Bentley

Current Date: 10/31/2022 7:25:44 AM
Units System: kip_in

Design code: AISC 360-16 LRFD, ACI 318-11

Interface between Gusset - Top left brace

Connection: Directly bolted

DEMANDS

Description	Pu kip	Load type
LC-2053	27.37	Design

GEOMETRIC CONSIDERATIONS

Dimensions	Unit	Value	Min.	Max.	Sta.	References
<u>Directly bolted</u>						
Transverse edge distance	[in]	1.74	1.00	-	✔	Tables J3.4, J3.5
$L_{emin} = e_{dmin} + C_2$ = 1 [in] + 0 [in] = **1 [in]**						Tables J3.4, J3.5
Longitudinal 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
Transverse center-to-center spacing (gage)	[in]	3.00	2.00	9.12	✔	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 [in]) = min(24*0.38 [in] , 12 [in]) = **9.12 [in]**						Sec. J3.5
Longitudinal center-to-center spacing (pitch)	[in]	3.00	2.00	9.12	✔	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 [in]) = min(24*0.38 [in] , 12 [in]) = **9.12 [in]**						Sec. J3.5
<u>Gusset</u>						
Transverse edge distance	[in]	2.44	1.00	-	✔	Tables J3.4, J3.5
$L_{emin} = e_{dmin} + C_2$ = 1 [in] + 0 [in] = **1 [in]**						Tables J3.4, J3.5
Longitudinal 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

DESIGN CHECK

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
<u>Directly bolted</u>						
Bolts shear	[kip]	71.60	27.37	LC-2053-0	0.38	Tables (7-1..14)
Bolt bearing under shear load	[kip]	115.32	27.37	LC-2053-0	0.24	Eq. J3-6

Bolts shear:

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

$\phi R_n = C * \phi R_n$ = 4*17.901 [kip] = **71.604 [kip]** — Tables (7-1..14)

Bolt bearing under shear load:

$L_{c\text{-}end}$ = 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

$\phi R_n = \phi$*(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*1.094 [in] , 2.4*0.75 [in]) + min(1.2*2.188 [in] , 2.4*0.75 [in])*(2 - 1))*0.38 [in] *65000 [lb/in2] *2 = **115.318 [kip]** — Eq. J3-6

Block shear rupture at brace web [kip] 119.30 27.37 LC-2053-0 0.23 Eq. J4-5

$L_h = d_h + 1/16$ [in] = 0.813 [in] + 1/16 [in] = **0.875 [in]** Sec. D3-2
$A_{nt} = 2 * (t_p*(L_{ev} + (n - 1)*(g - L_h) - L_h/2))$ = 2 * (0.38 [in] *(1.745 [in] + (1 - 1)*(3 [in] - 0.875 [in]) - 0.875 [in] /2)) = **0.994 [in2]** Sec. J4.3
$A_{gv} = 2 * ((L_{ev} + (n - 1)*s)*t_p)$ = 2 * ((1.5 [in] + (2 - 1)*3 [in])*0.38 [in]) = **3.42 [in2]** Sec. J4-3
$L_h = d_h + 1/16$ [in] = 0.813 [in] + 1/16 [in] = **0.875 [in]** Sec. D3-2
$A_{nv} = A_{gv} - n_c*(n - 0.5)*L_h*t_p$ = 3.42 [in2] - 2*(2 - 0.5)*0.875 [in] *0.38 [in] = **2.422 [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] *2.422 [in2] + 1*65000 [lb/in2] *0.994 [in2] , 0.6*50000 [lb/in2] *3.42 [in2] + 1*65000 [lb/in2] *0.994 [in2]) = **119.301 [kip]** Eq. J4-5

<u>Gusset</u>

Bolt bearing on gusset [kip] 113.80 27.37 LC-2053-0 0.24 Eq. J3-6

$L_{c\text{-}end} = \text{Max}(0.0, L_e - d_h/2)$ = Max(0.0, 1.5 [in] - 0.813 [in] /2) = **1.094 [in]** Sec. J3.10
$L_{c\text{-}spa} = \text{Max}(0.0, s - d_h)$ = 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*1.094 [in] , 2.4*0.75 [in]) + min(1.2*2.188 [in] , 2.4*0.75 [in])*(2 - 1))*0.375 [in] *65000 [lb/in2] *2 = **113.801 [kip]** Eq. J3-6

Block shear on gusset [kip] 108.77 27.37 LC-2053-0 0.25 Eq. J4-5

$L_h = d_h + 1/16$ [in] = 0.813 [in] + 1/16 [in] = **0.875 [in]** Sec. D3-2
$A_{nt} = t_p*((n - 1)*(g - L_h))$ = 0.375 [in] *((2 - 1)*(3 [in] - 0.875 [in])) = **0.797 [in2]** Sec. J4.3
$A_{gv} = 2*t_p*(L_{eh} + (n_c - 1)*s)$ = 2*0.375 [in] *(1.5 [in] + (2 - 1)*3 [in]) = **3.375 [in2]** Sec. J4.3
$L_h = d_h + 1/16$ [in] = 0.813 [in] + 1/16 [in] = **0.875 [in]** Sec. D3-2
$A_{nv} = 2*t_p*(L_{eh} + (n_c - 1)*(s - L_h) - L_h/2)$ = 2*0.375 [in] *(1.5 [in] + (2 - 1)*(3 [in] - 0.875 [in]) - 0.875 [in] /2) = **2.391 [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] *2.391 [in2] + 1*65000 [lb/in2] *0.797 [in2] , 0.6*50000 [lb/in2] *3.375 [in2] + 1*65000 [lb/in2] *0.797 [in2]) = **108.773 [kip]** Eq. J4-5

Ratio **0.38**

Checks for gusset and brace

DESIGN CHECK

<u>Member</u>

Yielding strength due to axial load [kip] 170.18 27.37 LC-2053-0 0.16 Eq. J4-1

$\phi R_n = \phi*F_y*A_g$ = 0.9*50000 [lb/in2] *3.782 [in2] = **170.181 [kip]** Eq. J4-1

Tension rupture [kip] 96.04 27.37 LC-2053-0 0.28 Eq. J4-2

$L_h = d_h + 1/16$ [in] = 0.813 [in] + 1/16 [in] = **0.875 [in]** Sec. D3-2
$A_{hf} = n*t_f*L_h$ = 2*0.23 [in] *0.875 [in] = **0.403 [in2]** Sec. D3.2
$A_n = A_g - A_{hf} - A_{hw}$ = 3.782 [in2] - 0.403 [in2] - 0 [in2] = **3.379 [in2]** Sec. D3.2
$U = 1 - x/l$ = 1 - 1.251 [in] /3 [in] = **0.583** Table D3.1
$A_e = A_n*U$ = 3.379 [in2] *0.583 = **1.97 [in2]** Eq. D3-1
$\phi R_n = \phi*F_u*A_e$ = 0.75*65000 [lb/in2] *1.97 [in2] = **96.043 [kip]** Eq. J4-2

<u>Gusset</u>

Tension yielding on the Whitmore section [kip] 109.08 27.37 LC-2053-0 0.25 Eq. J4-1

$A_g = L_w*t_p$ = 6.464 [in] *0.375 [in] = **2.424 [in2]**
$\phi R_n = \phi*F_y*A_g$ = 0.9*50000 [lb/in2] *2.424 [in2] = **109.082 [kip]** Eq. J4-1

Ratio **0.28**

<u>Calculation of the interface forces</u>

Load condition :LC-2053 DG29 p. 24-33
General case DG29 p. 24-33
$K = e_b*\tan\theta - e_c$ = 1.5 [in] *0.857 - 0.207 [in] = **1.078 [in]** p. 13-10
$K' = \alpha_{bar}*(\tan\theta + \alpha_{bar}/\beta_{bar})$ = 4 [in] *(0.857 + 4 [in] /7.5 [in]) = **5.562 [in]** p. 13-10
$D = (\tan\theta)^2 + (\alpha_{bar}/\beta_{bar})^2$ = $(0.857)^2$ + (4 [in] */7.5 [in])*^{2} = **1.019** p. 13-10

$\alpha = (K'*\tan\theta + K*(\alpha_{bar}/\beta_{bar})^2)/D = (5.562\ [in]\ *0.857 + 1.078\ [in]\ *(4\ [in]\ /7.5\ [in]\ )^2)/1.019 = \mathbf{4.979\ [in]}$ p. 13-10
$\beta = (K' - K*\tan\theta)/D = (5.562\ [in]\ - 1.078\ [in]\ *0.857)/1.019 = \mathbf{4.551\ [in]}$ p. 13-10
$r = ((\alpha + e_c)^2 + (\beta + e_b)^2)^{1/2} = ((4.979\ [in]\ + 0.207\ [in]\ )^2 + (4.551\ [in]\ + 1.5\ [in]\ )^2)^{1/2} = \mathbf{7.969\ [in]}$ p. 13-5
$H_b = \alpha*P/r = 4.979\ [in]\ *27.369\ [kip]\ /7.969\ [in]\ = \mathbf{17.099\ [kip]}$ p. 13-5
$H_c = e_c*P/r = 0.207\ [in]\ *27.369\ [kip]\ /7.969\ [in]\ = \mathbf{0.713\ [kip]}$ p. 13-5
$V_b = e_b*P/r - \Delta V = 1.5\ [in]\ *27.369\ [kip]\ /7.969\ [in]\ - 0\ [kip]\ = \mathbf{5.152\ [kip]}$ p. 13-5
$V_c = \beta*P/r + \Delta V = 4.551\ [in]\ *27.369\ [kip]\ /7.969\ [in]\ + 0\ [kip]\ = \mathbf{15.629\ [kip]}$ p. 13-5
$M_b = abs(V_b*(\alpha - \alpha_{bar})) + abs(\Delta V*\alpha) = abs(5.152\ [kip]\ *(4.979\ [in]\ - 4\ [in]\ )) + abs(0\ [kip]\ *4.979\ [in]\ ) = \mathbf{0.42\ [kip*ft]}$
p. 13-10
$M_c = abs(H_c*(\beta - \beta_{bar})) = abs(0.713\ [kip]\ *(4.551\ [in]\ - 7.5\ [in]\ )) = \mathbf{0.175\ [kip*ft]}$ p. 13-10

Left gusset interface - base plate

Directly welded
DEMANDS

Description	**Ru** kip	**Pu** kip	**Mu** kip*ft	**Pu** kip	**Mu22** kip*ft	**Mu33** kip*ft	**Load type**
LC-2053	17.10	5.15	0.42	0.00	0.00	0.00	Design

DESIGN CHECK

Verification	**Unit**	**Capacity**	**Demand**	**Ctrl EQ**	**Ratio**	**References**
<u>Gusset</u>						
Beam yielding (normal stress)	[kip]	135.00	7.67	LC-2053-0	0.06	Eq. B-1, Appendix B, DG29, Eq. J4-1

$N_{eq} = V_{ub} + ((4*M_{ub})/L_p) = 5.152\ [kip]\ + ((4*0.42\ [kip*ft]\ )/8\ [in]\ ) = \mathbf{7.673\ [kip]}$ Eq. B-1, Appendix B, DG29
$A_g = L_p*t_p = 8\ [in]\ *0.375\ [in]\ = \mathbf{3\ [in2]}$ Sec. D3-1
$\phi R_n = \phi*F_y*A_g = 0.9*50000\ [lb/in2]\ *3\ [in2]\ = \mathbf{135\ [kip]}$ Eq. J4-1
$N_{eq} = V_{ub} + ((4*M_{ub})/L_p) = 5.152\ [kip]\ + ((4*0.42\ [kip*ft]\ )/8\ [in]\ ) = \mathbf{7.673\ [kip]}$ Eq. B-1, Appendix B, DG29

Shear yielding	[kip]	90.00	17.10	LC-2053-0	0.19	Eq. J4-3

$A_g = L_p*t_p = 8\ [in]\ *0.375\ [in]\ = \mathbf{3\ [in2]}$ Sec. D3-1
$\phi R_n = \phi*0.60*F_y*A_g = 1*0.60*50000\ [lb/in2]\ *3\ [in2]\ = \mathbf{90\ [kip]}$ Eq. J4-3

Gusset edge tension stress	[ksi]	45.00	1.72	LC-2053-0	0.04	J4-1

$\phi F_n = \phi*F_y = 0.9*50000\ [lb/in2]\ = \mathbf{45000\ [lb/in2]}$ J4-1
$f_{ua} = H_c/(t_p*l) = 5.152\ [kip]\ /(0.375\ [in]\ *8\ [in]\ ) = \mathbf{1717.18\ [lb/in2]}$ [9]

Gusset edge shear stress	[ksi]	30.00	5.70	LC-2053-0	0.19	J4-1

$\phi F_n = \phi*0.6*F_y = 1*0.6*50000\ [lb/in2]\ = \mathbf{30000\ [lb/in2]}$ J4-1
$f_{uv} = V_c/(t_p*l) = 17.099\ [kip]\ /(0.375\ [in]\ *8\ [in]\ ) = \mathbf{5699.61\ [lb/in2]}$ [9]

Weld capacity	[kip]	128.92	22.78	LC-2053-0	0.18	Tables 8-4 .. 8-11

$\phi R_n = 2 * (\phi*C*C_1*D*L) = 2 * (0.75*2.149\ [kip/in]\ *1*5*8\ [in]\ ) = \mathbf{128.916\ [kip]}$ Tables 8-4 .. 8-11
$f_{ua} = V_c/l = 5.152\ [kip]\ /8\ [in]\ = \mathbf{0.644\ [kip/in]}$ [9]
$f_{uv} = H_c/l = 17.099\ [kip]\ /8\ [in]\ = \mathbf{2.137\ [kip/in]}$ [9]
$f_{ub} = M_c/(l^2/6) = 0.42\ [kip*ft]\ /(8\ [in]\ ^2/6) = \mathbf{0.473\ [kip/in]}$ [9]
$f_{uPeak} = ((f_{ua} + f_{ub})^2 + f_{uv}^2)^{1/2} = ((0.644\ [kip/in]\ + 0.473\ [kip/in]\ )^2 + 2.137\ [kip/in]\ ^2)^{1/2} = \mathbf{2.411\ [kip/in]}$ [9]
$f_{uAve} = 0.5*(((f_{ua} - f_{ub})^2 + f_{uv}^2)^{1/2} + ((f_{ua} + f_{ub})^2 + f_{uv}^2)^{1/2}) = 0.5*(((0.644\ [kip/in]\ - 0.473\ [kip/in]\ )^2 + 2.137\ [kip/in]\ ^2)^{1/2} + ((0.644\ [kip/in]\ + 0.473\ [kip/in]\ )^2 + 2.137\ [kip/in]\ ^2)^{1/2}) = \mathbf{2.278\ [kip/in]}$ [9]
$f_{uWeld} = l*max(f_{uPeak}, 1.25*f_{uAve}) = 8\ [in]\ *max(2.411\ [kip/in]\ , 1.25*2.278\ [kip/in]\ ) = \mathbf{22.778\ [kip]}$ [9]

Ratio	**0.19**

Upper left gusset interface - column

Directly welded
DEMANDS

Description	**Ru** kip	**Pu** kip	**Mu** kip*ft	**Pu** kip	**Mu22** kip*ft	**Mu33** kip*ft	**Load type**

LC-2053	15.63	0.71	0.18	32.82	0.00	0.00	Design

DESIGN CHECK

Gusset

Beam yielding (normal stress) [kip] 253.13 1.27 LC-2053-0 0.01 Eq. B-1, Appendix B, DG29, Eq. J4-1

$N_{eq} = V_{ub} + ((4*M_{ub})/L_p)$ = 0.713 [kip] + ((4*0.175 [kip*ft])/15 [in]) = **1.273 [kip]** Eq. B-1, Appendix B, DG29
$A_g = L_p*t_p$ = 15 [in] *0.375 [in] = **5.625 [in2]** Sec. D3-1
$\phi R_n = \phi*F_y*A_g$ = 0.9*50000 [lb/in2] *5.625 [in2] = **253.125 [kip]** Eq. J4-1
$N_{eq} = V_{ub} + ((4*M_{ub})/L_p)$ = 0.713 [kip] + ((4*0.175 [kip*ft])/15 [in]) = **1.273 [kip]** Eq. B-1, Appendix B, DG29

Shear yielding [kip] 168.75 15.63 LC-2053-0 0.09 Eq. J4-3

$A_g = L_p*t_p$ = 15 [in] *0.375 [in] = **5.625 [in2]** Sec. D3-1
$\phi R_n = \phi*0.60*F_y*A_g$ = 1*0.60*50000 [lb/in2] *5.625 [in2] = **168.75 [kip]** Eq. J4-3

Gusset edge tension stress [ksi] 45.00 0.13 LC-2053-0 0.00 J4-1

$\phi F_n = \phi*F_y$ = 0.9*50000 [lb/in2] = **45000 [lb/in2]** J4-1
$f_{ua} = H_c/(t_p*l)$ = 0.713 [kip] /(0.375 [in] *15 [in]) = **126.69 [lb/in2]** [9]

Gusset edge shear stress [ksi] 30.00 2.78 LC-2053-0 0.09 J4-1

$\phi F_n = \phi*0.6*F_y$ = 1*0.6*50000 [lb/in2] = **30000 [lb/in2]** J4-1
$f_{uv} = V_c/(t_p*l)$ = 15.629 [kip] /(0.375 [in] *15 [in]) = **2778.4 [lb/in2]** [9]

Weld capacity [kip] 212.07 19.58 LC-2053-0 0.09 Tables 8-4 .. 8-11

$\phi R_n = 2 * (\phi*C*C_1*D*L)$ = 2 * (0.75*1.885 [kip/in] *1*5*15 [in]) = **212.065 [kip]** Tables 8-4 .. 8-11
$f_{ua} = V_c/l$ = 0.713 [kip] /15 [in] = **0.0475 [kip/in]** [9]
$f_{uv} = H_c/l$ = 15.629 [kip] /15 [in] = **1.042 [kip/in]** [9]
$f_{ub} = M_c/(l^2/6)$ = 0.175 [kip*ft] */(15 [in]* ²/6) = **0.056 [kip/in]** [9]
$f_{uPeak} = ((f_{ua} + f_{ub})^2 + f_{uv}^2)^{1/2}$ = ((0.0475 [kip/in] *+ 0.056 [kip/in])*² + 1.042 [kip/in] ²)^1/2 = **1.047 [kip/in]** [9]
$f_{uAve} = 0.5*(((f_{ua} - f_{ub})^2 + f_{uv}^2)^{1/2} + ((f_{ua} + f_{ub})^2 + f_{uv}^2)^{1/2})$ = 0.5*(((0.0475 [kip/in] *- 0.056 [kip/in])*² + 1.042 [kip/in] ²)^1/2 + ((0.0475 [kip/in] *+ 0.056 [kip/in])*² + 1.042 [kip/in] ²)^1/2) = **1.044 [kip/in]** [9]
$f_{uWeld} = l*max(f_{uPeak}, 1.25*f_{uAve})$ = 15 [in] *max(1.047 [kip/in] , 1.25*1.044 [kip/in]) = **19.584 [kip]** [9]

Column

Web plate strength due out-of-plane transverse load [kip] 36.51 0.71 LC-2053-0 0.02 p.9-16

$\phi R_n = \phi*t_w^2*(F_y/4.0)*(4.0*(2.0*T*a*b*(a + b))^{0.5} + L*(a + b))/(a*b)$ = 1*0.415 [in] ²*(50000 [lb/in2] */4.0)*(4.0*(2.0*11.38 [in] *5.503 [in] *5.503 [in] *(5.503 [in] + 5.503 [in]))*^0.5 + 15 [in] *(5.503 [in] + 5.503 [in]))/(5.503 [in] *5.503 [in]) = **36.505 [kip]** p.9-16

Ratio	**0.09**

interface between Column - base plate

DEMANDS

Description	Pu kip	Mu22 kip*ft	Mu33 kip*ft	Vu2 kip	Vu3 kip	Load type
LC-2053	53.60	7.72	-6.57	0.67	16.86	Design

Design for minor axis
Base plate (AISC 360-16 LRFD)

GEOMETRIC CONSIDERATIONS

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Base plate						
Distance from anchor to edge	[in]	4.75	0.25	-	✔	
Weld size	[1/16in]	6	3.00	-	✔	table J2.4

Left gusset

Weld size	[1/16in]	5	3.00	-	✔	table J2.4

DESIGN CHECK

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Pedestal						
Axial bearing	[ksi]	4.42	0.00	LC-2053-0	0.00	DG1 3.1.1;

$A_2 = ((B/N)*N_{cs})*N_{cs}$ = ((18 [in] /18 [in])*36 [in])*36 [in] = **1296 [in2]** DG1 Sec 3.1.1
$A_1 = B*N$ = 18 [in] *18 [in] = **324 [in2]** DG1 Sec 3.1.1
$f_{p,max} = \phi*\min(0.85*f'_c*(A_2/A_1)^{1/2}, 1.7*f'_c)$ = 0.65*min(0.85*4000 [lb/in2] *(4)$^{1/2}$, 1.7*4000 [lb/in2] ***) = 4420 [lb/in2]*** DG1 3.1.1

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Base plate						
Flexural yielding (bearing interface)	[kip*ft/ft]	25.31	0.00	LC-2053-0	0.00	DG1 Eq. 3.3.13

$\phi M_n = \phi*F_y*t_p^2/4$ = 0.9*50000 [lb/in2] **1.5 [in]* ^{2}/4 = **25.313 [kip*ft/ft]** DG1 Eq. 3.3.13

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Flexural yielding (tension interface)	[kip*ft/ft]	25.31	10.01	LC-2053-0	0.40	DG1 Eq. 3.3.13

$\phi M_n = \phi*F_y*t_p^2/4$ = 0.9*50000 [lb/in2] **1.5 [in]* ^{2}/4 = **25.313 [kip*ft/ft]** DG1 Eq. 3.3.13
$M_{pT} = M_{strip}/B_{eff}$ = 1.301 [kip*ft] /1.56 [in] = **10.007 [kip*ft/ft]**

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
Column						
Weld capacity	[kip/in]	12.53	12.83	LC-2053-0	1.02	p. 8-9, Sec. J2.5, Sec. J2.4, DG1 p. 35

LoadAngleFactor = 1 + 0.5*(sin(θ))$^{1.5}$ = 1 + 0.5*(sin(1.571))$^{1.5}$ = **1.5** p. 8-9
$F_w = 0.6*F_{EXX}$*LoadAngleFactor = 0.6*70000 [lb/in2] *1.5 = **63000 [lb/in2]** Sec. J2.5
$A_w = (2)^{1/2}/2*D/16$ [in] **L = (2)$^{1/2}$/2*6/16 [in] *1 [in]* = ***0.265 [in2]*** Sec. J2.4
$\phi R_w = \phi*F_w*A_w/L$ = 0.75*63000 [lb/in2] *0.265 [in2] /1 [in] = **12.529 [kip/in]**
b_{eff} = 2*L = 2*0.78 [in] = **1.56 [in]** DG1 p. 35
Maximum weld load = T/b_{eff} = 20.014 [kip] /1.56 [in] = **12.83 [kip/in]**

WARNINGS
High value moments detected in the axis perpendicular to the design axis

Ratio	**1.02**

Minor axis
Anchors

GEOMETRIC CONSIDERATIONS

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Anchors						
Anchor spacing	[in]	7.00	6.00	-	✔	Sec. D.8.1

$s_{min} = 4*d_a$ = 4*1.5 [in] = **6 [in]** Sec. D.8.1

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Concrete cover	[in]	13.75	2.00	-	✔	Sec. 7.7.1

IsConcreteCastAgainstEarth → **False**
Cover = 2 [in] Sec. 7.7.1

Dimensions	Unit	Value	Min.	Max.	Sta.	References
Effective length	[in]	20.98	-	47.03	✔	

Verification	Unit	Capacity	Demand	Ctrl EQ	Ratio	References
DESIGN CHECK						
Anchor tension	[kip]	61.13	20.01	LC-2053-0	0.33	Eq. D-2

A_{se} = π/4.0*(d_a - 0.9743 [in] /n_t)^2 = π/4.0*(1.5 [in] *- 0.9743 [in] /6)*^{2} = **1.405 [in2]** Sec. D.5.1.1, D.6.1.2
f_{uta} = min(f_{uta}, 1.9*f_{ya}, 125 [ksi]) = min(58000 [lb/in2] , 1.9*36000 [lb/in2] , 125 [ksi]) = **58000 [lb/in2]** Sec. D.5.1.2
ϕN_{sa} = ϕ*$A_{se,N}$*f_{uta} = 0.75*1.405 [in2] *58000 [lb/in2] = **61.128 [kip]** Eq. D-2

Pullout of anchor in tension [kip] 58.63 20.01 LC-2053-0 0.34 Sec. D.3.3.4.4

A_{brg} = 0.866025*F^2 - A_g = 0.866025*2.25 [in] ^{2} - 1.767 [in2] = ***2.617 [in2]***
IsHeadedBolt → **True**
N_p = 8*A_{brg}*f_c = 8*2.617 [in2] *4000 [lb/in2] = **83.752 [kip]** Eq. D-14
CrackedConcrete → **True**
$\psi_{c,P}$ = 1 Sec. D.5.3.6
N_{pn} = $\psi_{c,P}$*N_p = 1*83.752 [kip] = **83.752 [kip]** Eq. D-13
HighSeismicDesignCategory → **False**
ϕN_{pn} = ϕ*N_{pn} = 0.7*83.752 [kip] = **58.626 [kip]** Sec. D.3.3.4.4

Anchors reinforcement in tension [kip] 237.60 53.60 LC-2053-0 0.23 Sec. D.5.2.9, D.6.2.9

ϕN_{sar} = 0.75*n*A_s*F_y = 0.75*12*0.44 [in2] *60000 [lb/in2] = **237.6 [kip]** Sec. D.5.2.9, D.6.2.9

Anchor shear [kip] 25.43 4.22 LC-2053-0 0.17 Eq. D-29, Sec. D.6.1.3

A_{se} = π/4.0*(d_a - 0.9743 [in] /n_t)^2 = π/4.0*(1.5 [in] *- 0.9743 [in] /6)*^{2} = **1.405 [in2]** Sec. D.5.1.1, D.6.1.2
f_{uta} = min(f_{uta}, 1.9*f_{ya}, 125 [ksi]) = min(58000 [lb/in2] , 1.9*36000 [lb/in2] , 125 [ksi]) = **58000 [lb/in2]** Sec. D.5.1.2
HasGroutPad → **True**
ϕV_{sa} = 0.8*ϕ*0.6*n*$A_{se,V}$*f_{uta} = 0.8*0.65*0.6*1*1.405 [in2] *58000 [lb/in2] = **25.429 [kip]** Eq. D-29, Sec. D.6.1.3

Pryout of anchor in shear [kip] 75.78 4.22 LC-2053-0 0.06 Eq. D-3, Table D.4.1.1, Sec. D.4.3

h_{ef}<2.5 [in] → 20 [in] <2.5 [in] → **False**
k_{cp} = 2 Sec. D.6.3.1
c_{a1Left}<1.5*h_{ef} → 14.5 [in] <1.5*20 [in] → **True**
c_{a1Left} = c_{a1Left} = **14.5 [in]** Sec. D.5.2.1
$c_{a1Right}$<1.5*h_{ef} → 21.5 [in] <1.5*20 [in] → **True**
$c_{a1Right}$ = $c_{a1Right}$ = **21.5 [in]** Sec. D.5.2.1
c_{a2Top}<1.5*h_{ef} → 14.5 [in] <1.5*20 [in] → **True**
c_{a2Top} = c_{a2Top} = **14.5 [in]** Sec. D.5.2.1
c_{a2Bot}<1.5*h_{ef} → 21.5 [in] <1.5*20 [in] → **True**
c_{a2Bot} = c_{a2Bot} = **21.5 [in]** Sec. D.5.2.1
IsCloseToThreeEdges → **True**
h_{ef} = c_{amax}/1.5 = 21.5 [in] /1.5 = **14.333 [in]** Sec. D.5.2.3
c_{a1Left}<1.5*h_{ef} → 14.5 [in] <1.5*14.333 [in] → **True**
c_{a1Left} = c_{a1Left} = **14.5 [in]** Sec. D.5.2.1
$c_{a1Right}$<1.5*h_{ef} → 21.5 [in] <1.5*14.333 [in] → **False**
$c_{a1Right}$ = 1.5*h_{ef} = 1.5*14.333 [in] = **21.5 [in]** Sec. D.5.2.1
c_{a2Top}<1.5*h_{ef} → 14.5 [in] <1.5*14.333 [in] → **True**
c_{a2Top} = c_{a2Top} = **14.5 [in]** Sec. D.5.2.1
c_{a2Bot}<1.5*h_{ef} → 21.5 [in] <1.5*14.333 [in] → **False**
c_{a2Bot} = 1.5*h_{ef} = 1.5*14.333 [in] = **21.5 [in]** Sec. D.5.2.1
A_{Nc} = (c_{a1Left} + $c_{a1Right}$)*(c_{a2Top} + c_{a2Bot}) = (14.5 [in] + 21.5 [in])*(14.5 [in] + 21.5 [in]) = **1296 [in2]** Sec. RD.5.2.1
A_{Nco} = 9*h_{ef}^2 = 9*14.333 [in] ^{2} = **1849 [in2]** Eq. D-5
$c_{a,min}$<1.5*h_{ef} → 14.5 [in] <1.5*14.333 [in] → **True**
$\psi_{ed,N}$ = 0.7 + 0.3*$c_{a,min}$/(1.5*h_{ef}) = 0.7 + 0.3*14.5 [in] /(1.5*14.333 [in]) = **0.902** Eq. D-10
CrackedConcrete → **True**
$\psi_{c,N}$ = 1 Sec. D.5.2.6
IsCastInPlaceAnchor → **True**
$\psi_{cp,N}$ = 1 Sec. D.5.2.7
IsCastInPlaceAnchor → **True**
k_c = 24 Sec. D.5.2.2
(IsCastInPlaceAnchor) and (IsHeadedBolt) and (h_{ef}>=11 [in]) and (h_{ef}<=25 [in]) → (True) and (True) and (14.333 [in] >=11 [in]) and (14.333 [in] <=25 [in]) → **True**
N_b = 16*λ_a*(f_c/(1 [psi]))$^{1/2}$*(h_{ef}/(1 [in]))$^{(5/3)}$ [lb] = *16*1*(4000 [lb/in2] /(1 [psi]))*$^{1/2}$*(14.333 [in] */(1 [in]))*$^{(5/3)}$ [lb] = ***85.585 [kip]*** Eq. D-7
N_{cb} = (A_{Nc}/A_{Nco})*$\psi_{ed,N}$*$\psi_{c,N}$*$\psi_{cp,N}$*N_b = (1296 [in2] /1849 [in2])*0.902*1*1*85.585 [kip] = **54.129 [kip]** Eq. D-3
V_{cp} = k_{cp}*N_{cb} = 2*54.129 [kip] = **108.257 [kip]** Eq. D-40

$\phi V_{cp} = \phi * V_{cp}$ = 0.7*108.257 [kip] = **75.78 [kip]** Table D.4.1.1, Sec. D.4.3

Pryout of group of anchors in shear	[kip]	87.94	16.86	LC-2053-0	0.19	Eq. D-4, Table D.4.1.1, Sec. D.4.3

h_{ef}<2.5 [in] → 20 [in] <2.5 [in] → **False**
k_{cp} = 2 Sec. D.6.3.1
$A_{Nco} = 9*h_{ef}^2$ = 9*9.667 [in] ^{2} = **841 [in2]** Eq. D-5
A_{Nc} = min(A_{Nc}, n*A_{Nco}) = min(1296 [in2] , 4*841 [in2]) = **1296 [in2]** Sec. D.5.2.1
$\psi_{ec,Ny}$ = min(1/(1 + 2*e'_N/(3*h_{ef})), 1) = min(1/(1 + 2*1.728 [in] /(3*9.667 [in])), 1) = **0.894** Eq. D-8
$\psi_{ec,Nx}$ = min(1/(1 + 2*e'_N/(3*h_{ef})), 1) = min(1/(1 + 2*0 [in] /(3*9.667 [in])), 1) = **1** Eq. D-8
$\psi_{ec,N} = \psi_{ec,Nx} * \psi_{ec,Ny}$ = 1*0.894 = **0.894** Eq. D-8
$c_{a,min}$<1.5*h_{ef} → 14.5 [in] <1.5*9.667 [in] → **False**
$\psi_{ed,N}$ = 1 Eq. D-9
CrackedConcrete → **True**
$\psi_{c,N}$ = 1 Sec. D.5.2.6
IsCastInPlaceAnchor → **True**
$\psi_{cp,N}$ = 1 Sec. D.5.2.7
IsCastInPlaceAnchor → **True**
k_c = 24 Sec. D.5.2.2
(IsCastInPlaceAnchor) and (IsHeadedBolt) and (h_{ef}>=11 [in]) and (h_{ef}<=25 [in]) → (True) and (True) and (9.667 [in] >=11 [in]) and (9.667 [in] <=25 [in]) → **False**
$N_b = k_c * \lambda_a * (f_c/(1\ [psi]))^{1/2} * (h_{ef}/(1\ [in]))^{1.5}$ [lb] = *24*1*(4000 [lb/in2] /(1 [psi]))$^{1/2}$*(9.667 [in] /(1 [in]))$^{1.5}$ [lb]* = ***45.62 [kip]*** Eq. D-6
$N_{cbg} = (A_{Nc}/A_{Nco}) * \psi_{ec,N} * \psi_{ed,N} * \psi_{c,N} * \psi_{cp,N} * N_b$ = (1296 [in2] /841 [in2])*0.894*1*1*1*45.62 [kip] = **62.818 [kip]** Eq. D-4
$V_{cpg} = k_{cp} * N_{cbg}$ = 2*62.818 [kip] = **125.635 [kip]** Eq. D-41
$\phi V_{cpg} = \phi * V_{cpg}$ = 0.7*125.635 [kip] = **87.945 [kip]** Table D.4.1.1, Sec. D.4.3

Anchors reinforcement in shear	[kip]	36.00	16.86	LC-2053-0	0.47	Sec. D.5.2.9, D.6.2.9

$\phi N_{sar} = 0.75 * n * A_s * F_y$ = 0.75*4*0.2 [in2] *60000 [lb/in2] = **36 [kip]** Sec. D.5.2.9, D.6.2.9

Interaction of tensile and shear forces	[kip]	1.20	0.00	LC-2053-0	0.00	Eq. D-2, Sec. D.3.3.4.4, Eq. D-29, Sec. D.6.1.3, Eq. D-3, Table D.4.1.1, Sec. D.4.3, Eq. D-4, Sec. D.7

$A_{se} = \pi/4.0*(d_a - 0.9743\ [in]/n_t)^2$ = π/4.0*(1.5 [in] *- 0.9743 [in] /6)*^{2} = **1.405 [in2]** Sec. D.5.1.1, D.6.1.2
f_{uta} = min(f_{uta}, 1.9*f_{ya}, 125 [ksi]) = min(58000 [lb/in2] , 1.9*36000 [lb/in2] , 125 [ksi]) = **58000 [lb/in2]** Sec. D.5.1.2
$\phi N_{sa} = \phi * A_{se,N} * f_{uta}$ = 0.75*1.405 [in2] *58000 [lb/in2] = **61.128 [kip]** Eq. D-2
$A_{brg} = 0.866025*F^2 - A_g$ = 0.866025*2.25 [in] ^{2} - 1.767 [in2] = ***2.617 [in2]***
IsHeadedBolt → **True**
$N_p = 8*A_{brg}*f_c$ = 8*2.617 [in2] *4000 [lb/in2] = **83.752 [kip]** Eq. D-14
CrackedConcrete → **True**
$\psi_{c,P}$ = 1 Sec. D.5.3.6
$N_{pn} = \psi_{c,P} * N_p$ = 1*83.752 [kip] = **83.752 [kip]** Eq. D-13
HighSeismicDesignCategory → **False**
$\phi N_{pn} = \phi * N_{pn}$ = 0.7*83.752 [kip] = **58.626 [kip]** Sec. D.3.3.4.4
SideFaceBlowoutApply = h_{ef}>2.5*c_{a1} = 20 [in] >2.5*14.5 [in] = **False** Sec. D.5.4.1
$A_{se} = \pi/4.0*(d_a - 0.9743\ [in]/n_t)^2$ = π/4.0*(1.5 [in] *- 0.9743 [in] /6)*^{2} = **1.405 [in2]** Sec. D.5.1.1, D.6.1.2
f_{uta} = min(f_{uta}, 1.9*f_{ya}, 125 [ksi]) = min(58000 [lb/in2] , 1.9*36000 [lb/in2] , 125 [ksi]) = **58000 [lb/in2]** Sec. D.5.1.2
HasGroutPad → **True**
$\phi V_{sa} = 0.8*\phi*0.6*n*A_{se,V}*f_{uta}$ = 0.8*0.65*0.6*1*1.405 [in2] *58000 [lb/in2] = **25.429 [kip]** Eq. D-29, Sec. D.6.1.3
h_{ef}<2.5 [in] → 20 [in] <2.5 [in] → **False**
k_{cp} = 2 Sec. D.6.3.1
c_{a1Left}<1.5*h_{ef} → 14.5 [in] <1.5*20 [in] → **True**
$c_{a1Left} = c_{a1Left}$ = **14.5 [in]** Sec. D.5.2.1
$c_{a1Right}$<1.5*h_{ef} → 21.5 [in] <1.5*20 [in] → **True**
$c_{a1Right} = c_{a1Right}$ = **21.5 [in]** Sec. D.5.2.1
c_{a2Top}<1.5*h_{ef} → 14.5 [in] <1.5*20 [in] → **True**
$c_{a2Top} = c_{a2Top}$ = **14.5 [in]** Sec. D.5.2.1
c_{a2Bot}<1.5*h_{ef} → 21.5 [in] <1.5*20 [in] → **True**
$c_{a2Bot} = c_{a2Bot}$ = **21.5 [in]** Sec. D.5.2.1
IsCloseToThreeEdges → **True**
$h_{ef} = c_{amax}/1.5$ = 21.5 [in] /1.5 = **14.333 [in]** Sec. D.5.2.3
c_{a1Left}<1.5*h_{ef} → 14.5 [in] <1.5*14.333 [in] → **True**
$c_{a1Left} = c_{a1Left}$ = **14.5 [in]** Sec. D.5.2.1
$c_{a1Right}$<1.5*h_{ef} → 21.5 [in] <1.5*14.333 [in] → **False**

$c_{a1Right} = 1.5*h_{ef} = 1.5*14.333$ [in] = **21.5 [in]** Sec. D.5.2.1

$c_{a2Top} < 1.5*h_{ef} \rightarrow 14.5$ [in] <1.5*14.333 [in] $\rightarrow$ **True**

$c_{a2Top} = c_{a2Top}$ = **14.5 [in]** Sec. D.5.2.1

$c_{a2Bot} < 1.5*h_{ef} \rightarrow 21.5$ [in] <1.5*14.333 [in] $\rightarrow$ **False**

$c_{a2Bot} = 1.5*h_{ef} = 1.5*14.333$ [in] = **21.5 [in]** Sec. D.5.2.1

$A_{Nc} = (c_{a1Left} + c_{a1Right})*(c_{a2Top} + c_{a2Bot})$ = (14.5 [in] + 21.5 [in])*(14.5 [in] + 21.5 [in]) = **1296 [in2]** Sec. RD.5.2.1

$A_{Nco} = 9*h_{ef}^2 = 9*14.333$ [in] ^{2} = **1849 [in2]** Eq. D-5

$c_{a,min} < 1.5*h_{ef} \rightarrow 14.5$ [in] <1.5*14.333 [in] $\rightarrow$ **True**

$\psi_{ed,N} = 0.7 + 0.3*c_{a,min}/(1.5*h_{ef})$ = 0.7 + 0.3*14.5 [in] /(1.5*14.333 [in]) = **0.902** Eq. D-10

CrackedConcrete $\rightarrow$ **True**

$\psi_{c,N} = 1$ Sec. D.5.2.6

IsCastInPlaceAnchor $\rightarrow$ **True**

$\psi_{cp,N} = 1$ Sec. D.5.2.7

IsCastInPlaceAnchor $\rightarrow$ **True**

$k_c = 24$ Sec. D.5.2.2

(IsCastInPlaceAnchor) and (IsHeadedBolt) and (h_{ef}>=11 [in]) and (h_{ef}<=25 [in]) $\rightarrow$ (True) and (True) and (14.333 [in] >=11 [in]) and (14.333 [in] <=25 [in]) $\rightarrow$ **True**

$N_b = 16*\lambda_a*(f_c/(1 \text{ [psi]}))^{1/2}*(h_{ef}/(1 \text{ [in]}))^{(5/3)}$ [lb] = *16*1*(4000 [lb/in2] /(1 [psi]))*$^{1/2}$*(14.333 [in] */(1 [in]))*$^{(5/3)}$ [lb] = ***85.585 [kip]*** Eq. D-7

$N_{cb} = (A_{Nc}/A_{Nco})*\psi_{ed,N}*\psi_{c,N}*\psi_{cp,N}*N_b$ = (1296 [in2] /1849 [in2])*0.902*1*1*85.585 [kip] = **54.129 [kip]** Eq. D-3

$V_{cp} = k_{cp}*N_{cb}$ = 2*54.129 [kip] = **108.257 [kip]** Eq. D-40

$\phi V_{cp} = \phi*V_{cp}$ = 0.7*108.257 [kip] = **75.78 [kip]** Table D.4.1.1, Sec. D.4.3

$h_{ef} < 2.5$ [in] $\rightarrow$ 20 [in] <2.5 [in] $\rightarrow$ **False**

$k_{cp} = 2$ Sec. D.6.3.1

$A_{Nco} = 9*h_{ef}^2 = 9*9.667$ [in] ^{2} = **841 [in2]** Eq. D-5

$A_{Nc} = \min(A_{Nc}, n*A_{Nco})$ = min(1296 [in2] , 4*841 [in2]) = **1296 [in2]** Sec. D.5.2.1

$\psi_{ec,Ny} = \min(1/(1 + 2*e'_N/(3*h_{ef})), 1)$ = min(1/(1 + 2*1.728 [in] /(3*9.667 [in])), 1) = **0.894** Eq. D-8

$\psi_{ec,Nx} = \min(1/(1 + 2*e'_N/(3*h_{ef})), 1)$ = min(1/(1 + 2*0 [in] /(3*9.667 [in])), 1) = **1** Eq. D-8

$\psi_{ec,N} = \psi_{ec,Nx}*\psi_{ec,Ny}$ = 1*0.894 = **0.894** Eq. D-8

$c_{a,min} < 1.5*h_{ef} \rightarrow 14.5$ [in] <1.5*9.667 [in] $\rightarrow$ **False**

$\psi_{ed,N} = 1$ Eq. D-9

CrackedConcrete $\rightarrow$ **True**

$\psi_{c,N} = 1$ Sec. D.5.2.6

IsCastInPlaceAnchor $\rightarrow$ **True**

$\psi_{cp,N} = 1$ Sec. D.5.2.7

IsCastInPlaceAnchor $\rightarrow$ **True**

$k_c = 24$ Sec. D.5.2.2

(IsCastInPlaceAnchor) and (IsHeadedBolt) and (h_{ef}>=11 [in]) and (h_{ef}<=25 [in]) $\rightarrow$ (True) and (True) and (9.667 [in] >=11 [in]) and (9.667 [in] <=25 [in]) $\rightarrow$ **False**

$N_b = k_c*\lambda_a*(f_c/(1 \text{ [psi]}))^{1/2}*(h_{ef}/(1 \text{ [in]}))^{1.5}$ [lb] = *24*1*(4000 [lb/in2] /(1 [psi]))*$^{1/2}$*(9.667 [in] */(1 [in]))*$^{1.5}$ [lb] = ***45.62 [kip]*** Eq. D-6

$N_{cbg} = (A_{Nc}/A_{Nco})*\psi_{ec,N}*\psi_{ed,N}*\psi_{c,N}*\psi_{cp,N}*N_b$ = (1296 [in2] /841 [in2])*0.894*1*1*1*45.62 [kip] = **62.818 [kip]** Eq. D-4

$V_{cpg} = k_{cp}*N_{cbg}$ = 2*62.818 [kip] = **125.635 [kip]** Eq. D-41

$\phi V_{cpg} = \phi*V_{cpg}$ = 0.7*125.635 [kip] = **87.945 [kip]** Table D.4.1.1, Sec. D.4.3

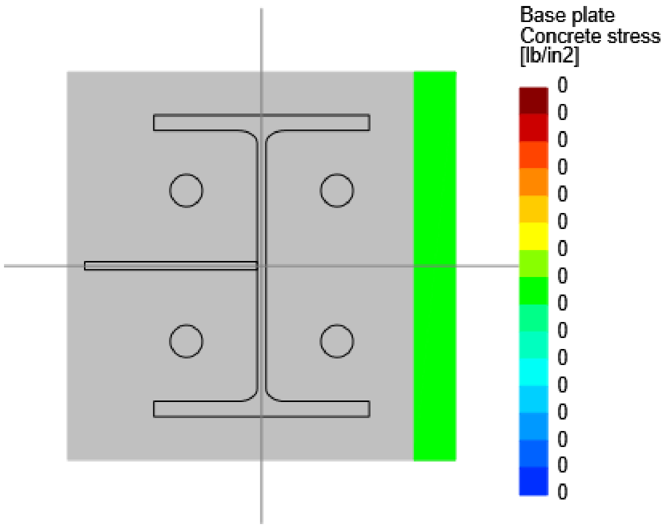
($N_{ua}>0.2*\phi N_n$) and ($V_{ua}>0.2*\phi V_n$) $\rightarrow$ (20.014 [kip] >0.2*58.626 [kip]) and (16.861 [kip] >0.2*87.945 [kip]) $\rightarrow$ **False**

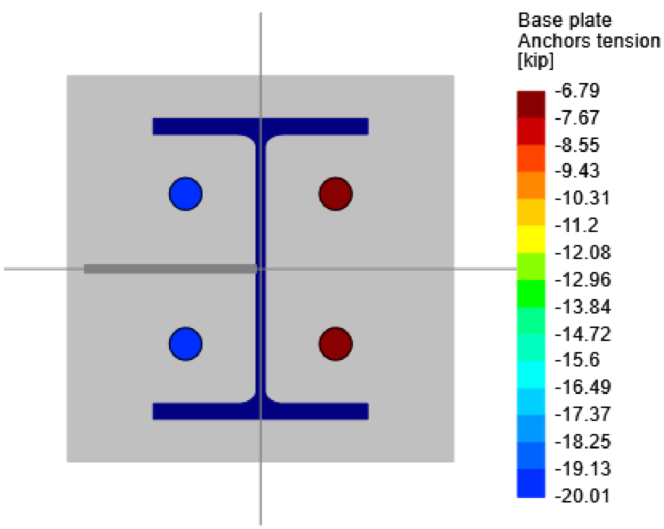
TensionShearInteraction = 0 Sec. D.7

Ratio	**0.47**

Ratio	**1.02**

Minor axis
Maximum compression and tension (LC-2053)





		lb/in2
Maximum bearing pressure		0.00
Minimum bearing pressure		0.00
Maximum anchor tension		20.01
Minimum anchor tension		6.79
Neutral axis angle	0.00	
Bearing length	1.91	

Anchors tensions

Anchor	**Transverse**		**Longitudinal**	**Shear**	**Tension**
	in	in	kip	kip	
1	-3.50	-3.50	4.22	20.01	
2	-3.50	3.50	4.22	20.01	
3	3.50	3.50	4.22	6.79	
4	3.50	-3.50	4.22	6.79	

Global critical strength ratio **1.02**

NOTATION

a : Plate depth

A_1 : Base plate area
A_2 : Maximum area of portion of the concrete supporting surface that is geometrically similar to and concentric with the load area
A_b : Nominal bolt area
A_e : Effective net area
A_g : Gross area
A_{gv} : Gross area subject to shear
A_{hf} : Flange holes area
A_{hw} : Holes area on web
A_n : Net area
A_{nt} : Net area subject to tension
A_{nv} : Net area subjected to shear
A_w : Effective area of the weld
α : Distance from the face of the column flange or web to the centroid of the gusset to beam connection
α_{bar} : Centroid of the gusset to beam connection
A_2/A_1 : Ratio between the concrete support area and the base plate area
b : Plate, connector or member width
B : Base plate design width
b_{eff} : Effective width of the compression block
B_{eff} : Controlling effective width
β : Distance from the face of the beam flange to the centroid of the gusset to column connection
β_{bar} : Centroid of the gusset to column connection
C : Bolt group coefficient
C_1 : Electrode strength coefficient
C_2 : Edge distance increment
C : Weld group coefficient
d : Nominal bolt diameter
d_h : Nominal hole dimension
D : Uniform force method factor
ΔV : Arbitrary shear
D : Number of sixteenths of an inch in the weld size
e_b : One half the depth of the beam
e_c : One half the depth of the column
f'_c : Specified compressive strength of concrete
F_{EXX} : Electrode classification number
F_{nv} : Nominal shear stress
$f_{p, max}$: Maximum uniformly bearing stress under base plate
F_u : Specified minimum tensile strength
f_{ua} : Axial stress on welds along gusset-beam or gusset-column interface
f_{ua} : Axial stress on welds along gusset-beam or gusset-column interface
f_{uAve} : Average weld stress on welds along gusset-beam or gusset-column interface
f_{ub} : Bending stress on welds along gusset-beam or gusset-column interface
f_{uPeak} : Peak weld stress on welds along gusset-beam or gusset-column interface
f_{uv} : Shear stress on welds along gusset-beam or gusset-column interface
f_{uv} : Shear stress on welds along gusset-beam or gusset-column interface
f_{uWeld} : Design weld force on welds along gusset-beam or gusset-column interface
F_w : Nominal strength of the weld metal per unit area
F_y : Specified minimum yield stress
g : Transversal gage between bolts
H_b : Required shear force on the beam to gusset connection
H_{Beam} : Beam horizontal force
$H_{BeamToColumn}$: Beam to column interrface total horizontal force
H_{Bot} : Bottom horizontal component of the gusset forces
H_c : Required axial force on the column to gusset connection
H_{Top} : Top horizontal component of the gusset forces
IsCorrosionConsidered : Is corrosion considered
k_1 : Bearing factor
k_2 : Bearing factor
K : Uniform force method factor
K' : Uniform force method factor
l : Length
L : Length
L : Distance from the anchor rod to the column
$L_{c\text{-}end}$: Clear distance
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_p : Plate length

L : Length of weld
L_w : Width of Whitmore section
LoadAngleFactor : Load angle factor
M_b : Required moment on the beam to gusset connection
M_c : Required moment on the column to gusset connection
M_{pT} : Plate bending moment per unit width at tension unstiffened strip interface
M_{strip} : Maximum bending moment at the strip
M_{ub} : Moment applied to the interface
Maximum weld load : Maximum weld load
e_{dmin} : Minimum edge distance
n : Bolts rows number
N : Base plate design length
n_c : Number of bolt columns
N_{cs} : Length of the concrete supporting surface or pier parallel to moment design direction
N_{eq} : Equivalent normal force
P : Required axial force
ϕ : Design factors
ϕF_n : Design or allowable tension/shear yielding stress
ϕM_n : Design or allowable strength per unit length
ϕR_n : Design or allowable strength
ϕR_w : Fillet weld capacity per unit length
r : Uniform force method parameter
s_{max} : Maximum spacing
s_{min} : Minimum spacing
s : Longitudinal bolt spacing
L_{c-spa} : Distance between adjacent holes edges
t_p : Thickness of the connected material
T : Clear distance between web fillets
T : Anchor rod tensile strength required
t_f : Thickness of the loaded flange
t_p : Plate thickness
t_w : Web thickness
$\tan\theta$: Tangent of the brace with the vertical angle
θ : Load angle
U : Shear lag factor
U_{bs} : Stress index
V_b : Required axial force on the beam to gusset connection
V_{Beam} : Beam vertical force
$V_{BeamToColumn}$: Beam to column interrface total vertical force
V_{Bot} : Bottom vertical component of the gusset forces
V_c : Required shear force on the column to gusset connection
V_{Top} : Top vertical component of the gusset forces
V_{ub} : Shear applied to the interface
w_{min} : Minimum weld size required
x : Connection eccentricity
A_{brg} : Net bearing area of the head of stud or anchor bolt
A_g : Gross area of anchor
A_{Nc} : Projected concrete failure area of a single anchor or group of anchors, for calculation of strength in tension
A_{Nco} : Projected concrete failure area of a single anchor, for calculation of strength in tension if not limited by edge distance or spacing
A_s : Effective cross-sectional area of anchor reinforcement
A_{se} : Effective cross-sectional area of anchor
$A_{se,N}$: Effective cross-sectional area of anchor in tension
$A_{se,V}$: Effective cross-sectional area of anchor in shear
c_{a1} : Distance from the anchor center to the concrete edge
c_{a1Left} : Distance from the anchor center to the left edge of the concrete base
$c_{a1Right}$: Distance from the anchor center to the right edge of the concrete base
c_{a2Bot} : Distance from the anchor center to the bottom edge of the concrete base
c_{a2Top} : Distance from the anchor center to the top edge of the concrete base
c_{amax} : Maximum distance from center of an anchor shaft to the edge of concrete
$c_{a,min}$: Minimum distance from center of an anchor shaft to the edge of concrete
Cover : Concrete cover
CrackedConcrete : Cracked concrete at service loads
d_a : Outside diameter of anchor or shaft diameter of headed stud, headed bolt, or hooked bolt
e'_N : Distance between resultant tension load on a group of anchors loaded in tension and the centroid of the group of anchors loaded in tension
F : Distance between head flat sides
f_c : Specified compressive strength of concrete
f_{uta} : Specified tensile strength of anchor steel

F_y : Specified minimum yield stress
f_{ya} : Specified yield strength of anchor steel
h_{ef} : Effective embedment depth of anchor
HasGroutPad : Has grout pad
HighSeismicDesignCategory : High seismic design category (i.e. C, D, E or F)
IsCastInPlaceAnchor : Is cast in place anchor
IsCloseToThreeEdges : Anchor is close to three or more edges
IsConcreteCastAgainstEarth : Is concrete cast against and permanently exposed to earth
IsHeadedBolt : Is anchor headed stud
k_c : Coefficient for concrete pry out basic strength
k_{cp} : Coefficient for pry out strength
λ_a : Lightweight concrete modification factor
n : Number of anchors in the group
N_b : Basic concrete breakout strength in tension of a single anchor in cracked concrete
N_{cb} : Nominal concrete breakout strength in tension of a single anchor
N_{cbg} : Nominal concrete breakout strength in tension of a group of anchors
N_p : Pullout strength in tension of a single anchor in cracked concrete
N_{pn} : Nominal pullout strength of a single anchor in tension
n : Number of anchor reinforcement bars
n_t : Number of threads per inch
N_{ua} : Factored tensile force applied to anchor or group of anchors
ϕ : Strength reduction factor
ϕN_n : Tension strength
ϕN_{pn} : Pullout strength in tension of a single anchor
ϕN_{sa} : Strength of a single anchor or group of anchors in tension
ϕN_{sar} : Strength of a single anchor reinforcement or group of anchors reinforcements in tension
ϕV_{cp} : Concrete pryout strength of a single anchor
ϕV_{cpg} : Concrete pryout strength of a group of anchors
ϕV_n : Shear strength
ϕV_{sa} : Strength in shear of a single anchor or group of anchors as governed by the steel strength
$\psi_{c,N}$: Factor used to modify tensile strength of anchors based on presence or absence of cracks in concrete
$\psi_{c,P}$: Factor used to modify pullout strength of anchors based on presence or absence of cracks in concrete
$\psi_{cp,N}$: Factor used to modify tensile strength of postinstalled anchors intended for use in uncracked concrete without supplementary reinforcement
$\psi_{ec,N}$: Factor used to modify tensile strength of anchors based on eccentricity of applied loads
$\psi_{ec,Nx}$: Factor used to modify tensile strength of anchors based on eccentricity in x axis of applied loads
$\psi_{ec,Ny}$: Factor used to modify tensile strength of anchors based on eccentricity in y axis of applied loads
$\psi_{ed,N}$: Factor used to modify tensile strength of anchors based on proximity to edges of concrete member
s_{min} : Center-to-center anchor minimum spacing
SideFaceBlowoutApply : Side-face blowout apply
TensionShearInteraction : Result from tension-shear interaction
V_{cp} : Nominal pryout strength of a anchor in shear
V_{cpg} : Nominal pryout strength of a group of anchor in shear
V_{ua} : Factored shear force applied to anchor or group of anchors

<u>REFERENCES</u>

[9] AISC 2005, Design Examples Version 13.0, pp. IIC-26 - IIC-27