P_1$	
	$P_1$	T 0.0=0
	$I_{13} \coloneqq \frac{P_1}{0.75 \ R_n}$	$I_{_{13}} = 0.279$
a , c1 , .		
	lding at connection 1	
Eccentricity of 10.	rce at connection 1	20 -0 in
	$ec_1 \coloneqq \max\left(c_2 - ex_1, 0\right)$	$ec_1=0$ in
Nominal moment stre	anght of gussot	$I_{_{13}}\!=\!0.279$ $ec_1\!=\!0$ $in$
Nomithat moment str	slight of gassee	O <sub>2</sub>
	$M_n \coloneqq rac{F_{yp} \! \cdot \! t_g \! \cdot \! g_1^{\ 2}}{4}$	$M_n = 84.375 \ kip \cdot ft$
	4	$m_n$ = $04.575 \text{ ktp} \cdot \text{j t}$
Interaction ratio	in gusset flexure	92
		Q,
	$I_{14} \coloneqq \frac{P_1 \cdot ec_1}{0.9 \cdot M_n}$	I = 0
	$^{-14}$ $0.9 \cdot M_n$	14
Bolt shear at conne	ection 2	72
Nominal slip resis		
	$R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$	$R_n = 21.696 \ kip$
	n i pre	

$I_{15}\coloneqqrac{P_{b2}}{R_{n}}$	I = 0.818
$\overline{}_{15}$ $\overline{}$ $\overline{}$ $\overline{}$ $R_n$	$I_{15} = 0.818$
Bolt bearing at gusset plate at connection 2	
Length of connection 2	
$L_2 \coloneqq (n_2 - 1) \cdot s$	$L_2\!=\!6$ in
Distance of gusset outer edge from work point	
$loc_{go} \coloneqq g_2 - ex_1$	$loc_{go}\!=\!14.5$ $in$
Distance of gusset inner edge from work point	
$loc_{gi} \coloneqq c_2 - ex_1 - \mathbf{if} \left( c_1 = 0 , 0 , \left( g_{bm2} + ex_2 \right) \cdot \frac{c_2}{c_1} \right)$	$loc_{gi}\!=\!-0.5$ $in$
Outer edge distance for clip on gusset	
$ed_{go}\!\coloneqq\!loc_{go}\!-\!loc_2\!-\!L_2$	$ed_{go}$ $=$ $2.5$ $in$
Inner edge distance for clip on gusset	
$ed_{gi}\!\coloneqq\!loc_2\!-\!loc_{gi}$	$ed_{gi}{=}6.5$ $m{in}$
Minimum edge distance for clip on gusset	
$ed_g \!\coloneqq\! min\left(ed_{go}, ed_{gi}\right)$	$ed_g$ = $2.5$ $m{in}$
Clear distance between bolt holes/ hole and edge	
$l_c\!\coloneqq\!min\left(\!s\!-\!d_{bh},ed_g\!=\!0.5\!ullet d_{bh}\! ight)$	$l_c = 1.937$ in
Nominal strength in bearing	
$R_{n}\!\coloneqq\!min\left(1.2\boldsymbol{\cdot} l_{c}\boldsymbol{\cdot} t_{g}\boldsymbol{\cdot} F_{up},2.4\boldsymbol{\cdot} d_{b}\boldsymbol{\cdot} t_{g}\boldsymbol{\cdot} F_{up}\right)$	$R_n = 67.408 \; kip$
Interaction ratio in bolt bearing	
$I_{_{16}}\!\coloneqq\!rac{P_{b2}}{0.75\;R_{n}}$	$I_{_{16}} = 0.351$
Bolt bearing at beam flange at connection 2	
Edge distance of bolt to beam flange edge	3
$ed_b\!\coloneqq\!loc_2\!-\!cp_2\!-\!sbb_2\!-\!0.5\ t_{wb2}$	$ed_b = 5.82$ in
Clear distance between bolt holes/ hole and edge	3
$l_c \coloneqq min\left(s - d_{bh}, ed_b - 0.5 ullet d_{bh} ight)$	$l_c = 1.937 \; in$
Nominal strength in bearing	
$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_{fb2} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb2} \cdot F_{ub}\right)$	$R_n = 96.695 \ kip$
Interaction ratio in bolt bearing	95
$I_{17} \coloneqq \frac{P_{b2}}{0.75 \; R_n}$	$I_{_{17}}\!=\!0.245$
	I = 0.245

\(\frac{\chi}{\chi}\).	$A_g\!\coloneqq\! \big(g_2\!-\!c_2\big)\!\cdot\! t_g$	$A_g = 7.5 \; \boldsymbol{in}^2$
Nominal shoar str	ength of gusset in yielding	
Nominal Shear Str	$R_n\!\coloneqq\!0.6\!\cdot\!F_{yp}\!\cdot\!A_q$	$R_n = 162 \; kip$
4.	$1c_n = 0.0 \cdot 1 \cdot yp \cdot 11g$	10 <sub>n</sub> = 102 100p
Interaction ratio	in gusset yieldling	
	$P_2$	
	$I_{18}\coloneqq rac{P_2}{R_n}$	$I_{_{18}} \! = \! 0.329$
	ure at connection 2	
Net area in shear	7	
1100 01200 111 011001	$A_n\!\coloneqq\!A_g\!-\!n_2\!\cdot\!d_{bh}\!\cdot\!t_g$	$A_n \! = \! 5.906 \; m{in}^2$
	3 - 50 9	
Nominal shear str	ength of gusset in rupture	
	$R_n = 0.6 \cdot F_{up} \cdot A_n$	$R_n = 205.511 \ kip$
Interaction ratio	in shear rupture	
	$I_{19}\coloneqq \frac{P_2}{0.75\ R_m}$	$I_{10} = 0.345$
	- 1 - 11	19
	k shear at connection 2	
Gross area subjec	ted to block shear	$A_{gv}\!=\!4.25$ $in^2$
	$A_{gv}\!\coloneqq\! \big(L_2\!+\!ed_g\big)\boldsymbol{\cdot} t_g$	
Net area subjecte	d to block shear	
	4 4 ( 0 5) 7 4	$A = 2.021 \text{ im}^2$
	$A_{nv} \coloneqq A_{gv} - (n_2 - 0.5) \cdot a_{bh} \cdot t_g$	$A_{nv} = 2.921 \ tm$
	$A_{nv} \coloneqq A_{gv} - (n_2 - 0.5) \cdot a_{bh} \cdot t_g$	$A_{nv}$ = 2.921 $m$
Net area subjecte	$A_{nv}\!\coloneqq\!A_{gv}\!-\!(n_2\!-\!0.5)\!\cdot\! d_{bh}\!\cdot\! t_g$ d to tension	$A_{nv} = 2.921 \text{ m}$
Net area subjecte	d to tension $A_{nt}\!\coloneqq\! \left(g_{bm2}\!+\!ex_2\!-\!0.5 ight)\!\cdot\!d_{bh}\!\cdot\!t_g$	$A_{nv}$ = 2.921 $m$ $A_{nt}$ = 1.484 $in^2$
Net area subjecte	$A_{nv}\!\coloneqq\!A_{gv}\!-\!(n_2\!-\!0.5)\!\cdot\!d_{bh}\!\cdot\!t_g$ d to tension $A_{nt}\!\coloneqq\!(g_{bm2}\!+\!ex_2\!-\!0.5\;d_{bh})\!\cdot\!t_g$ in block shear	$A_{nv}$ = 2.921 $m$ $A_{nt}$ = 1.484 $in^2$
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!(n_2\!-\!0.5)\!\cdot\! d_{bh}\!\cdot\! t_g$ d to tension $A_{nt}\!\coloneqq\! \left(g_{bm2}\!+\!ex_2\!-\!0.5\;d_{bh}\right)\!\cdot\! t_g$ in block shear $R_{n1}\!\coloneqq\!0.6\!\cdot\! F_{ua}\!\cdot\! A_{nv}\!+\! F_{ua}\!\cdot\! A_{nt}$	$A_{nv}$ = 2.921 $m$ $A_{nt}$ = 1.484 $m^2$
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!(n_2\!-\!0.5)\!\cdot\! d_{bh}\!\cdot\! t_g$ d to tension $A_{nt}\!\coloneqq\! \left(g_{bm2}\!+\!ex_2\!-\!0.5\;d_{bh}\right)\!\cdot\! t_g$ in block shear $R_{n1}\!\coloneqq\!0.6\!\cdot\! F_{ua}\!\cdot\! A_{nv}\!+\! F_{ua}\!\cdot\! A_{nt}$	$A_{nv}$ = 2.921 $m$ $A_{nt}$ = 1.484 $m^2$
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!(n_2\!-\!0.5)\!\cdot\! d_{bh}\!\cdot\! t_g$ d to tension $A_{nt}\!\coloneqq\! \left(g_{bm2}\!+\!ex_2\!-\!0.5\;d_{bh}\right)\!\cdot\! t_g$ in block shear $R_{n1}\!\coloneqq\!0.6\!\cdot\! F_{ua}\!\cdot\! A_{nv}\!+\!F_{ua}\!\cdot\! A_{nt}$ $R_{n2}\!\coloneqq\!0.6\!\cdot\! F_{ya}\!\cdot\! A_{gv}\!+\!F_{ua}\!\cdot\! A_{nt}$	$A_{nv}$ = 2.921 $m$ $A_{nt}$ = 1.484 $m$
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!(n_2\!-\!0.5)\!\cdot\! d_{bh}\!\cdot\! t_g$ d to tension $A_{nt}\!\coloneqq\! \left(g_{bm2}\!+\!ex_2\!-\!0.5\;d_{bh}\right)\!\cdot\! t_g$ in block shear $R_{n1}\!\coloneqq\!0.6\!\cdot\! F_{ua}\!\cdot\! A_{nv}\!+\! F_{ua}\!\cdot\! A_{nt}$ $R_{n2}\!\coloneqq\!0.6\!\cdot\! F_{ya}\!\cdot\! A_{gv}\!+\! F_{ua}\!\cdot\! A_{nt}$	$A_{nv} = 2.921  m$ $A_{nt} = 1.484  in^2$
	$A_{nv} \coloneqq A_{gv} - (n_2 - 0.5) \cdot a_{bh} \cdot t_g$ d to tension $A_{nt} \coloneqq (g_{bm2} + ex_2 - 0.5 \ d_{bh}) \cdot t_g$ in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$	$A_{nv} = 2.921  m$ $A_{nt} = 1.484  in^2$ $R_n = 177.887  kip$
	$A_{nv} \coloneqq A_{gv} - (n_2 - 0.5) \cdot a_{bh} \cdot t_g$ d to tension $A_{nt} \coloneqq (g_{bm2} + ex_2 - 0.5 \ d_{bh}) \cdot t_g$ in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$ in block shear	$A_{nv}$ = 2.921 $m$ $A_{nt}$ = 1.484 $m^2$ $R_n$ = 177.887 $kip$
Nominal strength	$A_{nv} \coloneqq A_{gv} - (n_2 - 0.5) \cdot a_{bh} \cdot t_g$ d to tension $A_{nt} \coloneqq (g_{bm2} + ex_2 - 0.5 \ d_{bh}) \cdot t_g$ in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$ in block shear $P_2$	$A_{nv}$ = 2.921 $m$ $A_{nt}$ = 1.484 $m^2$ $R_n$ = 177.887 $kip$
Nominal strength	$A_{nt} \coloneqq ig(g_{bm2} + ex_2 - 0.5 \ d_{bh}ig) \cdot t_g$ in block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$ in block shear	I = 0.399
Nominal strength  Interaction ratio	$\frac{1}{20}$ $\overline{0.75 R_n}$	I = 0.399
Nominal strength  Interaction ratio  Gusset flexure yi	elding at connection 2	I = 0.399
Nominal strength  Interaction ratio  Gusset flexure yi	$\frac{1}{20}$ $\overline{0.75 R_n}$	$A_{nv} = 2.921 \ m$ $A_{nt} = 1.484 \ in^2$ $R_n = 177.887 \ kip$ $I_{20} = 0.399$ $ec_2 = 0 \ in$

O K	$M_n\!\coloneqq\!rac{{F_{yp}\!\cdot\!t_g\!\cdot\!g_2}^2}{4}$	$M_n = 84.375 \; kip \cdot f$
nteraction ratio	in gusset flexure	
C.	$P_2 {ullet} ec_2$	
	$I_{21} \coloneqq \overline{0.9 \cdot M_n}$	$I_{21} = 0$
70,		
6		
	$M_n\coloneqq rac{F_{yp}\cdot t_g\cdot g_2^2}{4}$ in gusset flexure $I_2:=rac{P_2\cdot ec_2}{0.9\cdot M_n}$	
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# Validation Results

The calculated ratios are compared with the output of Osoconn and if it is within a tolerance of 1% the result is deemed to be OK.

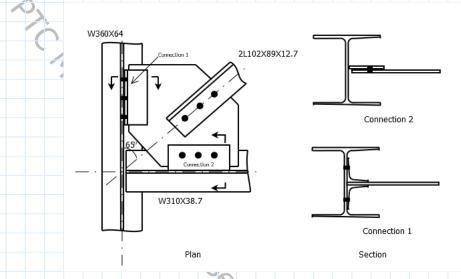
Table 4: Validation problem 3 results

Table 4: validation problem 5 results				
	Interactio	n Ratio		
Check	Calculated	Osoconn	Result	
Bolt shear at brace check	0.25	0.25	OK	
Bolt bearing at brace check	0.342	0.342	OK	
Bolt bearing at gusset check	0.429	0.428	OK	
Brace tension rupture check	0.372	0.372	OK	
Brace block shear check	0.459	0.459	OK	
Gusset tension yielding check	0.462	0.462	OK	
Gusset tension rupture check	0.456	0.456	OK	
Gusset block shear check	0.476	0.476	OK	
Bolt shear at connection 1	0.573	0.573	OK	
Bolt bearing at gusset plate at connection 1	0.246	0.246	OK	
Bolt bearing at beam flange at connection 1	0.421	0.421	OK	
Gusset shear yielding at connection 1	0.23	0.23	OK	
Gusset shear rupture at connection 1	0.242	0.242	OK	
Gusset plate block shear at connection 1	0.279	0.279	OK	
Gusset flexure yielding at connection 1	0.0	0.0	OK	
Bolt shear at connection 2	0.818	0.818	OK	
Bolt bearing at gusset plate at connection 2	0.351	0.351	OK	
Bolt bearing at beam flange at connection 2	0.245	0.245	OK	
Gusset shear yielding at connection 2	0.329	0.329	OK	
Gusset shear rupture at connection 2	0.345	0.345	OK	
Gusset plate block shear at connection 2	0.399	0.399	OK	
Gusset flexure yielding at connection 2	0.0	0.0	OK	

### 2.5 Validation Problem 4

### Problem Statement

Design a horizontal brace connection for a double angle 2L102X89X12.7 brace, with their back to back leg horizontal, framing into the junction between a W360X64 and a W310X38.7 using the ASD method. The brace has an angle of 65 degrees with the W360 beam. The brace has an axial force of 105kN. The beams are ASTM A992, angles and plates are of grade ASTM A36. The bolts are ASTM 3125 A325 slip critical type.



# Design Inputs

Material Properties	4,
Material grade for plate	ASTM A36
Yield strength	$F_{yp} = 250 \; MPa$
Tensile strength	$F_{up} \coloneqq 400 \; MPa$
Material grade of beam	ASTM A992
Yield strength	$F_{yb} \coloneqq 345 \; MPa$
Tensile strength	$F_{ub} \coloneqq 450 \; MPa$
	·c
Material grade of angles	ASTM A36
Yield strength	$F_{ya} = 250 \; MPa$
Tensile strength	$F_{ua} = 400 \; MPa$
	770,00
Material grade for weld electrode	E70XX
Tensile strength	$F_{EXX}$ :=482 $MPa$
Material specification for bolts	ASTM 3125 A325
Tensile strength	$F_{nt} = 620  MPa$
Shear strength	$F_{nv} = 372 \ MPa$
Silear Screngen	1 nv - 512 1111 W
Young's modulus for steel	$E \coloneqq 200000  MPa$
	94.
Design Forces	
Axial force in brace	P = 105  kN

Evace section  Phrace section  Phickness  Substanding leg length  Back-to-back leg length  Gross cross section area  Centroid of brace outstanding leg  Brace angle with horizontal  Beam section at connection 1  Section depth  Flange width		
Thickness Outstanding leg length Back-to-back leg length Gross cross section area Centroid of brace outstanding leg Brace angle with horizontal  Beam section at connection 1 Section depth Flange width Flange thickness Web thickness Distance from outer face to fillet edge  Beam section at connection 2 Section depth Flange width Flange sidth Flange thickness Distance from outer face to fillet edge  Beam section at connection 2 Section depth Flange width Flange sidth Flange sidth Flange thickness Distance from outer face to fillet edge  Beam section at connection 2 Section depth Flange sidth Flange sidth Flange thickness Distance from outer face to fillet edge  Clip angle section Thickness Outstanding leg length Welded leg length  Welded leg length  Shear tab thickness Shear tab width  Shear tab thickness Shear tab width  Thickness Shear tab width  Thickness Shear tab width  Connection 2  Thickness Shear tab width  Thickness Shear tab thickness Shear tab width	Connection Geometry	
Outstanding leg length Back-to-back leg length Gross cross section area Centroid of brace outstanding leg  Brace angle with horizontal  Beam section at connection 1 Section depth Flange width Flange thickness Web thickness Distance from outer face to fillet edge  Beam section at connection 2 Section depth Flange width Flange thickness Distance from outer face to fillet edge  Beam section at connection 2 Section depth Flange width Flange section at connection 2 Section depth Flange section Thickness Distance from outer face to fillet edge  Clip angle section Thickness Outstanding leg length Welded leg length Welded leg length  Welded leg length  Shear tab thickness Shear tab width  Connection 2  Conne	Brace section	2L102X89X12.7
Back-to-back leg length Gross cross section area Ab:= 4520 mm Ab:= 65 deg Ab:= 65 de	OThickness	$t_{br} \coloneqq 12.7   extit{mm}$
Back-to-back leg length Gross cross section area $A_{br}:=4520 \ mm^2$ $X_{br}:=4520 \ mm^2$ $X_{br}:=25.2 \ mm$ Brace angle with horizontal $\theta_{br}:=65 \ deg$ Beam section at connection 1 Wisdom $\theta_{br}:=65 \ deg$ Beam section depth $\theta_{br}:=65 \ deg$ Beam section depth $\theta_{br}:=203 \ mm$ $\theta_$	Outstanding leg length	$l_{obr} = 88.9 \ mm$
Gross cross section area Centroid of brace outstanding leg $x_{lr}:=25.2  mm$ Brace angle with horizontal  Beam section at connection 1 Section depth Flange width Flange thickness Distance from outer face to fillet edge  Beam section at connection 2 Section depth Flange width Flange thickness Web thickness Shear tab thickness Shear tab width  Flange thickness $t_{loa}:=88.9  mm$ $t_{loa}:=88.9  mm$ Shear tab thickness Shear tab width  Flange thickness $t_{s}:=12  mm$		$l_{ihr} \coloneqq 102 \; \boldsymbol{mm}$
Centroid of brace outstanding leg Brace angle with horizontal $\theta_{br} \coloneqq 65         $		
Brace angle with horizontal $ \theta_{br} := 65 \ deg $ Beam section at connection 1		
Beam section at connection 1  Section depth  Flange width  Flange thickness  Web thickness  Distance from outer face to fillet edge  Beam section at connection 2  Section depth  Flange width  Flange width  Flange width  Flange width  Flange thickness  Web thickness  Web thickness  Web thickness  Thickness  Outstanding leg length  Welded leg length  Shear tab thickness  Shear tab width  Section depth  Section at connection 2  W310X38.7 $d_{xb2} = 310 \text{ mm}$		
Section depth Flange width Flange thickness Web thickness Distance from outer face to fillet edge $k_{bdet1}$ := 34.9 mm  Beam section at connection 2 W310X38.7 Section depth Flange width Flange width Flange thickness Web thickness Distance from outer face to fillet edge $k_{bdet1}$ := 34.9 mm  Beam section at connection 2 Section depth Flange width Flange width Flange width Flange thickness Web thickness Distance from outer face to fillet edge $k_{bdet2}$ := 27 mm  Clip angle section Thickness Outstanding leg length Welded leg length $k_{oa}$ := 88.9 mm  Shear tab thickness Shear tab width $k_{s}$ := 12 mm  Shear tab thickness Shear tab width		0) 1119
Section depth Flange width Flange thickness Web thickness Distance from outer face to fillet edge $k_{bb}:=203\mathrm{mm}$ $k_{bb}:=203\mathrm{mm}$ $k_{bb}:=13.5\mathrm{mm}$ $k_{bb}:=7.75\mathrm{mm}$ Distance from outer face to fillet edge $k_{bb}:=7.75\mathrm{mm}$ $k_{bdet1}:=34.9\mathrm{mm}$ Beam section at connection 2 Section depth Flange width Flange width Flange thickness Web thickness Distance from outer face to fillet edge $k_{bb}:=310\mathrm{mm}$	Beam section at connection 1	W360X64
Flange width Flange thickness Web thickness Distance from outer face to fillet edge  Beam section at connection 2 Section depth Flange width Flange width Flange thickness Web thickness Distance from outer face to fillet edge  Beam section at connection 2 Section depth Flange width Flange width Flange thickness Web thickness Distance from outer face to fillet edge  Clip angle section Thickness Outstanding leg length Welded leg length  Shear tab thickness Shear tab width  Flange width $t_{fb2} := 3.00 \text{ mm}$ $t_{fb2} := 9.65 \text{ mm}$ $t_{bbet2} := 2.84 \text{ mm}$ $t_{bbet2} := 2.7 \text{ mm}$ Clip angle section  Thickness Outstanding leg length $t_{a} := 88.9 \text{ mm}$ $t_{a} := 88.9 \text{ mm}$ Shear tab thickness Shear tab width		
Flange thickness Web thickness Distance from outer face to fillet edge $t_{bbl} := 7.75  mm$ $k_{bdet1} := 34.9  mm$ Beam section at connection 2 Section depth Flange width Flange thickness Web thickness Distance from outer face to fillet edge $t_{bbl} := 165  mm$ $t_{bbl} := 165  mm$ $t_{bbl} := 9.65  mm$ $t_{bbl} := 5.84  mm$ Distance from outer face to fillet edge $k_{bdet2} := 27  mm$ Clip angle section Thickness Outstanding leg length Welded leg length $t_{ai} := 88.9  mm$ $t_{bal} := 88.9  mm$ Shear tab thickness Shear tab width  Commention 2  Commention 2		
Web thickness Distance from outer face to fillet edge		
Distance from outer face to fillet edge $k_{bdet1} := 34.9 \ mm$ Beam section at connection 2 $$W310x38.7$$ Section depth $$f_{lange} = 165 \ mm$$ Flange width $$f_{lange} = 165 \ mm$$ Flange thickness $$t_{pb2} := 165 \ mm$$ Web thickness $$t_{bdet2} := 27 \ mm$$ Clip angle section $$t_{lange} = 165 \ mm$$ Thickness $$t_{a1} := 9.53 \ mm$$ Outstanding leg length $$t_{lange} := 88.9 \ mm$$ Shear tab thickness $$t_{s1} := 12 \ mm$$ Shear tab width $$t_{s2} := 100 \ mm$$		
Beam section at connection 2		
Section depth Flange width Flange thickness Web thickness Distance from outer face to fillet edge  Clip angle section Thickness Outstanding leg length Welded leg length Welded leg length Shear tab thickness Shear tab width $d_{xb2} := 310 \text{ mm}$ $b_{fb2} := 165 \text{ mm}$ $t_{tb2} := 9.65 \text{ mm}$ $t_{wb2} := 5.84 \text{ mm}$ $k_{bdet2} := 27 \text{ mm}$ $l_{89X89X9.5}$ $t_{a} := 9.53 \text{ mm}$ $l_{oa} := 88.9 \text{ mm}$ $l_{ia} := 88.9 \text{ mm}$ $l_{ia} := 88.9 \text{ mm}$ $w_{s} := 100 \text{ mm}$	bistance from outer face to fiffer eage	hbdet1 - 94.3 IIIII
Section depth Flange width Flange thickness Web thickness Distance from outer face to fillet edge  Clip angle section Thickness Outstanding leg length Welded leg length Welded leg length Shear tab thickness Shear tab width $d_{xb2} := 310 \text{ mm}$ $b_{fb2} := 165 \text{ mm}$ $t_{tb2} := 9.65 \text{ mm}$ $t_{wb2} := 5.84 \text{ mm}$ $k_{bdet2} := 27 \text{ mm}$ $l_{a} := 9.53 \text{ mm}$ $l_{oa} := 88.9 \text{ mm}$ $l_{ia} := 88.9 \text{ mm}$ $l_{ia} := 88.9 \text{ mm}$ $v_{s} := 100 \text{ mm}$	Boam soction at connection 2	W310V30 7
Flange width Flange thickness Web thickness Distance from outer face to fillet edge $t_{vb2} := 5.84 \ mm$ $k_{bdet2} := 27 \ mm$ Clip angle section Thickness Outstanding leg length Welded leg length Welded leg length $t_{ia} := 88.9 \ mm$ Shear tab thickness Shear tab width $c_{gbeam2}$ $c_{gbeam2}$ $c_{gbeam2}$ $c_{gbeam2}$		
Flange thickness Web thickness Distance from outer face to fillet edge $t_{wb2} := 5.84 \ mm$ Distance from outer face to fillet edge $k_{bdet2} := 27 \ mm$ Clip angle section Thickness Outstanding leg length $l_{oa} := 88.9 \ mm$ Welded leg length $l_{ia} := 88.9 \ mm$ Shear tab thickness Shear tab width $k_{s} := 12 \ mm$ Shear tab width $k_{s} := 100 \ mm$		
Web thickness Distance from outer face to fillet edge $t_{wb2} := 5.84 \ mm$ $t_{bdet2} := 27 \ mm$ Clip angle section $t_{s} := 9.53 \ mm$ $t_{ca} := 9.53 \ mm$ Outstanding leg length $t_{ca} := 88.9 \ mm$ Welded leg length $t_{ca} := 88.9 \ mm$ Shear tab thickness $t_{s} := 12 \ mm$ Shear tab width $t_{ca} := 88.9 \ mm$		
Distance from outer face to fillet edge $k_{bdet2}\coloneqq 27~mm$ Clip angle section		
Clip angle section		
Thickness $t_a \coloneqq 9.53 \ mm$ Outstanding leg length $l_{oa} \coloneqq 88.9 \ mm$ Welded leg length $l_{ia} \coloneqq 88.9 \ mm$ Shear tab thickness $t_s \coloneqq 12 \ mm$ Shear tab width $w_s \coloneqq 100 \ mm$	Distance from outer face to fiffer edge	$\kappa_{bdet2}\coloneqq 21$ $mm$
Thickness Outstanding leg length $l_{oa} := 88.9 \ mm$ Welded leg length $l_{ia} := 88.9 \ mm$ Shear tab thickness $t_s := 12 \ mm$ Shear tab width $w_s := 100 \ mm$	Clip angle section	L89X89X9.5
Outstanding leg length $l_{oa} \coloneqq 88.9 \ mm$ Welded leg length $l_{ia} \coloneqq 88.9 \ mm$ Shear tab thickness $t_s \coloneqq 12 \ mm$ Shear tab width $w_s \coloneqq 100 \ mm$		$t_{o} = 9.53 \ mm$
Welded leg length $l_{ia}$ := 88.9 $mm$ Shear tab thickness $t_s$ := 12 $mm$ $w_s$ := 100 $mm$		
Shear tab thickness Shear tab width $t_s \coloneqq 12 \; mm \\ w_s \coloneqq 100 \; mm$		
Shear tab width $w_s \coloneqq 100 \; mm$	7	eu
G Beam 2  sb2  p  Connection 2	Shear tab thickness	$t_s = 12 \; mm$
G Beam 2  sb2  p  Connection 2	Shear tab width	$w_s = 100 \; mm$
sb <sub>2</sub> P  Connection 2		
Sb2 P Connection 2		
92 P <sub>2</sub>	& Beam ∠ sb2	
92 P2		P
92 82		×′
	Connection 2	
Gusset Plate  Connection 1  sb <sub>1</sub> F <sub>1</sub> Ge Beam 1	<sup>12</sup>   <sup>1</sup>   1   1   1   1   1   1   1   1   1	
Connection 1 sb <sub>1</sub>		
loc <sub>2</sub> Connection 1 sb <sub>1</sub> sb <sub>1</sub>		Gusset Plate
sb <sub>1</sub>		0
P <sub>1</sub>		sb <sub>1</sub>
	-\	
Worl 91		
Work point I loc <sub>1</sub>	WOLK &	

Gusset plate thickness

Gusset dimension along connection 1

 $t_g \coloneqq 12 \ \mathbf{mm}$   $g_1 \coloneqq 500 \ \mathbf{mm}$ 

Gusset dimension along connection 2	$g_2 = 500 \; mm$
Gusset cutout at connection 1	$c_1 \coloneqq 125 \; \boldsymbol{mm}$
Gusset cutout at connection 2	$c_2 \coloneqq 125 \; mm$
10 k	
Bolt diameter	$d_b \coloneqq 24 \; m{mm}$
Bolt hole diameter	$d_{bh} = 27$ $mm$
Slip coefficient (class A surface)	$\mu = 0.3$
Bolt pretension	$T_{pre} \coloneqq 205 \ \mathbf{kN}$
Number of bolts per row on brace	$n_{br}\!:=\!4$
Number of bolts at clip at beam 1	
	$n_1 = 4$
Number of bolts at clip at beam 2	$n_2$ :=4
Bolt spacing	s:=70 mm
Bolt gage on brace	$g_{br} = 55$ $mm$
Bolt gage on shear tab	$g_s = 50 \; mm$
Bolt gage on clip	$g \coloneqq 45   mm$
Location of connection 1 from work point	$loc_1 \coloneqq 150 \ mm$
Location of connection 2 from work point	$loc_2 = 150 \ mm$
Bolt edge distance on brace	$ed_1 \coloneqq 35 \; mm$
Bolt edge distance on gusset	$ed_2 = 35  mm$
Bolt edge distance on clip	$ed_3 = 35  mm$
Bott dage attended on cttp	cu390 mille
Clip to gusset weld thickness	w = 6  mm
Connection setback at connection 1	$sb_1 \coloneqq 12 \ \boldsymbol{mm}$
Connection setback at connection 2	$sb_2 \coloneqq 12   \boldsymbol{mm}$
	, , , , , , , , , , , , , , , , , , ,
sign Calculations	2
	3
sign Calculations Connection forces Shear per bolt at brace connection	
Connection forces Shear per bolt at brace connection	
Connection forces Shear per bolt at brace connection	
Connection forces	$P_b\!=\!26.25~ extbf{kN}$
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$	
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection 1	$P_b$ = 26.25 $kN$
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$	
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$	$P_b$ = 26.25 $kN$
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection 1	$P_b$ = 26.25 $kN$
Connection forces Shear per bolt at brace connection $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection 1 $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$ Force per bolt along connection 1	$P_b$ = 26.25 $kN$ $P_1$ = 44.375 $kN$
Connection forces Shear per bolt at brace connection $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection 1 $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$ Force per bolt along connection 1	$P_b$ = 26.25 $kN$ $P_1$ = 44.375 $kN$
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$	$P_b$ = 26.25 $kN$
Connection forces Shear per bolt at brace connection $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection 1 $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$ Force per bolt along connection 1	$P_b = 26.25 \; kN$ $P_1 = 44.375 \; kN$ $P_{b1} = 5.547 \; kN$
Connection forces Shear per bolt at brace connection $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection 1 $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{2 \cdot n_1}$	$P_b = 26.25 \; kN$ $P_1 = 44.375 \; kN$ $P_{b1} = 5.547 \; kN$
Connection forces Shear per bolt at brace connection $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection 1 $P_1 \coloneqq P \cdot \cos \left(\theta_{br}\right)$ Force per bolt along connection 1 $P_{b1} \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection 2	$P_b$ = 26.25 $kN$ $P_1$ = 44.375 $kN$
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$ Force per bolt along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$	$P_b = 26.25 \; kN$ $P_1 = 44.375 \; kN$ $P_{b1} = 5.547 \; kN$
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$ Force per bolt along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Force per bolt along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$	$P_b = 26.25 \; kN$ $P_1 = 44.375 \; kN$ $P_{b1} = 5.547 \; kN$ $P_2 = 95.162 \; kN$
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$ Force per bolt along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Force per bolt along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$	$P_b = 26.25 \; kN$ $P_1 = 44.375 \; kN$ $P_{b1} = 5.547 \; kN$ $P_2 = 95.162 \; kN$
Connection forces $P_b \coloneqq \frac{P}{n_{br}}$ Component of brace force along connection $P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$ Force per bolt along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$ Component of brace force along connection $P_b \coloneqq \frac{P_1}{2 \cdot n_1}$	$P_b = 26.25 \; kN$ $P_1 = 44.375 \; kN$ $P_{b1} = 5.547 \; kN$

	$R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre} \cdot 2$	$R_n = 138.99 \text{ kN}$
- 50		
Interaction ratio i	n bolt shear	
4	$_{I}$ 1.5 $P_{b}$	1 -0 283
	$I_0 \coloneqq \frac{1.5 P_b}{R_n}$	$I_0 = 0.283$
Bolt bearing on bra	ce check	
X ).	nce for bearing check	
	$l_{c1}\!\coloneqq\!min\left(s\!-\!d_{bh},ed_{1}\!-\!0.5\!ullet d_{bh} ight)$	$l_{c1} = 21.5 \; mm$
1	62 ( 60 2 60)	0.1
Nominal strength in		
Y	$R_n \coloneqq min\left(1.2 \cdot l_{c1} \cdot t_{br} \cdot F_{ua}, 2.4 \cdot d_b \cdot t_{br} \cdot F_{ua}\right)$	$R_n = 131.064 \ kN$
Interaction ratio i	n bolt bearing at brace	
	$2.0 \cdot 0.5 P_b$	7 _0 2
	$I_{1} = \frac{2.0 \cdot 0.5 \ P_b}{R_n}$	$I_1 = 0.2$
Bolt bearing on gus		
	nce for bearing on gusset	
	$l_{c2}\!\coloneqq\!min\left(s\!-\!d_{bh},ed_2\!-\!0.5\!ullet\!d_{bh} ight)$	$l_{c1} = 21.5 \ mm$
	(2) (10)	CI
Nominal strength in	bearing	
	$R_n \coloneqq min\left(1.2 \cdot l_{c2} \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 123.84 \text{ kN}$
	4	
Interaction ratio i	n bolt bearing at gusset	
	$_{\tau}$ 2.0 $P_b$	7 0 494
	$I_2 = \frac{2.0 P_b}{R_n}$	$I_2 = 0.424$
Brace tension ruptu	re check	
Net cross section a	rea of brace	
	$A_{nbr} \coloneqq A_{br} - 2 \cdot d_{bh} \cdot t_{br}$	$A_{nbr} = 3834.2 \ mm^2$
	1201 01	1601
Length of connection	n	
	re check rea of brace $A_{nbr}\!\coloneqq\!A_{br}\!-2\!\cdot\!d_{bh}\!\cdot\!t_{br}$ on $l_{br}\!\coloneqq\!s\!\cdot\!(n_{br}\!-1)$	$l_{br}\!=\!210$ $mm$
Shear lag factor	$x'_{br}$	
	$U \coloneqq 1 - \frac{x'_{br}}{l_{br}}$	U = 0.88
Brace strength in t	107	0
prace strength in t	ension rupture $P_n\!\coloneqq\!F_{ua}\!\cdot\!U\!\cdot\!A_{nbr}$	$P_n = 1349.638 \ kN$
	n · · · · ua · · · · · · · · · · · · · ·	$I_{3} = 0.156$
Interaction ratio f	or brace tension rupture	6
		72
	$I_3 = \frac{2.0 P}{P_n}$	$I_{_{3}}=0.156$
	$ P_n $	3

	$A_{gv} \coloneqq 2 ullet \left( \left( n_{br} - 1  ight) ullet s + ed_1  ight) ullet t_{br}$	$A_{gv}\!=\!6223\;\boldsymbol{mm}^2$
O k		
Net area in shear		
	$A_{nv} \coloneqq A_{gv} - 2 \cdot \left( n_{br} - 0.5 \right) \cdot d_{bh} \cdot t_{br}$	$A_{nv} = 3822.7 \ mm^2$
Net area in tension	4 0 /1 0 7 1 ) .	4 070 0 2
ŹÔ,	$A_{nt} \coloneqq 2 \boldsymbol{\cdot} \left(l_{ibr} - g_{br} - 0.5 \boldsymbol{\cdot} d_{bh}\right) \boldsymbol{\cdot} t_{br}$	$A_{nt} = 850.9 \ mm^2$
Nominal strength bloc	ik choor	
	$R_{n1} = 0.0$ $R_{nv} + R_{ua}$ $R_{nt}$	
9x,	$B_{-0} := 0.6 \cdot F_{} \cdot A_{} + F_{} \cdot A_{}$	
17	$10n2 = 0.0 \cdot 1 \cdot ya \cdot 11gv \cdot 1 \cdot ua \cdot 11nt$	
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$ block shear	$R_n = 1257.808 \ kN$
Interaction ratio in	block shear	10
	$I_4 = \frac{2.0 P}{B}$	$I_{4} = 0.167$
	$^4$ $R_n$	4
Gusset tension yieldi	ng check	
	<u> </u>	
	$\longrightarrow$	
	30	
	1 1 1	
T 13 C 7.73		
Length of Whitmore se		1 949 497
Length of Whitmore se		$l_w \!=\! 242.487 \; m{mm}$
		$l_w\!=\!242.487\;m{mm}$
		$l_w$ = 242.487 $mm$
		$l_w \! = \! 242.487 \; m{mm}$ $P_n \! = \! 727.461 \; m{kN}$
Nominal strength of g		$l_w = 242.487 \; mm$ $P_n = 727.461 \; kN$
Nominal strength of g		$l_w$ =242.487 $mm$ $P_n$ =727.461 $kN$
Nominal strength of g		$l_w$ =242.487 mm $P_n$ =727.461 kN
Nominal strength of g		$l_w = 242.487 \ \textit{mm}$ $P_n = 727.461 \ \textit{kN}$ $I_5 = 0.241$
Nominal strength of g		$l_w$ =242.487 $mm$ $P_n$ =727.461 $kN$
Nominal strength of g Interaction ratio in Gusset tension ruptur		$P_n = 727.461 \text{ kN}$ $I_5 = 0.241$
Nominal strength of g Interaction ratio in Gusset tension ruptur	$l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg)$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_5 \coloneqq \frac{1.67 \ P}{P_n}$ se check tension	$P_n = 727.461 \text{ kN}$ $I_5 = 0.241$
Nominal strength of g Interaction ratio in Gusset tension ruptur		$P_n = 727.461 \text{ kN}$ $I_5 = 0.241$
Nominal strength of g  Interaction ratio in  Gusset tension ruptur  Net area of gusset in	$l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg)$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_{\overline{5}} \coloneqq \frac{1.67 \ P}{P_n}$ The check in tension $A_{ng} \coloneqq (l_w - d_{bh}) \cdot t_g$	$P_n = 727.461 \text{ kN}$ $I_5 = 0.241$
Nominal strength of g  Interaction ratio in  Gusset tension ruptur  Net area of gusset in	$l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg)$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_{5} \coloneqq \frac{1.67 \ P}{P_n}$ se check tension $A_{ng} \coloneqq (l_w - d_{bh}) \cdot t_g$	$P_n$ =727.461 <b>kN</b> $I_5$ =0.241 $A_{ng}$ =2585.845 <b>mm</b>
Nominal strength of g  Interaction ratio in  Gusset tension ruptur  Net area of gusset in	$l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg)$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_{\overline{5}} \coloneqq \frac{1.67 \ P}{P_n}$ The check in tension $A_{ng} \coloneqq (l_w - d_{bh}) \cdot t_g$	$P_n = 727.461 \text{ kN}$ $I_5 = 0.241$
Nominal strength of g Interaction ratio in  Gusset tension ruptur Net area of gusset in  Nominal strength of g	$l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg)$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_{5} \coloneqq \frac{1.67 \ P}{P_n}$ The check of tension $A_{ng} \coloneqq (l_w - d_{bh}) \cdot t_g$ gusset in rupture $P_n \coloneqq F_{up} \cdot A_{ng}$	$P_n$ =727.461 <b>kN</b> $I_5$ =0.241 $A_{ng}$ =2585.845 <b>mm</b>
Length of Whitmore se  Nominal strength of g  Interaction ratio in  Gusset tension ruptur  Net area of gusset in  Nominal strength of g  Interaction ratio in	$l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg)$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_{5} \coloneqq \frac{1.67 \ P}{P_n}$ The check of tension $A_{ng} \coloneqq (l_w - d_{bh}) \cdot t_g$ gusset in rupture $P_n \coloneqq F_{up} \cdot A_{ng}$	$P_n$ =727.461 <b>kN</b> $I_5$ =0.241 $A_{ng}$ =2585.845 <b>mm</b>

Nominal slip resistand	re of holt	
NOMINAL SITP TESISCAN	$R_n \coloneqq \mu \cdot 1.13 \cdot T_{nre}$	$R_n = 69.495 \ kN$
0.	$n = \mu$ 1.15 1 pre	10n - 03.433 R2V
Interaction ratio in A	nolt shear	
4.	$I_7 = \frac{1.5 \ P_{b1}}{R_n}$	$I_{7} = 0.12$
1	$^{-7}$ $R_n$	7
Bolt bearing at clip a	angle at connection 1	
	n bolt holes/ hole and edge	
	$l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_3\!-\!0.5\!\boldsymbol{\cdot}\!d_{bh}\right)$	$l_c\!=\!21.5$ $mm$
7		
Nominal strength in be		
Y	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_a \cdot F_{ua}, 2.4 \cdot d_b \cdot t_a \cdot F_{ua}\right)$	$R_n = 98.35 \ kN$
Interaction ratio in b	polt bearing	
	$2.0P_{b1}$	
	$I_{8} = \frac{2.0 \ P_{b1}}{R_{n}}$	$I_{8} = 0.113$
Bolt bearing at beam w		
Nominal strength in be	earing District Control of the Contr	T \
	$R_n \coloneqq min\left(1.2 \cdot (s - d_{bh}) \cdot t_{wb1} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{ub}\right)$	$wb1 \cdot Fub$
	O	$R_n = 179.955 \ kN$
Interaction ratio in A		
inceraction ratio in i	Joil Bearing	
	$I_g \coloneqq rac{2.0 \ P_{b1}}{R_n}$	$I_{9} = 0.062$
	$R_n$	9 0.002
Gusset shear yielding		
	n of gusset in yielding	
	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot (g_1 - c_1) \cdot t_g$	$R_n = 675   kN$
	, gp (01 1) g	
Interaction ratio in o	gusset yieldling	
	15 P.	
	$I_{10} = \frac{1.5 P_1}{R}$	$I_{10} = 0.099$
	$R_n$	)
Gusset plate block she	ear at connection 1	
Length of clip angle		YA
	$L_1 \coloneqq (n_1 - 1) \cdot s + 2 \ ed_3$	$L_1 = 280 \ mm$
_		0,
Distance of gusset out	cer edge from work point	1. 0 514 00
	$loc_{go} := g_1 + sb_2 + 0.5 \cdot t_{wb2}$	$loc_{go} = 514.92$ mm
Distance of mass time	or odgo from work noint	
Distance of gusset in	ner edge from work point	42
log	$= c_1 + sb_2 + 0.5 \cdot t_{wb2} - \mathbf{if} \left( c_2 = 0 , 0 , \left( l_{ia} - sb_1 \right) \cdot \frac{c_1}{c_2} \right)$	$loc_{gi}\!=\!63.02$ $mm$
$\iota o c_{gi}$ .	$c_1$	
		100
Outer edge distance fo	or clip on gusset	

Inner edge distance for clip on gusset	
$ed_{gi}\!\coloneqq\!loc_1\!-\!loc_{gi}$	$ed_{gi}$ =86.98 $m{mm}$
Minimum edge distance for clip on gusset	ad = 94 00 mm
$ed_g \coloneqq min\left(ed_{go}, ed_{gi} ight)$	$ed_g = 84.92 \ \textit{mm}$
Gross area subjected to block shear	
$A_{gv}\!\coloneqq\!ig(L_1\!+\!ed_gig)ullet t_g$	$A_{gv} = 4379.04 \ mm^2$
Net area subjected to tension $A_{nt} \coloneqq (l_{ia} - sb_1) \cdot t_g$	$A_{nt} = 922.8  mm^2$
$T_{nt} := \langle v_{ia} \mid so_1 \rangle \cdot v_g$	71 <sub>nt</sub> = 322.0 <b>11111</b>
Nominal strength in block shear	
$R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	$R_n = 1025.976 \ kN$
Interaction ratio in block shear	
$I_{11}\coloneqq rac{2.0\ P_1}{R_n}$	$I_{11} = 0.087$
$R_n$	11
Gusset flexure yielding at connection 1	
Eccentricity of force at connection 1	aa - 140 975 mm
$ec_1 \coloneqq c_2 + sb_1 + 0.5 \ t_{wb1}$	$ec_1 = 140.875 \ mm$
Nominal moment strength of gusset	
$F_{\cdots} \cdot t_{\cdot} \cdot q_1^{2}$	
$M_n \coloneqq \frac{-yp + y - y_1}{4}$	$M_n = 187.5 \ \mathbf{kN \cdot m}$
$M_n \coloneqq rac{F_{yp} \cdot t_g \cdot {g_1}^2}{4}$ Interaction ratio in gusset flexure $I_{12} \coloneqq rac{1.67 \cdot P_1 \cdot ec_1}{M_n}$	
1.67 P	
$I_{12} = \frac{1.07 \cdot P_1 \cdot ec_1}{1.07 \cdot P_1}$	$I_{12} = 0.056$
$M_n$	12
Clip angle shear yielding at connection 1	
Gross area in shear $A_{qv}\!\coloneqq\!2\!\cdot\!L_1\!\cdot\!t_a$	$A_{gv} = 5336.8 \; mm^2$
Clip angle shear yielding at connection 1 Gross area in shear $A_{gv} \coloneqq 2 \cdot L_1 \cdot t_a$ Nominal strength in shear yielding $R_v \coloneqq 0.6 \cdot F_v \cdot A_v$	71gv = 0000.0 11111
Nominal strength in shear yielding	
$R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv}$	$R_n = 800.52 \ kN$
Interaction ratio in shear yielding	
	2
$I_{_{13}}\!\coloneqq\!rac{1.5\ P_1}{R_n}$	$I_{13} = 0.083$
Clip angle shear rupture at connection 1 Net area in shear	
Net area in Shear $A_{nv}\!\coloneqq\!A_{av}\!-2\!\cdot\!n_1\!\cdot\!d_{bh}\!\cdot\!t_a$	$A_{nv} = 3278.32 \; mm^2$
The go I one a	
Nominal strength in shear rupture	
$R_n\!\coloneqq\!0.6{lack}F_{ua}{lack}A_{nv}$	$R_n = 786.797 \text{ kN}$

2	$_{ au}$ 2.0 $P_{1}$	I 0.119
	$I_{14} = \frac{2.0 \ P_1}{R_n}$	$I_{_{14}} = 0.113$
Clip angle block she	ar at connection 1	
Gross area subjected		
4.	$A_{qv}\!\coloneqq\!2\boldsymbol{\cdot} \big(L_1\!-\!ed_3\big)\boldsymbol{\cdot} t_a$	$A_{gv} = 4669.7 \; mm^2$
	<i>g</i> ( 1	ge
Net area subjected t		
	$A_{nv} \coloneqq A_{gv} - 2 \cdot \left(n_1 - 0.5\right) \cdot d_{bh} \cdot t_a$	$A_{nv} = 2868.53 \ mm^2$
Net area subjected t		$A_{nt} = 693.784 \ mm^2$
(Q)	$A_{nt}\!\coloneqq\!\left(2\boldsymbol{\cdot} l_{oa}\!+\!t_g\!-\!2\boldsymbol{\cdot} g\!-\!d_{bh}\right)\boldsymbol{\cdot} t_a$	$A_{nt} = 093.784 \ mm$
Nominal strength in	block shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
	$R_{n2}\coloneqq 0.6 ullet F_{ya} ullet A_{gv} + F_{ua} ullet A_{nt}$	
		D 007 001 137
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 965.961 \text{ kN}$
Interaction ratio in	block shear	
	207	
	$I := \frac{2.0 P_1}{R_1}$	$I_{15} = 0.092$
	$^{15}$ $R_n$	15
Weld check at connec	$I_{_{15}}\coloneqq rac{2.0\ P_1}{R_n}$ etion 1	
	sb₁ → b <sub>w</sub>	
	P <sub>1</sub> <b>A</b>   e <sub>11</sub>	
	↑ • L₁	
	L <sub>1</sub> /2	
	<u> </u>	
		O <sub>2</sub>
Length of horizontal	run of weld	
<u> </u>	$b_w \coloneqq l_{ia} - sb_1$	$b_w = 76.9 \; mm$
Centroid of weld gro	$b_w^2$	
	$c_w \coloneqq \frac{{b_w}^2}{2 \cdot b_w + L_1}$	$c_w = 13.632 \; mm$
		194
Eccentricity of shea		0 -75 260 mm
	$e_w \coloneqq l_{ia} - c_w$	$e_w = 75.268$ mm

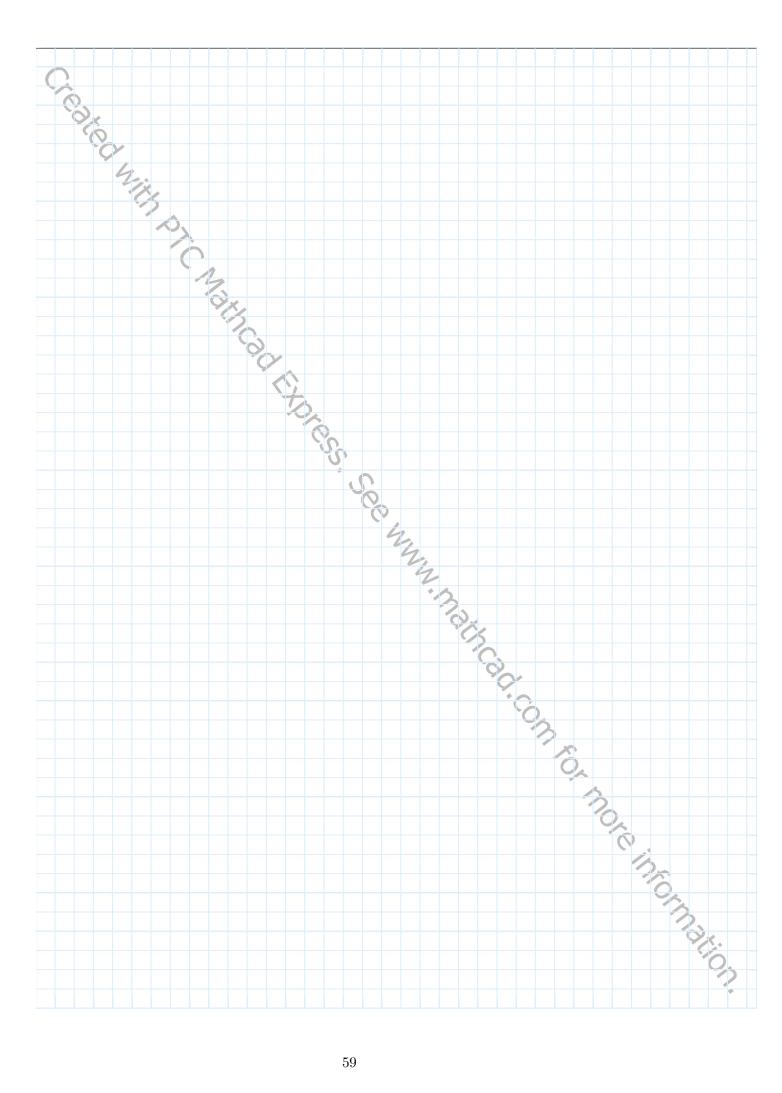
Polar moment of ine	ertia of weld group	
Ó	$I_w \! \coloneqq \! rac{\left(2 m{\cdot} b_w \! + \! L_1 ight)^3}{12} \! - \! rac{{b_w}^2 m{\cdot} \left(b_w \! + \! L_1 ight)^2}{2 m{\cdot} b_w \! + \! L_1}$	$I_w \! = \! 5066.369 \; {m cm}^3$
Care Care and a said a	w 1	
Component of weld s		
4	$f_{wx} \coloneqq rac{P_1 ullet e_w ullet L_1}{4 ullet I_w}$	$f_{wx} = 0.046 \frac{kN}{m}$
		mm
Component of weld s		
Ó	$f_{wy} \coloneqq \frac{P_1}{2 \boldsymbol{\cdot} \left( 2 \boldsymbol{\cdot} b_w + L_1 \right)} + \frac{P_1 \boldsymbol{\cdot} e_w \boldsymbol{\cdot} \left( b_w - c_w \right)}{2 \; I_w}$	$f_{wy} = 0.072 \frac{kN}{mm}$
1	$2 \cdot (2 \cdot b_w + L_1)$ 2 $I_w$	mm m
Resultant weld stre	ess a la 2 a 2	, kN
	$f_w \coloneqq \sqrt{f_{wx}^2 + f_{wy}^2}$	$f_w = 0.086 \frac{kN}{mm}$
Nominal weld streng	th $R_n\!\coloneqq\!0.6\!\cdot\!F_{EXX}\!\cdot\!rac{\sqrt{2}}{2}\!\cdot\!w$	
	$R_n = 0.6 \cdot F_{EXX} \cdot \frac{\sqrt{2}}{2} \cdot w$	$R_n = 1.227 \frac{kN}{}$
		$m{mm}$
Interaction ratio f		
	$I_{16} \coloneqq \frac{2.0 \ f_w}{R}$	$I_{16} = 0.139$
	$R_n$	16
MIIIIIIIIIII WED CIIICKIIE	ess to match weld strength	
Interaction ratio i	$t_{g.min} \coloneqq rac{2.0 \cdot 2 \cdot f_w}{0.6 \cdot F_{up}}$ n web rupture	$t_{g.min}\!=\!1.425$ $m{mm}$
Interaction ratio i	$t_{g.min} \coloneqq rac{2.0 \cdot 2 \cdot f_w}{0.6 \cdot F_{up}}$ n web rupture	
Interaction ratio i	$t_{g.min} \coloneqq rac{2.0 \cdot 2 \cdot f_w}{0.6 \cdot F_{up}}$ n web rupture $I_{17} \coloneqq rac{t_{g.min}}{t}$	$t_{g.min}\!=\!1.425~{m mm}$ $I_{_{17}}\!=\!0.119$
	$I_{17} \coloneqq rac{t_{g.min}}{t_{.}}$	$I_{_{17}} = 0.119$
Bolt shear at conne	$t_{g.min} \coloneqq rac{2.0 \cdot 2 \cdot f_w}{0.6 \cdot F_{up}}$ n web rupture $I_{17} \coloneqq rac{t_{g.min}}{t_g}$ ection 2	$I_{17} = 0.119$
	$t_{g.min} \coloneqq rac{2.0 \cdot 2 \cdot f_w}{0.6 \cdot F_{up}}$ on web rupture $I_{17} \coloneqq rac{t_{g.min}}{t_g}$ ection 2 ertia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} (i \cdot s)^2$	$I_{17} = 0.119$
Bolt shear at conne	$t_{g.min} \coloneqq rac{2.0 \cdot 2 \cdot f_w}{0.6 \cdot F_{up}}$ noweb rupture $I_{17} \coloneqq rac{t_{g.min}}{t_g}$ ection 2 Partia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} (i \cdot s)^2$ $I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5} ((i-0.5) \cdot s)^2$	$I_{17} = 0.119$
Bolt shear at conne	ection 2 ertia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} (i \cdot s)^2$	$I_{17} = 0.119$
Bolt shear at conne	ection 2  Pertia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} (i \cdot s)^2$ $I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5} ((i - 0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} \pmod{(n_2, 2)} = 1, I_{po}, I_{pe}$	$I_{_{17}} = 0.119$
Bolt shear at conner polar moment of ine	ection 2  Pertia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} (i \cdot s)^2$ $I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5} ((i - 0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} \pmod{(n_2, 2)} = 1, I_{po}, I_{pe}$	$I_{17} = 0.119$
Bolt shear at conner polar moment of ine polar	extion 2  Pertia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} (i \cdot s)^2$ $I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5  n_2} ((i - 0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} (\operatorname{mod} (n_2, 2) = 1, I_{po}, I_{pe})$ Emote bolt from CG $c \coloneqq 0.5 \ (n_2 - 1) \cdot s$	$I_{p} = 0.119$ $I_{p} = 245 \text{ cm}^{2}$
Bolt shear at conner polar moment of ine	ection 2  ertia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} (i \cdot s)^2$ $I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5} ((i - 0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} (\operatorname{mod} (n_2, 2) = 1, I_{po}, I_{pe})$ emote bolt from CG $c \coloneqq 0.5 \ (n_2 - 1) \cdot s$	$I_{p}$ = 245 $cm^{2}$
Bolt shear at conner polar moment of ine polar	ection 2  Pertia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} (i \cdot s)^2$ $I_{pe} \coloneqq 2 \cdot \sum_{i=1}^{0.5} ((i - 0.5) \cdot s)^2$ $I_p \coloneqq \mathbf{if} (\operatorname{mod} (n_2, 2) = 1, I_{po}, I_{pe})$ Emote bolt from CG $c \coloneqq 0.5 \ (n_2 - 1) \cdot s$	$I_p = 245 \ cm^2$ $c = 105 \ mm$

Interaction ratio in	bolt shear	
Ô,	$I_{18} \coloneqq \frac{1.5 \ P_{b2}}{R_n}$	$I_{_{18}}\!=\!0.514$
Bolt bearing at shear	r tab at connection 2	
TCV -	en bolt holes/ hole and edge	
4-12	$l_c \coloneqq min\left(s - d_{bh}, ed_3 - 0.5 \cdot d_{bh}\right)$	$l_c\!=\!21.5$ $mm$
Nominal strength in	bearing	
	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_s \cdot F_{up}, 2.4 \cdot d_b \cdot t_s \cdot F_{up}\right)$	$R_n = 123.84 \ kN$
Interaction ratio in	bolt bearing	
Y.	$I_{19} = \frac{2.0 P_{b2}}{R_n}$	$I_{_{19}} = 0.384$
Bolt bearing at guss	et at connection 2	
Length of shear tab		
	$L_2 \coloneqq \left(n_2 - 1\right) \cdot s + 2 \ ed_3$	$L_1 \!=\! 280$ $mm$
Distance of gusset of	uter edge from work point	
	$loc_{go} \coloneqq g_2 + sb_1 + 0.5 \cdot t_{wb1}$	$loc_{go} = 515.875$ mm
	nner edge from work point	
$loc_g$	$i = c_2 + sb_1 + 0.5 \cdot t_{wb1} - \mathbf{if} \left( c_1 = 0 , 0 , \left( g_s - sb_2 \right) \cdot \frac{c_2}{c_1} \right)$	$loc_{gi}$ = 102.875 $\emph{mm}$
Outer edge distance	for bolt on gusset $ed_{go}\!\coloneqq\!loc_{go}\!-\!loc_2\!-\!L_2\!+\!ed_3$	$ed_{go}$ = 120.875 $m{mm}$
	3	
Inner edge distance	for bolt on gusset	
	$ed_{gi} \coloneqq loc_2 - loc_{gi} + ed_3$	$ed_{gi} = 82.125 \; mm$
Minimum edge distance		
	$ed_g \coloneqq min\left(ed_{go}, ed_{gi} ight)$	$ed_g = 82.125 \ \textit{mm}$
Clear distance between	en bolt holes/ hole and edge	
	$l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_g\!-\!0.5\!\cdot\!d_{bh}\right)$	$l_c = 43$ mm
Nominal strength in 1		1.5
	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 247.68 \ kN$
Interaction ratio in		
	$I_{20} = \frac{2.0 \ P_{b2}}{R_n}$	$I_{20} = 0.192$
	$R_n$	20
Gusset shear yielding Gross area in shear	g at connection 2	94.
	$A_g\!\coloneqq\! \big(g_2\!-\!c_2\big)\!\cdot\! t_g$	$A_g = 4500 \; mm^2$

Nominal shear streng	th of gusset in yielding	D OFF LAT
Ô,	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g$	$R_n = 675 \text{ kN}$
Interaction ratio in	gusset yieldling	
Ch	$1.5~P_2$	7 0.911
4	$I_{21} = \frac{1.5 \ P_2}{R_n}$	$I_{21} = 0.211$
Gusset shear rupture	at connection 2	
Net area in shear		4 2224 2
	$A_n\!\coloneqq\! A_g\!-\!n_2\!ullet\! d_{bh}\!ullet\! t_g$	$A_n = 3204 \ mm^2$
Nominal shear streng	th of gusset in rupture	
	$R_n \coloneqq 0.6 \cdot F_{up} \cdot A_n$	$R_n = 768.96 \ kN$
Interaction ratio in	shear rupture	
	$I_{22} = \frac{2.0 \ P_2}{R_n}$	$I_{22} = 0.248$
	$R_n$	22
Gusset plate block s		
Gross area subjected		4 2505 5 2
	$A_{gv} \coloneqq \left(L_2 - 2 \ ed_3 + ed_g\right) \cdot t_g$	$A_{gv}\!=\!3505.5\;m{mm}^2$
Net area subjected t	o block shear	
	$A_{nv} \coloneqq A_{gv} - (n_2 - 0.5) \cdot d_{bh} \cdot t_g$	$A_{nv} = 2371.5 \ mm^2$
Net area subjected t	o tension	
	o tension $A_{nt} \!\coloneqq\! ig(g_s \!-\! sb_2 \!-\! 0.5 \; d_{bh}ig) \!\cdot\! t_g$	$A_{nt}$ = 294 $mm^2$
Nominal strength in	block shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	$R_n = 643.425 \text{ kN}$ $I_{23} = 0.296$
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 643.425 \ kN$
Interaction ratio in	block shear	3
	$\frac{1}{1}$ 2.0 $P_2$	Q <sub>1</sub> I con
	$I_{23} \coloneqq \frac{2.0 \ P_2}{R_n}$	$I_{23} = 0.296$
Gusset flexure yield	ing at connection 2	2
Eccentricity of forc		0100.00
	$ec_2 \coloneqq c_1 + sb_2 + 0.5 \cdot t_{wb2}$	$ec_2 = 139.92 \ mm$
Nominal moment stren	ght of gusset	70,
	$F_{up} \cdot t_q \cdot g_2^{-2}$	
	$M_n \coloneqq rac{F_{yp} \! \cdot \! t_g \! \cdot \! g_2^{\ 2}}{4}$	$M_n = 187.5 \ kN \cdot m$
		0.

	$P_1 = 1.67 (P_2 \cdot ec_2)$	7 0 110
O.	$I_{24} \coloneqq \frac{1.67 \ \left(P_2 \cdot ec_2\right)}{M_n}$	$I_{24} = 0.119$
Shear tab shear yi	elding at connection 2	
Gross area in shea:		
9-10-1	$A_{gv}\!\coloneqq\!L_2\!\cdot\!t_s$	$A_{gv} = 3360 \ mm^2$
Nominal strength in		
Ò	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_{gv}$	$R_n = 504 \text{ kN}$
Interaction ratio		
Ç	$I_{25} \coloneqq \frac{1.5 \ P_2}{R_n}$	$I_{25} = 0.283$
	$^{25}$ $R_n$	25
	oture at connection 2	
Net area in shear	$A_{nv}\!\coloneqq\!A_{gv}\!-\!n_2\!\cdot\!d_{bh}\!\cdot\!t_s$	4 - 20642
	$A_{nv} \coloneqq A_{gv} - n_2 \cdot a_{bh} \cdot t_s$	$A_{nv} = 2064 \; \boldsymbol{mm}^2$
Nominal strength i	n shear rupture	
		$R_n = 495.36 \text{ kN}$
Interaction ratio	in shear rupture	
	$r = 2.0 P_2$	1 0.004
	$I_{26} = R_n$	$I_{26} = 0.384$
Shear tab block sh	ear at connection 2 %	
Gross area subject	ed to block shear	
	$R_n\!\coloneqq\!0.6ullet F_{ua}\!\cdot\!A_{nv}$ in shear rupture $I_{26}\!\coloneqq\!rac{2.0P_2}{R_n}$ ear at connection 2 and to block shear $A_{gv}\!\coloneqq\!(L_2\!-\!ed_3)\!\cdot\!t_s$ to block shear	$A_{gv} = 2940  mm^2$
Net area subjected	to block shear	
	to block shear $A_{gv} \coloneqq (L_2 - ed_3) \cdot t_s$ to block shear $A_{nv} \coloneqq A_{gv} - (n_2 - 0.5) \cdot d_{bh} \cdot t_s$ to tension $A_{nt} \coloneqq (w_s - g_s - 0.5 \ d_{bh}) \cdot t_s$ in block shear	$A_{nv} = 1806 \ mm^2$
Net area subjected	to tension	
	$A_{nt} \coloneqq \left(w_s - g_s - 0.5 \ d_{bh}\right) \cdot t_s$	$A_{nt}$ =438 $mm^2$
Nominal strength i	n block shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	Q,
	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	20.
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 608.64 \text{ kN}$
Interaction ratio		71
	$2.0~P_2$	9
	$I_{27} \coloneqq \frac{2.0 \; P_2}{R_n}$	$I_{27} = 0.313$
		94.
		YO.

<b>1</b>             <del>-</del>	elding at connection 2	
Nominal moment stren	gnt of gusset	
	$F_{uv} \cdot t_s \cdot L_2^2$	
0,4	$M_n \coloneqq rac{F_{yp} \cdot t_s \cdot {L_2}^2}{4}$	$M_n = 58.8 \; kN \cdot m$
(0_	4	
Interaction ratio in	gusset flexure	
	$I_{28} \coloneqq \frac{1.67 \; P_2 \cdot g_s}{M_n}$	$I_{28} = 0.135$
	$M_n$	28 - 0.133
<b>Z</b> 0.		
Weld check at connec		
Polar moment of iner	tia of weld group	
Weld stress along we	7 3	
	$I_{m} \coloneqq \stackrel{D_2}{\longleftarrow}$	$I_w = 1829.333 \ cm^3$
Weld stress along we	1d " 12	w and the second
Werd Beress drong we	2	
	$P_2$	$c \sim 17 kN$
	$f_{wx} := \frac{1}{2 \cdot I_{xx}}$	$f_{wx} = 0.17 \; rac{kN}{mm}$
	2 22	110110
Max weld stress tran		
	$f_{wy} \coloneqq rac{P_2 \cdot g_s \cdot L_2}{4 \; I_w}$ s $f_w \coloneqq \sqrt{f_{wx}^2 + f_{wy}^2}$ h $R_n \coloneqq 0.6 \cdot F_{EXX} \cdot rac{\sqrt{2}}{2} \cdot w$ r weld check $I_{29} \coloneqq rac{2.0 \; f_w}{R_n}$	
	$f_{\cdot\cdot\cdot} \coloneqq \frac{P_2 \cdot g_s \cdot L_2}{I_1 \cdot I_2}$	$f_{wy}\!=\!0.182rac{m{kN}}{m{mm}}$
	$I^{wy}$ 4 $I_w$	mm
D	30	
Resultant weld stres		kN
	$f_w \coloneqq \sqrt{f_{wx}^2 + f_{wy}^2}$	$f_w = 0.249 \frac{kN}{mm}$
	(2)	Пен
Nominal weld strengt	h /6	
	$R_{\cdot \cdot \cdot} = 0.6 \cdot F_{\text{BVV}} \cdot \frac{\sqrt{2}}{2} \cdot w$	$R_n = 1.227 \frac{kN}{m}$
		$m{m}$
T., L		
Interaction ratio fo	r Weld check	
	$2.0 f_{\rm su}$	
	$I := \frac{J w}{D}$	$I_{29} = 0.406$
	$R_n$	29
Shear tab rupture at	weld at connection 2	
	ickness to match weld strength	
	The state of the s	
	$2.0 \cdot 2  f_w$	2 4 151
	$t_{s.min} \coloneqq rac{2.0 \cdot 2 \ f_w}{0.6 \cdot F_{up}}$	$t_{s.min}$ = 4.151 $m{mm}$
	0.01up	
Interaction ratio in	web rupture	
	4	O <sub>A</sub>
	$I_{30} \coloneqq rac{t_{s.min}}{t_c}$	I = 0.346
	$t_s$	30
Wah muntum at 1 -	at compation 2	9,
Web rupture at weld		10
Mınımum web thicknes	s to match weld strength	
	20 f	
	$t_{w.min} \coloneqq rac{2.0 \ f_w}{0.6 \cdot F_{ub}}$	$t_{w.min}\!=\!1.845$ $m{mm}$
	$0.6 \cdot F_{ub}$	William
Interaction ratio in		
Interaction ratio in	web lupture	O'at
Interaction ratio in		O.K.
Interaction ratio in	$I_{31} \coloneqq rac{t_{w.min}}{t_{wb2}}$	$I_{31} = 0.316$



# Validation Results

The calculated ratios are compared with the output of Osoconn and if it is within a tolerance of 1% the result is deemed to be OK.

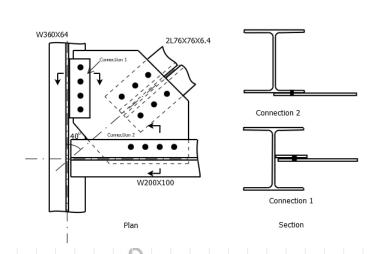
Table 5: Validation problem 4 results

Table 5: Validation prob			
	Interactio	n Ratio	
Check	Calculated	Osoconn	Result
Bolt shear check at brace	0.283	0.283	OK
Bolt bearing at brace check	0.2	0.2	OK
Bolt bearing at gusset check	0.424	0.424	OK
Brace tension rupture check	0.156	0.156	OK
Brace block shear check	0.167	0.167	OK
Gusset tension yielding check	0.241	0.241	OK
Gusset tension rupture check	0.203	0.203	OK
Bolt shear at connection 1	0.12	0.12	OK
Bolt bearing at clip angle at connection 1	0.113	0.113	OK
Bolt bearing at beam web at connection 1	0.062	0.062	OK
Gusset shear yielding at connection 1	0.099	0.099	OK
Gusset plate block shear at connection 1	0.087	0.087	OK
Gusset flexure yielding at connection 1	0.056	0.056	OK
Clip angle shear yielding at connection 1	0.083	0.083	OK
Clip angle shear rupture at connection 1	0.113	0.113	OK
Clip angle block shear at connection 1	0.092	0.092	OK
Weld check at connection 1	0.139	0.139	OK
Gusset rupture at weld at connection 1	0.119	0.119	OK
Bolt shear at connection 2	0.514	0.514	OK
Bolt bearing at shear tab at connection 2	0.384	0.384	OK
Bolt bearing at gusset at connection 2	0.192	0.192	OK
Gusset shear yielding at connection 2	0.211	0.211	OK
Gusset shear rupture at connection 2	0.248	0.248	OK
Gusset plate block shear at connection 2	0.296	0.296	OK
Gusset flexure yielding at connection 2	0.119	0.119	OK
Shear tab shear yielding at connection 2	0.283	0.283	OK
Shear tab shear rupture at connection 2	0.384	0.384	OK
Shear tab block shear at connection 2	0.313	0.313	OK
Shear tab flexure yielding at connection 2	0.135	0.135	OK
Weld check at connection 2	0.406	0.406	OK
Shear tab rupture at weld at connection 2	0.346	0.346	OK
Web rupture at weld at connection 2	0.316	0.316	OK

## 2.6 Validation Problem 5

### Problem Statement

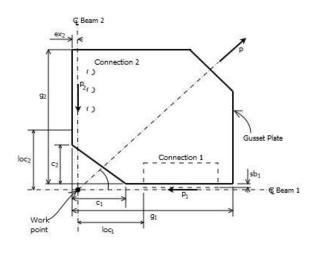
Design a horizontal brace connection for a double angle 2L76X76X6.4 brace, with their short leg back to back and vertical, framing into the junction between a W360X64 and a W200X100 using the ASD method. The brace has an angle of 40 degrees with the W360 beam. The brace has an axial force of 46 kN. The beams, angles and plates are of grade ASTM A36. The bolts are ASTM 3125 A490 bearing type.



D€	esi	.an	İnı	outs

Material Properties	
Material grade for plate	ASTM A36
Yield strength	$F_{yp} \coloneqq 250 \; MPa$
Tensile strength	$F_{up} = 400 \; MPa$
Material grade of beam	ASTM A36
Yield strength	$F_{yb} \coloneqq 250 \; MPa$
Tensile strength	$F_{ub} = 400 \; MPa$
Material grade of angles	ASTM A36
Yield strength	$F_{ya} = 250 \; MPa$
Tensile strength	$F_{ua} \coloneqq 400 \; MPa$
Material grade for weld electrode	E70XX <b>Q</b>
Tensile strength	$F_{EXX}$ :=482 <b>MPa</b>
Material specification for bolts	ASTM 3125 A490
Tensile strength	$F_{nt} \coloneqq 780 \; MPa$
Shear strength	$F_{nv} \coloneqq 469 \; MPa$
Young's modulus for steel	$E \coloneqq 200000 \; \boldsymbol{MPa}$
Design Forces	
Axial force in brace	P≔46 <b>kN</b>

Connection Geometry	
Brace section	2L76X76X6.4
Thickness	$t_{br}\!\coloneqq\!6.35$ $mm$
Horizontal leg length	$l_{obr} \coloneqq 76.2$ $mm$
Back-to-back leg length	$l_{ibr} \coloneqq 76.2  m{mm}$
Gross cross section area	$A_{br} \coloneqq 1858 \ \boldsymbol{mm}^2$
Centroid of brace back to back leg	$x'_{br} \coloneqq 21.2 \; \boldsymbol{mm}$
Brace angle with from beam at connection 1	$\theta_{br} \coloneqq 40  \boldsymbol{deg}$
Back to back leg spacing	$s_{br}$ := 6 $mm$
Beam section at connection 1	W360X64
Section depth	$d_{xb1} = 348 \; \boldsymbol{mm}$
Flange width	$b_{fb1} = 203 \; \boldsymbol{mm}$
Flange thickness	$t_{fb1} \coloneqq 13.5 \; \boldsymbol{mm}$
Web thickness	$t_{wb1} \coloneqq 7.75$ <b>mm</b>
Distance from outer face to fillet edge	$k_{bdet1} \coloneqq 34.9 \; \boldsymbol{mm}$
Beam section at connection 2	W200X100
Section depth	$d_{xb2}$ := 229 $m{mm}$
Flange width	<i>b<sub>fb2</sub></i> := 210 <i>mm</i>
Flange thickness	$t_{fb2} \coloneqq 23.7 \; \boldsymbol{mm}$
Web thickness	$t_{wb2}\coloneqq 14.5$ mm
Distance from outer face to fillet edge	$k_{bdet2} \coloneqq 41.3 \; \textit{mm}$
Shear tab thickness	$t_s \coloneqq 10 \; m{mm}$
Shear tab width	$w_s$ := 100 $mm$



Visal 91	P <sub>1</sub>
Work   loc1	9
Gusset plate thickness	$t_g\!\coloneqq\!12$ $mm$
Gusset dimension along connection 1	$g_1 = 500 \ mm$
Gusset dimension along connection 2	$g_2 = 500 \ mm$
Gusset cutout at connection 1	$c_1 \coloneqq 125 \ mm$
Gusset cutout at connection 2	$c_2 = 125 \ mm$
Gusset extention at connection 2	$ex_2 = 10 \; mm$

Bolt diameter	$d_b = 20 \; \boldsymbol{mm}$
Bolt hole diameter	$d_{bh}\!\coloneqq\!22$ $m{mm}$
Number of bolts per row on brace	$n_{br} \coloneqq 3$
Number of bolts at connection 1	$n_1 := 4$
Number of bolts at connection 2	$n_2 = 4$
9	
Bolt spacing	s:=60 <b>mm</b>
Bott spacing	3.2 00 11111
Bolt gage on brace	a 45 mm
	$g_{br} = 45  mm$
Bolt gage on shear tab	$g_s = 50 \ mm$
Bolt gage on beam 2	$g_{bm2}$ :=3 $in$
(Qx	
Shear tab location for connection 1	$loc_1 = 200 \ mm$
Bolt location for connection 2	$loc_2 = 200 \ mm$
0	
Bolt edge distance on brace	$ed_1 = 35$ $mm$
Bolt edge distance on gusset	$ed_2 = 35$ $mm$
Bolt edge distance on shear tab	$ed_3 = 35$ $mm$
Shear tab to beam weld thickness	w = 6  mm
3,	
Connection setback at connection 1	$sb_1 \coloneqq 12   \boldsymbol{mm}$
Beam bottom flange cope length at connection	on 2 $cp_2 \coloneqq 0$ $mm$
Setback of beam at connection 2	$sbb_2 = 12 \ mm$
2:	
sign Calculations	
Connection forces	2
Shear per bolt at brace connection	60
Shear per bore at brace connection	TÖK I I I I I I I I I I I I I I I I I I I
$P_b \coloneqq rac{P}{2 \cdot n_{br}}$	$P_b = 7.667 \; kN$
$r_b = \frac{1}{2 \cdot n_{br}}$	1 b=1.001 k1
Component of brace force along connection 1	$P_b = 7.667 \ kN$ $P_1 = 35.238 \ kN$
	D 25 220 LM
$P_1 \coloneqq P \cdot \cos\left(\theta_{br}\right)$	$P_1 = 35.238 \ kN$
Force per bolt along connection 1	O.
_	
$\_$ $P_1$	
$P_{b1} = \frac{P_1}{n}$	$P_{b1} = 8.81 \ kN$
$P_{b1}\!\coloneqq\!rac{P_1}{n_1}$	
Component of brace force along connection 2	
Component of brace force along connection 2	
Component of brace force along connection 2	
Component of brace force along connection 2 $P_2\!\coloneqq\!P\!\cdot\!\sin\left(\theta_{br}\right)$ Force per bolt along connection 2	
Component of brace force along connection 2 $P_2\!\coloneqq\!P\!\cdot\!\sin\left(\theta_{br}\right)$ Force per bolt along connection 2	$P_2$ = 29.568 $kN$
Component of brace force along connection 2 $P_2\!\coloneqq\!P\!\cdot\!\sin\left(\theta_{br}\right)$	
Component of brace force along connection 2 $P_2 \!\coloneqq\! P \! \cdot \! \sin \left(\theta_{br}\right)$ Force per bolt along connection 2	$P_2$ = 29.568 $kN$

Bolt shear at brace	check	
Area of bolt	$A_b \coloneqq \frac{oldsymbol{\pi} \cdot {d_b}^2}{4}$	4 214 1502
O.	$A_b \coloneqq {4}$	$A_b = 314.159 \ mm^2$
Nominal shear streng	th of bolt	
Ġ.	$R_n \coloneqq F_{nv} \cdot A_b$	$R_n = 147.341 \ kN$
Interaction ratio in	holt shear	
interaction factor in		
	$I_0 = \frac{2.0 \ P_b}{R_n}$	$I_0 = 0.104$
Bolt bearing at brac	ce for bearing check	
riffilmant cicar arstan	$l_{c1} \coloneqq min\left(s - d_{bh}, ed_1 - 0.5 \cdot d_{bh} ight)$	$l_{c1} = 24 \ mm$
Y.		
Nominal strength in		D = 150 151
	$R_n \coloneqq min\left(1.2 \cdot l_{c1} \cdot t_{br} \cdot F_{ua}, 2.4 \cdot d_b \cdot t_{br} \cdot F_{ua}\right)$	$R_n = 73.152 \text{ kN}$
Interaction ratio in	bolt bearing at brace	
	$I_1 = \frac{2.0 P_b}{R_a}$	$I_{_{1}} = 0.21$
Bolt bearing at guss	et shock	
	ce for bearing on gusset	
	$l_{c2}\!\coloneqq\!min\left(s\!-\!d_{bh},ed_2\!-\!0.5\!\boldsymbol{\cdot}\!d_{bh}\right)$	$l_{c1}\!=\!24$ $mm$
	6	
Nominal strength in	bearing $R_n \!\coloneqq\! min\left(1.2 \!\cdot\! l_{c2} \!\cdot\! t_g \!\cdot\! F_{up}, 2.4 \!\cdot\! d_b \!\cdot\! t_g \!\cdot\! F_{up} \right)$	$R_n = 138.24 $ <b>kN</b>
	$Te_n = meth \left(1.2 \cdot e_2 \cdot e_g \cdot Tup, 2.4 \cdot e_b \cdot e_g \cdot Tup\right)$	10 <sub>n</sub> = 150.24 M/V
Interaction ratio in	bolt bearing at gusset	
	$r = 2.0 P_b$	T 0.111
	$I_2 \coloneqq rac{2.0 \ P_b}{R_n}$ grace to gusset connection the angle of brace $A_{nbr} \coloneqq A_{br} - 2 \cdot d_{bh} \cdot t_{br}$	$I_2 = 0.111$
Tension rupture at b	race to gusset connection	
Net cross section ar	ea of brace	
	$A_{nbr} \coloneqq A_{br} - 2 \cdot d_{bh} \cdot t_{br}$	$A_{nbr} = 1578.6 \ mm^2$
Length of connection		),
Length of Connection	$l_{br}\!\coloneqq\!s\!\cdot\!\left(n_{br}\!-\!1 ight)$	$l_{br}\!=\!120$ $mm$
Shear lag factor	$x'_{br}$	0
	$U \coloneqq 1 - \frac{x'_{br}}{l_{br}}$	$U\!=\!0.823$
Brace strength in te	nsion rupture	6
	$P_n \coloneqq F_{ua} \cdot U \cdot A_{nbr}$	$P_n = 519.886 \ kN$
Interaction ratio fo	r brace tension rupture	
	$I_3 = \frac{2.0 P}{P_n}$	$I_{2} = 0.177$
	$ P_n $	3

3	$A_{gv} \coloneqq 2 ullet ig( ig( n_{br} - 1 ig) ullet s + ed_1 ig) ullet t_{br}$	$A_{gv} = 1968.5 \ mm^2$
Nat Prop in char	_	
Net area in shear	$A_{nv}\!\coloneqq\!A_{qv}\!-\!2\boldsymbol{\cdot}(n_{br}\!-\!0.5)\boldsymbol{\cdot}d_{bh}\!\boldsymbol{\cdot}t_{br}$	$A_{nv}$ = 1270 $m{mm}^2$
4	$A_{nv} = A_{gv} = 2$ ( $n_{br} = 0.0$ ) $a_{bh}$ $a_{br}$	$A_{nv} = 1210$ Helli
Net area in tens:	ion	
	$A_{nt}\!\coloneqq\!2ullet(l_{ibr}\!-\!g_{br}\!-\!0.5ullet d_{bh})ullet t_{br}$	$A_{nt} = 256.54 \ mm^2$
	,	
Nominal strength		
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
	$P \leftarrow 0.6 \cdot F \cdot A \rightarrow F \cdot A$	
	$R_{n2} = 0.0 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
	$R_n := min(R_{n1}, R_{n2})$	$R_n = 397.891 \ kN$
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$	-16
Interaction ratio	o in block shear	
	2.0 P	
	$I_{_4} \coloneqq rac{2.0\ P}{R_{_{g_1}}}$	$I_4 = 0.231$
	70	
Gusset tension y	lelding check	
	30/	
Length of Whitmo:	re section	
Length of Whitmo:	re section $l_w\!\coloneqq\!2\!\cdot\! l_{br}\!\cdot\!\tan\big(30\;\pmb{deg}\big)\!+\!2\!\cdot\! g_{br}\!+\!s_{br}$	$l_w\!=\!234.564~mm$
	re section $l_w\!\coloneqq\!2\!\cdot\!l_{br}\!\cdot\! anig(30\;degig)\!+\!2\!\cdot\!g_{br}\!+\!s_{br}$ of gusset in yielding	$l_w\!=\!234.564~m{mm}$
	re section $l_w\!\coloneqq\!2\!\cdot\!l_{br}\!\cdot\! anig(30\;degig)\!+\!2\!\cdot\!g_{br}\!+\!s_{br}$ of gusset in yielding $P_n\!\coloneqq\!F_{yp}\!\cdot\!l_w\!\cdot\!t_g$	$l_w$ = 234.564 $mm$ $P_n$ = 703.692 $kN$
Nominal strength	$l_w \coloneqq 2 \cdot l_{br} \cdot \tan \left(30 \ \textit{deg}\right) + 2 \cdot g_{br} + s_{br}$ of gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$	$l_w = 234.564 \ mm$ $P_n = 703.692 \ kN$
Nominal strength	re section $l_w\!\coloneqq\!2\!\cdot\!l_{br}\!\cdot\!\tan\left(30\;deg\right)\!+\!2\!\cdot\!g_{br}\!+\!s_{br}$ of gusset in yielding $P_n\!\coloneqq\!F_{yp}\!\cdot\!l_w\!\cdot\!t_g$ o in tension yielding	$l_w$ = 234.564 $mm$ $P_n$ = 703.692 $kN$
Nominal strength	o in tension yielding	Ô,
Nominal strength	re section $l_w\!\coloneqq\!2\!\cdot\!l_{br}\!\cdot\!\tan\left(30\;deg\right)\!+\!2\!\cdot\!g_{br}\!+\!s_{br}$ of gusset in yielding $P_n\!\coloneqq\!F_{yp}\!\cdot\!l_w\!\cdot\!t_g$ o in tension yielding $I_5\!\coloneqq\!\frac{1.67\;P}{P_n}$	Ô,
Nominal strength Interaction ratio	o in tension yielding $I_{\scriptscriptstyle{5}} \coloneqq \frac{1.67\;P}{P_{n}}$	$l_w$ = 234.564 $mm$ $P_n$ = 703.692 $kN$
Nominal strength  Interaction ratio	o in tension yielding $I_5 \coloneqq rac{1.67  P}{P_n}$ upture check	I = 0.109
Nominal strength  Interaction ratio	o in tension yielding $I_5 \coloneqq rac{1.67  P}{P_n}$ upture check	I = 0.109
Nominal strength  Interaction ratio	o in tension yielding $I_{5}\coloneqq\frac{1.67P}{P_{n}}$ upture check et in tension	Ô,
Nominal strength  Interaction ratio  Gusset tension related to the second strength to the s	o in tension yielding $I_5\!\coloneqq\!rac{1.67P}{P_n}$ upture check et in tension $A_{ng}\!\coloneqq\!(l_w\!-\!2\!\cdot\!d_{bh})\!\cdot\!t_g$ of gusset in rupture	$I_{5} = 0.109$ $A_{ng} = 2286.769 \; mm^{-1}$
Interaction ration  Gusset tension ration  Net area of gusse	o in tension yielding $I_5\coloneqq rac{1.67P}{P_n}$ upture check et in tension $A_{ng}\coloneqq (l_w\!-\!2\!\cdot\!d_{bh})\!\cdot\!t_g$	I = 0.109

Ô	$I_6 = \frac{2.0 P}{P_n}$	$I_{6} = 0.101$
\O_{\chi}	$^{6}$ $P_{n}$	6
Gusset block shear ch		
4.		
Y <sub>x</sub>		
	$A_{gv} \coloneqq 2 \left( \left( n_{br} - 1 \right) \cdot s + ed_2 \right) \cdot t_g$	$A_{gv} = 3720 \; \boldsymbol{mm}^2$
Net area in shear	$A_{gv}$ := $2 \ ig(ig(n_{br}-1ig)ullet s + ed_2ig)ullet t_g$ $A_{nv}$ := $A_{gv}-ig(2ullet n_{br}-1ig)ullet d_{bh}ullet t_g$	
area in onear	$A_{nv} = A_{qv} - (2 \cdot n_{br} - 1) \cdot d_{bh} \cdot t_{a}$	$A_{nv}$ = 2400 $m{mm}^2$
Net area in tension	1 (3 (3 ) 1 ) (	4 000 2
	$A_{nt}\!\coloneqq\!\left(2\;g_{br}\!+\!s_{br}\!-\!d_{bh} ight)\!\cdot\!t_g$ k shear	$A_{nt} = 888 \ mm^2$
Nominal strength bloc	k shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{up} \cdot A_{nv} + F_{up} \cdot A_{nt}$	
	$R_{n2} \coloneqq 0.6 \cdot F_{yp} \cdot A_{gv} + F_{up} \cdot A_{nt}$	
	$R_n \coloneqq min\left(R_{n1},R_{n2}\right)$	$R_n = 913.2 \ kN$
	(1)	
Interaction ratio in	block shear	
	$I_7 \coloneqq \frac{2.0 \ P}{R_n}$	$I_{7} = 0.101$
	$rac{1}{7}$ $R_n$	7 - 0.101
Bolt shear at connect	ion 1	
Polar moment of inert	ia of bolt group	20)
	$I_{po}\!\coloneqq\!2\!ullet \sum_{i=1}^{0.5} (i\!\cdot\!s)^2$	Ō,
	i=1 $i=1$ $i=1$	1/2
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$ block shear $I_7 \coloneqq rac{2.0\ P}{R_n}$ ion $1$ ia of bolt group $I_{po} \coloneqq 2 \cdot \sum_{i=1}^{0.5} rac{(i \cdot s)^2}{(i - 0.5) \cdot s)^2}$	
	$I_{pe}\!\coloneqq\!2\!ullet \sum_{i=1}^{0.5n_1} ig(ig(i\!-\!0.5ig)\!ullet sig)^2$	
	$I_p \coloneqq \mathbf{if} \left( \operatorname{mod} \left( n_1, 2 \right) = 1, I_{po}, I_{pe} \right)$	$I = 18000 \text{ mm}^2$
	$I_p = \mathbf{H} \left( \text{IIIOU} \left( n_1, \mathcal{L} \right) - \mathbf{H}, \mathbf{I}_{po}, \mathbf{I}_{pe} \right)$	$I_p = 18000 \; mm^2$ $c = 90 \; mm$
Distance of most remo		73
	$c \coloneqq 0.5 \ ig(n_1 - 1ig) \cdot s$	$c = 90 \ mm$

Maximum shear in bolt	$P_s \coloneqq \sqrt{\left(rac{P_1}{n_1} ight)^2 + \left(rac{P_1 \cdot g_s \cdot c}{I_n} ight)^2}$	$P_s = 12.459 \ \textit{kN}$
Nominal shear strengt	h of bolt $R_n\!\coloneqq\!F_{nv}\!\cdot\!A_b$	$R_n = 147.341 \ kN$
- L		
Interaction ratio in	bolt shear	
95	$\frac{1}{2}$ 2.0 $P_{b1}$	
ŹŮ	$I_8 = \frac{2.0 \ P_{b1}}{R_n}$	$I_{8} = 0.12$
Bolt bearing at shear		
Clear distance betwee	n bolt holes/ hole and edge	7 04
(Qx)	$l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_3\!-\!0.5\!ullet d_{bh} ight)$	$l_c\!=\!24$ mm
Nominal strength in b		
	$R_n := min \left( 1.2 \cdot l_c \cdot t_s \cdot F_{up}, 2.4 \cdot d_b \cdot t_s \cdot F_{up} \right)$	$R_n = 115.2 \ kN$
Interaction ratio in	bolt bearing	
	20 P.	
	$I_9 \coloneqq \frac{2.0 \ P_{b1}}{R}$	$I_{\rm q} = 0.153$
	$^{g}$ $R_{n}$	9
Bolt bearing at gusse	t at connection 1	
Length of shear tab		
	$L_1\!\coloneqq\!ig(n_1\!-\!1ig)\!\cdot\!s\!+\!2ed_3$	$L_1 = 250$ $mm$
Distance of gusset ou	ter edge from work point	
	here edge from work point $loc_{go} \coloneqq g_1 - ex_2$ for bolt on gusset $ed_{go} \coloneqq loc_{go} - loc_1 - L_1 + ed_3$ for bolt on gusset	$loc_{go} = 490$ mm
Distance of gusset in	ner edge from work point	
<u> </u>	$c_1$	
$loc_{gi}$	$\coloneqq c_1 - ex_2 - \mathrm{if} \left[ c_2 = 0, 0, (g_s - sb_1) \cdot \begin{array}{c} \cdot \\ \cdot \\ \cdot \end{array} \right]$	$loc_{gi}$ = 77 $m{mm}$
Outer edge distance f	or bolt on gusset	1 50
	$ed_{go} \coloneqq loc_{go} - loc_1 - L_1 + ed_3$	$ed_{go}$ =75 <b>mm</b>
	2	
Inner edge distance f	or boit on gusset	1 150
	$ed_{gi} \coloneqq loc_1 - loc_{gi} + ed_3$	$ed_{gi}$ =158 <b>mm</b>
	£., .1.,	
Minimum edge distance		24 75
	$ed_g \coloneqq min\left(ed_{go}, ed_{gi} ight)$	$ed_g = 75$ mm
Cloar distance between	un holt holos/ holo and adag	0
crear arstance betwee	n bolt holes/ hole and edge	1 - 20 mm
	$l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_g\!-\!0.5\!ullet d_{bh} ight)$	$l_c\!=\!38$ mm
Nominal atropath is b	naring	95
Nominal strength in b		D = 210 00 LAI
	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 218.88 \ kN$
		6

Ĉ	$I_{10} \coloneqq \frac{2.0 \ P_{b1}}{R_n}$	$I_{10} = 0.08$
		10
Gusset shear yieldir	ng at connection 1	
Gross area in shear	A ( ) I	4 4500 2
i i	$A_g \coloneqq ig(g_1 - c_1ig) ullet t_g$	$A_g$ =4500 $mm^2$
Nominal shear streng	gth of gusset in yielding	
	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g$	$R_n = 675   kN$
Interaction ratio in	n gusset yieldling	
6	$1.5 P_1$	
	$I_{11} := \frac{1.5 \ P_1}{R_n}$	$I_{_{11}} = 0.078$
Gusset shear rupture		
Net area in shear		
	$A_n\!\coloneqq\! A_g\!-\!n_1\!\cdot\!d_{bh}\!\cdot\!t_g$	$A_n = 5.338 \; in^2$
Nominal shear strend	gth of gusset in rupture	
Nominal Bried Beleni	$R_n \coloneqq 0.6 \cdot F_{up} \cdot A_n$	$R_n = 185.818 \ kip$
Interaction ratio in	n shear rupture	
	$2.0 P_1$	
	$I_{12} \coloneqq \frac{2.0 \ P_1}{R_n}$	$I_{_{12}} = 0.085$
Gusset plate block s	Shear at connection 1	
Gross area subjected	d to block shear	
	A to block shear $A_{gv}\!\coloneqq\!ig(L_1\!-\!2\;ed_3\!+\!ed_gig)\!\cdot\! t_g$	$A_{gv}$ = 3060 $mm^2$
Net area subjected t	o block shear	
nee area sasjeesea (	In to block shear $A_{gv} \coloneqq (L_1 - 2 \ ed_3 + ed_g) \cdot t_g$ to block shear $A_{nv} \coloneqq A_{gv} - (n_1 - 0.5) \cdot d_{bh} \cdot t_g$ to tension $A_{nt} \coloneqq (g_s - sb_1 - 0.5 \ d_{bh}) \cdot t_g$ block shear $R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	$A_{nv} = 2136 \ mm^2$
Net area subjected t	to tongion	
met area subjected (	$A_{-4} = (a_2 - sb_1 - 0.5 d_{44}) \cdot t$	$A_{nt}$ = 324 $mm^2$
	nt \9s 331 313 \won/ \9g	nt 321 mil
Nominal strength in	block shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	9,
	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	30,
	$R_{n}\!\coloneqq\!min\left(\!R_{n1}^{},R_{n2}^{} ight)$	$R_n = 588.6 $ kN
Interaction ratio in		
		3
	$I_{_{13}} \coloneqq \frac{2.0 \ P_{_{1}}}{R_{n}}$	$I_{13} = 0.12$
		10.

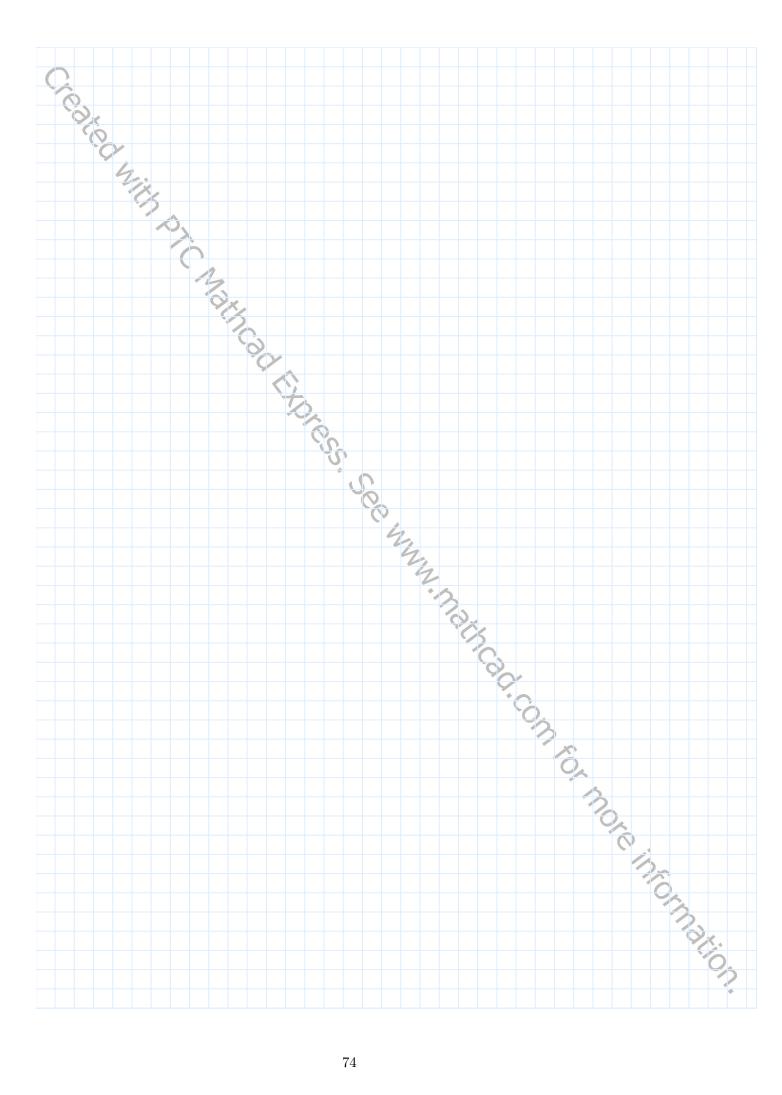
Eccentricity of f	orce at connection 1	
O,	$ec_1 \coloneqq c_1 + sb_1$	$ec_1 = 137   mm$
Nominal moment st		
4	$M_n \coloneqq rac{F_{yp} \! \cdot \! t_g \! \cdot \! g_1^{\; 2}}{4}$	$M_n = 187.5 \ \mathbf{kN \cdot m}$
	$M_n$ :- $4$	$M_n = 181.3$ kg · $m$
Interaction ratio	in gusset flexure	
	$P_1 \cdot ec_1$	7 0.042
	$I_{_{14}}\!\coloneqq\!rac{1.67\left(P_{1}\!\cdot\!ec_{1} ight)}{M_{n}}$	$I_{_{14}} = 0.043$
Shear tab shear y	ielding at connection 1	
Gross area in she	ear _	2
	$A_{gv}\!\coloneqq\!L_1\!\cdot\!t_s$	$A_{gv}$ = 2500 $mm^2$
Nominal strength	in shear yielding	
	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_{gv}$	$R_n = 375   kN$
	2	
Interaction ratio	o in shear yielding	
	$r = 1.5 P_1$	7 0 141
	$I_{15} \coloneqq \frac{1.5 P_1}{R_n}$	$I_{_{15}} = 0.141$
<b>Shear tab shear r</b> Net area in shear	cupture at connection 1	
Net alea III Shear	Fupture at connection 1 $A_{nv} \coloneqq A_{gv} - n_1 \cdot d_{bh} \cdot t_s$ in shear rupture $R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv}$ in shear rupture	$A_{nv}$ = 1620 $mm^2$
Nominal strength	in shear rupture	
	$R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv}$	$R_n = 388.8 \ kN$
Interaction ratio	in shear rupture	
	$I_{16} = \frac{2.0 P_1}{R_{\text{res}}}$	$I_{16} = 0.181$
	$R_n$	16
Shear tab block s	hear at connection 1	
Gross area subjec	ted to block shear	
	$A_{gv}\!\coloneqq\! \big(L_1\!-\!ed_3\big)\!\cdot\! t_s$	$A_{gv}$ = 2150 $m{mm}^2$
Net area subjecte	ed to block shear	/5
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!ig(n_1\!-\!0.5ig)\!ullet\!d_{bh}\!ullet\!t_s$	$A_{nv} = 1380 \ mm^2$
Net area subjecte	ed to tension	CY.
	$A_{nt} \coloneqq ig(w_s - g_s - 0.5 \ d_{bh}ig) \cdot t_s$	$A_{nt}\!=\!390$ $mm^2$
Nominal strength	in block shear	92
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	That = 030 with

	$R_n \coloneqq min\left(R_{n1}, R_{n2}\right)$	$R_n = 478.5 \text{ kN}$
Interaction ratio in	block shear	
	$I_{17} = \frac{2.0 \ P_1}{R_n}$	$I_{17} = 0.147$
Ç	$R_n$	17
Shear tab flexure yie	elding at connection 1	
Nominal moment streng	ght of gusset	
7.Ô.	$F_{uv} \cdot t_s \cdot L_1^{-2}$	
	$M_n \coloneqq rac{F_{yp} \cdot t_s \cdot {L_1}^2}{4}$	$M_n = 39.063 \ kN \cdot m$
Interaction ratio in		
(Q <sub>X</sub>	$I_{18} \coloneqq rac{1.67 \; P_1 \! \cdot \! g_s}{M_n}$	7 0.075
	$I_{18} = \overline{M_n}$	$I_{18} = 0.075$
Weld check at connect		
Polar moment of inert		
TOTAL MOMENTO OF THEIR		
	$I_{n} = L_1$	$I_w = 1302.083 \ cm^3$
Weld stress along wel	Ld 12	-w -50 <b>2</b> .000
	$f_{wx} \coloneqq rac{L_1^{-3}}{12}$	7.37
	$f_{wx} = \frac{P_{yy}}{1 - \frac{1}{2}}$	$f_{wx} = 0.07 \; rac{kN}{mm}$
	$2 \cdot L_1$	mm
Max weld stress trans	sverse to weld	
	$P_1 \cdot q_2 \cdot I_{11}$	<i>k</i> N
	$f_{wy} = \frac{1}{4} \frac{g_s}{I} \frac{g_s}{I}$	$f_{wy}$ = 0.085 $\frac{kN}{mm}$
	4 Iw	TICITE
Resultant weld stress	Everse to weld $f_{wy} \coloneqq rac{P_1 \cdot g_s \cdot L_1}{4 \; I_w}$ of $f_w \coloneqq \sqrt{f_{wx}^2 + f_{wy}^2}$	kN
	$f_w \coloneqq \sqrt{f_{wx}^2 + f_{wy}^2}$	$f_w = 0.11 \frac{kN}{mm}$
	Q.	
Nominal weld strength	$R_n \coloneqq 0.6 \cdot F_{EXX} \cdot \frac{\sqrt{2}}{2} \cdot w$	$R_n = 1.227 \frac{kN}{mm}$
	$R_n = 0.0 \cdot F_{EXX} \cdot \frac{1}{2} \cdot w$	$R_n = 1.227 {mm}$
Interaction ratio for	weld check	
	werd check	
	$R_n\!\coloneqq\!0.6\!\cdot\!F_{EXX}\!\cdot\!rac{\sqrt{2}}{2}\!\cdot\!w$ weld check $I_{19}\!\coloneqq\!rac{2.0f_w}{R_n}$ weld at connection 1	$I_{19} = 0.179$
	$^{19}$ $R_n$	19
Shear tab rupture at	weld at connection 1	O <sub>A</sub>
	ckness to match weld strength	3
	$2.0 \cdot 2 f$	70.
	$t_{s.min} \coloneqq rac{2.0 \cdot 2 \; f_w}{0.6 \cdot F_{up}}$	$t_{s.min}$ =1.835 $mm$
Interaction ratio in	web rupture	
	$t_{s.min}$	
	$I_{20}\!\coloneqq\!rac{t_{s.min}}{t_{s}}$	$I_{20} = 0.183$
	S	O.
		$I_{20} = 0.183$

0	2.0 f	
(C)	$t_{w.min} \coloneqq rac{2.0 \ f_w}{0.6 \cdot F_{ub}}$	$t_{w.min}$ = 0.917 $m{mm}$
,()		
Interaction ratio	in web rupture	
-/	$t_{w.min}$	7 0 110
	$I_{21} \coloneqq rac{t_{w.min}}{t_{wb1}}$	$I_{21} = 0.118$
Bolt shear at con		
Nominal shear str		
	$R_n := F_{nv} \cdot A_b$	$R_n = 147.341 \ kN$
		16
Interaction ratio	in bolt shear	
	$2.0 \ P_{\nu_2}$	
	$I_{22} = \frac{2.0 \ P_{b2}}{B}$	$I_{22} = 0.1$
	100	
	usset plate at connection 2	
Length of connect		$L_2 = 180 \; mm$
	$L_2 \coloneqq ig(n_2-1ig) \cdot s$	$L_2 = 100$ $mm$
Distance of gusse	t outer edge from work point	
	$loc_{go} \coloneqq g_2 + sb_1 + 0.5 \cdot t_{wb1}$	$loc_{go} = 515.875$ mm
	ge 52 wer	go
Distance of gusse	t inner edge from work point	
	$c_0$	
	$loc_{gi} := c_2 + sb_1 + 0.5 \cdot t_{wb1} - if \left(c_1 = 0, 0, \left(g_{bm2} + ex_2\right) \cdot \frac{c_2}{c_1}\right)$	$loc_{gi} = 54.675 \ mm$
		/
Duter eage aistar	ce for clip on gusset	od -125 975 mm
	$ed_{go}\!\coloneqq\!loc_{go}\!-\!loc_2\!-\!L_2$	$ed_{go} = 135.875 \ mm$
Inner edge distar	ce for clip on gusset	
	$ed_{qi} \coloneqq loc_2 - loc_{qi}$	$ed_{gi} = 145.325 \ mm$
	g g.	g.
Minimum edge dist	ance for clip on gusset	
	$ed_g \coloneqq min\left(ed_{go}, ed_{gi}\right)$	$ed_g = 135.875$ <b>mm</b>
Clear distance be	tween bolt holes/ hole and edge	20
	$l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_g\!-\!0.5\!ullet d_{bh} ight)$	$l_c$ = 38 $mm$
Nominal strength	in bearing	19,
.c	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 218.88 \text{ kN}$
	$(2-2)^2 = (2-2$	
Interaction ratio	in bolt bearing	16.
		$I_{23} = 0.068$
	$I_{23} \coloneqq rac{2.0 \; P_{b2}}{R_n}$	$I_{23} = 0.068$
	$oxed{n_n}$	40

Edge distance of	bolt to beam flange edge	
	$ed_b \coloneqq loc_2 - cp_2 - sbb_2 - 0.5 \ t_{wb2}$	$ed_b = 7.116$ in
Clear distance b	petween bolt holes/ hole and edge	
C	$l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_b\!-\!0.5ullet d_{bh} ight)$	$l_c = 1.496   in$
4		C
Nominal strength	in bearing	
70	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_{fb2} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb2} \cdot F_{ub}\right)$	$R_n = 97.182 \ kip$
Interaction rati	o in bolt bearing	
	$\frac{1}{2}$ 2.0 $P_{b2}$	T 0004
	$I_{24}$ := $\frac{2.0~P_{b2}}{R_n}$	$I_{24} = 0.034$
	elding at connection 2	
Gross area in sh	lear (	,
	$A_g\!\coloneqq\! ig(g_2\!-\!c_2ig)\!\cdot\! t_g$	$A_g = 4500 \; mm^2$
Nominal shear st	rength of gusset in yielding	
	$R_n\!\coloneqq\!0.6\!ullet\!F_{yp}\!ullet\!A_g$	$R_n = 675 $ kN
Interaction rati	o in gusset yieldling	
	$1.5 P_2$	
	$I_{25} := \frac{1.5 \ P_2}{R_n}$	$I_{25} = 0.066$
Gusset shear rup	oture at connection 2 $A_n := A_g - n_2 \cdot d_{bh} \cdot t_g$	
Net area in shea	ır	
	$A_n\!\coloneqq\! A_g\!-\!n_2\!\cdot\!d_{bh}\!\cdot\!t_g$	$A_n = 3444 \ mm^2$
Nominal shear st	rength of gusset in rupture	
	$R_n \coloneqq 0.6 \cdot F_{up} \cdot A_n$	$R_n = 826.56 \ kN$
Interaction rati	o in shear rupture	
	$2.0 P_2$	
	$I_{26} \coloneqq \frac{2.0 \ P_2}{R_n}$	$I_{26} = 0.072$
Gusset plate blo	ock shear at connection 2	
Gross area subje	ected to block shear	Ç,
	$A_{gv} \coloneqq \left(L_2 + ed_g\right) \boldsymbol{\cdot} t_g$	$A_{gv} = 3790.5 \; mm^2$
		O <sub>A</sub>
wet area subject	ed to block shear	$A_{nv}\!=\!2866.5~ extbf{mm}^2$
	$A_{nv} \coloneqq A_{gv} - \left(n_2 - 0.5\right) \cdot d_{bh} \cdot t_g$	$A_{nv} = 2806.5 \ mm^{-1}$
Net area subject		6
	$A_{nt} \coloneqq ig(g_{bm2} + ex_2 - 0.5 \ d_{bh}ig) \cdot t_g$	$A_{nv} = 2866.5 \ mm^2$ $A_{nt} = 902.4 \ mm^2$
		(0),
Nominal strength	in block shear $R_{n1}\!\coloneqq\!0.6\!\cdot\!F_{ua}\!\cdot\!A_{nv}\!+\!F_{ua}\!\cdot\!A_{nt}$	

	$R_{n2}\!\coloneqq\!0.6\!\bullet\!F_{ya}\!\bullet\!A_{gv}\!+\!F_{ua}\!\bullet\!A_{nt}$	
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = 929.535 \ kN$
Interaction ratio	in block shear	
4	$2.0~P_2$	I 0.064
4.	$I_{27} \coloneqq \frac{2.0 \ P_2}{R_n}$	$I_{27} = 0.064$
	elding at connection 2	
Eccentricity of f	orce at connection 2 $ec_2 \coloneqq \max \left(c_1 - ex_2, 0\right)$	$ec_2$ = 115 $mm$
		552 113 11111
Nominal moment st	Y X	
	$M_n \coloneqq rac{F_{yp} \cdot t_g \cdot {g_2}^2}{4}$	$M_n = 187.5 \ \mathbf{kN \cdot m}$
	4	
Interaction ratio	in gusset flexure $I_{28} = \frac{1.67 \; (P_2 \cdot ec_2)}{M_n}$	
	$I:=1.67 \ (P_2 \cdot ec_2)$	$I_{28} = 0.03$
	$M_n$	28
	35	
	8	
	2-	
	2	
	.2	
	105	
	Ş	
		O.
		2x
		O <sub>A</sub>
		2
		92



### Validation Results

The calculated ratios are compared with the output of Osoconn and if it is within a tolerance of 1% the result is deemed to be OK.

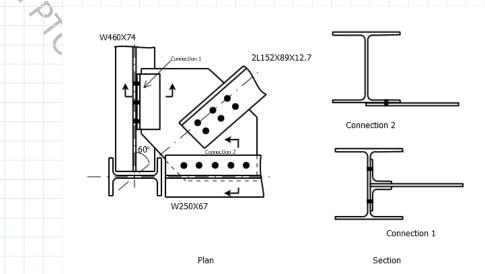
Table 6: Validation problem 5 results

Table 6. Validation prob	Interaction	n Ratio	
Check	Calculated	Osoconn	Result
Bolt shear at brace check	0.104	0.104	OK
Bolt bearing at brace check	0.21	0.21	OK
Bolt bearing at gusset check	0.111	0.111	OK
Brace tension rupture check	0.177	0.177	OK
Brace block shear check	0.231	0.231	OK
Gusset tension yielding check	0.109	0.109	OK
Gusset tension rupture check	0.101	0.101	OK
Gusset block shear check	0.101	0.101	OK
Bolt shear at connection 1	0.12	0.12	OK
Bolt bearing at shear tab at connection 1	0.153	0.153	OK
Bolt bearing at gusset at connection 1	0.08	0.08	OK
Gusset shear yielding at connection 1	0.078	0.078	OK
Gusset shear rupture at connection 1	0.085	0.085	OK
Gusset plate block shear at connection 1	0.12	0.125	OK
Gusset flexure yielding at connection 1	0.043	0.044	OK
Shear tab shear yielding at connection 1	0.141	0.141	OK
Shear tab shear rupture at connection 1	0.181	0.181	OK
Shear tab block shear at connection 1	0.147	0.147	OK
Shear tab flexure yielding at connection 1	0.075	0.075	OK
Weld check at connection 1	0.179	0.179	OK
Shear tab rupture at weld check	0.183	0.183	OK
Web rupture at weld at connection 1	0.118	0.118	OK
Bolt shear at connection 2	0.1	0.1	OK
Bolt bearing at gusset plate at connection 2	0.068	0.068	OK
Bolt bearing at beam web at connection 2	0.034	0.034	OK
Gusset shear yielding at connection 2	0.066	0.066	OK
Gusset shear rupture at connection 2	0.072	0.072	OK
Gusset plate block shear at connection 2	0.064	0.068	OK
Gusset flexure yielding at connection 2	0.03	0.026	OK

#### 2.7 Validation Problem 6

#### Problem Statement

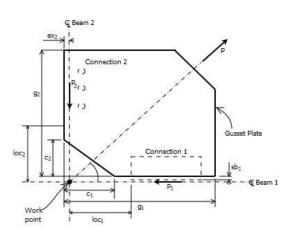
Design a horizontal brace connection for a double angle 2L152X89X12.7 brace, with their back to back leg horizontal, framing into the junction between two W460X74 and a W250X67 using the ASD method. The brace has an angle of 60 degrees with the W460. The brace has an axial force of 190kN. The beams are of grad ASTM A992, angles and plates are of grade ASTM A36. The bolts are ASTM 3125 A325 slip critical type.



## Design Inputs

Material Properties	
Material grade for plate	ASTM A36
Yield strength	4-3
	$F_{yp} = 250 \ MPa$
Tensile strength	$F_{up} = 400 \; MPa$
Material grade of beam	ASTM A992
Yield strength	$F_{yb} \coloneqq 345 \; MPa$
Tensile strength	$F_{ub} \coloneqq 450 \; MPa$
Material grade of angles	ASTM A36
Yield strength	$F_{ya} = 250 \; MPa$
Tensile strength	$F_{ua} = 400 \; MPa$
Material grade for weld electrode	E70XX
Tensile strength	$F_{EXX}$ := 482 <b>MPa</b>
Material specification for bolts	ASTM 3125 A325
Tensile strength	$F_{nt} \coloneqq 620 \; ksi$
Shear strength	
Young's modulus for steel	$F_{nv} \coloneqq 372 \ \textbf{ksi}$ $E \coloneqq 200000 \ \textbf{MPa}$
Design Forces	Ö
Axial force in brace	$P \coloneqq 190 \ kN$

Connection Geometry	
Brace section	2L152X89X12.7
Thickness	$t_{br} \coloneqq 12.7 \; m{mm}$
Outstanding leg length	l <sub>obr</sub> :=88.9 <b>mm</b>
Back-to-back leg length	$l_{ibr} \coloneqq 152 \; m{mm}$
Gross cross section area	$A_{br} = 5800 \ \boldsymbol{mm}^2$
Centroid of brace outstanding leg	$x'_{br} \coloneqq 21.1  \boldsymbol{mm}$
Brace angle with horizontal	$\theta_{br}$ := 60 $m{deg}$
Beam section at connection 1	W460X74
Section depth	$d_{xb1} \coloneqq 457 \ mm$
Flange width	$b_{fb1} \coloneqq 191 \ mm$
Flange thickness	$t_{fb1}\coloneqq 14.5~mm$
Web thickness	$t_{wb1}^{jo1} := 9.02 \; mm$
Distance from outer face to fillet edge	$k_{bdet1} = 31.8 \; mm$
Beam section at connection 2	W250X67
Section depth	$d_{xb2} = 257 \ \textit{mm}$
Flange width	$b_{fb2} = 204 \ mm$
Flange thickness	$t_{fb2} \coloneqq 15.7 \ \textit{mm}$
Web thickness	$t_{wb2} = 8.89 \ mm$
Distance from outer face to fillet edge	$k_{bdet2} = 33.3 \; mm$



Gusset plate thickness	$t_q \coloneqq 16  mm$
Gusset dimension along connection 1	$g_1 = 500 \ mm$
Gusset dimension along connection 2	$g_2 = 500 \; mm$
Gusset cutout at connection 1	$c_1 = 150 \ mm$
Gusset cutout at connection 2	$c_2 = 150 \; mm$
Gusset extension at connection 2	$ex_2 = 25$ mm
Clip angle section Thickness Outstanding leg length Welded leg length	L89X89X9.5 $t_a := 9.53 \ mm$ $l_{oa} := 88.9 \ mm$ $l_{ia} := 88.9 \ mm$

Bolt diameter	$d_b \coloneqq 22 \; m{mm}$
Bolt hole diameter	$d_{bh}\!\coloneqq\!24$ $mm$
Slip coefficient (class A surface)	$\mu \coloneqq 0.3$
Bolt pretension	$T_{pre} \coloneqq 176 \ \mathbf{kN}$
Number of bolts per row on brace	$n_{br} = 3$
Number of bolts at connection 1	$n_0 = 3$ $n_1 = 3$
Number of bolts at connection 2	$n_1 = 0$ $n_2 = 5$
Number of gores at connection 2	$n_2$ - $\sigma$
Bolt spacing	s≔70 <b>mm</b>
Bolt row spacing	$s_r = 70  mm$
Bolt gage on brace	$g_{br} = 50  mm$
Bolt gage on clip	$g = 45 \ mm$
Bolt gage on beam 2	$g_{bm2} = 50   m{mm}$
Bort gage on beam 2	$g_{bm2}$ - 30 mm
Location of connection 1 from work point	$loc_1 = 200 \ mm$
Location of connection 2 from work point	$loc_2 = 200 \ mm$
	1002 - 200 11111
Bolt edge distance on brace	$ed_1 = 30 \ mm$
Bolt edge distance on gusset	$ed_2 = 30 \ mm$
Bolt edge distance on clip	$ed_3 = 35 \ mm$
Clip to gusset weld thickness	w = 6  mm
Connection setback at connection 1	$sb_1 \coloneqq 12$ $mm$
Beam bottom flange cope length at connection	$cp_2 = 0 \ mm$
Setback of beam at connection 2	$sbb_2 \coloneqq 12$ $mm$
	2
sign Calculations	3.
Connection forces	(3)
Shear per bolt at brace connection	$P_b$ =31.667 $kN$ $P_1$ =95 $kN$
P	C
$P_b \coloneqq rac{P}{2 \; n_{ba}}$	$P_b = 31.667 \ kN$
$\sim 10 br$	***************************************
Component of brace force along connection 1	
$P_1 \coloneqq P \cdot \cos\left( heta_{br} ight)$	$P_1 = 95 \text{ kN}$
	Ġ.
Force per bolt along connection 1	7
$P_1$	3 4 000 1 1
$P_{b1} \coloneqq \frac{P_1}{2 \; n_1}$	$P_{b1} = 15.833 \ kN$
Component of brace force along connection 2	D WALL IN
Component of brace force along connection 2 $P_2\!\coloneqq\!P\!\cdot\!\sin\left( heta_{br} ight)$	$P_2 = 164.545 \; kN$
$P_2 \coloneqq P \cdot \sin\left(\theta_{br}\right)$	$P_2 = 164.545 \ kN$
$P_2\!\coloneqq\!P\!\cdot\!\sin\left( heta_{br} ight)$ Force per bolt along connection 2	$P_2 \! = \! 164.545 \;  extbf{kN}$
$P_2\!\coloneqq\!P\!\cdot\!\sin\left( heta_{br} ight)$ Force per bolt along connection 2	
$P_2 \coloneqq P \cdot \sin\left(\theta_{br}\right)$	$P_2 = 164.545 \; kN$ $P_{b2} = 32.909 \; kN$

Ó.	$R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre} \cdot 2$	$R_n = 119.328 \ kN$
O.		
Interaction ratio	in bolt shear	
4.	$_{I}$ 1.5 $P_b$	1 -0 200
4	$I_0 \coloneqq \frac{1.5 \ P_b}{R_n}$	$I_0 = 0.398$
Bolt bearing on b	race check	
Minimum clear dist	cance for bearing check	
	$l_{c1}\!\coloneqq\!min\left(s\!-\!d_{bh},ed_1\!-\!0.5\!ullet d_{bh} ight)$	$l_{c1} = 18 \ mm$
Nominal strength	h bearing $R_n\!\coloneqq\!min\left(1.2\!ullet\!ll_{c1}\!ullet\!t_{br}\!ullet\!F_{ua},2.4\!ullet\!d_b\!ullet\!t_{br}\!ullet\!F_{ua} ight)$	D = 100 729 hN
	$R_n = min \left(1.2 \cdot t_{c1} \cdot t_{br} \cdot F_{ua}, 2.4 \cdot u_b \cdot t_{br} \cdot F_{ua}\right)$	$R_n = 109.728 \ kN$
Interaction ratio	in bolt bearing at brace	
	$K_1 = \frac{2.0 \cdot 0.5 P_b}{R_n}$	$I_{1} = 0.289$
	7/2	
Bolt bearing on gu		
MITHIMUM Clear dist	cance for bearing on gusset $l_{c2}\!\coloneqq\!min\left(s\!-\!d_{bh},ed_2\!-\!0.5\!\cdot\!d_{bh} ight)$	$l_{c1} = 18  mm$
	$a_{c2} = a_{cb}$ , $a_{bh}$ , $a_{bh}$	
Nominal strength	in bearing	
	$R_n \!\coloneqq\! min\left(1.2 \cdot l_{c2} \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 138.24 \text{ kN}$
	2	
Interaction ratio	in bolt bearing at gusset	
	$I_2 = \frac{2.0 P_b}{B}$	$I_{2} = 0.458$
	$R_n$	2 0.130
Brace tension rupt	ture check	
Net cross section	area of brace	
	$A_{nbr}\!:=\!A_{br}\!-\!4\cdot d_{bh}\cdot t_{br}$	$A_{nbr} = 4580.8 \ mm^2$
Length of connect:	3	
nongen of connect.	area of brace $A_{nbr}\!\coloneqq\!A_{br}\!-\!4\cdot d_{bh}\!\cdot\!t_{br}$ for $l_{br}\!\coloneqq\!s\!\cdot\!(n_{br}\!-\!1)$	$l_{br}$ = 140 $m{mm}$
		01
Shear lag factor		<u> </u>
	$U\!\coloneqq\!1\!-\!rac{x'_{br}}{l_{br}}$	U = 0.849
Dan do at 100 - 11 /		0
Brace strength in	tension rupture $P_n \coloneqq F_{ua} \cdot U \cdot A_{nbr}$	$P_n = 1556.163 \ kN$
		n - 1000.100 MIV
Interaction ratio	for brace tension rupture	$I_{3} = 0.244$
		72
	$I_{3} = \frac{2.0 P}{P_{n}}$	$I_3 = 0.244$
	1 n	

Gross area in shear		
CO.	$A_{gv}\!\coloneqq\!2\boldsymbol{\cdot} \big(\big(n_{br}\!-\!1\big)\boldsymbol{\cdot} s\!+\!ed_1\big)\boldsymbol{\cdot} t_{br}$	$A_{gv}\!=\!4318\;\boldsymbol{mm}^2$
Net area in shear		
Net area in snear	$A_{nv}\!:=\!A_{gv}\!-\!2ullet(n_{br}\!-\!0.5)ullet d_{bh}\!\cdot\!t_{br}$	$A_{nv}$ = 2794 $m{mm}^2$
Ġ	$A_{nv} = A_{gv} = 2$ $(n_{br} = 0.5)$ $a_{bh}$ $a_{br}$	$A_{nv}$ – 2194 mm
Not area is tongion		
Net area in tension	$A_{nt} \coloneqq 2 \cdot (l_{ibr} - g_{br} - 1.5 \cdot d_{bh}) \cdot t_{br}$	$A_{nt} = 1676.4 \ mm^2$
<b>10</b>	$A_{nt} \coloneqq 2 \cdot (\iota_{ibr} - g_{br} - 1.3 \cdot a_{bh}) \cdot \iota_{br}$	$A_{nt}=1070.4~mm$
N	-1- 1	
Nominal strength blo	CK snear	
	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
(Q)	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$ $R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$ $R_n \coloneqq min(R_{n1}, R_{n2})$	
	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
	$R_n \coloneqq min\left(R_{n1},R_{n2}\right)$	$R_n = 1318.26 \ kN$
Interaction ratio in	block shear	
	20 P	
	$I_4 = \frac{2.0 \ P}{R_n}$	$I_{_{4}} = 0.288$
	$^{4}$ $R_{n}$	4
Gusset tension yield	ing check	
Gusset tension yield	ing check	
Gusset tension yield	ing check	
Gusset tension yield	367	
	367	
	367	$l_w\!=\!231.658~mm$
Length of Whitmore s	367	$l_w\!=\!231.658~mm$
Length of Whitmore s	367	$l_w = 231.658 \; mm$ $P_n = 926.632 \; kN$
Length of Whitmore s	367	$l_w$ = 231.658 mm $P_n$ = 926.632 kN
Length of Whitmore s	367	$l_w$ = 231.658 $mm$ $P_n$ = 926.632 $kN$
Length of Whitmore s	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding	92
Length of Whitmore s	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding	92
Length of Whitmore s	367	$l_w$ = 231.658 $mm$ $P_n$ = 926.632 $kN$
Length of Whitmore s Nominal strength of Interaction ratio in	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_5 \coloneqq \frac{1.67 \; P}{P_n}$	92
Length of Whitmore s Nominal strength of Interaction ratio in Gusset tension ruptu	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_5 \coloneqq \frac{1.67 \; P}{P_n}$ re check	I = 0.342
Length of Whitmore s Nominal strength of Interaction ratio in Gusset tension ruptu	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \ deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_5 \coloneqq \frac{1.67 \ P}{P_n}$ re check n tension	I = 0.342
Length of Whitmore s Nominal strength of Interaction ratio in Gusset tension ruptu	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_5 \coloneqq \frac{1.67 \; P}{P_n}$ re check	92
Length of Whitmore s  Nominal strength of  Interaction ratio in  Gusset tension ruptu  Net area of gusset i	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_5 \coloneqq \frac{1.67 \; P}{P_n}$ re check n tension $A_{ng} \coloneqq (l_w - 2 \; d_{bh}) \cdot t_g$	I = 0.342
Length of Whitmore s  Nominal strength of  Interaction ratio in  Gusset tension ruptu  Net area of gusset i	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_5 \coloneqq \frac{1.67 \; P}{P_n}$ re check n tension $A_{ng} \coloneqq (l_w - 2 \; d_{bh}) \cdot t_g$ gusset in rupture	$I_{_{5}} = 0.342$ $A_{ng} = 2938.529 \; mm^2$
Cusset tension yield  Length of Whitmore s  Nominal strength of  Interaction ratio in  Gusset tension ruptu  Net area of gusset i  Nominal strength of	ection $l_w \coloneqq 2 \cdot l_{br} \cdot  an(30 \; deg) + s_r$ gusset in yielding $P_n \coloneqq F_{yp} \cdot l_w \cdot t_g$ tension yielding $I_5 \coloneqq \frac{1.67 \; P}{P_n}$ re check n tension $A_{ng} \coloneqq (l_w - 2 \; d_{bh}) \cdot t_g$	I = 0.342

(A)	$I_6 = \frac{2.0 P}{P_n}$	I = 0.323
O.	$P_n$	$I_{6} = 0.323$
Gusset block shear ch	eck	
Gross area in shear		
4.	$A_{gv} \coloneqq 2 \left( \left( n_{br} - 1 \right) \cdot s + ed_2 \right) \cdot t_g$	$A_{gv} = 5440 \; mm^2$
	ge (( c,	gc
Net area in shear		
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!\left(2ullet n_{br}\!-\!1 ight)\!ullet d_{bh}\!ullet t_g$	$A_{nv} = 3520 \ mm^2$
Net area in tension	$A_{nt} \coloneqq \left(s_r - d_{bh}\right) \cdot t_g$	$A_{nt}$ =736 $mm^2$
Nominal strength bloc	k shear	
	$R_{n1} \coloneqq 0.6 \cdot F_{up} \cdot A_{nv} + F_{up} \cdot A_{nt}$	
	Restricted $R_{n1}$ := $0.6 \cdot F_{up} \cdot A_{nv} + F_{up} \cdot A_{nt}$ $R_{n2}$ := $0.6 \cdot F_{yp} \cdot A_{gv} + F_{up} \cdot A_{nt}$ $R_n$ := $min\left(R_{n1}, R_{n2}\right)$ block shear	
	$R_n \coloneqq min\left(R_{n1},R_{n2}\right)$	$R_n = 1110.4 \ kN$
Interaction ratio in	block shear	
	$I_7 = \frac{2.0 P}{B}$	$I_{7} = 0.342$
	$R_n$	7
Bolt shear at connect	ion 1	
Nominal slip resistar	ce of bolt	
	$R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$	$R_n = 59.664 \ kN$
Interaction ratio in	bolt shear	O,
	$-1.5P_{b1}$	3
	$I_8 \coloneqq \frac{1.5 \ P_{b1}}{R_n}$	I <sub>8</sub> =0.398
Bolt bossing of ali-		
	<pre>angle at connection 1 n bolt holes/ hole and edge</pre>	
Crear distance betwee	$l_c \coloneqq min\left(s\!-\!d_{bh}, ed_3\!-\!0.5\!\cdot\!d_{bh} ight)$	$l_c\!=\!23$ mm
	$c_c = more (s - a_{bh}, cas - s - a_{bh})$	°c - 20 110110
Nominal strength in b	earing	
	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_a \cdot F_{ua}, 2.4 \cdot d_b \cdot t_a \cdot F_{ua}\right)$	$R_n = 105.211 \ kN$

Interaction ratio in bo	olt bearing	
Co.	$I_9 := \frac{2.0 \ P_{b1}}{R_n}$	$I_{0} = 0.301$
\Q_e	$^{9}$ $R_{n}$	9
Bolt bearing at beam we		
Nominal strength in beautiful $R_n$ :	$=\!min\left(1.2\cdot\!\left(s\!-\!d_{bh}\!\right)\cdot\!t_{wb1}\cdot\!F_{ub},2.4\cdot\!d_{b}\cdot\!t_{wb1}\cdot\!F_{ub}\right)$	$R_n = 214.315 \ kN$
Interaction ratio in bo		
	$I_{10} \coloneqq \frac{2.0 \ P_{b1}}{R_n}$	$I_{10} = 0.148$
Gusset shear yielding	at connection 1	
Nominal shear strength	of gusset in yielding	
<u> </u>	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot \left(g_1 - c_1\right) \cdot t_g$	$R_n = 840 \ kN$
Interaction ratio in g		
	$I_{11} = \frac{1.5 P_1}{R_n}$	$I_{_{11}} = 0.17$
Gusset plate block she	ar at connection 1	
Length of gusset to co.		
	$L_1 \coloneqq ig(n_1-1ig) \cdot s + 2 \ ed_3$	$L_1 = 210 \ mm$
Distance of gusset out	er edge from work point	
	$loc_{go} \coloneqq g_1 - ex_2$	$loc_{go} = 475$ mm
	er edge from work point	
$loc_{gi}$ :=	$=c_{1}-ex_{2}-\mathbf{if}\left(c_{2}=0,0,\left(l_{ia}-sb_{1}\right)\cdot\frac{c_{1}}{c_{2}}\right)$	$loc_{gi} = 48.1$ mm
Outer edge distance for	r clip on gusset	
	$ed_{go}\!\coloneqq\!loc_{go}\!-\!loc_1\!-\!L_1$	$ed_{go}$ =65 $mm$
Inner edge distance for	r clip on gusset	
	$ed_{gi}\!\coloneqq\!loc_1\!-\!loc_{gi}$	$ed_{gi}$ =151.9 $mm$
Minimum edge distance	for clip on gusset	
	$ed_g \coloneqq min\left(ed_{go}, ed_{gi} ight)$	$ed_g$ =65 $mm$
Gross area subjected to	o block shear	72
	$A_{gv} \coloneqq ig(L_1 + ed_gig) m{\cdot} t_g$	$A_{gv}\!=\!4400$ $mm^2$
Net area subjected to		TO <sub>2</sub>
	$A_{nt} \coloneqq ig(l_{ia} - sb_1ig) m{\cdot} t_g$	$A_{nt} = 1230.4 \; m{mm}^2$
Nominal strength in blo	ock shear	94.
	$R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	$R_n = 1152.16 \ kN$

Ô	$I_{12} \coloneqq \frac{2.0 \ P_1}{R_n}$	$I_{12} = 0.165$
		12
Gusset flexure yieldi:	_	
Eccentricity of force		
Zix.	$ec_1 := c_2 + sb_1 + 0.5 \ t_{wb1}$	$ec_1 = 6.556$ in
Nominal moment strengh	nt of gusset	
	$M_n\!\coloneqq\!rac{F_{yp}\!\cdot\! t_g\!\cdot\! {g_1}^2}{4}$	$M_n = 250 \ kN \cdot m$
7	4	
Interaction ratio in o	gusset flexure	
Y	1.67 (P. •ec.)	
	$I_{13} \coloneqq \frac{1.67 \ \left(P_1 \cdot ec_1\right)}{M_n}$	$I_{13} = 0.106$
	Y	15
Clip angle shear yield		
Length of gusset to co	olumn clip	
	$L_1 \coloneqq ig(n_1 - 1ig) \cdot s + 2 \ ed_3$ $A_{gv} \coloneqq 2 \cdot L_1 \cdot t_a$	$L_1 = 210 \; \boldsymbol{mm}$
Gross area in shear	0	
GIOSS area III Silear	A :-2. P.+	$A_{gv}\!=\!4002.6\;m{mm}^2$
	$A_{gv} = 2 \cdot D_1 \cdot \iota_a$	$A_{gv}$ = 4002.0 $IIIII$
Nominal strength in sh	near vielding	
	$R_n \coloneqq 0.6 \cdot F_{ya} \cdot A_{qv}$	$R_n = 600.39 \ kN$
Interaction ratio in s	Shear yielding $I_{14} \coloneqq \frac{1.5 \; P_1}{R_n}$ ure at connection 1	
	$_{\tau}$ 1.5 $P_{1}$	I 0.007
	$I_{14} = \overline{R_n}$	$I_{_{14}}\!=\!0.237$
Clip angle shear ruptu	re at connection 1	
Net area in shear		
119 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	$A_{nv}\!\coloneqq\!A_{qv}\!-\!2m{\cdot}n_1m{\cdot}d_{bh}m{\cdot}t_a$	$A_{nv} = 2630.28 \; mm^2$
	ne ge 1 on a	160
Nominal strength in sh	near rupture	
	$R_n \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv}$	$R_n = 631.267 \ kN$
Interaction ratio in s	shear runture	O <sub>2</sub>
	$I_{15} = \frac{2.0 \ P_1}{R}$	$I_{15} = 0.301$
	$R_n$	15/
Clip angle block shear	r at connection 1	CV.
Gross area subjected t		
	$A_{gv}\!\coloneqq\!2\boldsymbol{\cdot} \big(L_1\!-\!ed_3\big)\boldsymbol{\cdot} t_a$	$A_{gv} = 3335.5 \; mm^2$
Net area subjected to	hlock shear	
net area subjected to	$A_{nv} \coloneqq A_{gv} - 2 \cdot (n_1 - 0.5) \cdot d_{bh} \cdot t_a$	$A_{nv} = 2191.9 \; mm^2$
	nv - gv - (-1 - gv) - a	nv = 10 110 11011

	$A_{nt}\!\coloneqq\!\left(2m{\cdot} l_{oa}\!+\!t_g\!-\!2m{\cdot} g\!-\!d_{bh} ight)\!m{\cdot} t_a$	$A_{nt} = 760.494 \ mm^2$
Nominal strength		
Ğν	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
4	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{qv} + F_{ua} \cdot A_{nt}$	
100	10n2	
	$R_n \coloneqq min\left(R_{n1},R_{n2}\right)$	$R_n = 804.523 \ kN$
Interaction ratio	in block shear	
	$\frac{1}{1} = 2.0 P_1$	7 -0.226
i	$I_{_{16}}\coloneqqrac{2.0\ P_1}{R_n}$	$I_{16} = 0.236$
Weld check at con	nection 1	
	0	
	sb,   b <sub>w</sub>	
	P <sub>1</sub>	
	L <sub>1</sub> /2	
Length of horizon	tal run of weld	
Length of horizon	tal run of weld $b_w \!\coloneqq\! l_{ia} \!-\! sb_1$	$b_w$ = 76.9 $m{mm}$
	tal run of weld $b_w\!\coloneqq\! l_{ia}\!-\!sb_1$	$b_w$ = 76.9 $mm$
Length of horizon Centroid of weld	tal run of weld $b_w \coloneqq l_{ia} - sb_1$ group $b_w^2$	$b_w = 76.9 \ mm$
	tal run of weld $b_w\!\coloneqq\!l_{ia}\!-\!sb_1$ group $c_w\!\coloneqq\!rac{b_w^2}{2\!\cdot\!b_w\!+\!L_1}$	$b_w\!=\!76.9~mm$ $c_w\!=\!16.255~mm$
Centroid of weld	group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$	$b_w\!=\!76.9~mm$ $c_w\!=\!16.255~mm$
	group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ thear force $e_w \coloneqq l_{ia} - c_w$	$b_w\!=\!76.9~m{mm}$ $c_w\!=\!16.255~m{mm}$ $e_w\!=\!72.645~m{mm}$
Centroid of weld	tal run of weld $b_w \coloneqq l_{ia} - sb_1$ group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ thear force $e_w \coloneqq l_{ia} - c_w$	$b_w$ = 76.9 $mm$ $c_w$ = 16.255 $mm$ $e_w$ = 72.645 $mm$
Centroid of weld  Eccentricity of s	tal run of weld $b_w\!\coloneqq\! l_{ia}\!-\!sb_1$ group $c_w\!\coloneqq\! \frac{b_w^2}{2\!\cdot\! b_w\!+\! L_1}$ thear force $e_w\!\coloneqq\! l_{ia}\!-\!c_w$	$b_w$ = 76.9 $mm$ $c_w$ = 16.255 $mm$ $e_w$ = 72.645 $mm$
Centroid of weld  Eccentricity of s	tal run of weld $b_w \coloneqq l_{ia} - sb_1$ group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ thear force $e_w \coloneqq l_{ia} - c_w$ nertia of weld group $(2 \cdot b_w + L_1)^3  b_w^2 \cdot (b_w + L_1)^2$	$b_{w}\!=\!76.9~mm$ $c_{w}\!=\!16.255~mm$ $e_{w}\!=\!72.645~mm$
Centroid of weld  Eccentricity of s	tal run of weld $b_w \coloneqq l_{ia} - sb_1$ group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ shear force $e_w \coloneqq l_{ia} - c_w$ nertia of weld group $I_w \coloneqq \frac{\left(2 \cdot b_w + L_1\right)^3}{12} - \frac{b_w^2 \cdot \left(b_w + L_1\right)^2}{2 \cdot b_w + L_s}$	$b_{w}\!=\!76.9\;m{mm}$ $c_{w}\!=\!16.255\;m{mm}$ $e_{w}\!=\!72.645\;m{mm}$ $I_{w}\!=\!2674.44\;m{cm}^{3}$
Centroid of weld  Eccentricity of s  Polar moment of i	That $c_w := l_{ia} - sb_1$ group $c_w := \frac{b_w^2}{2 \cdot b_w + L_1}$ whear force $e_w := l_{ia} - c_w$ when $c_w := l_{ia} - c_w$ where $c_w := l_{ia} - c_w$ and $c_w := \frac{(2 \cdot b_w + L_1)^3}{12} - \frac{b_w^2 \cdot (b_w + L_1)^2}{2 \cdot b_w + L_1}$	$b_{w}\!=\!76.9\;mm$ $c_{w}\!=\!16.255\;mm$ $e_{w}\!=\!72.645\;mm$ $I_{w}\!=\!2674.44\;cm^{3}$
Centroid of weld  Eccentricity of s	tal run of weld $b_w \coloneqq l_{ia} - sb_1$ group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ shear force $e_w \coloneqq l_{ia} - c_w$ nertia of weld group $I_w \coloneqq \frac{\left(2 \cdot b_w + L_1\right)^3}{12} - \frac{b_w^2 \cdot \left(b_w + L_1\right)^2}{2 \cdot b_w + L_1}$ a stress along x	$b_{w}\!=\!76.9~mm$ $c_{w}\!=\!16.255~mm$ $e_{w}\!=\!72.645~mm$ $I_{w}\!=\!2674.44~cm^{3}$
Centroid of weld  Eccentricity of s  Polar moment of i	Stal run of weld $b_w \coloneqq l_{ia} - sb_1$ group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ shear force $e_w \coloneqq l_{ia} - c_w$ nertia of weld group $I_w \coloneqq \frac{\left(2 \cdot b_w + L_1\right)^3}{12} - \frac{b_w^2 \cdot \left(b_w + L_1\right)^2}{2 \cdot b_w + L_1}$ a stress along x $f_w \coloneqq \frac{P_1 \cdot e_w \cdot L_1}{2}$	$b_{w}\!=\!76.9\;mm$ $c_{w}\!=\!16.255\;mm$ $e_{w}\!=\!72.645\;mm$ $I_{w}\!=\!2674.44\;cm^{3}$
Centroid of weld  Eccentricity of s  Polar moment of i	tal run of weld $b_w \coloneqq l_{ia} - sb_1$ group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ shear force $e_w \coloneqq l_{ia} - c_w$ nertia of weld group $I_w \coloneqq \frac{\left(2 \cdot b_w + L_1\right)^3}{12} - \frac{b_w^2 \cdot \left(b_w + L_1\right)^2}{2 \cdot b_w + L_1}$ a stress along x $f_{wx} \coloneqq \frac{P_1 \cdot e_w \cdot L_1}{4 \cdot I_w}$	$b_{w}\!=\!76.9~mm$ $c_{w}\!=\!16.255~mm$ $e_{w}\!=\!72.645~mm$ $I_{w}\!=\!2674.44~cm^{3}$ $f_{wx}\!=\!0.135~\frac{kN}{mm}$
Centroid of weld  Eccentricity of s  Polar moment of i	Stal run of weld $b_w \coloneqq l_{ia} - sb_1$ group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ shear force $e_w \coloneqq l_{ia} - c_w$ nertia of weld group $I_w \coloneqq \frac{\left(2 \cdot b_w + L_1\right)^3}{12} - \frac{b_w^2 \cdot \left(b_w + L_1\right)^2}{2 \cdot b_w + L_1}$ is stress along x $f_{wx} \coloneqq \frac{P_1 \cdot e_w \cdot L_1}{4 \cdot I_w}$ is stress along y	$b_{w}\!=\!76.9~mm$ $c_{w}\!=\!16.255~mm$ $e_{w}\!=\!72.645~mm$ $f_{wx}\!=\!0.135~\frac{kN}{mm}$
Centroid of weld  Eccentricity of s  Polar moment of i  Component of weld	group $c_w \coloneqq \frac{b_w^2}{2 \cdot b_w + L_1}$ whear force $e_w \coloneqq l_{ia} - c_w$ nertia of weld group $I_w \coloneqq \frac{\left(2 \cdot b_w + L_1\right)^3}{12} - \frac{b_w^2 \cdot \left(b_w + L_1\right)^2}{2 \cdot b_w + L_1}$ a stress along x $f_{wx} \coloneqq \frac{P_1 \cdot e_w \cdot L_1}{4 \cdot I_w}$ a stress along y	$b_{w}\!=\!76.9~mm$ $c_{w}\!=\!16.255~mm$ $e_{w}\!=\!72.645~mm$ $I_{w}\!=\!2674.44~cm^{3}$ $f_{wx}\!=\!0.135~\frac{kN}{mm}$
Centroid of weld  Eccentricity of s  Polar moment of i  Component of weld	The stress along $\mathbf{y}$ is the stress along $$	$b_{w}\!=\!76.9~mm$ $c_{w}\!=\!16.255~mm$ $e_{w}\!=\!72.645~mm$ $f_{wx}\!=\!2674.44~cm^{3}$ $f_{wx}\!=\!0.135~\frac{kN}{mm}$

Resultant weld stress		1.37
	$f_w \coloneqq \sqrt{f_{wx}^2 + f_{wy}^2}$	$f_w = 0.249 \frac{kN}{mm}$
Nominal weld strength		
No. The series of the series o	$R_n \coloneqq 0.6 \cdot F_{EXX} \cdot \frac{\sqrt{2}}{2} \cdot w$	$R_n = 1.227 \frac{kN}{mm}$
Interaction ratio for		
	$I_{17} \coloneqq \frac{2.0 \ f_w}{R_n}$	$I_{_{17}} \! = \! 0.406$
		.,
Gusset rupture at weld	d at connection 1 to match weld strength	
7.		
(2) (2) (3)	$t_{g.min} \coloneqq rac{2.0 \cdot 2 \cdot f_w}{0.6 \cdot F_{up}}$	$t_{g.min}$ = 4.148 $mm$
Interaction ratio in	web rupture	
	$I_{18} = rac{t_{g.min}}{t_g}$	$I_{18} = 0.259$
Dall share at server		
Bolt shear at connect. Nominal slip resistan		
	$R_n := \mu \cdot 1.13 \cdot T_{pre}$	$R_n = 13.413 \ kip$
	$R_n \coloneqq \mu \cdot 1.13 \cdot T_{pre}$	
Interaction ratio in 1		
	Solt shear $I_{19} \coloneqq rac{1.5 \ P_{b2}}{R_n}$	$I_{_{19}} = 0.827$
Bolt bearing at gusse Length of connection	t plate at connection 2	
	$L_2 \coloneqq ig(n_2 - 1ig) \cdot s$	$L_2 \!=\! 11.024 \; in$
Distance of gusset ou	ter edge from work point	
	$loc_{go} \coloneqq g_2 + sb_1 + 0.5 \ t_{wb1}$	$loc_{go} = 20.335$ in
Distance of gusset in	ner edge from work point	
$loc_{gi}$ :	$=c_{2}+sb_{1}+0.5 \ t_{wb1}-\mathbf{if}igg(c_{1}=0\ ,0\ ,ig(g_{bm2}+ex_{2}ig)\cdotrac{c_{2}}{c_{1}}igg)$	$loc_{gi}\!=\!3.603$ $in$
Outer edge distance for	or clip on gusset	
	$ed_{go}\coloneqq loc_{go}-loc_2-L_2$	$ed_{go}$ $=$ $1.437$ $in$
Inner edge distance for	or clip on gusset	0
	$ed_{gi} \coloneqq loc_2 - loc_{gi}$	$ed_{gi}$ $=$ $4.271$ $m{in}$
Minimum edge distance	for clip on gusset	42
	$ed_g \coloneqq min\left(ed_{go}^{J}, ed_{gi} ight)$	$ed_g$ =1.437 $in$
Clear distance between	n bolt holes/ hole and edge	Ö.
	$l_c \coloneqq min\left(s - d_{bh}, ed_q - 0.5 \cdot d_{bh}\right)$	$l_c = 0.965   in$

Nominal strength	n in bearing	
	$R_n \coloneqq min\left(1.2 \cdot l_c \cdot t_g \cdot F_{up}, 2.4 \cdot d_b \cdot t_g \cdot F_{up}\right)$	$R_n = 42.317 \; kip$
Interaction rati	io in bolt bearing	
(0)	$2.0 \ P_{b2}$	
Ġ	$I_{20} \coloneqq \frac{2.0 \; P_{b2}}{R_n}$	$I_{20} = 0.35$
Bolt bearing at	beam flange at connection 2	
	bolt to beam flange edge	
	$ed_b\!\coloneqq\!loc_2\!-\!cp_2\!-\!sbb_2\!-\!0.5\ t_{wb2}$	$ed_b = 183.555$ mm
Clear distance k	petween bolt holes/ hole and edge	
	$l_c\!\coloneqq\!min\left(s\!-\!d_{bh},ed_b\!-\!0.5\!ullet d_{bh} ight)$	$l_c = 46$ mm
Nominal strength		
	$R_n = min\left(1.2 \cdot l_c \cdot t_{fb2} \cdot F_{ub}, 2.4 \cdot d_b \cdot t_{fb2} \cdot F_{ub}\right)$	$R_n = 373.032 \ kN$
Interaction rati	io in bolt bearing	
	$I_{21} \coloneqq \frac{2.0 \; P_{b2}}{R}$	$I_{_{21}} = 0.176$
Cusset sheer	elding at connection 2	
Gross area in sh	near	
	$A_g\!\coloneqq\!(g_2\!-\!c_2)\!\cdot\! t_g$	$A_g\!=\!8.68$ $in^2$
Nominal shear st	crength of gusset in yielding	
	$R_n \coloneqq 0.6 \cdot F_{yp} \cdot A_g$	$R_n = 188.84 \ kip$
Interaction rati	io in gusset yieldling $I \coloneqq \frac{1.5 \; P_2}{}$	
	$1.5 P_2$	
	$I_{22} := \frac{1.5 \ P_2}{R_n}$	$I_{22} = 0.294$
Current sheem must		
Net area in shear	oture at connection 2	
Net area in blice	$I_{22}$ := $\frac{1}{R_n}$ poture at connection 2  ar $A_n$ := $A_g - n_2 \cdot d_{bh} \cdot t_g$ crength of gusset in rupture	$A_n = 5.704 \; in^2$
Nominal shear st	crength of gusset in rupture	150
	$R_n \coloneqq 0.6 \cdot F_{up} \cdot A_n$	$R_n = 198.551 \; kip$
Interaction rati	io in shear rupture	$I_{23} = 0.373$
	$_{I}$ $^{2.0}$ $P_{2}$	7 0 272
	$I_{23} = \frac{2.0 \ P_2}{R_n}$	23 = 0.575
Gusset plate blo	ock shear at connection 2	16
	ected to block shear	72
	$A_{gv}\!\coloneqq\! \big(L_2\!+\!ed_g\big)\!\cdot\! t_g$	$A_{gv}\!=\!5064.16\;m{mm}^2$
Net area subject	ted to block shear	10.
	$A_{nv}\!\coloneqq\!A_{gv}\!-\!\left(n_2\!-\!0.5\right)\!\cdot\!d_{bh}\!\cdot\!t_g$	$A_{nv} = 3336.16 \ mm^2$

Net area subjecte	$A_{nt} \coloneqq ig(g_{bm2} + ex_2 - 0.5 \ d_{bh}ig) ullet t_g$	$A_{nt}$ = 1008 $m{mm}^2$
0		
Nominal strength	in block shear	
,(0	$R_{n1} \coloneqq 0.6 \cdot F_{ua} \cdot A_{nv} + F_{ua} \cdot A_{nt}$	
Ç,		
9	$R_{n2} \coloneqq 0.6 \cdot F_{ya} \cdot A_{gv} + F_{ua} \cdot A_{nt}$	
	$R_n \coloneqq min\left(R_{n1},R_{n2} ight)$	$R_n = (1.163 \cdot 10^3) \ kN$
79	( 1027 1027	
Interaction ratio	in block shear	
	$I_{24} = \frac{2.0 \ P_2}{R_n}$	$I_{24} = 0.283$
	$rac{1}{24}$ $R_n$	24
Cusset florum wi	olding at connection 2	
	elding at connection 2	
Eccentricity of f	orce at connection 2	
	$ec_2 \coloneqq \max\left(c_1 - ex_2, 0\right)$	$ec_2 = 125$ mm
Nominal moment st	renght of gusset	
	$F_{sa} \cdot t_s \cdot q_s^2$	
	$M_n \coloneqq rac{oldsymbol{F_{yp} \cdot t_g \cdot g_2}^2}{4}$	$M_n = 250 \; \mathbf{kN \cdot m}$
	$M_n \coloneqq \frac{g_1 - g_2}{4}$ in gusset flexure $I_2 \coloneqq \frac{1.67 \; \left(P_2 \cdot ec_2\right)}{M_n}$	
Interaction ratio	in gusset flexure	
	1.67 (D	
	$I := \frac{1.07 \left(P_2 \cdot ec_2\right)}{1.07 \left(P_2 \cdot ec_2\right)}$	$I_{25} = 0.137$
	$M_n$	25
	2.	
	42	
	2	
	C	
	<del></del>	
	<u> </u>	
	<b></b>	8
		80,
		63
		So <sub>2</sub>
		Co. So.
		6, 6, 2,
		603 604 704
		Co. So.
		Co. So.

### Validation Results

The calculated ratios are compared with the output of Osoconn and if it is within a tolerance of 1% the result is deemed to be OK.

Table 7: Validation problem 6 results

	Interactio	n Ratio	
Check	Calculated	Osoconn	Result
Bolt shear at brace check	0.398	0.398	OK
Bolt bearing at brace check	0.289	0.289	OK
Bolt bearing at gusset check	0.458	0.458	OK
Brace tension rupture check	0.244	0.244	OK
Brace block shear check	0.288	0.288	OK
Gusset tension yielding check	0.342	0.342	OK
Gusset tension rupture check	0.323	0.323	OK
Gusset block shear check	0.342	0.342	OK
Bolt shear at connection 1	0.398	0.398	OK
Bolt bearing at clip angle at connection 1	0.301	0.301	OK
Bolt bearing at beam web at connection 1	0.148	0.148	OK
Gusset shear yielding at connection 1	0.17	0.17	OK
Gusset plate block shear at connection 1	0.165	0.165	OK
Gusset flexure yielding at connection 1	0.106	0.106	OK
Clip angle shear yielding at connection 1	0.237	0.237	OK
Clip angle shear rupture at connection 1	0.301	0.301	OK
Clip angle block shear at connection 1	0.236	0.236	OK
Weld check at connection 1	0.406	0.406	OK
Gusset rupture at weld at connection 1	0.259	0.259	OK
Bolt shear at connection 2	0.827	0.827	OK
Bolt bearing at gusset plate at connection 2	0.35	0.35	OK
Bolt bearing at beam web at connection 2	0.176	0.176	OK
Gusset shear yielding at connection 2	0.294	0.294	OK
Gusset shear rupture at connection 2	0.373	0.373	OK
Gusset plate block shear at connection 2	0.283	0.283	OK
Gusset flexure yielding at connection 2	0.137	0.137	OK

# 3 Osoconn Output

## 3.1 Validation problem 1

Connection code : HB001AM10  Connection ID : HB001_1	
Design Summary	
Connection is OK  Maximum interaction ratio	     0.572
Design Input	İ
Design method	LRFD
Brace axial force (P)	35.000 kip
Beam steel grade	ASTM A36
Beam yield strength	36.000 ksi
Beam tensile strength	58.000 ksi
Angle steel grade	I   ASTM A36
Angle yield strength	36.000 ksi
Angle tensile strength	58.000 ksi
Plate steel grade	   ASTM A36
Plate yield strength	36.000 ksi
Plate tensile strength	58.000 ksi
Number of bolts in gusset to brace connection	3
Number of bolt rows in gusset to brace connection	1
Number of bolts in connection 1 (n1)	3
Number of bolts in connection 2 (n2)	3
Bolt grade	   ASTM A325
Bolt nominal tensile strength	90.000 ksi
Bolt type	Friction
Bolt thread in shear plane	Yes
Bolt diameter	0.875 in
Bolt gage on brace angle	1.750 in
Bolt spacing	2.500 in
Bolt distance to edge on brace in the direction of force	1.250 in
Weld electrode	   E70
Weld tensile strength	70.000 ksi
Brace section	   2 X L3-1/2X3-1/2X3/8
Brace angle from beam at connection 1 (theta)	45.000 deg
Orientation of back to back legs	Horizontal
Outstanding leg type	Short Leg
Gusset plate thickness	   0.500 in

Gusset dimension along connection 1	15.000 in
Gusset dimension along connection 2	15.000 in
Gusset cutout along connection 1	4.000 in
Gusset cutout along connection 2	4.000 in
Connection type at connection 1	   Clin Anglo
Connection type at connection 1	Clip Angle
Connection type at connection 2	Clip Angle
Clip angles at connection to beam	   2 X L3-1/2X3X3/8
Thickness of clip to gusset weld	0.250 in
Bolt gage on clip angle	1.750 in
Section property of beam at connection 1	W12x40
Thickness of web	0.295 in
	·
Thickness of flange	0.515 in
Width of fange	8.010 in
Section property of beam at connection 2	W14x48
Thickness of web	0.340 in
Thickness of flange	0.595 in
Width of fange	8.030 in
Design Calculation	 
Bolt shear at brace check:	i
Nominal strength of bolts in shear (Rn)	79.326 kip
LRFD factor in bolt shear (phi)	1.000
Allowable strength in bolt shear	1
_	70 206 h-i-
[Ra=phi*Rn]	79.326 kip
Interaction ratio in bolt shear	
[P/Ra]	0.441
Bolt bearing at brace check:	ļ
Shear force per bolt in brace connection (Pb)	,   11.667 kip
<del>-</del>	<del>-</del>
Nominal strength in bolt bearing at brace (Rn)	20.391 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at brace	
[Ra=phi*Rn]	15.293 kip
Interaction ratio in bolt bearing at brace	
[Pb/(2*Ra)]	0.381
Bolt bearing at gusset check:	l I
	l   07 400 1-≟
Nominal strength in bolt bearing at gusset plate	27.188 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at gusset	
[Ra=phi*Rn]	20.391 kip
Interaction ratio in bolt bearing at gusset plate	1
[Pb/Ra]	1 0.572
	1
Brace tension rupture check:	I
Gross area of brace	5.000 in^2
Shear Lag Factor (U)	0.800
Net area of brace (An)	4.297 in^2
· · · · · · · · · · · · · · · · · · ·	, . <del> ·</del>

Effective area for tensile rupture	
[Ae=An*U]	3.438 in^2
Nominal strength in brace rupture (Pn)	199.375 kip
-	0.750
Allowable strength in brace rupture	
[Pa=phi*Pn]	149.531 kip
Interaction ratio in brace rupture	
[P/Pa]	0.234
Brace block shear check:	
	4.688 in^2
	2.930 in^2
	0.961 in^2
Nominal block shear strength at brace (Rn)	156.984 kip
1	0.750
Alloable block shear strength at brace	117 720 1-:
[Ra=phi*Rn]	117.738 kip
Interaction ratio in block shear at brace [P/Ra]	0.297
[r/na]	0.291
Gusset tension yielding check:	
Lenght of Whitmore section	5.774 in
Gusset plate area in tension yielding	5.000 in^2
Nominal strength in gusset yielding (Pn)	103.923 kip
LRFD factor in tension yielding	
[phi]	0.900
Allowable strength of gusset tension yielding	
[Pa=phi*Pn]	93.531 kip
Interaction ratio in gusset plate tension yielding	
[P/Pa]	0.374
Charact tongion muntum shock.	
Gusset tension rupture check:  Gusset plate net area in tension	2.418 in^2
Nominal strength in gusset rupture (Pn)	140.244 kip
LRFD factor in tension rupture	140.244 KIP
[phi]	0.750
Allowable strength of gusset tension rupture	0.700
[Pa=phi*Pn]	105.183 kip
Interaction ratio in gusset plate tension rupture	100.100 111
[P/Pa]	0.333
Connection 1 Checks	
Component of brace force along connection 1	
[P1=P*cos(theta)]	24.749 kip
Force per bolt in connection 1	4 405 1-1-
[Pb1=P1/n1]	4.125 kip
Bolt shear check:	
Nominal strength in bolt shear (Rn)	13.221 kip
LRFD factor in bolt shear (phi)	1.000
Allowable strength in bolt shear	
[Ra=phi*Rn]	13.221 kip
	•

Interaction ratio in bolt shear	I
[Pb1/Ra]	0.312
Bolt bearing at clip angle check:	17 100 lein
Nominal strength in bolt bearing at clip angle (Rn) LRFD factor in bolt bearing (phi)	17.128 kip   0.750
Allowable strength in bolt bearing at clip angle	1
[Ra=phi*Rn]	12.846 kip
Interaction ratio in bolt bearing at clip angle	
[Pb1/Ra]	0.321
	1
Bolt bearing at beam web check:	1
Nominal strength in bolt bearing at beam web (Rn)	32.081 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at beam web	
[Ra=phi*Rn]	24.061 kip
Interaction ratio in bolt bearing at beam web	0 171
[Pb1/Ra]	0.171
Gusset shear yielding check:	1
Gusset plate shear area	5.500 in^2
Nominal shear strength of gusset in yielding (Rn)	118.800 kip
LRFD factor in shear yielding (phi)	1.000
Allowable shear strength of gusset in yielding	1
[Ra=phi*Rn]	118.800 kip
Interaction ratio in shear yielding at gusset	1
[P1/Ra]	0.208
Cugaet wists blook about sheek.	
Gusset plate block shear check:  Gross area in shear for block shear rupture	4.835 in^2
Net area in shear for block shear rupture	4.835 in 2
Net area in tension for block shear rupture	1.250 in^2
Nominal strength in block shear at gusset (Rn)	176.936 in^2
LRFD factor in BLOCK shear (phi)	0.750
Allowable strength in block shear at gusset plate	1
[Ra=phi*Rn]	132.702 kip
Interaction ratio in block shear at gusset plate	1
[P1/Ra]	0.186
Gusset flexure yielding check:	   4.647 in
Eccentricity of force at connection (e)  Nominal flexure strength of gusset in yielding (Mn)	1012.500 kip in
LRFD factor in flexure yielding (phi)	0.900
Allowable flexure strength of gusset in yielding	1
[Ma=phi*Mn]	911.250 kip in
Interaction ratio in flexure yielding at gusset	1
[P1*e/Ma]	0.126
Clip angle shear yielding check:	   E 420 ÷=^0
Gross area in shear Nominal shear yielding strength of connecting element (Rn)	5.438 in^2   117.450 kip
LRFD factor in shear yielding (phi)	117.450 kIp
Allowable shear yielding strength of connecting element	
	•

[Ra=phi*Rn]	117.450 kip
Interaction ratio in shear yielding of element [P1/Ra]	   0.211
Clip angle shear rupture check:  Connecting element net area in shear  Nominal shear strength of connecting element in rupture (Rn)  LRFD factor in shear rupture (phi)  Allowable shear strength of connecting element in rupture  [Ra=phi*Rn]  Interaction ratio in shear rupture of connecting element  [P1/Ra]	   3.328 in^2   115.819 kip   0.750     86.864 kip 
Allowable strength in block shear at connecting element [Ra=phi*Rn] Interaction ratio in block shear at connecting element [P1/Ra]	4.594 in^2
Weld check:  Maximum stress in weld (f)  Nominal weld strength (fn)  LRFD factor for weld strength(phi)  Allowable weld strength  [fa=phi*fn]  Interaction ratio for weld strength  [f/fa]	1.920 kip/in   7.423 kip/in   0.750     5.568 kip/in     0.345
Gusset rupture at weld check:  Nominal strength of gusset at weld (Rn)  LRFD factor for rupture at weld (phi)  Allowable strength of gusset rupture at weld  [Ra=phi*Rn]  Interaction ratio for gusset rupture at weld  [P1/Ra]	   17.400 kip/in   0.750     13.050 kip/in     0.294
Connection 2 Checks	'   
Component of brace force along connection 2  [P2=P*sin(theta)]  Force per bolt in connection 2  [Pb2=P2/n2]	   24.749 kip     4.125 kip 
Bolt shear check:  Nominal strength in bolt shear (Rn)  LRFD factor in bolt shear (phi)  Allowable strength in bolt shear  [Ra=phi*Rn]	   13.221 kip   1.000     13.221 kip

Interaction ratio in bolt shear	I
[Pb2/Ra]	0.312
Bolt bearing at clip angle check:	
Nominal strength in bolt bearing at clip angle (Rn)	17.128 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at clip angle	
[Ra=phi*Rn]	12.846 kip
Interaction ratio in bolt bearing at clip angle	1 0 301
[Pb2/Ra]	0.321
Bolt bearing at beam web check:	I I
Nominal strength in bolt bearing at beam web (Rn)	36.975 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at beam web	1
[Ra=phi*Rn]	27.731 kip
Interaction ratio in bolt bearing at beam web	
[Pb2/Ra]	0.149
[- v=, vva]	1
Gusset shear yielding check:	İ
Gusset plate shear area	5.500 in^2
Nominal shear strength of gusset in yielding (Rn)	118.800 kip
LRFD factor in shear yielding (phi)	1.000
Allowable shear strength of gusset in yielding	I
[Ra=phi*Rn]	118.800 kip
Interaction ratio in shear yielding at gusset	I
[P2/Ra]	0.208
Gusset block shear check:	1
Gross area in shear for block shear rupture	4.824 in^2
Net area in shear for block shear rupture	4.824 in^2
Net area in tension for block shear rupture	1.250 in^2
Nominal strength in block shear at gusset (Rn)	176.693 in^2
LRFD factor in BLOCK shear (phi)	0.750
Allowable strength in block shear at gusset plate	120 E00 lein
[Ra=phi*Rn]	132.520 kip
Interaction ratio in block shear at gusset plate [P2/Ra]	0.187
[r z/ ha]	1 0.107
Gusset flexure yielding check:	i I
Eccentricity of force at connection (e)	4.670 in
Nominal flexure strength of gusset in yielding (Mn)	1012.500 kip in
LRFD factor in flexure yielding (phi)	0.900
Allowable flexure strength of gusset in yielding	1
[Ma=phi*Mn]	911.250 kip in
Interaction ratio in flexure yielding at gusset	I
[P1*e/Ma]	0.127
	1
Clip angle shear yielding check:	
Gross area in shear	5.438 in^2
Nominal shear yielding strength of connecting element (Rn)	117.450 kip
LRFD factor in shear yielding (phi)	1.000
Allowable shear yielding strength of connecting element	I

[Ra=phi*Rn]	117.450 kip
Interaction ratio in shear yielding of element [P2/Ra]	0.211
Clip angle shear rupture check:  Connecting element net area in shear  Nominal shear strength of connecting element in rupture (Rn)	     3.328 in^2   115.819 kip
LRFD factor in shear rupture (phi) Allowable shear strength of connecting element in rupture [Ra=phi*Rn]	0.750     86.864 kip
Interaction ratio in shear rupture of connecting element [P2/Ra]	00.004 kTp     0.285
Clip angle block shear check:	 
Gross area in shear for block shear rupture	4.594 in^2
Net area in shear for block shear rupture	2.836 in^2
Net area in tension for block shear rupture	1.148 in^2
Nominal strength in block shear at shear tab (Rn)	165.300 kip
LRFD factor in block shear (phi)	0.750
Allowable strength in block shear at connecting element	l
[Ra=phi*Rn]	123.975 kip
Interaction ratio in block shear at connecting element	I
[P2/Ra]	0.200
Weld check:	
Maximum stress in weld (f)	1.920 kip/in
<del>-</del>	7.423 kip/in
LRFD factor for weld strength(phi)	0.750
Allowable weld strength	
[fa=phi*fn]	5.568 kip/in
Interaction ratio for weld strength	
[f/fa]	0.345 
Gusset rupture at weld check:	
Nominal strength of gusset at weld (Rn)	17.400 kip
LRFD factor for rupture at weld (phi)	0.750
Allowable strength of gusset rupture at weld [Ra=phi*Rn] Interaction ratio for gusset rupture at weld	   13.050 kip 
[P2/Ra]	0.294
3.2 Validation problem 2	
Osoconn v1.1	
Connection code: HB001AM10	
Connection ID : HB001_2	
Design Summary	   
Connection is OK	 
Maximum interaction ratio	0.490
	+

Design Input

Design method	   LRFD
Brace axial force (P)	45.000 kip
	i
Beam steel grade	ASTM A36
Beam yield strength	36.000 ksi
Beam tensile strength	58.000 ksi
	I
Angle steel grade	ASTM A36
Angle yield strength	36.000 ksi
Angle tensile strength	58.000 ksi
	I
Plate steel grade	ASTM A36
Plate yield strength	36.000 ksi
Plate tensile strength	58.000 ksi
	I
Number of bolts in gusset to brace connection	3
Number of bolt rows in gusset to brace connection	1
Number of bolts in connection 1 (n1)	5
Number of bolts in connection 2 (n2)	4
	I
Bolt grade	ASTM A325
Bolt nominal tensile strength	90.000 ksi
Bolt type	Bearing
Bolt thread in shear plane	Yes
Bolt diameter	0.875 in
Bolt gage on brace angle	1.750 in
Bolt spacing	2.500 in
Bolt distance to edge on brace in the direction of force	1.250 in
Weld electrode	l E70
Weld tensile strength	70.000 ksi
HOLG CONSILO BOLONGON	1
Brace section	2 X L4X3X3/8
Brace angle from beam at connection 1 (theta)	35.000 deg
Orientation of back to back legs	Vertical
Outstanding leg type	Short Leg
211111111111111111111111111111111111111	I
Gusset plate thickness	0.500 in
Gusset dimension along connection 1	20.000 in
Gusset dimension along connection 2	20.000 in
Gusset cutout along connection 1	4.000 in
Gusset cutout along connection 2	4.000 in
	İ
Connection type at connection 1	Shear Tab
Connection type at connection 2	Shear Tab
V.1	İ
Thickness of shear tab	0.500 in
Thickness of shear tab to beam weld	0.250 in
Bolt gage on shear tab (gs)	1.750 in
	1
Section property of beam at connection 1	W10X30
Thickness of web	0.300 in

Nath of Tange   Section property of beam at connection 2   WiNX19	Thickness of flange	0.510 in
Thickness of flange   0.395 in   0.395 in   4.020 in    Width of fange   1.0.395 in   4.020 in    Design Calculation	Width of fange	5.810 in
Thickness of flange   0.395 in   4.020 in		·
Design Calculation		
Design Calculation	_	
Bolt shear at brace check:		
Nominal strength of bolts in shear (Rn)		 
Nominal strength of bolts in shear (Rn)   194.853 kip     LHFD factor in bolt shear (phi)   0.750     Allowable strength in bolt shear     [Ra=phi*Rn]   146.140 kip     Interaction ratio in bolt shear     [P/Ra]   0.308     Bolt bearing at brace check:       Shear force per bolt in brace connection (Pb)   7.500 kip     Nominal strength in bolt bearing at brace (Rn)   20.391 kip     LRFD factor in bolt bearing at brace (Rn)   20.391 kip     LRFD factor in bolt bearing at brace (Rn)   15.293 kip     Interaction ratio in bolt bearing at brace     [Ra=phi*Rn]   15.293 kip     Interaction ratio in bolt bearing at brace     [Pb/Ra]   0.490     Bolt bearing at gusset check:       Nominal strength in bolt bearing at gusset plate   27.188 kip     LRFD factor in bolt bearing (phi)   0.750     Allowable strength in bolt bearing at gusset plate   20.391 kip     Interaction ratio in bolt bearing at gusset plate   [Pb/Ra]   0.368     Brace tension rupture check:       Gross area of brace   4.980 in^2     Shear Lag Factor (U)   0.845     Not area of brace (An)   4.277 in^2     Effective area for tensile rupture       [Ae-An*U]   3.614 in^2     Nominal strength in brace rupture (Phi)   0.750     Allowable strength in brace rupture (Phi)   0.750     Allowable strength in brace rupture (Phi)   0.750     Allowable strength in brace rupture (Phi)   0.750     Allowable strength in brace rupture (Phi)   0.750     Allowable strength in brace rupture (Phi)   0.286     Brace block shear check:       Gross area in shear   4.688 in^2     Net area in shear   4.688 in^2     Net area in shear   4.980 in^2     Net area in shear   1.336 in^2     Net area in tension   1.336 in^2		1
LRFD factor in bolt shear (phi)   1 0.750	Bolt shear at brace check:	i
LRFD factor in bolt shear (phi)   1 0.750		194.853 kip
Allowable strength in bolt shear  [Ra-phi*Rn]   146.140 kip  Interaction ratio in bolt shear	_	<del>-</del>
Ra=phi*Rn      146.140 kip		
P/Ra	_	146.140 kip
Bolt bearing at brace check:  Shear force per bolt in brace connection (Pb)  Nominal strength in bolt bearing at brace (Rn)  LRFD factor in bolt bearing (phi)  Allowable strength in bolt bearing at brace  [Pb/Ra]  Bolt bearing at gusset check:  Nominal strength in bolt bearing at gusset plate  [Ra=phi*Rn]  LRFD factor in bolt bearing at gusset plate  [Ra=phi*Rn]  Interaction ratio in bolt bearing at gusset plate  [Ra=phi*Rn]  Interaction ratio in bolt bearing at gusset  [Ra=phi*Rn]  Interaction ratio in bolt bearing at gusset  [Ra=phi*Rn]  Interaction ratio in bolt bearing at gusset plate  [Pb/Ra]  Brace tension rupture check:  Gross area of brace  Shear Lag Factor (U)  Net area of brace (An)  Effective area for tensile rupture  [Ae=An*U]  Nominal strength in brace rupture (Pn)  LRFD factor in tension rupture (Phi)  Allowable strength in brace rupture  [Pa=phi*Pn]  Interaction ratio in brace rupture  [Pa=phi*Pn]  Interaction ratio in brace rupture  [Pa=phi*Pn]  Interaction ratio in brace rupture  [PA=p	-	ı
Shear force per bolt in brace connection (Pb)	[P/Ra]	0.308
Shear force per bolt in brace connection (Pb)		
Nominal strength in bolt bearing at brace (Rn)	Bolt bearing at brace check:	1
LRFD factor in bolt bearing (phi)   0.750	Shear force per bolt in brace connection (Pb)	7.500 kip
Allowable strength in bolt bearing at brace  [Ra=phi*Rn]  Interaction ratio in bolt bearing at brace  [Pb/Ra]  Bolt bearing at gusset check:  Nominal strength in bolt bearing at gusset plate  LRFD factor in bolt bearing (phi)  Allowable strength in bolt bearing at gusset  [Ra=phi*Rn]  Interaction ratio in bolt bearing at gusset plate  [Pb/Ra]  Brace tension rupture check:  Gross area of brace  Shear Lag Factor (U)  Not area of brace (An)  Effective area for tensile rupture  [Ae=An*U]  Nominal strength in brace rupture (Pn)  LRFD factor in tension rupture (phi)  Allowable strength in brace rupture  [Pa=phi*Pn]  Interaction ratio in brace rupture  [P]  [P]  [P]  Brace block shear check:  Gross area in shear  Net area in shear  Net area in tension  [1.336 in^2]	Nominal strength in bolt bearing at brace (Rn)	20.391 kip
[Ra=phi*Rn]   15.293 kip Interaction ratio in bolt bearing at brace [Pb/Ra]   0.490  Bolt bearing at gusset check:     Nominal strength in bolt bearing at gusset plate   27.188 kip LRFD factor in bolt bearing (phi)   0.750  Allowable strength in bolt bearing at gusset [Ra=phi*Rn]   20.391 kip Interaction ratio in bolt bearing at gusset plate [Pb/Ra]   0.368  Brace tension rupture check:     Gross area of brace   4.980 in^2   Shear Lag Factor (U)   0.845 Net area of brace (An)   4.277 in^2   Effective area for tensile rupture [Ae=An*U]   3.614 in^2   Nominal strength in brace rupture (Pn)   209.610 kip LRFD factor in tension rupture (phi)   0.750 Allowable strength in brace rupture     [Pa=phi*Pn]   157.207 kip Interaction ratio in brace rupture     [P/Pa]   0.286  Brace block shear check:     Gross area in shear   4.688 in^2   Net area in shear   2.930 in^2   Net area in tension   1.336 in^2	LRFD factor in bolt bearing (phi)	0.750
Interaction ratio in bolt bearing at brace	Allowable strength in bolt bearing at brace	I
[Pb/Ra]   0.490     Bolt bearing at gusset check:     Nominal strength in bolt bearing at gusset plate   27.188 kip   LRFD factor in bolt bearing (phi)   0.750   Allowable strength in bolt bearing at gusset   [Ra=phi*Rn]   20.391 kip   Interaction ratio in bolt bearing at gusset plate   [Pb/Ra]   0.368    Brace tension rupture check:     Gross area of brace   4.980 in^2   Shear Lag Factor (U)   0.845   Net area of brace (An)   4.277 in^2   Effective area for tensile rupture     [Ae=An*U]   3.614 in^2   Nominal strength in brace rupture (Pn)   209.610 kip   LRFD factor in tension rupture (phi)   0.750   Allowable strength in brace rupture     [Pa=phi*Pn]   157.207 kip   Interaction ratio in brace rupture     [P/Pa]   0.286    Brace block shear check:     Gross area in shear   4.688 in^2   Net area in shear   4.688 in^2   Net area in tension   1.336 in^2	•	15.293 kip
Bolt bearing at gusset check:  Nominal strength in bolt bearing at gusset plate  LRFD factor in bolt bearing (phi)  Allowable strength in bolt bearing at gusset  [Ra=phi*Rn]  Interaction ratio in bolt bearing at gusset plate  [Pb/Ra]  Brace tension rupture check:  Gross area of brace  Shear Lag Factor (U)  Net area of brace (An)  Effective area for tensile rupture  [Ae=An*U]  Nominal strength in brace rupture (Ph)  LRFD factor in tension rupture (phi)  Allowable strength in brace rupture  [Pa=phi*Pn]  Interaction ratio in brace rupture  [P/Pa]  Brace block shear check:  Gross area in shear  Net area in shear  Net area in shear  1 4.688 in^2  Net area in tension  1 1.336 in^2  Net area in tension  1 1.336 in^2		
Nominal strength in bolt bearing at gusset plate   27.188 kip	[Pb/Ra]	0.490
Nominal strength in bolt bearing at gusset plate   27.188 kip	Bolt bearing at gusset check:	
LRFD factor in bolt bearing (phi)   0.750		27.188 kip
Allowable strength in bolt bearing at gusset  [Ra=phi*Rn]		
[Ra=phi*Rn]	<b>~</b> .	
Interaction ratio in bolt bearing at gusset plate		20.391 kip
Brace tension rupture check:  Gross area of brace Shear Lag Factor (U) Net area of brace (An)  [Ae=An*U]  Nominal strength in brace rupture (Pn)  [Repaphi*Pn]  Interaction ratio in brace rupture  [P/Pa]  Brace block shear check:  Gross area in shear  Net area in shear  Net area in shear  Net area of brace (An)    4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.980 in^2   4.688 in^2   4.688 in^2   4.688 in^2   4.688 in^2   1.336 in^2		1
Gross area of brace         4.980 in^2         Shear Lag Factor (U)         0.845         Net area of brace (An)         4.277 in^2         Effective area for tensile rupture                 [Ae=An*U]         3.614 in^2         Nominal strength in brace rupture (Pn)         209.610 kip         LRFD factor in tension rupture (phi)         0.750         Allowable strength in brace rupture                 [Pa=phi*Pn]         157.207 kip         Interaction ratio in brace rupture                 [P/Pa]         0.286         Brace block shear check:                 Gross area in shear         4.688 in^2         Net area in shear         2.930 in^2         Net area in tension         1.336 in^2	[Pb/Ra]	0.368
Gross area of brace         4.980 in^2         Shear Lag Factor (U)         0.845         Net area of brace (An)         4.277 in^2         Effective area for tensile rupture                 [Ae=An*U]         3.614 in^2         Nominal strength in brace rupture (Pn)         209.610 kip         LRFD factor in tension rupture (phi)         0.750         Allowable strength in brace rupture                 [Pa=phi*Pn]         157.207 kip         Interaction ratio in brace rupture                 [P/Pa]         0.286         Brace block shear check:                 Gross area in shear         4.688 in^2         Net area in shear         2.930 in^2         Net area in tension         1.336 in^2		I
Shear Lag Factor (U)         0.845         Net area of brace (An)         4.277 in^2         Effective area for tensile rupture                 [Ae=An*U]         3.614 in^2         Nominal strength in brace rupture (Pn)         209.610 kip         LRFD factor in tension rupture (phi)         0.750         Allowable strength in brace rupture                 [Pa=phi*Pn]         157.207 kip         Interaction ratio in brace rupture                 [P/Pa]         0.286         Brace block shear check:                 Gross area in shear         4.688 in^2         Net area in shear         2.930 in^2         Net area in tension         1.336 in^2	Brace tension rupture check:	l
Net area of brace (An)         4.277 in^2         Effective area for tensile rupture                 [Ae=An*U]         3.614 in^2         Nominal strength in brace rupture (Pn)         209.610 kip         LRFD factor in tension rupture (phi)         0.750         Allowable strength in brace rupture                 [Pa=phi*Pn]         157.207 kip         Interaction ratio in brace rupture                 [P/Pa]         0.286         Brace block shear check:                 Gross area in shear         4.688 in^2         Net area in shear         2.930 in^2         Net area in tension         1.336 in^2		,
Effective area for tensile rupture  [Ae=An*U]  Nominal strength in brace rupture (Pn)  LRFD factor in tension rupture (phi)  Allowable strength in brace rupture  [Pa=phi*Pn]  Interaction ratio in brace rupture  [P/Pa]  Brace block shear check:  Gross area in shear  Net area in shear  Net area in tension    3.614 in^2   209.610 kip   1.57.207 kip   1.57.207 kip   1.57.207 kip   1.57.207 kip   1.57.207 kip   1.57.207 kip   1.336 in^2	<u> </u>	·
[Ae=An*U]   3.614 in^2  Nominal strength in brace rupture (Pn)   209.610 kip  LRFD factor in tension rupture (phi)   0.750  Allowable strength in brace rupture   157.207 kip  [Pa=phi*Pn]   157.207 kip  Interaction ratio in brace rupture   0.286  [P/Pa]   0.286  Brace block shear check:   4.688 in^2  Net area in shear   4.688 in^2  Net area in tension   1.336 in^2		4.277 in^2
Nominal strength in brace rupture (Pn)   209.610 kip LRFD factor in tension rupture (phi)   0.750 Allowable strength in brace rupture     157.207 kip Interaction ratio in brace rupture     0.286  Brace block shear check:		
LRFD factor in tension rupture (phi)   0.750 Allowable strength in brace rupture     157.207 kip		
Allowable strength in brace rupture  [Pa=phi*Pn]   157.207 kip  Interaction ratio in brace rupture  [P/Pa]   0.286  Brace block shear check:  Gross area in shear   4.688 in^2  Net area in tension   1.336 in^2	-	
[Pa=phi*Pn]         157.207 kip         Interaction ratio in brace rupture                 [P/Pa]         0.286                           Brace block shear check:                 Gross area in shear         4.688 in^2         Net area in shear         2.930 in^2         Net area in tension         1.336 in^2		0.750
Interaction ratio in brace rupture  [P/Pa]   0.286    Brace block shear check:   Gross area in shear   4.688 in^2  Net area in shear   2.930 in^2  Net area in tension   1.336 in^2		157 007 1-:
[P/Pa]   0.286     Brace block shear check:     Gross area in shear   4.688 in^2   Net area in shear   2.930 in^2   Net area in tension   1.336 in^2	•	157.207 kip
Brace block shear check:  Gross area in shear  Net area in shear  Net area in tension    4.688 in^2   2.930 in^2   1.336 in^2		1 0 286
Gross area in shear         4.688 in^2         Net area in shear         2.930 in^2         Net area in tension         1.336 in^2	[1/1 a]	0.200
Net area in shear   2.930 in^2 Net area in tension   1.336 in^2	Brace block shear check:	i
Net area in tension   1.336 in^2	Gross area in shear	4.688 in^2
	Net area in shear	
Nominal block shear strength at brace (Rn)   178.734 kip	Net area in tension	1.336 in^2
	Nominal block shear strength at brace (Rn)	178.734 kip

LRFD factor in block shear (phi) Alloable block shear strength at brace	0.750
[Ra=phi*Rn] Interaction ratio in block shear at brace	134.051 kip
[P/Ra]	0.336
Gusset tension yielding check:	0.504
Lenght of Whitmore section	9.524 in
·	4.980 in^2
Nominal strength in gusset yielding (Pn)	171.423 kip
LRFD factor in tension yielding	0.000
[phi]	0.900
Allowable strength of gusset tension yielding [Pa=phi*Pn]	154.281 kip
Interaction ratio in gusset plate tension yielding	101.201 KIP
[P/Pa]	0.292
Gusset tension rupture check:	
Gusset plate net area in tension	3.824 in^2
Nominal strength in gusset rupture (Pn)	221.807 kip
LRFD factor in tension rupture	
[phi]	0.750
Allowable strength of gusset tension rupture	
[Pa=phi*Pn]	166.355 kip
Interaction ratio in gusset plate tension rupture	
[P/Pa]	0.271
Gusset block shear check:	
Gusset block shear check:  Gross area in shear	6.250 in^2
Gross area in shear	
Gross area in shear Net area in shear	6.250 in <sup>2</sup> 3.906 in <sup>2</sup> 1.406 in <sup>2</sup>
Gross area in shear Net area in shear	3.906 in^2
Gross area in shear Net area in shear Net area in tension	3.906 in <sup>2</sup> 1.406 in <sup>2</sup>
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn)	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip
Gross area in shear  Net area in shear  Net area in tension  Nominal strength of gusset in block shear (Rn)  LRFD factor in block shear (phi)	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn]	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks Component of brace force along connection 1 [P1=P*cos(theta)] Force per bolt in connection 1	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip 0.277
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks Component of brace force along connection 1 [P1=P*cos(theta)] Force per bolt in connection 1	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip 0.277
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks Component of brace force along connection 1 [P1=P*cos(theta)] Force per bolt in connection 1 [Pb1=P1/n1]	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip 0.277
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip 0.277 36.862 kip 7.372 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks Component of brace force along connection 1 [P1=P*cos(theta)] Force per bolt in connection 1 [Pb1=P1/n1]  Bolt shear check: Nominal strength in bolt shear (Rn) LRFD factor in bolt shear (phi) Allowable strength in bolt shear	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip 0.277 36.862 kip 7.372 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks Component of brace force along connection 1 [P1=P*cos(theta)] Force per bolt in connection 1 [Pb1=P1/n1]  Bolt shear check: Nominal strength in bolt shear (Rn) LRFD factor in bolt shear (phi) Allowable strength in bolt shear [Ra=phi*Rn]	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip 0.277 36.862 kip 7.372 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks Component of brace force along connection 1 [P1=P*cos(theta)] Force per bolt in connection 1 [Pb1=P1/n1]  Bolt shear check: Nominal strength in bolt shear (Rn) LRFD factor in bolt shear (phi) Allowable strength in bolt shear [Ra=phi*Rn] Interaction ratio in bolt shear	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip 0.277 36.862 kip 7.372 kip 32.476 kip 0.750 24.357 kip
Gross area in shear Net area in shear Net area in tension Nominal strength of gusset in block shear (Rn) LRFD factor in block shear (phi) Allowable strength og gusset in block shear [Ra=phi*Rn] Interaction ratio in block shear at gusset plate [P/Ra]  Connection 1 Checks Component of brace force along connection 1 [P1=P*cos(theta)] Force per bolt in connection 1 [Pb1=P1/n1]  Bolt shear check: Nominal strength in bolt shear (Rn) LRFD factor in bolt shear (phi) Allowable strength in bolt shear [Ra=phi*Rn]	3.906 in <sup>2</sup> 1.406 in <sup>2</sup> 216.562 kip 0.750 162.422 kip 0.277 36.862 kip 7.372 kip 32.476 kip 0.750

Bolt bearing at shear tab check:	1
Nominal strength in bolt bearing at shear tab (Rn)	22.837 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at shear tab	
[Ra=phi*Rn]	17.128 kip
Interaction ratio in bolt bearing at shear tab	
[Pb1/Ra]	0.430
Delt hooming at guaget check.	1
Bolt bearing at gusset check:  Nominal strength in bolt bearing at gusset (Rn)	   5/1 275 lein
LRFD factor in bolt bearing (phi)	54.375 kip   0.750
Allowable strength in bolt bearing at gusset	1 0.730
[Ra=phi*Rn]	40.781 kip
Interaction ratio in bolt bearing at gusset	
[Pb1/Ra]	0.181
	1
Gusset shear yielding check:	I
Gusset plate shear area	8.000 in^2
Nominal shear strength of gusset in yielding (Rn)	172.800 kip
LRFD factor in shear yielding (phi)	1.000
Allowable shear strength of gusset in yielding	1
[Ra=phi*Rn]	172.800 kip
Interaction ratio in shear yielding at gusset	I
[P1/Ra]	0.213
	1
Gusset shear rupture check:	1
Gusset gross area in shear	8.000 in^2
Gusset net area in shear	5.656 in^2
Nominal shear strength of gusset in rupture (Rn)	196.837 kip
LRFD factor in shear rupture (phi)	0.750
Allowable shear strength of gusset in rupture	1
[phi*Rn]	147.628 kip
Interaction ratio in shear rupture of gusset	1 0 050
[P1/Ra]	0.250
Cugaet plate block shoop shock.	 
Gusset plate block shear check:  Gross area in shear for block shear rupture	6.750 in^2
Net area in shear for block shear rupture	4.641 in^2
Net area in tension for block shear rupture	0.391 in <sup>2</sup>
Nominal strength in block shear at gusset (Rn)	168.456 in^2
LRFD factor in BLOCK shear (phi)	0.750
Allowable strength in block shear at gusset plate	1
[Ra=phi*Rn]	126.342 kip
Interaction ratio in block shear at gusset plate	
[P1/Ra]	0.292
	1
Gusset flexure yielding check:	I
Eccentricity of force at connection (e)	4.650 in
Nominal flexure strength of gusset in yielding (Mn)	1800.000 kip in
LRFD factor in flexure yielding (phi)	0.900
Allowable flexure strength of gusset in yielding	1
[Ma=phi*Mn]	1620.000 kip in
Interaction ratio in flexure yielding at gusset	I

[P1*e/Ma]	0.106
Shear tab shear yielding check:  Gross area in shear	   6.125 in^2
	132.300 kip
LRFD factor in shear yielding (phi)	1.000
Allowable shear yielding strength of connecting element	
[Ra=phi*Rn]	132.300 kip
Interaction ratio in shear yielding of element	I
[P1/Ra]	0.279
Chan tab about runture about	 
Shear tab shear rupture check:  Connecting element net area in shear	   3.781 in^2
Nominal shear strength of connecting element in rupture (Rn)	131.587 kip
LRFD factor in shear rupture (phi)	0.750
Allowable shear strength of connecting element in rupture	I
[Ra=phi*Rn]	98.691 kip
Interaction ratio in shear rupture of connecting element	
[P1/Ra]	0.374
Shear tab block shear check:	 
Gross area in shear for block shear rupture	   5.562 in^2
	3.453 in^2
1	0.641 in^2
Nominal strength in block shear at shear tab (Rn)	157.306 kip
LRFD factor in block shear (phi)	0.750
Allowable strength in block shear at connecting element	I
[Ra=phi*Rn]	117.980 kip
Interaction ratio in block shear at connecting element	
[P1/Ra]	0.312 
Shear tab flexure yeilding check:	i I
Nominal flexure yeilding strength of connecting element (Mn)	675.281 kip in
LRFD factor in flexure (phi)	0.900
Allowable strength of connecting element in flexure	<u> </u>
[Ma=phi*Mn]	607.753 kip in
Interaction ratio in flexure yielding of connecting element	I   0.106
[P1*gs/Ma]	0.10 <del>0</del> 
Weld check:	I
Maximum stress in weld (f)	1.982 kip/in
Nominal weld strength (fn)	7.423 kip/in
LRFD factor for weld strength(phi)	0.750
Allowable weld strength	
[fa=phi*fn]	5.568 kip/in
Interaction ratio for weld strength [f/fa]	ı   0.356
[1/14]	0.000
Shear tab rupture at weld check:	I
Nominal strength of shear tab rupture at weld (Rn)	17.400 kip/in
LRFD factor for rupture at weld (phi)	0.750
Allowable strength of shear tab rupture at weld	
[Ra=phi*Rn]	13.050 kip/in

Interpolation motio for about the muntum of wold	ı
Interaction ratio for shear tab rupture at weld [P1/Ra]	0.304
[2 2/ 200]	
Beam web rupture at weld check:	Ī
Nominal strength of beam web at weld (Rn)	10.440 kip/in
LRFD factor for rupture at weld (phi)	0.750
Allowable strength of beam web rupture at weld	
[Ra=phi*Rn]	7.830 kip/in
Interaction ratio for beam web rupture at weld	l
[P1/Ra]	0.253
Connection 2 Checks	 
Component of brace force along connection 2	   OF 011 1-:
<pre>[P2=P*sin(theta)] Force per bolt in connection 2</pre>	25.811 kip
[Pb2=P2/n2]	   6.453 kip
	0.405 kip 
Bolt shear check:	I
Nominal strength in bolt shear (Rn)	32.476 kip
LRFD factor in bolt shear (phi)	0.750
Allowable strength in bolt shear	l
[Ra=phi*Rn]	24.357 kip
Interaction ratio in bolt shear	
[Pb2/Ra]	0.265
Bolt bearing at shear tab check:	! 
Nominal strength in bolt bearing at shear tab (Rn)	22.837 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at shear tab	
[Ra=phi*Rn]	17.128 kip
Interaction ratio in bolt bearing at shear tab	
[Pb2/Ra]	0.377
Bolt bearing at gusset check:	 
Nominal strength in bolt bearing at gusset (Rn)	   54.375 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at gusset	<u> </u>
[Ra=phi*Rn]	40.781 kip
Interaction ratio in bolt bearing at gusset	Ī
[Pb2/Ra]	0.158
Character above and all discuss above.	
Gusset shear yielding check:	   0 000 ÷=^0
Gusset plate shear area Nominal shear strength of gusset in yielding (Rn)	8.000 in^2   172.800 kip
LRFD factor in shear yielding (phi)	172.800 kip   1.000
Allowable shear strength of gusset in yielding	1 1.000
[Ra=phi*Rn]	   172.800 kip
Interaction ratio in shear yielding at gusset	
[P2/Ra]	0.149
	I
Gusset shear rupture check:	1
Gusset gross area in shear	8.000 in^2

Gusset net area in shear  Nominal shear strength of gusset in rupture (Rn)  LRFD factor in shear rupture (phi)  Allowable shear strength of gusset in rupture  [phi*Rn]  Interaction ratio in shear rupture of gusset  [P2/Ra]	6.125 in^2   213.150 kip   0.750     159.862 kip   0.161
Gusset block shear check:	
Gross area in shear for block shear rupture	5.612 in^2
Net area in shear for block shear rupture	3.972 in^2
Net area in tension for block shear rupture	0.391 in^2
Nominal strength in block shear at gusset (Rn)	143.886 in^2
LRFD factor in BLOCK shear (phi)	0.750
Allowable strength in block shear at gusset plate	
[Ra=phi*Rn]	107.915 kip
Interaction ratio in block shear at gusset plate	
[P2/Ra]	0.239
Gusset flexure yielding check:	
Eccentricity of force at connection (e)	4.625 in
Nominal flexure strength of gusset in yielding (Mn)	1800.000 kip in
LRFD factor in flexure yielding (phi)	0.900
Allowable flexure strength of gusset in yielding	
[Ma=phi*Mn]	1620.000 kip in
Interaction ratio in flexure yielding at gusset	
[P1*e/Ma]	0.074
Chan tab about vialding about	
Shear tab shear yielding check:  Gross area in shear	 
	4.875 in^2
Nominal shear yielding strength of connecting element (Rn) LRFD factor in shear yielding (phi)	105.300 kip   1.000
Allowable shear yielding strength of connecting element	1.000 
[Ra=phi*Rn]	   105.300 kip
Interaction ratio in shear yielding of element	100.000 kip 
[P2/Ra]	0.245
Shear tab shear rupture check:	· 
Connecting element net area in shear	3.000 in^2
Nominal shear strength of connecting element in rupture (Rn)	104.400 kip
LRFD factor in shear rupture (phi)	0.750
Allowable shear strength of connecting element in rupture	
[Ra=phi*Rn]	78.300 kip
Interaction ratio in shear rupture of connecting element	]
[P2/Ra]	0.330
Shear tab block shear check:	
Gross area in shear for block shear rupture	4.312 in^2
Net area in shear for block shear rupture	2.672 in^2
Net area in tension for block shear rupture	0.641 in^2
Nominal strength in block shear at shear tab (Rn)	130.137 kip
LRFD factor in block shear (phi)	0.750
Allowable strength in block shear at connecting element	

[Ra=phi*Rn]	97.603 kip
Interaction ratio in block shear at connecting element	
[P2/Ra]	0.264
Shear tab flexure yeilding check:	407 704 1-: :
Nominal flexure yeilding strength of connecting element (Mn)	427.781 kip in
LRFD factor in flexure (phi)	0.900
Allowable strength of connecting element in flexure [Ma=phi*Mn]	   385.003 kip in
Interaction ratio in flexure yielding of connecting element	000.000 kip in
[P2*gs/Ma]	0.117
[. 2 82,]	
Weld check:	
Maximum stress in weld (f)	1.945 kip/in
Nominal weld strength (fn)	7.423 kip/in
LRFD factor for weld strength(phi)	0.750
Allowable weld strength	l
[fa=phi*fn]	5.568 kip/in
Interaction ratio for weld strength	
[f/fa]	0.349
Shear tab rupture at weld check:	
Nominal strength of shear tab rupture at weld (Rn)	17.400 kip
LRFD factor for rupture at weld (phi)	0.750
Allowable strength of shear tab rupture at weld [Ra=phi*Rn]	   13.050 kip
Interaction ratio for shear tab rupture at weld	10.000 kip 
[P2/Ra]	0.298
Beam web rupture at weld check:	
Nominal strength of beam web at weld (Rn)	8.700 kip
LRFD factor for rupture at weld (phi)	0.750
Allowable strength of beam web rupture at weld	
[Ra=phi*Rn]	6.525 kip
Interaction ratio for beam web rupture at weld	
[P2/Ra]	0.298
9.9. W.P.J.P	
3.3 Validation problem 3	
Osoconn v1.1	
Connection code : HB001AM10	
Connection ID : HB001_3	
	<b>+</b> .
Design Summary	
Connection is OK	 I
***************************************	   0.818
Design Input	 
Design method	LRFD
Brace axial force (P)	65.000 kip

Beam steel grade	ASTM A992
Beam yield strength	50.000 ksi
Beam tensile strength	65.000 ksi
	1
Angle steel grade	ASTM A36
Angle yield strength	36.000 ksi
Angle tensile strength	58.000 ksi
Plate steel grade	ASTM A36
Plate yield strength	36.000 ksi
Plate tensile strength	58.000 ksi
	1
Number of bolts in gusset to brace connection	3
Number of bolt rows in gusset to brace connection	1 2
Number of bolts in connection 1 (n1)	3
Number of bolts in connection 2 (n2)	3
Number of boits in connection 2 (n2)	1 3
Bolt grade	ASTM A490
Bolt nominal tensile strength	113.000 ksi
Bolt type	Friction
Bolt thread in shear plane	Yes
Bolt diameter	1.000 in
Bolt gage on brace angle	2.000 in
Bolt spacing	3.000 in
Bolt distance to edge on brace in the direction of force	1.500 in
bold distance to edge on blace in the direction of force	1
Weld electrode	l E70
	•
Weld tensile strength	70.000 ksi
Brace section	2 X L6X4X5/16
Brace angle from beam at connection 1 (theta)	55.000 deg
Orientation of back to back legs	Horizontal
Outstanding leg type	Short Leg
	1
Gusset plate thickness	0.500 in
Gusset dimension along connection 1	15.000 in
Gusset dimension along connection 2	15.000 in
Gusset cutout along connection 1	0.000 in
-	0.000 in
Gusset cutout along connection 2	1 0.000 III
	1
Connection type at connection 1	Bolted to Flange
Connection type at connection 2	Bolted to Flange
	1
	I
Section property of beam at connection 1	W12X58
Thickness of web	0.360 in
Thickness of flange	0.640 in
Width of fange	10.000 in
Section property of beam at connection 2	W12X58
Thickness of web	0.360 in
Thickness of flange	0.640 in
Width of fange	10.000 in

Design Calculation	l 
Bolt shear at brace check:	 
Nominal strength of bolts in shear (Rn)	260.352 kip
LRFD factor in bolt shear (phi)	1.000
Allowable strength in bolt shear [Ra=phi*Rn]	   260 252 kin
Interaction ratio in bolt shear	260.352 kip
[P/Ra]	1 0.250
[r/na]	0.250 
Bolt bearing at brace check:	! 
Shear force per bolt in brace connection (Pb)	10.833 kip
Nominal strength in bolt bearing at brace (Rn)	21.104 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at brace	
[Ra=phi*Rn]	15.828 kip
Interaction ratio in bolt bearing at brace	<u>.</u> 
[Pb/(2*Ra)]	0.342
	I
Bolt bearing at gusset check:	
Nominal strength in bolt bearing at gusset plate	33.712 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at gusset	
[Ra=phi*Rn]	25.284 kip
Interaction ratio in bolt bearing at gusset plate	
[Pb/Ra]	0.428
Brace tension rupture check:	[ [
Gross area of brace	6.060 in^2
Shear Lag Factor (U)	0.849
Net area of brace (An)	4.730 in^2
Effective area for tensile rupture	
[Ae=An*U]	4.014 in^2
Nominal strength in brace rupture (Pn)	232.811 kip
LRFD factor in tension rupture (phi)	0.750
Allowable strength in brace rupture	
[Pa=phi*Pn]	174.608 kip
Interaction ratio in brace rupture	
[P/Pa]	0.372
	<u> </u>
Brace block shear check:	
Gross area in shear	4.695 in^2
Net area in shear	3.032 in^2
Net area in tension	1.506 in^2
Nominal block shear strength at brace (Rn)	188.778 kip
LRFD factor in block shear (phi)	0.750
Alloable block shear strength at brace	
[Ra=phi*Rn]	141.584 kip
Interaction ratio in block shear at brace	I 0 450
[P/Ra]	0.459 
Gusset tension yielding check:	! 
dabbot sombion jiotaing oncon.	1

Gusset plate area in tension yielding  Nominal strength in gusset yielding (Pn)  LRFD factor in tension yielding  [phi]  Allowable strength of gusset tension yielding	8.678 in 6.060 in^2 156.208 kip 0.900
[Pa=phi*Pn] Interaction ratio in gusset plate tension yielding [P/Pa]	140.587 kip
Gusset tension rupture check:  Gusset plate net area in tension  Nominal strength in gusset rupture (Pn)  LRFD factor in tension rupture  [phi]  Allowable strength of gusset tension rupture  [Pa=phi*Pn]  Interaction ratio in gusset plate tension rupture  [P/Pa]	3.277 in <sup>2</sup> 190.043 kip 0.750 142.532 kip 0.456
Net area in shear	7.500 in <sup>2</sup> 4.844 in <sup>2</sup> 0.344 in <sup>2</sup> 181.937 kip 0.750 136.453 kip
Connection 1 Checks	
Component of brace force along connection 1  [P1=P*cos(theta)]  Force per bolt in connection 1  [Pb1=P1/n1]	37.282 kip
Bolt shear check:  Nominal strength in bolt shear (Rn)  LRFD factor in bolt shear (phi)  Allowable strength in bolt shear  [Ra=phi*Rn]  Interaction ratio in bolt shear  [Pb1/Ra]	21.696 kip 1.000 21.696 kip 0.573
Bolt bearing at gusset check:  Nominal strength in bolt bearing at gusset (Rn)  LRFD factor in bolt bearing (phi)  Allowable strength in bolt bearing at gusset  [Ra=phi*Rn]  Interaction ratio in bolt bearing at gusset  [Pb1/Ra]	67.425 kip 0.750 50.569 kip 0.246

	I
Bolt bearing at beam flange check:	! 
Nominal strength in bolt bearing at beam flange (Rn)	39.374 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at beam flange	I
[Ra=phi*Rn]	29.531 kip
Interaction ratio in bolt bearing at beam flange	l
[Pb1/Ra]	0.421
Gusset shear yielding check:	   7.500 in^2
Gusset plate shear area Nominal shear strength of gusset in yielding (Rn)	7.500 In 2   162.000 kip
LRFD factor in shear yielding (phi)	1.000
Allowable shear strength of gusset in yielding	
[Ra=phi*Rn]	162.000 kip
Interaction ratio in shear yielding at gusset	I
[P1/Ra]	0.230
	1
Gusset shear rupture check:	
	7.500 in^2
	5.906 in^2
Nominal shear strength of gusset in rupture (Rn) LRFD factor in shear rupture (phi)	205.537 kip   0.750
Allowable shear strength of gusset in rupture	0.750 
[phi*Rn]	   154.153 kip
Interaction ratio in shear rupture of gusset	
[P1/Ra]	0.242
	1
Gusset plate block shear check:	
Gross area in shear for block shear rupture	4.250 in^2
Net area in shear for block shear rupture Net area in tension for block shear rupture	2.922 in^2   1.484 in^2
Net area in tension for block shear rupture  Nominal strength in block shear at gusset (Rn)	1.484 IN 2   177.894 in^2
LRFD factor in BLOCK shear (phi)	0.750
Allowable strength in block shear at gusset plate	 
[Ra=phi*Rn]	133.420 kip
Interaction ratio in block shear at gusset plate	I
[P1/Ra]	0.279
Gusset flexure yielding check:  Eccentricity of force at connection (e)	   0.000 in
Nominal flexure strength of gusset in yielding (Mn)	1012.500 kip in
LRFD factor in flexure yielding (phi)	0.900
Allowable flexure strength of gusset in yielding	 
[Ma=phi*Mn]	911.250 kip in
Interaction ratio in flexure yielding at gusset	l
[P1*e/Ma]	0.000
Connection 2 Checks	 
Component of brace force along connection 2	I
[P2=P*sin(theta)]	53.245 kip
Force per bolt in connection 2	I

[Pb2=P2/n2]	17.748 kip
Bolt shear check:	
Nominal strength in bolt shear (Rn)	21.696 kip
LRFD factor in bolt shear (phi)	1.000
Allowable strength in bolt shear	
[Ra=phi*Rn]	21.696 kip
Interaction ratio in bolt shear	
[Pb2/Ra]	0.818
Dalt hasning at morat shash.	
Bolt bearing at gusset check:  Nominal strength in bolt bearing at gusset (Rn)	   67.425 kip
LRFD factor in bolt bearing (phi)	07.425 kip
Allowable strength in bolt bearing at gusset	0.700
[Ra=phi*Rn]	50.569 kip
Interaction ratio in bolt bearing at gusset	_
[Pb2/Ra]	0.351
Bolt bearing at beam flange check:	
Nominal strength in bolt bearing at beam flange (Rn)	96.720 kip
LRFD factor in bolt bearing (phi)	0.750
Allowable strength in bolt bearing at beam flange	70 540 1-:
[Ra=phi*Rn] Interaction ratio in bolt bearing at beam flange	72.540 kip
[Pb2/Ra]	0.245
Gusset shear yielding check:	
Gusset plate shear area	7.500 in^2
Nominal shear strength of gusset in yielding (Rn)	162.000 kip
LRFD factor in shear yielding (phi)	1.000
Allowable shear strength of gusset in yielding	
[Ra=phi*Rn]	162.000 kip
Interaction ratio in shear yielding at gusset [P2/Ra]	   0 200
[r2/na]	0.329
Gusset shear rupture check:	
Gusset gross area in shear	7.500 in^2
Gusset net area in shear	5.906 in^2
Nominal shear strength of gusset in rupture (Rn)	205.537 kip
LRFD factor in shear rupture (phi)	0.750
Allowable shear strength of gusset in rupture	
[phi*Rn]	154.153 kip
Interaction ratio in shear rupture of gusset	   0.245
[P2/Ra]	0.345
Gusset block shear check:	
Gross area in shear for block shear rupture	4.250 in^2
Net area in shear for block shear rupture	2.922 in^2
Net area in tension for block shear rupture	1.484 in^2
Nominal strength in block shear at gusset (Rn)	177.894 in^2
LRFD factor in BLOCK shear (phi)	0.750
Allowable strength in block shear at gusset plate	
[Ra=phi*Rn]	133.420 kip

Interaction ratio in block shear at gusset plate	
[P2/Ra]	0.399
Gusset flexure yielding check:  Eccentricity of force at connection (e)  Nominal flexure strength of gusset in yielding (Mn)  LRFD factor in flexure yielding (phi)  Allowable flexure strength of gusset in yielding  [Ma=phi*Mn]  Interaction ratio in flexure yielding at gusset  [P1*e/Ma]	   0.000 in   1012.500 kip in   0.900     911.250 kip in 
3.4 Validation problem 4	
Osoconn v1.1 Connection code: HB001AM10 Connection ID: HB001_4	
Design Summary	
Connection is OK  Maximum interaction ratio	   0.514
Design Input	į
Design method	+   ASD
Brace axial force (P)	105000.000 N
Beam steel grade Beam yield strength Beam tensile strength	   ASTM A992   345.000 MPa   450.000 MPa
Angle steel grade Angle yield strength Angle tensile strength	ASTM A36   250.000 MPa   400.000 MPa
Plate steel grade Plate yield strength Plate tensile strength	ASTM A36   250.000 MPa   400.000 MPa
Number of bolts in gusset to brace connection  Number of bolt rows in gusset to brace connection  Number of bolts in connection 1 (n1)  Number of bolts in connection 2 (n2)	   4   1   4   4
Bolt grade Bolt nominal tensile strength Bolt type Bolt thread in shear plane Bolt diameter Bolt gage on brace angle Bolt spacing Bolt distance to edge on brace in the direction of force	ASTM A325   620.000 MPa   Friction   Yes   24.000 mm   55.000 mm   70.000 mm

	1
Weld electrode	,   E70
Weld tensile strength	482.000 MPa
	1
Brace section	2 X L102X89X12.7
Brace angle from beam at connection 1 (theta)	65.000 deg
Orientation of back to back legs	Horizontal
Outstanding leg type	Short Leg
Gusset plate thickness	12.000 mm
Gusset dimension along connection 1	500.000 mm
Gusset dimension along connection 2	500.000 mm
Gusset cutout along connection 1	125.000 mm
Gusset cutout along connection 2	125.000 mm
	1
Connection type at connection 1	Clip Angle
Connection type at connection 2	Shear Tab
	1
Thickness of shear tab	12.000 mm
Thickness of shear tab to beam weld	6.000 mm
Bolt gage on shear tab (gs)	50.000 mm
Clip angles at connection to beam	2 X L89X89X9.5
Thickness of clip to gusset weld	6.000 mm
Bolt gage on clip angle	45.000 mm
	1
Section property of beam at connection 1	W360X64
Thickness of web	7.750 mm
Thickness of flange	13.500 mm
Width of fange	203.000 mm
Section property of beam at connection 2	W310X38.7
Thickness of web	5.840 mm
Thickness of flange	9.650 mm
Width of fange	165.000 mm
Design Calculation	l .
Bolt shear at brace check:	
Nominal strength of bolts in shear (Rn)	,   555960.000 N
ASD factor in bolt shear (omega)	1.500
Allowable strength in bolt shear	
[Ra=Rn/omega]	,   370640.000 N
Interaction ratio in bolt shear	
[P/Ra]	1 0.283
[1 / 100]	1
Bolt bearing at brace check:	i
Shear force per bolt in brace connection (Pb)	26250.000 N
Nominal strength in bolt bearing at brace (Rn)	131064.000 N
ASD factor in bolt bearing (omega)	2.000
Allowable strength in bolt bearing	·
[Ra=Rn/omega]	65532.000 N
Interaction ratio in bolt bearing at brace	1
[Pb/(2*Ra)]	0.200
<u></u>	,

Bolt bearing at gusset check:	
Nominal strength in bolt bearing at gusset plate	1 123840.000 N
ASD factor in bolt bearing (omega)	1 2.000
Allowable strength in bolt bearing at gusset	
[Ra=Rn/omega]	61920.000 N
Interaction ratio in bolt bearing at gusset plate	
[Pb/Ra]	0.424
Brace tension rupture check:	
Gross area of brace	4520.000 mm^2
Shear Lag Factor (U)	0.880
Net area of brace (An)	3834.200 mm^2
Effective area for tensile rupture	
[Ae=An*U]	3374.096 mm^2
Nominal strength in brace rupture (Pn)	1349638.400 N
ASD factor in tension rupture (omega)	2.000
Allowable strength in brace rupture	
[Pa=Pn/omega]	674819.200 N
Interaction ratio in brace rupture	
[P/Pa]	0.156
Brace block shear check:	
Gross area in shear	6223.000 mm <sup>2</sup>
Net area in shear	3822.700 mm <sup>2</sup>
Net area in tension	850.900 mm^2
Nominal block shear strength at brace (Rn)	1257808.000 N
ASD factor in block shear (omega)	2.000
Allowable block shear strength at brace	· 
[cap= Rn/omega]	628904.000 N
Interaction ratio in block shear at brace	
[P/Ra]	0.167
Gusset tension yielding check:	
Lenght of Whitmore section	242.487 mm
Gusset plate area in tension yielding	4520.000 mm <sup>2</sup>
Nominal strength in gusset yielding (Pn)	727461.339 N
ASD factor in tension yielding	
[omega]	1.670
Allowable strength of gusset in tension yielding	
[Pa=Pn/omega]	435605.592 N
Interaction ratio in gusset plate tension yielding	
[P/Pa]	0.241
Gusset tension rupture check:	
Gusset plate net area in tension	2585.845 mm <sup>2</sup>
Nominal strength in gusset rupture (Pn)	1034338.143 N
ASD factor in tension rupture	
[omega]	2.000
Allowable strength of gusset in tension rupture	
[Pa=Pn/omega]	517169.071 N
Interaction ratio in gusset plate tension rupture	
[P/Pa]	0.203

Connection 1 Checks	
Component of brace force along connection 1	
[P1=P*cos(theta)]	44374.917 N
Force per bolt in connection 1	
[Pb1=P1/n1]	5546.865 N 
Bolt shear check:	i
Nominal strength in bolt shear (Rn)	69495.000 N
ASD factor in bolt shear (omega)	1.500
Allowable strength in bolt shear	
[Ra=Rn/omega]	46330.000 N
Interaction ratio in bolt shear	
[Pb1/Ra]	0.120
Bolt bearing at clip angle check:	İ
Nominal strength in bolt bearing at clip angle (Rn)	98349.600 N
ASD factor in bolt shear (omega)	1 2.000
Allowable strength in bolt bearing at clip angle	I
[Ra=Rn/omega]	49174.800 N
Interaction ratio in bolt bearing at clip angle	I
[Pb1/Ra]	0.113
Bolt bearing at beam web check:	
Nominal strength in bolt bearing at beam web (Rn)	179955.000 N
ASD factor in bolt shear (omega)	2.000
Allowable strength in bolt bearing at beam web	I
[Ra=Rn/omega]	89977.500 N
Interaction ratio in bolt bearing at beam web	I
[Pb1/Ra]	0.062
Gusset shear yielding check:	
Gusset plate shear area	4500.000 mm <sup>2</sup>
Nominal shear strength of gusset in yielding (Rn)	675000.000 N
ASD factor in shear yielding (omega)	1.500
Allowable shear strength of gusset in yielding	I
[Ra=Rn/omega]	450000.000 N
Interaction ratio in shear yielding at gusset	I
[P1/Ra]	0.099
Gusset plate block shear check:	
Gross area in shear for block shear rupture	4379.040 mm <sup>2</sup>
Net area in shear for block shear rupture	4379.040 mm <sup>2</sup>
Net area in tension for block shear rupture	922.800 mm^2
Nominal strength in block shear at gusset (Rn)	1025976.000 mm^2
ASD factor in block shear (omega)	1 2.000
Allowable strength in block shear at gusset plate	   E10000 000 N
[Ra=Rn/omega]	512988.000 N
Interaction ratio in block shear at gusset plate [P1/Ra]	   0.087
	<u> </u>
Gusset flexure yielding check:	1

Eccentricity of force at connection (e)  Nominal flexure strength of gusset in yielding (Mn)  ASD factor in flexure yielding (omega)  Allowable flexure strength of gusset in yielding  [Ma=Mn/omega]  Interaction ratio in flexure yielding at gusset  [P1*e/Ma]	140.875 mm   187500000.000 N mm   1.670     112275449.102 N mm     0.056
Clip angle shear yielding check: Gross area in shear Nominal shear yielding strength of connecting element (Rn) ASD factor in shear yielding (omega) Allowable shear yielding strength of connecting element [Ra=Rn/omega] Interaction ratio in shear yielding of element [P1/Ra]	5336.800 mm^2   800520.000 N   1.500   533680.000 N     0.083
Clip angle shear rupture check:    Connecting element net area in shear    Nominal shear strength of connecting element in rupture (Rn)    ASD factor in shear rupture (omega)    Allowable shear strength of connecting element in rupture         [Ra=Rn/omega]    Interaction ratio in shear rupture of connecting element    [P1/Ra]	3278.320 mm^2
Clip angle block shear check:  Gross area in shear for block shear rupture  Net area in shear for block shear rupture  Net area in tension for block shear rupture  Nominal strength in block shear at shear tab (Rn)  ASD factor in block shear (omega)  Allowable strength in block shear at connecting element  [Ra=Rn/omega]  Interaction ratio in block shear at connecting element  [P1/Ra]	4669.700 mm^2   2868.530 mm^2   693.784 mm^2   965960.800 N   2.000   482980.400 N   0.092
Weld check:  Maximum stress in weld (f)  Nominal weld strength (fn)  ASD factor for weld strength (omega)  Allowable weld strength  [fa=fn/omega]  Interaction ratio for weld strength  [f/fa]	85.521 N/mm   1226.786 N/mm   2.000   613.393 N/mm   0.139
Gusset rupture at weld check:  Nominal strength of gusset at weld (Rn)  ASD factor for rupture at weld (omega)  Allowable strength of gusset rupture at weld  [Ra=Rn/omega]  Interaction ratio for gusset rupture at weld  [P1/Ra]	2880.000 N/mm   2.000   1440.000 N/mm   0.119

	I
Connection 2 Checks	
Component of brace force along connection 2	 
[P2=P*sin(theta)]	95162.318 N
Force per bolt in connection 2	
[Pb2=P2/n2]	23790.579 N
Bolt shear check:	İ
Nominal strength in bolt shear (Rn)	69495.000 N
ASD factor in bolt shear (omega)	1.500
Allowable strength in bolt shear [Ra=Rn/omega]	   46330.000 N
Interaction ratio in bolt shear	40550.000 N
[Pb2/Ra]	0.514
Bolt bearing at shear tab check:	 
Nominal strength in bolt bearing at shear tab (Rn)	123840.000 N
ASD factor in bolt shear (omega)	2.000
Allowable strength in bolt bearing at shear tab	1
[Ra=Rn/omega]	61920.000 N
Interaction ratio in bolt bearing at shear tab [Pb2/Ra]	I   0.384
	0.504
Bolt bearing at gusset check:	ĺ
Nominal strength in bolt bearing at gusset (Rn)	247680.000 N
ASD factor in bolt shear (omega)	2.000
Allowable strength in bolt bearing at gusset [Ra=Rn/omega]	l   123840.000 N
Interaction ratio in bolt bearing at gusset	125040.000 N
[Pb2/Ra]	0.192
Gusset shear yielding check:	
Gusset plate shear area Nominal shear strength of gusset in yielding (Rn)	4500.000 mm^2   675000.000 N
ASD factor in shear yielding (omega)	1.500
Allowable shear strength of gusset in yielding	
[Ra=Rn/omega]	450000.000 N
Interaction ratio in shear yielding at gusset	
[P2/Ra]	0.211 
Gusset shear rupture check:	İ
Gusset gross area in shear	4500.000 mm <sup>2</sup>
Gusset net area in shear	3204.000 mm <sup>2</sup>
Nominal shear strength of gusset in rupture (Rn)	768960.000 N   2.000
ASD factor in shear rupture (omega) Allowable shear strength of gusset in rupture	2.000
[Rn/omega]	384480.000 N
Interaction ratio in shear rupture of gusset	1
[P2/Ra]	0.248
Consist block shows should	
Gusset block shear check: Gross area in shear for block shear rupture	   3505.500 mm^2
arose aroa in bhoar for brook bhoar rapoure	, 5505.500 mm Z

Net area in shear for block shear rupture Net area in tension for block shear rupture Nominal strength in block shear at gusset (Rn) ASD factor in block shear (omega) Allowable strength in block shear at gusset plate [Ra=Rn/omega] Interaction ratio in block shear at gusset plate [P2/Ra]	2371.500 mm^2   294.000 mm^2   643425.000 mm^2   2.000     321712.500 N
Gusset flexure yielding check:  Eccentricity of force at connection (e)  Nominal flexure strength of gusset in yielding (Mn)  ASD factor in flexure yielding (omega)  Allowable flexure strength of gusset in yielding  [Ma=Mn/omega]  Interaction ratio in flexure yielding at gusset  [P1*e/Ma]	139.920 mm   187500000.000 N mm   1.670   112275449.102 N mm   0.119
Shear tab shear yielding check:  Gross area in shear  Nominal shear yielding strength of connecting element (Rn)  ASD factor in shear yielding (omega)  Allowable shear yielding strength of connecting element  [Ra=Rn/omega]  Interaction ratio in shear yielding of element  [P2/Ra]	3360.000 mm^2
Shear tab shear rupture check:  Connecting element net area in shear  Nominal shear strength of connecting element in rupture (Rn)  ASD factor in shear rupture (omega)  Allowable shear strength of connecting element in rupture  [Ra=Rn/omega]  Interaction ratio in shear rupture of connecting element  [P2/Ra]	2064.000 mm^2   495360.000 N   2.000     247680.000 N     0.384
Shear tab block shear check:  Gross area in shear for block shear rupture  Net area in shear for block shear rupture  Net area in tension for block shear rupture  Nominal strength in block shear at shear tab (Rn)  ASD factor in block shear (omega)  Allowable strength in block shear at connecting element  [Ra=Rn/omega]  Interaction ratio in block shear at connecting element  [P2/Ra]	2940.000 mm^2
Shear tab flexure yeilding check:  Nominal flexure yeilding strength of connecting element (Mn)  ASD factor in flexure (omega)  Allowable strength of connecting element in flexure  [Ma=Mn/omega]  Interaction ratio in flexure yielding of connecting element	58800000.000 N mm   1.670   35209580.838 N mm

[P2*gs/Ma]	0.135
Weld check:	1
Maximum stress in weld (f)	249.052 N/mm
Nominal weld strength (fn)	1226.786 N/mm
ASD factor for weld strength (omega)	1 2.000
Allowable weld strength	Í
[fa=fn/omega]	613.393 N/mm
Interaction ratio for weld strength	İ
[f/fa]	0.406
Shear tab rupture at weld check:	
Nominal strength of shear tab rupture at weld (Rn)	2880.000 N
ASD factor for rupture at weld (omega)	2.000
Allowable strength of shear tab rupture at weld	1
[Ra=Rn/omega]	1440.000 N
Interaction ratio for shear tab rupture at weld	
[P2/Ra]	0.346
Beam web rupture at weld check:	
Nominal strength of beam web at weld (Rn)	1576.800 N
ASD factor for rupture at weld (omega)	1 2.000
Allowable strength of beam web rupture at weld	1
[Ra=Rn/omega]	788.400 N
Interaction ratio for beam web rupture at weld	1
[P2/Ra]	0.316
3.5 Validation problem 5  Osoconn v1.1  Connection code: HB001AM10  Connection ID: HB001_5	
Design Summary	-+ 
Connection is OK	-+ 
Maximum interaction ratio	0.231
	-+
Design Input	
Design method	ASD
Brace axial force (P)	46000.000 N
	1
Beam steel grade	ASTM A36
Beam yield strength	250.000 MPa
Beam tensile strength	400.000 MPa
	A CITINA A C.C.
Angle steel grade	ASTM A36
Angle yield strength	250.000 MPa
Angle tensile strength	400.000 MPa
Plata staal srada	I I ASTM A36
Plate steel grade Plate yield strength	250.000 MPa
Trace Arera porenton	1 200.000 FII a

Plate tensile strength	400.000 MPa
Number of bolts in gusset to brace connection	3
Number of bolt rows in gusset to brace connection	1
Number of bolts in connection 1 (n1)	4
Number of bolts in connection 2 (n2)	4
Bolt grade	   ASTM A490
Bolt nominal tensile strength	780.000 MPa
Bolt type	Bearing
Bolt thread in shear plane	Yes
Bolt diameter	20.000 mm
Bolt gage on brace angle	45.000 mm
Bolt spacing	60.000 mm
Bolt distance to edge on brace in the direction of force	35.000 mm
Weld electrode	   E70
Weld tensile strength	482.000 MPa
Brace section	2 X L76X76X6.4
Brace angle from beam at connection 1 (theta)	40.000 deg
Orientation of back to back legs	Vertical
Outstanding leg type	Short Leg
Gusset plate thickness	12.000 mm
Gusset dimension along connection 1	500.000 mm
Gusset dimension along connection 2	500.000 mm
Gusset cutout along connection 1	125.000 mm
Gusset cutout along connection 2	125.000 mm
Connection type at connection 1	Shear Tab
Connection type at connection 2	Bolted to Flange
Thickness of shear tab	10.000 mm
Thickness of shear tab to beam weld	6.000 mm
Bolt gage on shear tab (gs)	50.000 mm
Section property of beam at connection 1	   W360X64
Thickness of web	7.750 mm
Thickness of flange	13.500 mm
Width of fange	203.000 mm
Section property of beam at connection 2	W200X100
Thickness of web	14.500 mm
Thickness of flange	23.700 mm
Width of fange	210.000 mm
ign Calculation	 
t shear at brace check: Nominal strength of bolts in shear (Rn) ASD factor in bolt shear (omega)	     884158.800 N   2.000
	1 / 000

[Ra=Rn/omega]	442079.400 N
Interaction ratio in bolt shear [P/Ra]	0.104
Bolt bearing at brace check:  Shear force per bolt in brace connection (Pb)  Nominal strength in bolt bearing at brace (Rn)  ASD factor in bolt bearing (omega)  Allowable strength in bolt bearing  [Ra=Rn/omega]  Interaction ratio in bolt bearing at brace  [Pb/Ra]	   7666.667 N   73152.000 N   2.000     36576.000 N     0.210
Bolt bearing at gusset check:  Nominal strength in bolt bearing at gusset plate  ASD factor in bolt bearing (omega)  Allowable strength in bolt bearing at gusset  [Ra=Rn/omega]  Interaction ratio in bolt bearing at gusset plate  [Pb/Ra]	138240.000 N
Brace tension rupture check:  Gross area of brace Shear Lag Factor (U) Net area of brace (An) Effective area for tensile rupture [Ae=An*U] Nominal strength in brace rupture (Pn) ASD factor in tension rupture (omega) Allowable strength in brace rupture [Pa=Pn/omega] Interaction ratio in brace rupture [P/Pa]	1858.000 mm^2   0.823   1578.600 mm^2     1299.714 mm^2     519885.600 N   2.000     259942.800 N     0.177
Brace block shear check:  Gross area in shear  Net area in shear  Net area in tension  Nominal block shear strength at brace (Rn)  ASD factor in block shear (omega)  Allowable block shear strength at brace  [cap= Rn/omega]  Interaction ratio in block shear at brace  [P/Ra]	1968.500 mm^2   1270.000 mm^2   256.540 mm^2   397891.000 N   2.000   198945.500 N
Gusset tension yielding check: Lenght of Whitmore section Gusset plate area in tension yielding Nominal strength in gusset yielding (Pn) ASD factor in tension yielding [omega] Allowable strength of gusset in tension yielding [Pa=Pn/omega]	234.564 mm   1858.000 mm^2   703692.194 N   1.670   421372.571 N

Interaction ratio in gusset plate tension yielding [P/Pa]	   0.109 
Gusset tension rupture check:	
Gusset plate net area in tension Nominal strength in gusset rupture (Pn)	2286.769 mm <sup>2</sup>   914707.510 N
ASD factor in tension rupture	914707.310 N
[omega]	2.000
Allowable strength of gusset in tension rupture	l
[Pa=Pn/omega]	457353.755 N
Interaction ratio in gusset plate tension rupture [P/Pa]	   0.101
[r/ra]	0.101
Gusset block shear check:	I
Gross area in shear	3720.000 mm <sup>2</sup>
Net area in shear	2400.000 mm <sup>2</sup>
Net area in tension	888.000 mm <sup>2</sup>
Nominal strength of gusset in block shear (Rn)	913200.000 N
ASD factor in block shear (omega)	2.000
Allowable strength og gusset in block shear [Ra=Rn/omega]	   456600.000 N
Interaction ratio in block shear at gusset plate	1 450000.000 N
[P/Ra]	0.101
	I
Connection 1 Checks	
Component of brace force along connection 1	 
[P1=P*cos(theta)]	   35238.044 N
Force per bolt in connection 1	
[Pb1=P1/n1]	8809.511 N
	<u> </u>
Bolt shear check:	 
Nominal strength in bolt shear (Rn)	147359.800 N
ASD factor in bolt shear (omega) Allowable strength in bolt shear	2.000
[Ra=Rn/omega]	73679.900 N
Interaction ratio in bolt shear	
[Pb1/Ra]	0.120
	<u> </u>
Bolt bearing at shear tab check:	   115000 000 N
Nominal strength in bolt bearing at shear tab (Rn)	115200.000 N   2.000
ASD factor in bolt shear (omega) Allowable strength in bolt bearing at shear tab	2.000 
[Ra=Rn/omega]	57600.000 N
Interaction ratio in bolt bearing at shear tab	
[Pb1/Ra]	0.153
	I
Bolt bearing at gusset check:	
Nominal strength in bolt bearing at gusset (Rn)	218880.000 N
ASD factor in bolt shear (omega)	2.000
Allowable strength in bolt bearing at gusset [Ra=Rn/omega]	   109440.000 N
Interaction ratio in bolt bearing at gusset	100 <del>11</del> 0.000 N
	•

[Pb1/Ra]	0.080
Cugaet shear wielding shock.	
Gusset shear yielding check: Gusset plate shear area	4500.000 mm^2
Nominal shear strength of gusset in yielding (Rn)	675000.000 N
ASD factor in shear yielding (omega)	1.500
Allowable shear strength of gusset in yielding	I 1.300
[Ra=Rn/omega]	450000.000 N
Interaction ratio in shear yielding at gusset	
[P1/Ra]	1 0.078
L/J	
Gusset shear rupture check:	1
Gusset gross area in shear	4500.000 mm <sup>2</sup>
Gusset net area in shear	3444.000 mm <sup>2</sup>
Nominal shear strength of gusset in rupture (Rn)	826560.000 N
ASD factor in shear rupture (omega)	2.000
Allowable shear strength of gusset in rupture	1
[Rn/omega]	413280.000 N
Interaction ratio in shear rupture of gusset	1
[P1/Ra]	0.085
Gusset plate block shear check:	1
Gross area in shear for block shear rupture	2880.000 mm^2
Net area in shear for block shear rupture	1956.000 mm <sup>2</sup>
Net area in tension for block shear rupture	324.000 mm^2
Nominal strength in block shear at gusset (Rn)	561600.000 mm^2
ASD factor in block shear (omega)	2.000
Allowable strength in block shear at gusset plate	
[Ra=Rn/omega]	280800.000 N
Interaction ratio in block shear at gusset plate	
[P1/Ra]	0.125
	1
Gusset flexure yielding check:	
Eccentricity of force at connection (e)	140.875 mm
Nominal flexure strength of gusset in yielding (Mn)	187500000.000 N mm
ASD factor in flexure yielding (omega)	1.670
Allowable flexure strength of gusset in yielding	11007F440 100 N
[Ma=Mn/omega]	112275449.102 N mm
Interaction ratio in flexure yielding at gusset [P1*e/Ma]	0.044
[1 1 76 / 114]	0.044
Shear tab shear yielding check:	İ
Gross area in shear	2500.000 mm <sup>2</sup>
Nominal shear yielding strength of connecting element (Rn)	375000.000 N
ASD factor in shear yielding (omega)	1.500
Allowable shear yielding strength of connecting element	
[Ra=Rn/omega]	250000.000 N
Interaction ratio in shear yielding of element	1
[P1/Ra]	0.141
Chear tab about munture about	 
Shear tab shear rupture check:  Connecting element net area in shear	1620.000 mm^2
Nominal shear strength of connecting element in rupture (Rn)	388800.000 N
nominat pheat potention of conneceing element in inhente (im)	1 000000.000 10

ASD factor in shear rupture (omega)	1 2.000
Allowable shear strength of connecting element in rupture [Ra=Rn/omega]	   194400.000 N
Interaction ratio in shear rupture of connecting element [P1/Ra]	0.181
Shear tab block shear check:	
Gross area in shear for block shear rupture	2150.000 mm^2
Net area in shear for block shear rupture	1380.000 mm <sup>2</sup>
Net area in tension for block shear rupture	390.000 mm <sup>2</sup>
Nominal strength in block shear at shear tab (Rn)	478500.000 N
ASD factor in block shear (omega)	2.000
Allowable strength in block shear at connecting element [Ra=Rn/omega]	   239250.000 N
Interaction ratio in block shear at connecting element	239230.000 N
[P1/Ra]	0.147
Shear tab flexure yeilding check:	
Nominal flexure yeilding strength of connecting element (Mn)	39062500.000 N mm
ASD factor in flexure (omega)	1.670
Allowable strength of connecting element in flexure	1
[Ma=Mn/omega]	23390718.563 N mm
Interaction ratio in flexure yielding of connecting element	
[P1*gs/Ma]	0.075 
Weld check:	i
Maximum stress in weld (f)	110.087 N/mm
Nominal weld strength (fn)	1226.786 N/mm
ASD factor for weld strength (omega)	2.000
Allowable weld strength	 
[fa=fn/omega]	613.393 N/mm
Interaction ratio for weld strength [f/fa]	0.179
[1/14]	0.179
Shear tab rupture at weld check:	I
Nominal strength of shear tab rupture at weld (Rn)	2400.000 N/mm
ASD factor for rupture at weld (omega)	2.000
Allowable strength of shear tab rupture at weld	   1200.000 N/mm
[Ra=Rn/omega] Interaction ratio for shear tab rupture at weld	1200.000 N/MM
[P1/Ra]	0.183
Beam web rupture at weld check:	1
Nominal strength of beam web at weld (Rn)	1860.000 N/mm
ASD factor for rupture at weld (omega)	1 2.000
Allowable strength of beam web rupture at weld	
[Ra=Rn/omega]	930.000 N/mm
Interaction ratio for beam web rupture at weld	1
[P1/Ra]	0.118
Connection 2 Checks	
•	•

[P2=P*sin(theta)]	29568.230 N
Force per bolt in connection 2 [Pb2=P2/n2]	   7392.058 N
Bolt shear check:  Nominal strength in bolt shear (Rn)  ASD factor in bolt shear (omega)  Allowable strength in bolt shear  [Ra=Rn/omega]  Interaction ratio in bolt shear  [Pb2/Ra]	   147359.800 N   2.000     73679.900 N     0.100
Bolt bearing at gusset check:  Nominal strength in bolt bearing at gusset (Rn)  ASD factor in bolt shear (omega)  Allowable strength in bolt bearing at gusset  [Ra=Rn/omega]  Interaction ratio in bolt bearing at gusset  [Pb2/Ra]	218880.000 N
Bolt bearing at beam flange check:  Nominal strength in bolt bearing at beam flange (Rn)  ASD factor in bolt shear (omega)  Allowable strength in bolt bearing at beam flange  [Ra=Rn/omega]  Interaction ratio in bolt bearing at beam flange  [Pb2/Ra]	432288.000 N
Gusset shear yielding check: Gusset plate shear area Nominal shear strength of gusset in yielding (Rn) ASD factor in shear yielding (omega) Allowable shear strength of gusset in yielding [Ra=Rn/omega] Interaction ratio in shear yielding at gusset [P2/Ra]	4500.000 mm^2
Gusset shear rupture check: Gusset gross area in shear Gusset net area in shear Nominal shear strength of gusset in rupture (Rn) ASD factor in shear rupture (omega) Allowable shear strength of gusset in rupture [Rn/omega] Interaction ratio in shear rupture of gusset [P2/Ra]	4500.000 mm^2   3444.000 mm^2   826560.000 N   2.000   413280.000 N   0.072
Gusset block shear check: Gross area in shear for block shear rupture Net area in shear for block shear rupture Net area in tension for block shear rupture Nominal strength in block shear at gusset (Rn) ASD factor in block shear (omega)	3769.500 mm^2   2845.500 mm^2   768.000 mm^2   872625.000 mm^2   2.000

Allowable strength in block shear at gusset plate [Ra=Rh/mosga]	All	1
Interaction ratio in block shear at gusset plate	•	l   436312 500 N
Gusset flexure yielding check:   Eccentricity of force at connection (e)	<u> </u>	
Eccentricity of force at connection (e)   100.000 mm     Nominal flexure strength of gusset in yielding (Mm)   187500000.000 N mm     ASD factor in flexure yielding (onega)   1.670     Allowable flexure strength of gusset in yielding   1.670     [MamMronega]   112275449.102 N mm     Interaction ratio in flexure yielding at gusset   1.0006     [Pi+e/Ma]   0.006     3.6 Validation problem 6     Osconn v1.1     Osconn v1.1     Osconnection id : HB001AM10     Connection ID : HB001_6     Design Summary   1     Connection is OK   1     Maximum interaction ratio   0.827     Design method   1   ASD     Brace axial force (P)   190000.000 N     Beam steel grade   1   ASTM   A992     Beam yield strength   1   345.000 MPa     Angle steel grade   1   ASTM   A992     Baam tensile strength   1   450.000 MPa     Angle steel grade   1   ASTM   A36     Angle yield strength   2   250.000 MPa     Angle tensile strength   4   400.000 MPa     Plate steel grade   1   ASTM   A36     Plate yield strength   1   250.000 MPa     Plate steel grade   1   ASTM   A36     Plate tensile strength   1   400.000 MPa     Plate steel grade   1   ASTM   A36     Plate tensile strength   1   250.000 MPa     Plate tensile strength   1   250.000 MPa     Plate tensile strength   1   ASTM   A36     Plate tensile strength   1   250.000 MPa     Plate tensile strength   1   3   3     Number of bolts in connection 1 (n1)   1   3     Number of bolts in connection 2 (n2)   1   5     Bolt grade   1   ASTM   A325     Bolt type   1   Friction     Bolt type   1   Friction     Bolt type   1   Friction     Bolt thread in shear plane   1   22.000 mm		0.068
Eccentricity of force at connection (e)   100.000 mm     Nominal flexure strength of gusset in yielding (Mm)   187500000.000 N mm     ASD factor in flexure yielding (onega)   1.670     Allowable flexure strength of gusset in yielding   1.670     [MamMronega]   112275449.102 N mm     Interaction ratio in flexure yielding at gusset   1.0006     [Pi+e/Ma]   0.006     3.6 Validation problem 6     Osconn v1.1     Osconn v1.1     Osconnection id : HB001AM10     Connection ID : HB001_6     Design Summary   1     Connection is OK   1     Maximum interaction ratio   0.827     Design method   1   ASD     Brace axial force (P)   190000.000 N     Beam steel grade   1   ASTM   A992     Beam yield strength   1   345.000 MPa     Angle steel grade   1   ASTM   A992     Baam tensile strength   1   450.000 MPa     Angle steel grade   1   ASTM   A36     Angle yield strength   2   250.000 MPa     Angle tensile strength   4   400.000 MPa     Plate steel grade   1   ASTM   A36     Plate yield strength   1   250.000 MPa     Plate steel grade   1   ASTM   A36     Plate tensile strength   1   400.000 MPa     Plate steel grade   1   ASTM   A36     Plate tensile strength   1   250.000 MPa     Plate tensile strength   1   250.000 MPa     Plate tensile strength   1   ASTM   A36     Plate tensile strength   1   250.000 MPa     Plate tensile strength   1   3   3     Number of bolts in connection 1 (n1)   1   3     Number of bolts in connection 2 (n2)   1   5     Bolt grade   1   ASTM   A325     Bolt type   1   Friction     Bolt type   1   Friction     Bolt type   1   Friction     Bolt thread in shear plane   1   22.000 mm	Gusset flexure vielding check:	l I
Nominal flexure strength of gusset in yielding (Mn)	·	100.000 mm
ASD factor in flexure yielding (omega)   1.670 Allowable flexure strength of gusset in yielding   [Ma-Mn/omega]   112275449.102 N mm   [Ma-Mn/omega]   112275449.102 N mm   [Ma-Mn/omega]   1.0026  3.6 Validation problem 6  Osconn v1.1 Connection code: HB001AM10 Connection ID: HB001_6  Design Summary	•	187500000.000 N mm
Allowable flexure strength of gusset in yielding [Ma-Mn/onegal]   112275449.102 N mm  Interaction ratio in flexure yielding at gusset     0.026  3.6 Validation problem 6  Osconn v1.1 Connection code: HB001AM10 Connection ID: HB001_6  Design Summary		1.670
MawMn/omegal   112275449.102 N mm   Interaction ratio in flexure yielding at gusset	• • •	1
Pi*e/Ma    0.026		112275449.102 N mm
3.6 Validation problem 6  Osconn v1.1  Connection code: HB001AM10  Connection ID: HB001_6	Interaction ratio in flexure yielding at gusset	1
Osconn v1.1 Connection code: HB001AM10 Connection ID: HB001_6  Design Summary      Connection is OK	[P1*e/Ma]	0.026
Connection code : HB001AM10   Connection ID : HB001_6	3.6 Validation problem 6	
Connection ID : HB001_6	Osoconn v1.1	
Design Summary	Connection code : HB001AM10	
Design Summary		
Connection is OK   Maximum interaction ratio   0.827	Design Summary	İ
Design Input		 
Design Input		0.827
Design method   I ASD   Brace axial force (P)   I 190000.000 N	Design Input	! !
Brace axial force (P)		•
Beam steel grade	-	•
Beam yield strength  Beam tensile strength  Angle steel grade  Angle yield strength  Angle tensile strength  Plate steel grade  Plate yield strength  Plate tensile strength  Instruction	brace axial force (1)	130000.000 N
Beam yield strength  Beam tensile strength  Angle steel grade  Angle yield strength  Angle tensile strength  Plate steel grade  Plate yield strength  Plate tensile strength  Number of bolts in gusset to brace connection  Number of bolts in connection 1 (n1)  Number of bolts in connection 2 (n2)  Bolt grade  Bolt type  Bolt type  Bolt thread in shear plane  Bolt grade  Bolt grade   ASTM A36  ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A325  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrength   ASTM A36  Pastrengt	Beam steel grade	ASTM A992
Angle steel grade	Beam yield strength	345.000 MPa
Angle yield strength  Angle tensile strength  Plate steel grade  Plate yield strength  Plate tensile strength  Number of bolts in gusset to brace connection  Number of bolts in connection 1 (n1)  Number of bolts in connection 2 (n2)  Bolt grade  Bolt grade  Bolt type  Bolt thread in shear plane  Bolt diameter    250.000 MPa     400.000 MPa     400.000 MPa     1	Beam tensile strength	450.000 MPa
Angle yield strength  Angle tensile strength  Plate steel grade  Plate yield strength  Plate tensile strength  Number of bolts in gusset to brace connection  Number of bolts in connection 1 (n1)  Number of bolts in connection 2 (n2)  Bolt grade  Bolt grade  Bolt type  Bolt thread in shear plane  Bolt diameter    250.000 MPa     400.000 MPa     400.000 MPa     1	Angle steel grade	I I ASTM A36
Angle tensile strength   400.000 MPa   Plate steel grade   ASTM A36 Plate yield strength   250.000 MPa   Plate tensile strength   400.000 MPa   Number of bolts in gusset to brace connection   3   Number of bolts in connection 1 (n1)   3   Number of bolts in connection 2 (n2)   5   Bolt grade   ASTM A325 Bolt nominal tensile strength   620.000 MPa   Bolt type   Friction   Bolt thread in shear plane   Yes   Bolt diameter   22.000 mm		
Plate steel grade Plate yield strength Plate tensile strength  Number of bolts in gusset to brace connection Number of bolts in connection 1 (n1) Number of bolts in connection 2 (n2)  Bolt grade Bolt nominal tensile strength Bolt type Bolt thread in shear plane Bolt diameter    ASTM A36   250.000 MPa   400.000 MPa   3   3   400.000 MPa   5   620.000 MPa   Friction   620.000 mm		
Plate yield strength  Plate tensile strength  Number of bolts in gusset to brace connection  Number of bolts in connection 1 (n1)  Number of bolts in connection 2 (n2)  Bolt grade  Bolt nominal tensile strength  Bolt type  Bolt diameter    250.000 MPa     400.000 MPa     3		İ
Plate tensile strength   400.000 MPa    Number of bolts in gusset to brace connection   3    Number of bolt rows in gusset to brace connection   2    Number of bolts in connection 1 (n1)   3    Number of bolts in connection 2 (n2)   5    Bolt grade   ASTM A325    Bolt nominal tensile strength   620.000 MPa    Bolt type   Friction    Bolt thread in shear plane   Yes    Bolt diameter   22.000 mm	Plate steel grade	ASTM A36
Number of bolts in gusset to brace connection   3  Number of bolt rows in gusset to brace connection   2  Number of bolts in connection 1 (n1)   3  Number of bolts in connection 2 (n2)   5  Bolt grade   ASTM A325  Bolt nominal tensile strength   620.000 MPa  Bolt type   Friction  Bolt thread in shear plane   Yes  Bolt diameter   22.000 mm	Plate yield strength	250.000 MPa
Number of bolt rows in gusset to brace connection   2 Number of bolts in connection 1 (n1)   3 Number of bolts in connection 2 (n2)   5 Bolt grade   ASTM A325 Bolt nominal tensile strength   620.000 MPa Bolt type   Friction Bolt thread in shear plane   Yes Bolt diameter   22.000 mm	Plate tensile strength	400.000 MPa
Number of bolt rows in gusset to brace connection   2 Number of bolts in connection 1 (n1)   3 Number of bolts in connection 2 (n2)   5 Bolt grade   ASTM A325 Bolt nominal tensile strength   620.000 MPa Bolt type   Friction Bolt thread in shear plane   Yes Bolt diameter   22.000 mm	Number of bolts in gusset to brace connection	3
Number of bolts in connection 1 (n1)   3  Number of bolts in connection 2 (n2)   5  Bolt grade   ASTM A325  Bolt nominal tensile strength   620.000 MPa  Bolt type   Friction  Bolt thread in shear plane   Yes  Bolt diameter   22.000 mm	<u> </u>	· ·
Bolt grade   ASTM A325 Bolt nominal tensile strength   620.000 MPa Bolt type   Friction Bolt thread in shear plane   Yes Bolt diameter   22.000 mm	_	3
Bolt nominal tensile strength   620.000 MPa Bolt type   Friction Bolt thread in shear plane   Yes Bolt diameter   22.000 mm		· ·
Bolt nominal tensile strength   620.000 MPa Bolt type   Friction Bolt thread in shear plane   Yes Bolt diameter   22.000 mm	Bolt grade	l   ASTM A325
Bolt type   Friction Bolt thread in shear plane   Yes Bolt diameter   22.000 mm	_	
Bolt thread in shear plane   Yes Bolt diameter   22.000 mm	_	<u>:</u>
Bolt diameter   22.000 mm	• •	
	<del>-</del>	•
	Bolt gage on brace angle	

Bolt spacing	70.000 mm
Bolt distance to edge on brace in the direction of force	30.000 mm
<u> </u>	1
Weld electrode	E70
Weld tensile strength	482.000 MPa
Brace section	   2 X L152X89X12.7
Brace angle from beam at connection 1 (theta)	60.000 deg
Orientation of back to back legs	Horizontal
Outstanding leg type	Short Leg
outstanding leg type	bhort leg
Gusset plate thickness	16.000 mm
Gusset dimension along connection 1	500.000 mm
Gusset dimension along connection 2	500.000 mm
Gusset cutout along connection 1	150.000 mm
Gusset cutout along connection 2	150.000 mm
Connection type at connection 1	Clip Angle
Connection type at connection 2	Bolted to Flange
Clip angles at connection to beam	2 X L89X89X9.5
Thickness of clip to gusset weld	6.000 mm
Bolt gage on clip angle	45.000 mm
	1
Section property of beam at connection 1	W460X74
Thickness of web	9.020 mm
Thickness of flange	14.500 mm
Width of fange	191.000 mm
Section property of beam at connection 2	W250X67
Thickness of web	8.890 mm
Thickness of flange	15.700 mm
Width of fange	204.000 mm
Design Calculation	
	İ
Bolt shear at brace check:	
Nominal strength of bolts in shear (Rn)	715968.000 N
ASD factor in bolt shear (omega)	1.500
Allowable strength in bolt shear	<u>.</u>
[Ra=Rn/omega]	477312.000 N
Interaction ratio in bolt shear	I
[P/Ra]	0.398
Bolt bearing at brace check:	i
Shear force per bolt in brace connection (Pb)	31666.667 N
Nominal strength in bolt bearing at brace (Rn)	109728.000 N
ASD factor in bolt bearing (omega)	1 2.000
Allowable strength in bolt bearing	
[Ra=Rn/omega]	,   54864.000 N
Interaction ratio in bolt bearing at brace	
[Pb/(2*Ra)]	1 0.289
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	1

Bolt bearing at gusset check:	I
Nominal strength in bolt bearing at gusset plate	   138240.000 N
ASD factor in bolt bearing (omega)	2.000
Allowable strength in bolt bearing at gusset	I
[Ra=Rn/omega]	69120.000 N
Interaction ratio in bolt bearing at gusset plate	I
[Pb/Ra]	0.458
	I
Brace tension rupture check:	l
Gross area of brace	5800.000 mm <sup>2</sup>
Shear Lag Factor (U)	0.849
Net area of brace (An)	4580.800 mm <sup>2</sup>
Effective area for tensile rupture	l
[Ae=An*U]	3890.408 mm^2
Nominal strength in brace rupture (Pn)	1556163.200 N
ASD factor in tension rupture (omega)	1 2.000
Allowable strength in brace rupture	
[Pa=Pn/omega]	778081.600 N
Interaction ratio in brace rupture	<u> </u>
[P/Pa]	0.244
	<u> </u>
Brace block shear check:	
Gross area in shear	4318.000 mm^2
Net area in shear	2794.000 mm^2
Net area in tension	1676.400 mm^2
Nominal block shear strength at brace (Rn)	1318260.000 N
ASD factor in block shear (omega)	2.000
Allowable block shear strength at brace [cap= Rn/omega]	   659130.000 N
Interaction ratio in block shear at brace	039130.000 N
[P/Ra]	0.288
[1 / 164]	0.200
Gusset tension vielding check:	
Lenght of Whitmore section	231.658 mm
Gusset plate area in tension yielding	5800.000 mm^2
Nominal strength in gusset yielding (Pn)	926632.301 N
ASD factor in tension yielding	l
[omega]	1.670
Allowable strength of gusset in tension yielding	I
[Pa=Pn/omega]	554869.642 N
Interaction ratio in gusset plate tension yielding	l
[P/Pa]	0.342
	l
Gusset tension rupture check:	I
Gusset plate net area in tension	2938.529 mm^2
Nominal strength in gusset rupture (Pn)	1175411.682 N
ASD factor in tension rupture	<u> </u>
[omega]	2.000
Allowable strength of gusset in tension rupture	
[Pa=Pn/omega]	587705.841 N
Interaction ratio in gusset plate tension rupture	
[P/Pa]	0.323
	I

Gusset block shear check:	I
Gross area in shear	5440.000 mm^2
Net area in shear	3520.000 mm^2
Net area in tension	736.000 mm^2
Nominal strength of gusset in block shear (Rn)	1110400.000 N
ASD factor in block shear (omega)	2.000
Allowable strength og gusset in block shear	2.000 
	   555200.000 N
[Ra=Rn/omega]	555200.000 N
Interaction ratio in block shear at gusset plate	l 0 240
[P/Ra]	0.342
Connection 1 Checks	
	l
Component of brace force along connection 1	
[P1=P*cos(theta)]	95000.000 N
Force per bolt in connection 1	
[Pb1=P1/n1]	15833.333 N
Bolt shear check:	1
Nominal strength in bolt shear (Rn)	59664.000 N
ASD factor in bolt shear (omega)	1.500
Allowable strength in bolt shear	
[Ra=Rn/omega]	39776.000 N
Interaction ratio in bolt shear	
[Pb1/Ra]	0.398
Bolt bearing at clip angle check:	
Nominal strength in bolt bearing at clip angle (Rn)	105211.200 N
ASD factor in bolt shear (omega)	2.000
Allowable strength in bolt bearing at clip angle	
[Ra=Rn/omega]	52605.600 N
Interaction ratio in bolt bearing at clip angle	
[Pb1/Ra]	0.301
Bolt bearing at beam web check:	
Nominal strength in bolt bearing at beam web (Rn)	214315.200 N
ASD factor in bolt shear (omega)	2.000
Allowable strength in bolt bearing at beam web	
[Ra=Rn/omega]	107157.600 N
Interaction ratio in bolt bearing at beam web	
[Pb1/Ra]	0.148
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Gusset shear yielding check:	   5600.000 mm^2
Gusset plate shear area	84000.000 N
Nominal shear strength of gusset in yielding (Rn)	
ASD factor in shear yielding (omega)	1.500
Allowable shear strength of gusset in yielding	   E60000 000 N
[Ra=Rn/omega]	560000.000 N
Interaction ratio in shear yielding at gusset	I I 0 170
[P1/Ra]	0.170
Gusset plate block shear check:	I I
Gross area in shear for block shear rupture	4400.000 mm^2
gross area in shear for prock shear inhinte	1 1100.000 111111 2

Net area in shear for block shear rupture  Net area in tension for block shear rupture  Nominal strength in block shear at gusset (Rn)  ASD factor in block shear (omega)  Allowable strength in block shear at gusset plate  [Ra=Rn/omega]  Interaction ratio in block shear at gusset plate  [P1/Ra]	4400.000 mm^2   1230.400 mm^2   1152160.000 mm^2   2.000   576080.000 N   0.165
Gusset flexure yielding check:  Eccentricity of force at connection (e)  Nominal flexure strength of gusset in yielding (Mn)  ASD factor in flexure yielding (omega)  Allowable flexure strength of gusset in yielding  [Ma=Mn/omega]  Interaction ratio in flexure yielding at gusset  [P1*e/Ma]	166.510 mm
Clip angle shear yielding check:  Gross area in shear  Nominal shear yielding strength of connecting element (Rn)  ASD factor in shear yielding (omega)  Allowable shear yielding strength of connecting element  [Ra=Rn/omega]  Interaction ratio in shear yielding of element  [P1/Ra]	4002.600 mm^2   600390.000 N   1.500   400260.000 N   0.237
Clip angle shear rupture check:  Connecting element net area in shear  Nominal shear strength of connecting element in rupture (Rn)  ASD factor in shear rupture (omega)  Allowable shear strength of connecting element in rupture  [Ra=Rn/omega]  Interaction ratio in shear rupture of connecting element  [P1/Ra]	2630.280 mm^2
Clip angle block shear check:  Gross area in shear for block shear rupture  Net area in shear for block shear rupture  Net area in tension for block shear rupture  Nominal strength in block shear at shear tab (Rn)  ASD factor in block shear (omega)  Allowable strength in block shear at connecting element  [Ra=Rn/omega]  Interaction ratio in block shear at connecting element  [P1/Ra]	3335.500 mm^2
Weld check:  Maximum stress in weld (f)  Nominal weld strength (fn)  ASD factor for weld strength (omega)  Allowable weld strength  [fa=fn/omega]	   248.909 N/mm   1226.786 N/mm   2.000     613.393 N/mm

Interaction ratio for weld strength	I
[f/fa]	0.406
	Ī
Gusset rupture at weld check:	1
Nominal strength of gusset at weld (Rn)	3840.000 N/mm
ASD factor for rupture at weld (omega)	2.000
Allowable strength of gusset rupture at weld	 
[Ra=Rn/omega]	1920.000 N/mm
Interaction ratio for gusset rupture at weld [P1/Ra]	l 0.259
[FI/Na]	0.259
Connection 2 Checks	İ
Component of brace force along connection 2	 
[P2=P*sin(theta)]	   164544.827 N
Force per bolt in connection 2	
[Pb2=P2/n2]	32908.965 N
2	
Bolt shear check:	I
Nominal strength in bolt shear (Rn)	59664.000 N
ASD factor in bolt shear (omega)	1.500
Allowable strength in bolt shear	
[Ra=Rn/omega]	39776.000 N
Interaction ratio in bolt shear	
[Pb2/Ra]	0.827
Bolt bearing at gusset check:	! 
Nominal strength in bolt bearing at gusset (Rn)	188236.800 N
ASD factor in bolt shear (omega)	2.000
Allowable strength in bolt bearing at gusset	I
[Ra=Rn/omega]	94118.400 N
Interaction ratio in bolt bearing at gusset	
[Pb2/Ra]	0.350
Bolt bearing at beam flange check:	 
Nominal strength in bolt bearing at beam flange (Rn)	373032.000 N
ASD factor in bolt shear (omega)	1 2.000
Allowable strength in bolt bearing at beam flange	l
[Ra=Rn/omega]	186516.000 N
Interaction ratio in bolt bearing at beam flange	0 476
[Pb2/Ra]	0.176
Gusset shear yielding check:	 
Gusset plate shear area	5600.000 mm^2
Nominal shear strength of gusset in yielding (Rn)	840000.000 N
ASD factor in shear yielding (omega)	1.500
Allowable shear strength of gusset in yielding	l
[Ra=Rn/omega]	560000.000 N
Interaction ratio in shear yielding at gusset	
[P2/Ra]	0.294
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Gusset shear rupture check:	   E600 000
Gusset gross area in shear	5600.000 mm <sup>2</sup>

Gusset net area in shear	3680.000 mm <sup>2</sup>
Nominal shear strength of gusset in rupture (Rn)	883200.000 N
ASD factor in shear rupture (omega)	2.000
Allowable shear strength of gusset in rupture	
[Rn/omega]	441600.000 N
Interaction ratio in shear rupture of gusset	
[P2/Ra]	0.373
Gusset block shear check:	
Gross area in shear for block shear rupture	5064.160 mm <sup>2</sup>
Net area in shear for block shear rupture	3336.160 mm <sup>2</sup>
Net area in tension for block shear rupture	1008.000 mm <sup>2</sup>
Nominal strength in block shear at gusset (Rn)	1162824.000 mm <sup>2</sup>
ASD factor in block shear (omega)	2.000
Allowable strength in block shear at gusset plate	
[Ra=Rn/omega]	581412.000 N
Interaction ratio in block shear at gusset plate	
[P2/Ra]	0.283
Gusset flexure yielding check:	
Eccentricity of force at connection (e)	125.000 mm
Nominal flexure strength of gusset in yielding (Mn)	250000000.000 N mm
ASD factor in flexure yielding (omega)	1.670
Allowable flexure strength of gusset in yielding	
[Ma=Mn/omega]	149700598.802 N mm
Interaction ratio in flexure yielding at gusset	
[P1*e/Ma]	0.137