RAM Connection CONNECT Edition **Worley**

**Current Date:** 6/21/2022 6:55 PM
**Units system:** English
**File name:** C:\Users\Suman.Nandi\OneDrive - Worley\SUMAN 21.12.2020\US Projects\Eastman Boiler Project\WORKING\Connection\Calc\EL 1224\EL 1224_CONNECTIONS.rcnx

# Steel connections

## Results

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**Connection name : DA BG All bolted**
**Connection ID : 1V**

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Family: Beam - Girder (BG)
Type: Angle(s)
Description: 1224_W12_SC
Design code: AISC 360-16 LRFD

**DEMANDS**

| Description | Ru [kip] | Pu [kip] | Load type |
|---|---|---|---|
| TL | 5.00 | 1.00 | Design |
| CL | 5.00 | -1.00 | Design |

**GEOMETRIC CONSIDERATIONS**

| Dimensions | Unit | Value | Min. value | Max. value | Sta. | References |
|---|---|---|---|---|---|---|
| <u>Angle</u> | | | | | | |
| Length | [in] | 6.00 | 5.42 | 10.74 | ✔ | p. 10-8 |

$L_{min}$ = T/2
= 10.84[in]/2
= **5.42**[in] — p. 10-8

$L_{max}$ = d - max(k, $d_{ct}$) - max(k, $d_{cb}$)
= 12.2[in] - max(0.68[in], 0.785[in]) - max(0.68[in], 0[in])
= **10.735**[in] — p. 10-8

| Dimensions | Unit | Value | Min. value | Max. value | Sta. | References |
|---|---|---|---|---|---|---|
| <u>Angle (Beam side)</u> | | | | | | |
| Weld size | [1/16in] | 3 | 2 | 3 | ✔ | table J2.4, Sec. J2.2b |

$w_{min}$ = $w_{min}$
= **0.0104** — table J2.4

$t_p$<1/4 [in] → 0.25[in]<1/4 [in] → **False**

$w_{max}$ = $t_p$ - 1/16 [in]
= 0.25[in] - 1/16 [in]
= **0.0156** — Sec. J2.2b

Angle (Support side)

| | | | | | | |
|---|---|---|---|---|---|---|
| Vertical edge distance | [in] | 1.50 | 1.00 | -- | ✓ | Tables J3.4, J3.5 |

$L_{emin} = e_{dmin} + C_2$
= 1[in] + 0[in]
= **1**[in] Tables J3.4, J3.5

| | | | | | | |
|---|---|---|---|---|---|---|
| Horizontal edge distance | [in] | 1.50 | 1.00 | -- | ✓ | Tables J3.4, J3.5 |

$L_{emin} = e_{dmin} + C_2$
= 1[in] + 0[in]
= **1**[in] Tables J3.4, J3.5

| | | | | | | |
|---|---|---|---|---|---|---|
| Vertical center-to-center spacing (pitch) | [in] | 3.00 | 2.00 | 6.00 | ✓ | Sec. J3.3, Sec. J3.5 |

$s_{min}$ = 8/3*d
= 8/3*0.75[in]
= **2**[in] Sec. J3.3

IsCorrosionConsidered → **False**

$s_{max} = \min(24*t_p, 12 \text{ [in]})$
= min(24*0.25[in], 12 [in])
= **6**[in] Sec. J3.5

Beam

| | | | | | | |
|---|---|---|---|---|---|---|
| Top cope length | [in] | 3.23 | -- | 24.40 | ✓ | |

$c_{max}$ = 2*d
= 2*12.2[in]
= **24.4**[in]

| | | | | | | |
|---|---|---|---|---|---|---|
| Top cope depth | [in] | 0.78 | -- | 1.81 | ✓ | |

$d_{ctmax} = \min(d/2, d_{top} - w)$
= min(12.2[in]/2, 2[in] - 0.188[in])
= **1.813**[in]

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**DESIGN CHECK**

| Verification | Unit | Capacity | Demand | Ctrl EQ | Ratio | References |
|---|---|---|---|---|---|---|
| Angle (Beam side) | | | | | | |
| Weld capacity | [Kip] | 42.54 | 5.10 | CL | **0.12** | Tables 8-4 .. 8-11 |

$\phi R_n = \phi*C*C_1*D*L$
= 0.75*3.151[kip/in]*1*3*6[in]
= **42.537**[kip] Tables 8-4 .. 8-11

| | | | | | | |
|---|---|---|---|---|---|---|
| Shear yielding | [Kip] | 32.40 | 5.00 | TL | **0.15** | Eq. J4-3 |

$A_g = L_p*t_p$
= 6[in]*0.25[in]
= **1.5**[in2] Sec. D3-1

$\phi R_n = \phi * 0.60 * F_y * A_g$
= 1*0.60*36000[lb/in2]*1.5[in2]
= **32.4**[kip] Eq. J4-3

| | | | | | | |
|---|---|---|---|---|---|---|
| Leg tensile yielding | [Kip] | 48.60 | 1.00 | TL | 0.02 | Eq. J4-1 |

$\phi R_n = \phi * F_y * A_g$
= 0.9*36000[lb/in2]*1.5[in2]
= **48.6**[kip] Eq. J4-1

Angle (Support side)

| | | | | | | |
|---|---|---|---|---|---|---|
| Bolts shear | [Kip] | 17.13 | 5.00 | TL | 0.29 | Tables (7-1..14) |

$\phi R_n = \phi * F_{nv} * A_b$
= 0.75*54000[lb/in2]*0.442[in2]
= **17.901**[kip] Eq. J3-1

$\phi R_n = C * \phi R_n$
= 0.957*17.901[kip]
= **17.132**[kip] Tables (7-1..14)

| | | | | | | |
|---|---|---|---|---|---|---|
| Bolt bearing under shear load | [Kip] | 16.20 | 5.00 | TL | 0.31 | p. 7-18, Sec. J3.10 |

$L_{c\text{-}end} = Max(0.0, L_e - d_h/2)$
= Max(0.0, 1.5[in] - 0.813[in]/2)
= **1.094**[in] Sec. J3.10

$L_{c\text{-}spa} = Max(0.0, s - d_h)$
= Max(0.0, 3[in] - 0.813[in])
= **2.188**[in] Sec. J3.10

$\phi R_n = \phi * (C/(n_c * n)) * (min(k_1 * l_c, k_2 * d) + min(k_1 * L_{c\text{-}spa}, k_2 * d) * (n - 1)) * t_p * F_u * n_c$
= 0.75*(0.957/(1*2))*(min(1.2*1.094[in], 2.4*0.75[in]) + min(1.2*2.188[in], 2.4*0.75[in])*(2 - 1))*0.25[in]*58000[lb/in2]*1
= **16.197**[kip] p. 7-18, Sec. J3.10

| | | | | | | |
|---|---|---|---|---|---|---|
| Shear yielding | [Kip] | 32.40 | 5.00 | TL | 0.15 | Eq. J4-3 |

$A_g = L_p * t_p$
= 6[in]*0.25[in]
= **1.5**[in2] Sec. D3-1

$\phi R_n = \phi * 0.60 * F_y * A_g$
= 1*0.60*36000[lb/in2]*1.5[in2]
= **32.4**[kip] Eq. J4-3

| | | | | | | |
|---|---|---|---|---|---|---|
| Shear rupture | [Kip] | 27.73 | 5.00 | TL | 0.18 | Eq. J4-4 |

$L_h = d_h + 1/16$ [in]
= 0.813[in] + 1/16 [in]
= **0.875**[in] Sec. D3-2

$L_e = L - n * L_h$
= 6[in] - 2*0.875[in]
= **4.25**[in] DG4 Eq. 3-13

$A_{nv} = L_e*t_p$
= 4.25[in]*0.25[in]
= **1.063**[in2] Sec. J4-2

$\phi R_n = \phi*0.60*F_u*A_{nv}$
= 0.75*0.60*58000[lb/in2]*1.063[in2]
= **27.731**[kip] Eq. J4-4

| | | | | | | |
|---|---|---|---|---|---|---|
| Block shear | [Kip] | 29.78 | 5.00 | TL | **0.17** | Eq. J4-5 |

$dh_h = d_h + 1/16$ [in]
= 0.813[in] + 1/16 [in]
= **0.875**[in] Sec. D3-2

$dh_v = d_h + 1/16$ [in]
= 0.813[in] + 1/16 [in]
= **0.875**[in] Sec. D3-2

$A_{nt} = (L_{eh} + (n_c - 1)*spa - (n_c - 0.5)*dh_h)*t_p$
= (1.5[in] + (1 - 1)*5.5[in] - (1 - 0.5)*0.875[in])*0.25[in]
= **0.266**[in2] Sec. J4-3

$A_{gv} = (L_{ev} + (n - 1)*s)*t_p$
= (1.5[in] + (2 - 1)*3[in])*0.25[in]
= **1.125**[in2] Sec. J4-3

$A_{nv} = (L_{ev} + (n - 1)*(s - dh_v) - dh_v/2)*t_p$
= (1.5[in] + (2 - 1)*(3[in] - 0.875[in]) - 0.875[in]/2)*0.25[in]
= **0.797**[in2] Sec. J4-3

IsStressUniform → **True**

$U_{bs} = 1$ Sec. J4-3

$\phi R_n = \phi*\min(0.6*F_u*A_{nv} + U_{bs}*F_u*A_{nt}, 0.6*F_y*A_{gv} + U_{bs}*F_u*A_{nt})$
= 0.75*min(0.6*58000[lb/in2]*0.797[in2] + 1*58000[lb/in2]*0.266[in2], 0.6*36000[lb/in2]*1.125[in2] + 1*58000[lb/in2]*0.266[in2])
= **29.78**[kip] Eq. J4-5

| | | | | | | |
|---|---|---|---|---|---|---|
| Resulting tension capacity due prying action | [Kip] | 4.23 | 1.00 | TL | **0.24** | p. 9-12, p. 9-10 |

$f_v = F/(A_b*N_{bolts})$
= 5[kip]/(0.442[in2]*2)
= **5656.11**[lb/in2] Sec. J3.7

$F'_{nt} = \min(\max(1.3*F_{nt} - F_{nt}*f_v/(\phi*F_{nv}), 0.0), F_{nt})$
= min(max(1.3*90000[lb/in2] - 90000[lb/in2]*5656.11[lb/in2]/(0.75*54000[lb/in2]), 0.0), 90000[lb/in2])
= **90000**[lb/in2] Eq. J3-3

$\phi R_n = \phi*F'_{nt}*A_b$
= 0.75*90000[lb/in2]*0.442[in2]
= **29.835**[kip] Eq. J3-2

$f_v = F/(A_b*N_{bolts})$
= 5[kip]/(0.442[in2]*2)
= **5656.11**[lb/in2] Sec. J3.7

$F'_{nt} = min(max(1.3*F_{nt} - F_{nt}*f_v/(\phi*F_{nv}), 0.0), F_{nt})$
= min(max(1.3*90000[lb/in2] - 90000[lb/in2]*5656.11[lb/in2]/(0.75*54000[lb/in2]), 0.0), 90000[lb/in2])
= **90000**[lb/in2] Eq. J3-3

$\phi R_n = \phi*F'_{nt}*A_b$
= 0.75*90000[lb/in2]*0.442[in2]
= **29.835**[kip] Eq. J3-2

$p_{inner} = min(p, s, 3.5*b)$
= min(3[in], 3[in], 3.5*2.375[in])
= **3**[in] p. 9-12

$p_{outer} = min(p, s, 3.5*b)$
= min(3[in], 3[in], 3.5*2.375[in])
= **3**[in] p. 9-12

a' = Min(a + d/2, 1.25*b + d/2)
= Min(1.5[in] + 0.75[in]/2, 1.25*2.375[in] + 0.75[in]/2)
= **1.875**[in] p. 9-12

b' = b - d/2
= 2.375[in] - 0.75[in]/2
= **2**[in] p. 9-12

$\rho$ = b'/a'
= 2[in]/1.875[in]
= **1.067** p. 9-12

$\delta$ = 1 - d'/p
= 1 - 0.813[in]/3[in]
= **0.729** p. 9-11

$t_c = ((4*B*b')/(\phi*p*F_u))^{0.5}$
= ((4*29.835[kip]*2[in])/(0.9*3[in]*58000[lb/in2]))$^{0.5}$
= **1.235**[in] p. 9-13

$\alpha' = (1/(\delta*(1 + \rho)))*((t_c/t_p)^2 - 1)$
= (1/(0.729*(1 + 1.067)))*((1.235[in]/0.25[in])$^2$ - 1)
= **15.519** p. 9-13

$Q = (t_p/t_c)^2*(1 + \delta)$
= (0.25[in]/1.235[in])$^2$*(1 + 0.729)
= **0.0709** p. 9-13

$T_{avail}$ = 2 * (B*Q)
= 2 * (29.835[kip]*0.0709)
= **4.231**[kip] p. 9-10

| | | | | | | |
|---|---|---|---|---|---|---|
| Flexural yielding | [Kip*ft] | 29.16 | 5.00 | TL | **0.17** | p. 15-7 |

$Z_x = t_p*L^2/4$
$= 0.25$[in]$*6$[in]$^2/4$
$=$ **2.25**[in3] — T. 17-27

$\phi R_n = \phi*F_y*Z_x/e$
$= 0.9*36000$[lb/in2]$*2.25$[in3]$/2.5$[in]
$=$ **29.16**[kip] — p. 15-7

| | | | | | | |
|---|---|---|---|---|---|---|
| Flexural rupture | [Kip*ft] | 30.59 | 5.00 | TL | **0.16** | p. 9-10 |

$L_h = d_h + 1/16$ [in]
$= 0.813$[in] $+ 1/16$ [in]
$=$ **0.875**[in] — Sec. D3-2

$Z_{net} = t_p/4*(L^2 - s^2*n*(n^2 - 1)*L_h/L)$
$= 0.25$[in]$/4*(6$[in]$^2 - 3$[in]$^2*2*(2^2 - 1)*0.875$[in]$/6$[in]$)$
$=$ **1.758**[in3] — [4]

$\phi R_n = \phi*F_u*Z_{net}/e$
$= 0.75*58000$[lb/in2]$*1.758$[in3]$/2.5$[in]
$=$ **30.586**[kip] — p. 9-10

<u>Beam</u>

| | | | | | | |
|---|---|---|---|---|---|---|
| Welds rupture | [Kip/ft] | 107.64 | 8.01 | CL | **0.07** | p. 9-5 |

$R_n = 0.6*F_u*t_p$
$= 0.6*65000$[lb/in2]$*0.23$[in]
$=$ **8.97**[kip/in] — p. 9-5

$D_{min} = P/(\phi*C*C_1*L)$
$= 5.099$[kip]$/(0.75*3.151$[kip/in]$*1*6$[in]$)$
$=$ **0.36** — tables 8-4..11

HasWeldsOnBothSides → **False**

$R_u = 0.6*F_{EXX}*(2)^{1/2}/2*D_{min}/16$ [in]
$= 0.6*70000$[lb/in2]$*(2)^{1/2}/2*0.36/16$ [in]
$=$ **0.668**[kip/in] — p. 9-5

| | | | | | | |
|---|---|---|---|---|---|---|
| Shear yielding | [Kip] | 78.76 | 5.00 | TL | **0.06** | Eq. J4-3 |

$A_g = L_p*t_p$
$= 11.415$[in]$*0.23$[in]
$=$ **2.625**[in2] — Sec. D3-1

$\phi R_n = \phi*0.60*F_y*A_g$
$= 1*0.60*50000$[lb/in2]$*2.625$[in2]
$=$ **78.764**[kip] — Eq. J4-3

| | | | | | | |
|---|---|---|---|---|---|---|
| Shear rupture | [Kip] | 76.79 | 5.00 | TL | **0.07** | Eq. J4-4 |

$A_{nv} = L_e*t_p$
$= 11.415$[in]$*0.23$[in]
$=$ **2.625**[in2] — Sec. J4-2

$\phi R_n = \phi*0.60*F_u*A_{nv}$
= 0.75*0.60*65000[lb/in2]*2.625[in2]
= **76.794**[kip] Eq. J4-4

Tear out under axial load [Kip] 103.50 1.00 TL **0.01** Eq. J4-5

$A_{gv} = 2.0*(b - c)*t_p$
= 2.0*(4[in] - 0.5[in])*0.23[in]
= **1.61**[in2] Sec. J4-3

$A_{nv} = A_{gv}$
= **1.61**[in2] Sec. J4-3

$A_{nt} = L*t_p$
= 6[in]*0.23[in]
= **1.38**[in2] Sec. J4-3

$\phi R_n = \phi*\min(0.6*F_u*A_{nv} + U_{bs}*F_u*A_{nt}, 0.6*F_y*A_{gv} + U_{bs}*F_u*A_{nt})$
= 0.75*min(0.6*65000[lb/in2]*1.61[in2] + 1*65000[lb/in2]*1.38[in2], 0.6*50000[lb/in2]*1.61[in2] + 1*65000[lb/in2]*1.38[in2])
= **103.5**[kip] Eq. J4-5

Block shear [Kip] 76.58 5.00 TL **0.07** Eq. J4-5

$A_{gv} = L*t_p$
= 7.215[in]*0.23[in]
= **1.659**[in2] Sec. J4-3

$A_{nt} = L*t_p$
= 3.5[in]*0.23[in]
= **0.805**[in2] Sec. J4-3

$\phi R_n = \phi*\min(0.6*F_u*A_{nv} + U_{bs}*F_u*A_{nt}, 0.6*F_y*A_{gv} + U_{bs}*F_u*A_{nt})$
= 0.75*min(0.6*65000[lb/in2]*1.659[in2] + 1*65000[lb/in2]*0.805[in2], 0.6*50000[lb/in2]*1.659[in2] + 1*65000[lb/in2]*0.805[in2])
= **76.581**[kip] Eq. J4-5

Flexural yielding [Kip] 96.56 5.00 TL **0.05** p. 9-6

$\phi R_n = \phi*F_y*S_{net}/e$
= 0.9*50000[lb/in2]*8.004[in3]/3.73[in]
= **96.564**[kip] p. 9-6

Flexural rupture [Kip] 189.07 5.00 TL **0.03** p. 9-6

$\phi R_n = \phi*F_u*Z_{net}/e$
= 0.75*65000[lb/in2]*14.467[in3]/3.73[in]
= **189.075**[kip] p. 9-6

Local web buckling [Kip] 141.89 5.00 TL **0.04** p. 9-7

$\lambda = h_o/t_w$
= 11.415[in]/0.23[in]
= **49.63** Eq. 9-11

c/d< = 1 → 3.23[in]/12.2[in]<
= 1 → **True**

f = 2*c/d
= 2*3.23[in]/12.2[in]
= **0.53** Eq. 9-14a

$c/h_o$< = 1 → 3.23[in]/11.415[in]<
= 1 → **True**

$k = 2.2*(h_o/c)^{1.65}$
$= 2.2*(11.415[in]/3.23[in])^{1.65}$
= **17.663** Eq. 9-13a

$k_1$ = Max(f*k, 1.61)
= Max(0.53*17.663, 1.61)
= **9.353** Eq. 9-10

$\lambda_p = 0.475*((k_1*E)/F_y)^{1/2}$
$= 0.475*((9.353*2.90E+07[lb/in2])/50000[lb/in2])^{1/2}$
= **34.985** Eq. 9-12

Limit1Applies = λ<
= $\lambda_p$
= 49.63<
= 34.985
= **False** p. 9-7

Limit2Applies = λ<
= $2*\lambda_p$
= 49.63<
= 2*34.985
= **True** p. 9-7

$M_p = F_y*Z_{net}$
= 50000[lb/in2]*14.467[in3]
= **60.278**[kip*ft] p. 9-7

$M_y = F_y*S_{net}$
= 50000[lb/in2]*8.004[in3]
= **33.35**[kip*ft] p. 9-7

$M_n = M_p - (M_p - M_y)*(\lambda/\lambda_p - 1)$
= 60.278[kip*ft] - (60.278[kip*ft] - 33.35[kip*ft])*(49.63/34.985 - 1)
= **49.005**[kip*ft] Eq. 9-7

$\phi R_n = \phi*M_n/e$
= 0.9*49.005[kip*ft]/3.73[in]
= **141.892**[kip] p. 9-7

<u>Support</u>

| | | | | | | |
|---|---|---|---|---|---|---|
| Bolt bearing under shear load | [Kip] | 23.69 | 5.00 | TL | 0.21 | Eq. J3-6 |

$L_{c\text{-}end} = Max(0.0, L_e - d_h/2)$
= Max(0.0, 1.20E+31[in] - 0.813[in]/2)
= **1.20E+31**[in] Sec. J3.10

$L_{c\text{-}spa}$ = Max(0.0, s - $d_h$)
= Max(0.0, 3[in] - 0.813[in])
= **2.188**[in] Sec. J3.10

$\phi R_n = \phi$*(min($k_1$*$L_{c\text{-}end}$, $k_2$*d) + min($k_1$*$L_{c\text{-}spa}$, $k_2$*d)*(n - 1))*$t_p$*$F_u$*$n_c$
= 0.75*(min(1.2*1.20E+31[in], 2.4*0.75[in]) + min(1.2*2.188[in], 2.4*0.75[in])*(2 - 1))*0.27[in]*65000[lb/in2]*
1
= **23.693**[kip] Eq. J3-6

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**Global critical strength ratio** **0.31**

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**NOTATION**

a: Plate depth
$A_b$: Nominal bolt area
$A_g$: Gross area
$A_{gv}$: Gross area subject to shear
$A_{nt}$: Net area subject to tension
$A_{nv}$: Net area subjected to shear
a': Distance for prying action
$\alpha'$: Value that either maximizes the bolt available tensile strength for a given thickness or minimizes the thickness required for a given bolt available tensile strength
B: Available tensile strength per bolt
b: Plate, connector or member width
B: Available strength of all bolts
b': Distance for prying action
b: Distance from bolt centerline to the face/centerline of tee stem/angle leg.
C: Bolt group coefficient
c: Coped length
$C_1$: Electrode strength coefficient
$C_2$: Edge distance increment
c: Setback
$c_{max}$: Maximum coped length
C: Weld group coefficient
$\cos\theta$: Cosine of the brace with the horizontal angle
d: Nominal bolt diameter
$d_{cb}$: Bottom cope depth
$d_{ct}$: Top cope depth
$d_{ctmax}$: Maximum top coped depth
$d_h$: Nominal hole dimension
$d_{top}$: Beam top edge distance
d': Width of the hole along the length of the fitting
$\delta$: Ratio of the net area at bolt line to gross area at face of the stem or leg of angle
d: Beam depth
$dh_h$: Horizontal hole dimension
$dh_v$: Vertical hole dimension
D: Number of sixteenths of an inch in the weld size
$D_{min}$: Number of sixteenths of an inch in the minimum weld size
e: Load eccentricity
E: Elastic modulus
f: Plate buckling model adjustment factor
F: Required shear force for combined tension and shear
$F_{EXX}$: Electrode classification number
$F_{nt}$: Nominal tensile stress
$F_{nv}$: Nominal shear stress
$F_u$: Specified minimum tensile strength
$f_v$: Required shear stress
$F_y$: Specified minimum yield stress
$F'_{nt}$: Nominal tensile stress modified to include the effects of shear stress
H: Brace axial force horizontal component
$H_{Left}$: Left brace axial force horizontal component

$h_o$: Reduced beam depth
$H_{Right}$: Right brace axial force horizontal component
HasWeldsOnBothSides: Has welds on both sides
IsCorrosionConsidered: Is corrosion considered
IsStressUniform: Is the stress uniform
k: Plate buckling coefficient
$k_1$: Bearing factor
$k_2$: Bearing factor
k: Outside corner radius
L: Length
$L_{c\text{-}end}$: Clear distance
$l_c$: Clear distance
$L_e$: Effective length
$L_e$: Edge distance
$L_{eh}$: Horizontal edge distance
$L_{emin}$: Minimum edge distance
$L_{ev}$: Vertical edge distance
$L_h$: Hole dimension for tension and shear net area
$L_{max}$: Maximum length
$L_{min}$: Minimum length
$L_p$: Plate length
L: Length of weld
$\lambda$: Slenderness
M: Bending required
$M_n$: Nominal moment
$M_p$: Yielding plastic moment
$e_{dmin}$: Minimum edge distance
n: Bolts rows number
$N_{bolts}$: Number of bolts
$n_c$: Number of bolt columns
P: Required axial force
$\phi$: Design factors
$\phi R_n$: Design or allowable strength
$p_{inner}$: Inner tributary length per pair of bolts, which should preferably not exceed the gage between the pair of bolts
$p_{outer}$: Outer tributary length per pair of bolts, which should preferably not exceed the gage between the pair of bolts
p: Tributary length per pair of bolts, which should preferably not exceed the gage between the pair of bolts
Q: Prying action coefficient
Q: Prying action coefficient
$R_n$: Nominal strength
$R_u$: Required strength
$\rho$: Prying distances ratio
$s_{max}$: Maximum spacing
$s_{min}$: Minimum spacing
$S_{net}$: Net section modulus
$\sin\theta$: Sine of the brace with the horizontal angle
spa: Transversal spacing between bolts or welds
s: Longitudinal bolt spacing
$L_{c\text{-}spa}$: Distance between adjacent holes edges
$t_p$: Thickness of the connected material
T: Clear distance between web fillets
$T_{avail}$: Available tensile strength per bolt including effects of prying action
$t_c$: Flange or angle thickness required to develop the available strength of the bolt with no prying action
$t_p$: Plate thickness
$t_w$: Web thickness
$U_{bs}$: Stress index
V: Brace axial force vertical component
$V_{Left}$: Left vertical component of the gusset forces
$V_{Right}$: Right vertical component of the gusset forces
$w_{max}$: Maximum weld size required
$w_{min}$: Minimum weld size required
w: Weld size
$x_{Left}$: Distance from the gusset center to the left vertical force
$x_{Right}$: Distance from the gusset center to the right vertical force
$Z_{net}$: Net plastic section modulus
$Z_x$: Plastic section modulus about the x-axis

Limit1Applies: Nominal flexural buckling limit 1 applies
Limit2Applies: Nominal flexural buckling limit 2 applies
$\lambda_p$: Limiting slenderness for a compact web
$M_y$: Yield moment
$k_1$: Modified plate buckling coefficient

**REFERENCES**

[4] AISC 2005, Design Examples Version 13.0, pp. IIA-63, IIA_86, IIA-98