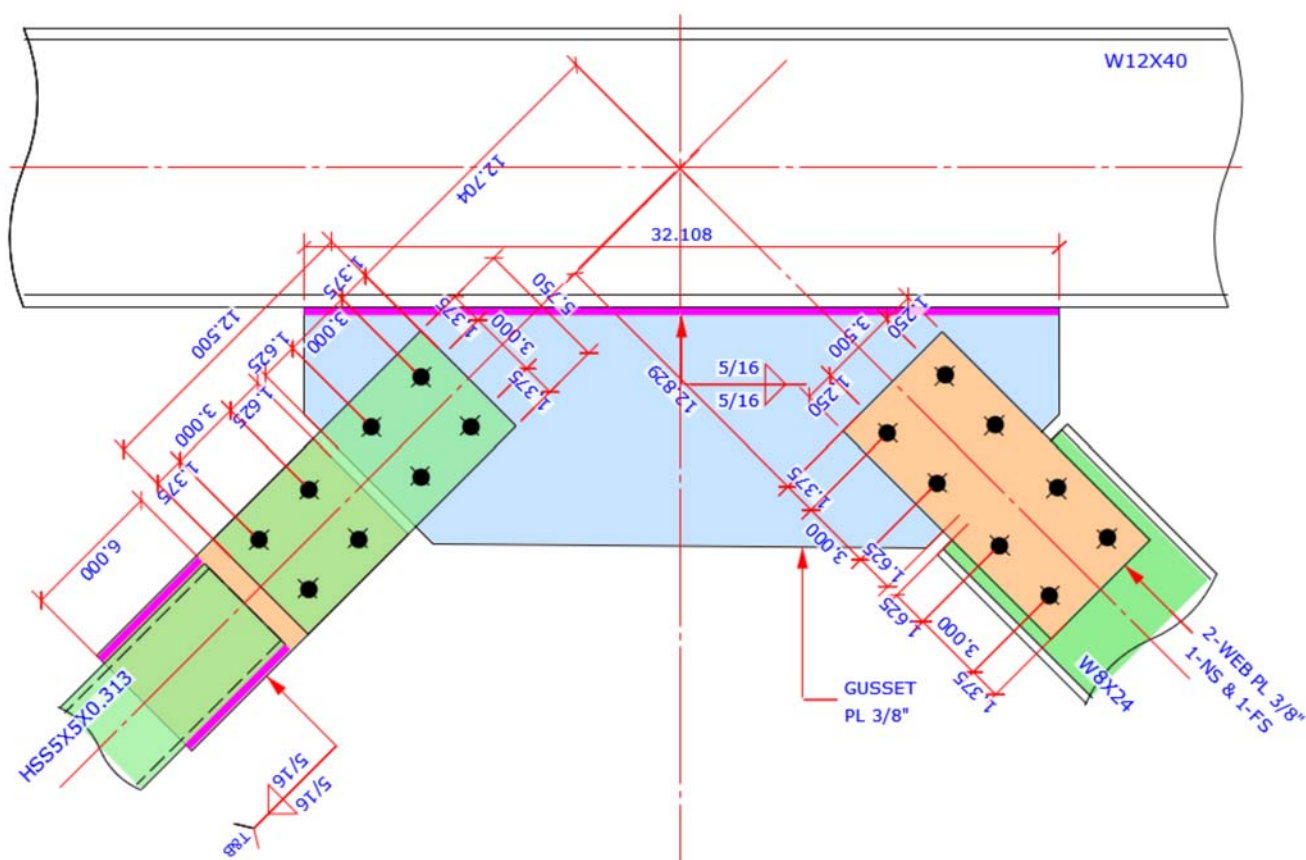
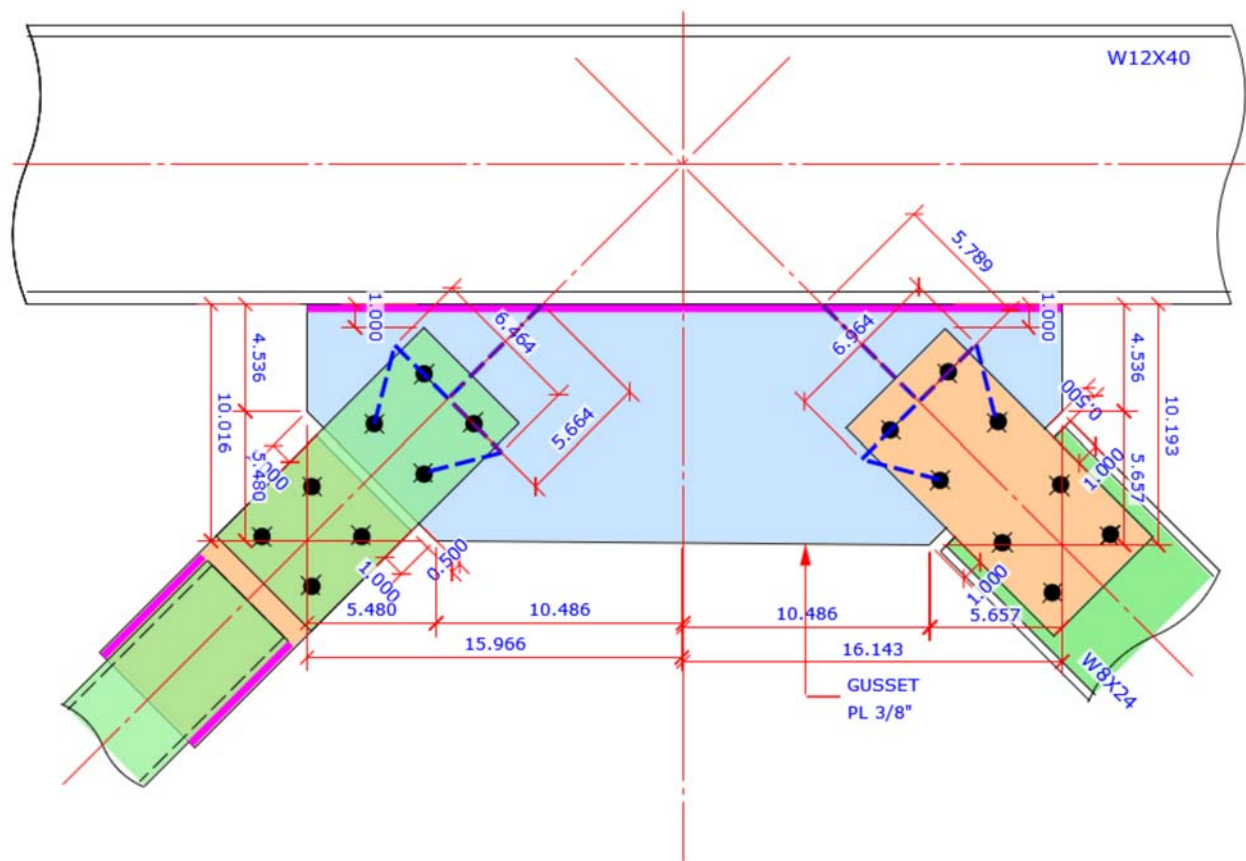


Sketch                      Vertical Brace Connection                      Code=AISC 360-10 LRFD





| Members & Components Summary |                          |                    |                                           |
|------------------------------|--------------------------|--------------------|-------------------------------------------|
| Member                       | Brace Connection         |                    | Code=AISC 360-10 LRFD                     |
| Column Section               |                          |                    |                                           |
| W12X40                       | d = 11.900               | [in]               | b <sub>f</sub> = 8.010 [in]               |
|                              | t <sub>f</sub> = 0.515   | [in]               | t <sub>w</sub> = 0.295 [in]               |
|                              | k <sub>des</sub> = 1.020 | [in]               | k <sub>det</sub> = 1.375 [in]             |
|                              | k <sub>1</sub> = 0.875   | [in]               | A = 11.700 [in <sup>2</sup> ]             |
|                              | S <sub>x</sub> = 51.50   | [in <sup>3</sup> ] | Z <sub>x</sub> = 57.00 [in <sup>3</sup> ] |
| Steel Grade A992             | F <sub>y</sub> = 50.0    | [ksi]              | F <sub>u</sub> = 65.0 [ksi]               |

**Gusset Plate Interface Forces Calculation****Brace Axial Force Load Case 1**

Refer to AISC DG29 Fig. 4-5 ~ Fig. 4-7 for all charts and definitions of variables and symbols shown in calculation below

|                               |                              |                         |                |
|-------------------------------|------------------------------|-------------------------|----------------|
| Right brace axial force       | $P_1 =$ from user input      | $= -60.00$ [kips]       | in tension     |
| Right brace to hor line angle | $\theta_1 =$ from user input | $= 45.0$ [°]            |                |
|                               | $H_1 = -42.43$ [kips]        | $V_1 = -42.43$ [kips]   |                |
| Left brace axial force        | $P_2 =$ from user input      | $= 60.00$ [kips]        | in compression |
| Left brace to hor line angle  | $\theta_2 =$ from user input | $= 45.0$ [°]            |                |
|                               | $H_2 = 42.43$ [kips]         | $V_2 = 42.43$ [kips]    |                |
|                               | $L_1 = 16.142$ [in]          | $L_2 = 15.966$ [in]     |                |
|                               | $L = L_1 + L_2$              | $= 32.108$ [in]         |                |
|                               | $\Delta = (L_2 - L_1) / 2$   | $= -0.088$ [in]         |                |
|                               | $e = 5.950$ [in]             | $h = 10.192$ [in]       |                |
|                               | $M_1 = -20.73$ [kip-ft]      | $M_2 = -21.35$ [kip-ft] |                |

**Forces on Section a-a**

AISC DG29 Fig. 4-6

|        |                 |                     |
|--------|-----------------|---------------------|
| Shear  | $V = H_1 - H_2$ | $= -84.85$ [kips]   |
| Axial  | $N = V_1 + V_2$ | $= 0.00$ [kips]     |
| Moment | $M = M_1 + M_2$ | $= -42.07$ [kip-ft] |

**Forces on Section b-b**

AISC DG29 Fig. 4-7

|        |                                                                                                          |                    |
|--------|----------------------------------------------------------------------------------------------------------|--------------------|
| Shear  | $V' = \frac{1}{2}(V_1 + V_2) + \frac{M}{0.5XL} - V_1$                                                    | $= 10.98$ [kips]   |
| Axial  | $N' = \frac{1}{2}(H_1 - H_2) \times -1 + H_1$                                                            | $= 0.00$ [kips]    |
| Moment | $M' = \frac{L}{8}(V_1 + V_2) + \frac{h}{4}(H_1 - H_2) + \frac{M}{2} - V_1 \Delta - H_1(e + \frac{h}{2})$ | $= -0.31$ [kip-ft] |

**Brace Axial Force Load Case 2**

Refer to AISC DG29 Fig. 4-5 ~ Fig. 4-7 for all charts and definitions of variables and symbols shown in calculation below

|                               |                              |                        |                |
|-------------------------------|------------------------------|------------------------|----------------|
| Right brace axial force       | $P_1 =$ from user input      | $= 60.00$ [kips]       | in compression |
| Right brace to hor line angle | $\theta_1 =$ from user input | $= 45.0$ [°]           |                |
|                               | $H_1 = 42.43$ [kips]         | $V_1 = 42.43$ [kips]   |                |
| Left brace axial force        | $P_2 =$ from user input      | $= -60.00$ [kips]      | in tension     |
| Left brace to hor line angle  | $\theta_2 =$ from user input | $= 45.0$ [°]           |                |
|                               | $H_2 = -42.43$ [kips]        | $V_2 = -42.43$ [kips]  |                |
|                               | $L_1 = 16.142$ [in]          | $L_2 = 15.966$ [in]    |                |
|                               | $L = L_1 + L_2$              | $= 32.108$ [in]        |                |
|                               | $\Delta = (L_2 - L_1) / 2$   | $= -0.088$ [in]        |                |
|                               | $e = 5.950$ [in]             | $h = 10.192$ [in]      |                |
|                               | $M_1 = 20.73$ [kip-ft]       | $M_2 = 21.35$ [kip-ft] |                |

Right Brace - Brace to Gusset

Sect=W8X24

P<sub>LC1</sub> = -60.00 kips (T) P<sub>LC2</sub> = 60.00 kips (C) Code=AISC 360-10 LRFD**Result Summary**geometries & weld limitations = **PASS**limit states max ratio = **0.79** **PASS****Geometry Restriction Checks - Web Plate to Gusset****PASS****Min Bolt Edge Distance - Web Plate to Gusset**

|                                          |               |                     |                                  |
|------------------------------------------|---------------|---------------------|----------------------------------|
| Bolt diameter                            | $d_b =$       | = 0.750 [in]        |                                  |
| Min edge distance allowed                | $L_{e-min} =$ | = <b>1.000</b> [in] | AISC 14 <sup>th</sup> Table J3.4 |
| Min edge distance in Web Plate to Gusset | $L_e =$       | = <b>1.250</b> [in] |                                  |
|                                          |               | > $L_{e-min}$       | <b>OK</b>                        |

**Min Bolt Spacing - Web Plate to Gusset**

|                                         |                         |                     |                            |
|-----------------------------------------|-------------------------|---------------------|----------------------------|
| Bolt diameter                           | $d_b =$                 | = 0.750 [in]        |                            |
| Min bolt spacing allowed                | $L_{s-min} = 2.667 d_b$ | = <b>2.000</b> [in] | AISC 14 <sup>th</sup> J3.3 |
| Min Bolt spacing in Web Plate to Gusset | $L_s =$                 | = <b>3.000</b> [in] |                            |
|                                         |                         | > $L_{s-min}$       | <b>OK</b>                  |

**Geometry Restriction Checks - Web Plate to Brace Web****PASS****Min Bolt Edge Distance - Web Plate to Brace Web**

|                                             |               |                     |                                  |
|---------------------------------------------|---------------|---------------------|----------------------------------|
| Bolt diameter                               | $d_b =$       | = 0.750 [in]        |                                  |
| Min edge distance allowed                   | $L_{e-min} =$ | = <b>1.000</b> [in] | AISC 14 <sup>th</sup> Table J3.4 |
| Min edge distance in Web Plate to Brace Web | $L_e =$       | = <b>1.250</b> [in] |                                  |
|                                             |               | > $L_{e-min}$       | <b>OK</b>                        |

**Min Bolt Spacing - Web Plate to Brace Web**

|                                            |                         |                     |                            |
|--------------------------------------------|-------------------------|---------------------|----------------------------|
| Bolt diameter                              | $d_b =$                 | = 0.750 [in]        |                            |
| Min bolt spacing allowed                   | $L_{s-min} = 2.667 d_b$ | = <b>2.000</b> [in] | AISC 14 <sup>th</sup> J3.3 |
| Min Bolt spacing in Web Plate to Brace Web | $L_s =$                 | = <b>3.000</b> [in] |                            |
|                                            |                         | > $L_{s-min}$       | <b>OK</b>                  |

**Brace Force Load Case 1**

Sect=W8X24

P = -60.00 kips (T) ratio = **0.79** **PASS****W Shape Brace - Tensile Yield**ratio = 60.00 / 318.60 = **0.19** **PASS**

|                               |                     |                            |                               |
|-------------------------------|---------------------|----------------------------|-------------------------------|
| Gross area subject to tension | $A_g =$             | = 7.080 [in <sup>2</sup> ] |                               |
| Steel yield strength          | $F_y =$             | = 50.0 [ksi]               |                               |
| Tensile force required        | $P_u =$             | = <b>60.00</b> [kips]      |                               |
| Tensile yielding strength     | $R_n = F_y A_g$     | = 354.00 [kips]            | AISC 14 <sup>th</sup> Eq D2-1 |
| Resistance factor-LRFD        | $\phi = 0.90$       |                            | AISC 14 <sup>th</sup> D2 (a)  |
|                               | $\phi R_n =$        | = <b>318.60</b> [kips]     | AISC 14 <sup>th</sup> Eq D2-1 |
|                               | ratio = <b>0.19</b> | > $P_u$                    | <b>OK</b>                     |

| W Shape Brace - Tensile Rupture   |                                                                                       | ratio = 60.00 / 123.94 = 0.48 |                    | PASS                             |
|-----------------------------------|---------------------------------------------------------------------------------------|-------------------------------|--------------------|----------------------------------|
| Section gross area                | $A_g =$                                                                               | = 7.080                       | [in <sup>2</sup> ] |                                  |
| Tensile net area                  | $A_n =$                                                                               | = 6.651                       | [in <sup>2</sup> ] |                                  |
| No of bolt column                 | $n_h = 2$                                                                             | bolt space $s_h = 3.000$      | [in]               |                                  |
| Length of connection              | $L = (n_h - 1) s_h$                                                                   | = 3.000                       | [in]               |                                  |
| WT centroid to web bolt line dist | $\bar{x} =$ half of W8X24 sect centroid to web<br>exterior row hor bolt line distance | = 1.853                       | [in]               |                                  |
| Shear lag factor                  | $U = 1 - \bar{x} / L$                                                                 | = 0.382                       |                    | AISC 14 <sup>th</sup> Table D3.1 |
| Tensile force required            | $P_u =$                                                                               | = 60.00                       | [kips]             |                                  |
| Tensile effective net area        | $A_e = A_n U$                                                                         | = 2.542                       | [in <sup>2</sup> ] |                                  |
| Plate tensile strength            | $F_u =$                                                                               | = 65.0                        | [ksi]              |                                  |
| Tensile rupture strength          | $R_n = F_u A_e$                                                                       | = 165.26                      | [kips]             | AISC 14 <sup>th</sup> Eq D2-2    |
| Resistance factor-LRFD            | $\phi = 0.75$                                                                         |                               |                    | AISC 14 <sup>th</sup> D2 (b)     |
|                                   | $\phi R_n =$                                                                          | = 123.94                      | [kips]             | AISC 14 <sup>th</sup> Eq D2-2    |
|                                   | ratio = 0.48                                                                          | > $P_u$                       | OK                 |                                  |

| Web Plate - Tensile Yield       |                     | ratio = 30.00 / 101.25 |                         | = 0.30             | PASS                          |
|---------------------------------|---------------------|------------------------|-------------------------|--------------------|-------------------------------|
| Plate Tensile Yielding Check    |                     |                        |                         |                    |                               |
| Plate size                      | width $b_p = 6.000$ | [in]                   | thickness $t_p = 0.375$ | [in]               |                               |
| Plate yield strength            | $F_y = 50.0$        | [ksi]                  |                         |                    |                               |
| Plate gross area in shear       | $A_g = b_p t_p$     |                        | = 2.250                 | [in <sup>2</sup> ] |                               |
| Tensile force required          | $P_u =$             |                        | = 30.00                 | [kips]             |                               |
| Plate tensile yielding strength | $R_n = F_y A_g$     |                        | = 112.50                | [kips]             | AISC 14 <sup>th</sup> Eq J4-1 |
| Resistance factor-LRFD          | $\phi = 0.90$       |                        |                         |                    | AISC 14 <sup>th</sup> Eq J4-1 |
|                                 | $\phi R_n =$        |                        | = 101.25                | [kips]             |                               |
|                                 | ratio = 0.30        |                        | > $P_u$                 | OK                 |                               |

| Web Plate - Tensile Rupture    |                              | ratio = 30.00 / 77.70 |                                   | = 0.39             | PASS                          |
|--------------------------------|------------------------------|-----------------------|-----------------------------------|--------------------|-------------------------------|
| Plate Tensile Rupture Check    |                              |                       |                                   |                    |                               |
| Bolt hole diameter             | bolt dia $d_b = \frac{3}{4}$ | [in]                  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b   |
| Number of bolt                 | $n = 2$                      |                       |                                   |                    |                               |
| Plate size                     | width $b_p = 6.000$          | [in]                  | thickness $t_p = 0.375$           | [in]               |                               |
| Plate tensile strength         | $F_u = 65.0$                 | [ksi]                 |                                   |                    |                               |
| Plate net area in tension      | $A_{nt} = (b_p - n d_h) t_p$ |                       | = 1.594                           | [in <sup>2</sup> ] |                               |
| Tensile force required         | $P_u =$                      |                       | = 30.00                           | [kips]             |                               |
| Plate tensile rupture strength | $R_n = F_u A_{nt}$           |                       | = 103.59                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-2 |
| Resistance factor-LRFD         | $\phi = 0.75$                |                       | AISC 14 <sup>th</sup> Eq J4-2     |                    |                               |
|                                | $\phi R_n =$                 |                       | = 77.70                           | [kips]             | AISC 14 <sup>th</sup> Eq J4-2 |
|                                | ratio = 0.39                 |                       | > $P_u$                           | OK                 |                               |

| Web Plate - Brace Side - Bolt Shear |                                 | ratio = 60.00 / 143.14 | = 0.42                  | PASS                             |
|-------------------------------------|---------------------------------|------------------------|-------------------------|----------------------------------|
| Bolt shear stress                   | bolt grade = A325-N             | $F_{nv} = 54.0$        | [ksi]                   | AISC 14 <sup>th</sup> Table J3.2 |
|                                     | bolt dia $d_b = 0.750$          | [in]                   | bolt area $A_b = 0.442$ | [in <sup>2</sup> ]               |
| Number of bolt carried shear        | $n_s = 4.0$                     | shear plane $m = 2$    |                         |                                  |
| Required shear strength             | $V_u =$                         | = 60.00                | [kips]                  |                                  |
| Bolt shear strength                 | $R_n = F_{nv} A_b n_s m C_{ec}$ | = 190.85               | [kips]                  | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt resistance factor-LRFD         | $\phi = 0.75$                   |                        |                         | AISC 14 <sup>th</sup> Eq J3-1    |
|                                     | $\phi R_n =$                    | = 143.14               | [kips]                  |                                  |
|                                     | ratio = 0.42                    | > $V_u$                | OK                      |                                  |

| Web Plate - Brace Side - Slip Critical - Web Plate / Brace Web |                                            | ratio = 60.00 / 75.94          | = 0.79                     | PASS                                    |
|----------------------------------------------------------------|--------------------------------------------|--------------------------------|----------------------------|-----------------------------------------|
| Bolt dia & bolt pretension                                     | dia $d_b = \frac{3}{4}$                    | [in]                           | Pretension $T_b = 28.00$   | [kips] AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                                  | = Class A                                  |                                | Slip coeff. $\mu = 0.30$   | AISC 14 <sup>th</sup> J3.8              |
| Min. bolt pretension                                           | $D_u = 1.13$                               |                                | Filler factor $h_f = 1.00$ | AISC 14 <sup>th</sup> J3.8              |
| No of bolt row & column                                        | $n_r = 2$                                  |                                | $n_c = 2$                  |                                         |
| No of slip plane                                               | $n_s = 2$                                  |                                |                            |                                         |
| Bolt group eccentricity coefficient                            | $C_{ec} =$                                 | = 1.000                        |                            |                                         |
| Required shear strength                                        | $V_u =$                                    | = 60.00                        | [kips]                     |                                         |
| Slip resistance                                                | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$ | = 75.94                        | [kips]                     | AISC 14 <sup>th</sup> Eq J3-4           |
| Resistance factor-LRFD                                         | $\phi = 1.00$                              | for standard size or SSLT hole |                            | AISC 14 <sup>th</sup> J3.8              |
|                                                                | $\phi R_n =$                               | = 75.94                        | [kips]                     |                                         |
|                                                                | ratio = 0.79                               | > $V_u$                        | OK                         |                                         |

| Web Plate - Brace Side - Bolt Bearing on Web Plate |                                                    | ratio = 30.00 / 71.57 |                             | = 0.42                           | PASS                             |
|----------------------------------------------------|----------------------------------------------------|-----------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                         |                                                    |                       |                             |                                  |                                  |
| Bolt shear stress                                  | bolt grade = A325-N                                | $F_{nv} = 54.0$       | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                    | bolt dia $d_b = 0.750$                             | [in]                  | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                         | $R_{n-bolt} = F_{nv} A_b$                          | = 23.86               | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate           |                                                    |                       |                             |                                  |                                  |
| Bolt hole diameter                                 | bolt dia $d_b = 3/4$                               | [in]                  | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance                       | spacing $L_s = 3.000$                              | [in]                  | edge distance $L_e = 1.375$ | [in]                             |                                  |
| Plate tensile strength                             | $F_u = 65.0$                                       | [ksi]                 |                             |                                  |                                  |
| Plate thickness                                    | $t = 0.375$                                        | [in]                  |                             |                                  |                                  |
| Interior Bolt                                      |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance                      | $L_c = L_s - d_h$                                  | = 2.188               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                    | = 79.98 ≤ 54.84                                    | = 54.84               | [kips]                      |                                  |                                  |
| Bolt strength at interior                          | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 23.86               | [kips]                      |                                  |                                  |
| Edge Bolt                                          |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance                      | $L_c = L_e - d_h / 2$                              | = 0.969               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                    | = 35.42 ≤ 54.84                                    | = 35.42               | [kips]                      |                                  |                                  |
| Bolt strength at edge                              | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 23.86               | [kips]                      |                                  |                                  |
| Number of bolt                                     | interior $n_{in} = 2$                              | edge $n_{ed} = 2$     |                             |                                  |                                  |
| Bolt bearing strength for all bolts                | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 95.43               | [kips]                      |                                  |                                  |
| Required shear strength                            | $V_u =$                                            | = 30.00               | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD                        | $\phi = 0.75$                                      |                       |                             |                                  | AISC 14 <sup>th</sup> J3-10      |
|                                                    | $\phi R_n =$                                       | = 71.57               | [kips]                      |                                  |                                  |
|                                                    | ratio = 0.42                                       | > $V_u$               | OK                          |                                  |                                  |

| Web Plate - Brace Side - Bolt Bearing on Brace Web |                                                    | ratio = 60.00 / 97.42 |                             | = 0.62                           | PASS                             |
|----------------------------------------------------|----------------------------------------------------|-----------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                         |                                                    |                       |                             |                                  |                                  |
| Bolt shear stress                                  | bolt grade = A325-N                                | $F_{nv} = 54.0$       | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                    | bolt dia $d_b = 0.750$                             | [in]                  | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                         | $R_{n-bolt} = 2 \times F_{nv} A_b$                 | = 47.71               | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate           |                                                    |                       |                             |                                  |                                  |
| Bolt hole diameter                                 | bolt dia $d_b = 3/4$                               | [in]                  | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance                       | spacing $L_s = 3.000$                              | [in]                  | edge distance $L_e = 1.625$ | [in]                             |                                  |
| Plate tensile strength                             | $F_u = 65.0$                                       | [ksi]                 |                             |                                  |                                  |
| Plate thickness                                    | $t = 0.245$                                        | [in]                  |                             |                                  |                                  |
| Interior Bolt                                      |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance                      | $L_c = L_s - d_h$                                  | = 2.188               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             | AISC 14 <sup>th</sup> Eq J3-6b   |                                  |
|                                                    | = 52.25 ≤ 35.83                                    | = 35.83               | [kips]                      |                                  |                                  |
| Bolt strength at interior                          | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 35.83               | [kips]                      |                                  |                                  |
| Edge Bolt                                          |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance                      | $L_c = L_e - d_h / 2$                              | = 1.219               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             | AISC 14 <sup>th</sup> Eq J3-6b   |                                  |
|                                                    | = 29.11 ≤ 35.83                                    | = 29.11               | [kips]                      |                                  |                                  |
| Bolt strength at edge                              | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 29.11               | [kips]                      |                                  |                                  |
| Number of bolt                                     | interior $n_{in} = 2$                              | edge $n_{ed} = 2$     |                             |                                  |                                  |
| Bolt bearing strength for all bolts                | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 129.89              | [kips]                      |                                  |                                  |
| Required shear strength                            | $V_u =$                                            | = 60.00               | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD                        | $\phi = 0.75$                                      |                       |                             | AISC 14 <sup>th</sup> J3-10      |                                  |
|                                                    | $\phi R_n =$                                       | = 97.42               | [kips]                      |                                  |                                  |
|                                                    | ratio = 0.62                                       | > $V_u$               | OK                          |                                  |                                  |

| Web Plate - Block Shear - Center Strip |                                                                 |       | ratio = 30.00 / 115.17            | = 0.26             | PASS                             |
|----------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| Plate Block Shear - Center Strip       |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                     | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                        | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                         | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir               | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir          | $s_v = 3.500$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir        | $e_v = 1.250$                                                   | [in]  | $e_h = 1.375$                     | [in]               |                                  |
| Gross area subject to shear            | $A_{gv} = [ (n_h - 1) s_h + e_h ] t_p \times 2$                 |       | = 3.281                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear              | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$          |       | = 2.297                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension            |                                                                 |       |                                   |                    |                                  |
| when sheared out by center strip       | $A_{nt} = (n_v - 1) (s_v - d_h) t_p$                            |       | = 0.984                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required          | $V_u =$                                                         |       | = 30.00                           | [kips]             |                                  |
| Uniform tension stress factor          | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided         | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 153.56                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                 | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                        | $\phi R_n =$                                                    |       | = 115.17                          | [kips]             |                                  |
|                                        | ratio = 0.26                                                    |       | > $V_u$                           | OK                 |                                  |

| Web Plate - Block Shear - 1-Side Strip |                                                                 |       | ratio = 30.00 / 96.43             | = 0.31             | PASS                             |
|----------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| Plate Block Shear - Side Strip         |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                     | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                        | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                         | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir               | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir          | $s_v = 3.500$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir        | $e_v = 1.250$                                                   | [in]  | $e_h = 1.375$                     | [in]               |                                  |
| Gross area subject to shear            | $A_{gv} = [ (n_h - 1) s_h + e_h ] t_p$                          |       | = 1.641                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear              | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$                   |       | = 1.148                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension            |                                                                 |       |                                   |                    |                                  |
| when sheared out by side strip         | $A_{nt} = [(n_v - 1)s_v + e_v - ((n_v - 1) + 0.5)d_h] t_p$      |       | = 1.289                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required          | $V_u =$                                                         |       | = 30.00                           | [kips]             |                                  |
| Uniform tension stress factor          | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided         | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 128.58                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                 | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                        | $\phi R_n =$                                                    |       | = 96.43                           | [kips]             |                                  |
|                                        | ratio = 0.31                                                    |       | > $V_u$                           | OK                 |                                  |

| Web Plate - Block Shear - 2-Side Strip   |                                                                 |       | ratio = 30.00 / 96.89             | = 0.31             | PASS                             |
|------------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| <b>Plate Block Shear - 2 Side Strips</b> |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                       | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                          | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                           | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir                 | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir            | $s_v = 3.500$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir          | $e_v = 1.250$                                                   | [in]  | $e_h = 1.375$                     | [in]               |                                  |
| Gross area subject to shear              | $A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$                   |       | = 3.281                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear                | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$          |       | = 2.297                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension              |                                                                 |       |                                   |                    |                                  |
| when sheared out by 2 side strips        | $A_{nt} = (e_v - 0.5 d_h) t_p \times 2$                         |       | = 0.609                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required            | $V_u =$                                                         |       | = 30.00                           | [kips]             |                                  |
| Uniform tension stress factor            | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided           | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 129.19                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                   | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                          | $\phi R_n =$                                                    |       | = 96.89                           | [kips]             |                                  |
|                                          | ratio = 0.31                                                    |       | > $V_u$                           | OK                 |                                  |

| Brace Web - Block Shear - Center Strip  |                                                                 |       | ratio = 60.00 / 78.83             | = 0.76             | PASS                             |
|-----------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| <b>Plate Block Shear - Center Strip</b> |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                      | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                         | $t_p = 0.245$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                          | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir                | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir           | $s_v = 3.500$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir         | $e_v = 2.215$                                                   | [in]  | $e_h = 1.625$                     | [in]               |                                  |
| Gross area subject to shear             | $A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$                   |       | = 2.266                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear               | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$          |       | = 1.623                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension             |                                                                 |       |                                   |                    |                                  |
| when sheared out by center strip        | $A_{nt} = (n_v - 1) (s_v - d_h) t_p$                            |       | = 0.643                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required           | $V_u =$                                                         |       | = 60.00                           | [kips]             |                                  |
| Uniform tension stress factor           | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided          | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 105.11                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                  | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                         | $\phi R_n =$                                                    |       | = 78.83                           | [kips]             |                                  |
|                                         | ratio = 0.76                                                    |       | > $V_u$                           | OK                 |                                  |

| Web Plate - Gusset PL Side - Bolt Shear |                                 | ratio = 60.00 / 143.14 | = 0.42                  | PASS                             |
|-----------------------------------------|---------------------------------|------------------------|-------------------------|----------------------------------|
| Bolt shear stress                       | bolt grade = A325-N             | $F_{nv} = 54.0$        | [ksi]                   | AISC 14 <sup>th</sup> Table J3.2 |
|                                         | bolt dia $d_b = 0.750$          | [in]                   | bolt area $A_b = 0.442$ | [in <sup>2</sup> ]               |
| Number of bolt carried shear            | $n_s = 4.0$                     | shear plane $m = 2$    |                         |                                  |
| Required shear strength                 | $V_u =$                         | = 60.00                | [kips]                  |                                  |
| Bolt shear strength                     | $R_n = F_{nv} A_b n_s m C_{ec}$ | = 190.85               | [kips]                  | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt resistance factor-LRFD             | $\phi = 0.75$                   |                        |                         | AISC 14 <sup>th</sup> Eq J3-1    |
|                                         | $\phi R_n =$                    | = 143.14               | [kips]                  |                                  |
|                                         | ratio = 0.42                    | > $V_u$                | OK                      |                                  |

| Web Plate - Gusset PL Side - Slip Critical - Web Plate / Gusset PL |                                              | ratio = 60.00 / 75.94 | = 0.79                     | PASS                                    |
|--------------------------------------------------------------------|----------------------------------------------|-----------------------|----------------------------|-----------------------------------------|
| Bolt dia & bolt pretension                                         | dia $d_b = \frac{3}{4}$                      | [in]                  | Pretension $T_b = 28.00$   | [kips] AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                                      | = Class A                                    |                       | Slip coeff. $\mu = 0.30$   | AISC 14 <sup>th</sup> J3.8              |
| Min. bolt pretension                                               | $D_u = 1.13$                                 |                       | Filler factor $h_f = 1.00$ | AISC 14 <sup>th</sup> J3.8              |
| No of bolt row & column                                            | $n_r = 2$                                    |                       | $n_c = 2$                  |                                         |
| No of slip plane                                                   | $n_s = 2$                                    |                       |                            |                                         |
| Bolt group eccentricity coefficient                                | $C_{ec} =$                                   | = 1.000               |                            |                                         |
| Required shear strength                                            | $V_u =$                                      | = 60.00               | [kips]                     |                                         |
| Slip resistance                                                    | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$   | = 75.94               | [kips]                     | AISC 14 <sup>th</sup> Eq J3-4           |
| Resistance factor-LRFD                                             | $\phi = 1.00$ for standard size or SSLT hole |                       |                            | AISC 14 <sup>th</sup> J3.8              |
|                                                                    | $\phi R_n =$                                 | = 75.94               | [kips]                     |                                         |
|                                                                    | ratio = 0.79                                 | > $V_u$               | OK                         |                                         |

| Web Plate - Gusset PL Side - Bolt Bearing on Web Plate |                                                    | ratio = 30.00 / 71.57 |                             | = 0.42                           | PASS                             |
|--------------------------------------------------------|----------------------------------------------------|-----------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                             |                                                    |                       |                             |                                  |                                  |
| Bolt shear stress                                      | bolt grade = A325-N                                | $F_{nv} = 54.0$       | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                        | bolt dia $d_b = 0.750$                             | [in]                  | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                             | $R_{n-bolt} = F_{nv} A_b$                          | = 23.86               | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate               |                                                    |                       |                             |                                  |                                  |
| Bolt hole diameter                                     | bolt dia $d_b = 3/4$                               | [in]                  | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance                           | spacing $L_s = 3.000$                              | [in]                  | edge distance $L_e = 1.375$ | [in]                             |                                  |
| Plate tensile strength                                 | $F_u = 65.0$                                       | [ksi]                 |                             |                                  |                                  |
| Plate thickness                                        | $t = 0.375$                                        | [in]                  |                             |                                  |                                  |
| Interior Bolt                                          |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance                          | $L_c = L_s - d_h$                                  | = 2.188               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                         | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                        | = 79.98 ≤ 54.84                                    | = 54.84               | [kips]                      |                                  |                                  |
| Bolt strength at interior                              | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 23.86               | [kips]                      |                                  |                                  |
| Edge Bolt                                              |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance                          | $L_c = L_e - d_h / 2$                              | = 0.969               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                         | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                        | = 35.42 ≤ 54.84                                    | = 35.42               | [kips]                      |                                  |                                  |
| Bolt strength at edge                                  | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 23.86               | [kips]                      |                                  |                                  |
| Number of bolt                                         | interior $n_{in} = 2$                              | edge $n_{ed} = 2$     |                             |                                  |                                  |
| Bolt bearing strength for all bolts                    | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 95.43               | [kips]                      |                                  |                                  |
| Required shear strength                                | $V_u =$                                            | = 30.00               | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD                            | $\phi = 0.75$                                      |                       |                             |                                  | AISC 14 <sup>th</sup> J3-10      |
|                                                        | $\phi R_n =$                                       | = 71.57               | [kips]                      |                                  |                                  |
|                                                        | ratio = 0.42                                       | > $V_u$               | OK                          |                                  |                                  |

| Web Plate - Gusset PL Side - Bolt Bearing on Gusset Plate |                                                    | ratio = 60.00 / 138.41 |                             | = 0.43                           | PASS                             |
|-----------------------------------------------------------|----------------------------------------------------|------------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                                |                                                    |                        |                             |                                  |                                  |
| Bolt shear stress                                         | bolt grade = A325-N                                | $F_{nv} = 54.0$        | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                           | bolt dia $d_b = 0.750$                             | [in]                   | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                                | $R_{n-bolt} = 2 \times F_{nv} A_b$                 | = 47.71                | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate                  |                                                    |                        |                             |                                  |                                  |
| Bolt hole diameter                                        | bolt dia $d_b = 3/4$                               | [in]                   | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance                              | spacing $L_s = 3.000$                              | [in]                   | edge distance $L_e = 1.625$ | [in]                             |                                  |
| Plate tensile strength                                    | $F_u = 65.0$                                       | [ksi]                  |                             |                                  |                                  |
| Plate thickness                                           | $t = 0.375$                                        | [in]                   |                             |                                  |                                  |
| Interior Bolt                                             |                                                    |                        |                             |                                  |                                  |
| Bolt hole edge clear distance                             | $L_c = L_s - d_h$                                  | = 2.188                | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                            | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                        |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                           | = 79.98 ≤ 54.84                                    | = 54.84                | [kips]                      |                                  |                                  |
| Bolt strength at interior                                 | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 47.71                | [kips]                      |                                  |                                  |
| Edge Bolt                                                 |                                                    |                        |                             |                                  |                                  |
| Bolt hole edge clear distance                             | $L_c = L_e - d_h / 2$                              | = 1.219                | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                            | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                        |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                           | = 44.56 ≤ 54.84                                    | = 44.56                | [kips]                      |                                  |                                  |
| Bolt strength at edge                                     | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 44.56                | [kips]                      |                                  |                                  |
| Number of bolt                                            | interior $n_{in} = 2$                              | edge $n_{ed} = 2$      |                             |                                  |                                  |
| Bolt bearing strength for all bolts                       | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 184.55               | [kips]                      |                                  |                                  |
| Required shear strength                                   | $V_u =$                                            | = 60.00                | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD                               | $\phi = 0.75$                                      |                        |                             |                                  | AISC 14 <sup>th</sup> J3-10      |
|                                                           | $\phi R_n =$                                       | = 138.41               | [kips]                      |                                  |                                  |
|                                                           | ratio = 0.43                                       | > $V_u$                | OK                          |                                  |                                  |

| Gusset Plate at Web Plate - Block Shear - Center Strip |                                                                 |       |                                   | ratio = 60.00 / 120.66 | = 0.50                      | PASS                             |
|--------------------------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|------------------------|-----------------------------|----------------------------------|
| Plate Block Shear - Center Strip                       |                                                                 |       |                                   |                        |                             |                                  |
| Bolt hole diameter                                     | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]                   | AISC 14 <sup>th</sup> B4.3b |                                  |
| Plate thickness                                        | $t_p = 0.375$                                                   | [in]  |                                   |                        |                             |                                  |
| Plate strength                                         | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]                  |                             |                                  |
| Bolt no in ver & hor dir                               | $n_v = 2$                                                       |       | $n_h = 2$                         |                        |                             |                                  |
| Bolt spacing in ver & hor dir                          | $s_v = 3.500$                                                   | [in]  | $s_h = 3.000$                     | [in]                   |                             |                                  |
| Bolt edge dist in ver & hor dir                        | $e_v = 2.215$                                                   | [in]  | $e_h = 1.625$                     | [in]                   |                             |                                  |
| Gross area subject to shear                            | $A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$                   |       |                                   | = 3.469                | [in <sup>2</sup> ]          |                                  |
| Net area subject to shear                              | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$          |       |                                   | = 2.484                | [in <sup>2</sup> ]          |                                  |
| Net area subject to tension                            |                                                                 |       |                                   |                        |                             |                                  |
| when sheared out by center strip                       | $A_{nt} = (n_v - 1) (s_v - d_h) t_p$                            |       |                                   | = 0.984                | [in <sup>2</sup> ]          |                                  |
| Block shear strength required                          | $V_u =$                                                         |       |                                   | = 60.00                | [kips]                      |                                  |
| Uniform tension stress factor                          | $U_{bs} = 1.00$                                                 |       |                                   |                        |                             | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided                         | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       |                                   | = 160.88               | [kips]                      | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                                 | $\phi = 0.75$                                                   |       |                                   |                        |                             | AISC 14 <sup>th</sup> Eq J4-5    |
|                                                        | $\phi R_n =$                                                    |       |                                   | = 120.66               | [kips]                      |                                  |
|                                                        | ratio = 0.50                                                    |       |                                   | > $V_u$                | OK                          |                                  |
| Gusset Plate - Tensile Yield (Whitmore)                |                                                                 |       |                                   | ratio = 60.00 / 117.52 | = 0.51                      | PASS                             |
| Plate Tensile Yielding Check                           |                                                                 |       |                                   |                        |                             |                                  |
| Plate size                                             | width $b_p = 6.964$                                             | [in]  | thickness $t_p = 0.375$           | [in]                   |                             |                                  |
| Plate yield strength                                   | $F_y = 50.0$                                                    | [ksi] |                                   |                        |                             |                                  |
| Plate gross area in shear                              | $A_g = b_p t_p$                                                 |       |                                   | = 2.612                | [in <sup>2</sup> ]          |                                  |
| Tensile force required                                 | $P_u =$                                                         |       |                                   | = 60.00                | [kips]                      |                                  |
| Plate tensile yielding strength                        | $R_n = F_y A_g$                                                 |       |                                   | = 130.58               | [kips]                      | AISC 14 <sup>th</sup> Eq J4-1    |
| Resistance factor-LRFD                                 | $\phi = 0.90$                                                   |       |                                   |                        |                             | AISC 14 <sup>th</sup> Eq J4-1    |
|                                                        | $\phi R_n =$                                                    |       |                                   | = 117.52               | [kips]                      |                                  |
|                                                        | ratio = 0.51                                                    |       |                                   | > $P_u$                | OK                          |                                  |
| Gusset Plate - Tensile Rupture (Whitmore)              |                                                                 |       |                                   | ratio = 60.00 / 95.32  | = 0.63                      | PASS                             |
| Plate Tensile Rupture Check                            |                                                                 |       |                                   |                        |                             |                                  |
| Bolt hole diameter                                     | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]                   | AISC 14 <sup>th</sup> B4.3b |                                  |
| Number of bolt                                         | $n = 2$                                                         |       |                                   |                        |                             |                                  |
| Plate size                                             | width $b_p = 6.964$                                             | [in]  | thickness $t_p = 0.375$           | [in]                   |                             |                                  |
| Plate tensile strength                                 | $F_u = 65.0$                                                    | [ksi] |                                   |                        |                             |                                  |
| Plate net area in tension                              | $A_{nt} = (b_p - n d_h) t_p$                                    |       |                                   | = 1.955                | [in <sup>2</sup> ]          |                                  |
| Tensile force required                                 | $P_u =$                                                         |       |                                   | = 60.00                | [kips]                      |                                  |
| Plate tensile rupture strength                         | $R_n = F_u A_{nt}$                                              |       |                                   | = 127.09               | [kips]                      | AISC 14 <sup>th</sup> Eq J4-2    |
| Resistance factor-LRFD                                 | $\phi = 0.75$                                                   |       |                                   |                        |                             | AISC 14 <sup>th</sup> Eq J4-2    |
|                                                        | $\phi R_n =$                                                    |       |                                   | = 95.32                | [kips]                      | AISC 14 <sup>th</sup> Eq J4-2    |
|                                                        | ratio = 0.63                                                    |       |                                   | > $P_u$                | OK                          |                                  |

**Brace Force Load Case 2**

Sect=W8X24

P =60.00 kips (C)

ratio = **0.79****PASS**

| <b>Web Plate - Brace Side - Bolt Shear</b> |                                 | ratio = 60.00 / 143.14 = <b>0.42</b> |                    | <b>PASS</b>                      |
|--------------------------------------------|---------------------------------|--------------------------------------|--------------------|----------------------------------|
| Bolt shear stress                          | bolt grade = A325-N             | $F_{nv} = 54.0$                      | [ksi]              | AISC 14 <sup>th</sup> Table J3.2 |
|                                            | bolt dia $d_b = 0.750$ [in]     | bolt area $A_b = 0.442$              | [in <sup>2</sup> ] |                                  |
| Number of bolt carried shear               | $n_s = 4.0$                     | shear plane $m = 2$                  |                    |                                  |
| Required shear strength                    | $V_u =$                         | $= 60.00$                            | [kips]             |                                  |
| Bolt shear strength                        | $R_n = F_{nv} A_b n_s m C_{ec}$ | $= 190.85$                           | [kips]             | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt resistance factor-LRFD                | $\phi = 0.75$                   |                                      |                    | AISC 14 <sup>th</sup> Eq J3-1    |
|                                            | $\phi R_n =$                    | $= 143.14$                           | [kips]             |                                  |
|                                            | ratio = <b>0.42</b>             | $> V_u$                              |                    | <b>OK</b>                        |

| <b>Web Plate - Brace Side - Slip Critical - Web Plate / Brace Web</b> |                                              | ratio = 60.00 / 75.94 = <b>0.79</b> |        | <b>PASS</b>                      |
|-----------------------------------------------------------------------|----------------------------------------------|-------------------------------------|--------|----------------------------------|
| Bolt dia & bolt pretension                                            | dia $d_b = 3/4$ [in]                         | Pretension $T_b = 28.00$            | [kips] | AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                                         | = Class A                                    | Slip coeff. $\mu = 0.30$            |        | AISC 14 <sup>th</sup> J3.8       |
| Min. bolt pretension                                                  | $D_u = 1.13$                                 | Filler factor $h_f = 1.00$          |        | AISC 14 <sup>th</sup> J3.8       |
| No of bolt row & column                                               | $n_r = 2$                                    | $n_c = 2$                           |        |                                  |
| No of slip plane                                                      | $n_s = 2$                                    |                                     |        |                                  |
| Bolt group eccentricity coefficient                                   | $C_{ec} =$                                   | $= 1.000$                           |        |                                  |
| Required shear strength                                               | $V_u =$                                      | $= 60.00$                           | [kips] |                                  |
| Slip resistance                                                       | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$   | $= 75.94$                           | [kips] | AISC 14 <sup>th</sup> Eq J3-4    |
| Resistance factor-LRFD                                                | $\phi = 1.00$ for standard size or SSLT hole |                                     |        | AISC 14 <sup>th</sup> J3.8       |
|                                                                       | $\phi R_n =$                                 | $= 75.94$                           | [kips] |                                  |
|                                                                       | ratio = <b>0.79</b>                          | $> V_u$                             |        | <b>OK</b>                        |

| Web Plate - Brace Side - Bolt Bearing on Web Plate |                                                    | ratio = 30.00 / 71.57 |                             | = 0.42                           | PASS                             |
|----------------------------------------------------|----------------------------------------------------|-----------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                         |                                                    |                       |                             |                                  |                                  |
| Bolt shear stress                                  | bolt grade = A325-N                                | $F_{nv} = 54.0$       | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                    | bolt dia $d_b = 0.750$                             | [in]                  | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                         | $R_{n-bolt} = F_{nv} A_b$                          | = 23.86               | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate           |                                                    |                       |                             |                                  |                                  |
| Bolt hole diameter                                 | bolt dia $d_b = 3/4$                               | [in]                  | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance                       | spacing $L_s = 3.000$                              | [in]                  | edge distance $L_e = 1.375$ | [in]                             |                                  |
| Plate tensile strength                             | $F_u = 65.0$                                       | [ksi]                 |                             |                                  |                                  |
| Plate thickness                                    | $t = 0.375$                                        | [in]                  |                             |                                  |                                  |
| Interior Bolt                                      |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance                      | $L_c = L_s - d_h$                                  | = 2.188               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                    | = 79.98 ≤ 54.84                                    | = 54.84               | [kips]                      |                                  |                                  |
| Bolt strength at interior                          | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 23.86               | [kips]                      |                                  |                                  |
| Edge Bolt                                          |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance                      | $L_c = L_e - d_h / 2$                              | = 0.969               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                    | = 35.42 ≤ 54.84                                    | = 35.42               | [kips]                      |                                  |                                  |
| Bolt strength at edge                              | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 23.86               | [kips]                      |                                  |                                  |
| Number of bolt                                     | interior $n_{in} = 2$                              | edge $n_{ed} = 2$     |                             |                                  |                                  |
| Bolt bearing strength for all bolts                | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 95.43               | [kips]                      |                                  |                                  |
| Required shear strength                            | $V_u =$                                            | = 30.00               | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD                        | $\phi = 0.75$                                      |                       |                             |                                  | AISC 14 <sup>th</sup> J3-10      |
|                                                    | $\phi R_n =$                                       | = 71.57               | [kips]                      |                                  |                                  |
|                                                    | ratio = 0.42                                       | > $V_u$               | OK                          |                                  |                                  |

| Web Plate - Brace Side - Bolt Bearing on Brace Web |                                                      | ratio = 60.00 / 107.49      |                    | = 0.56                           | PASS |
|----------------------------------------------------|------------------------------------------------------|-----------------------------|--------------------|----------------------------------|------|
| Single Bolt Shear Strength                         |                                                      |                             |                    |                                  |      |
| Bolt shear stress                                  | bolt grade = A325-N                                  | $F_{nv} = 54.0$             | [ksi]              | AISC 14 <sup>th</sup> Table J3.2 |      |
|                                                    | bolt dia $d_b = 0.750$ [in]                          | bolt area $A_b = 0.442$     | [in <sup>2</sup> ] |                                  |      |
| Single bolt shear strength                         | $R_{n-bolt} = 2 \times F_{nv} A_b$                   | = 47.71                     | [kips]             | AISC 14 <sup>th</sup> Eq J3-1    |      |
| Bolt Bearing / TearOut Strength on Plate           |                                                      |                             |                    |                                  |      |
| Bolt hole diameter                                 | bolt dia $d_b = 3/4$ [in]                            | bolt hole dia $d_h = 13/16$ | [in]               | AISC 14 <sup>th</sup> Table J3.3 |      |
| Bolt spacing                                       | spacing $L_s = 3.000$ [in]                           |                             |                    |                                  |      |
| Plate tensile strength                             | $F_u = 65.0$ [ksi]                                   |                             |                    |                                  |      |
| Plate thickness                                    | $t = 0.245$ [in]                                     |                             |                    |                                  |      |
| Interior Bolt                                      |                                                      |                             |                    |                                  |      |
| Bolt hole edge clear distance                      | $L_c = L_s - d_h$                                    | = 2.188                     | [in]               |                                  |      |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$ |                             |                    | AISC 14 <sup>th</sup> Eq J3-6b   |      |
|                                                    | = 52.25 ≤ 35.83                                      | = 35.83                     | [kips]             |                                  |      |
| Bolt strength at interior                          | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$     | = 35.83                     | [kips]             |                                  |      |
| Number of bolt                                     | interior $n_{in} = 4$                                |                             |                    |                                  |      |
| Bolt bearing strength for all bolts                | $R_n = n_{in} R_{n-in}$                              | = 143.33                    | [kips]             |                                  |      |
| Required shear strength                            | $V_u =$                                              | = 60.00                     | [kips]             |                                  |      |
| Bolt resistance factor-LRFD                        | $\phi = 0.75$                                        | AISC 14 <sup>th</sup> J3-10 |                    |                                  |      |
|                                                    | $\phi R_n =$                                         | = 107.49                    | [kips]             |                                  |      |
|                                                    | ratio = 0.56                                         | > $V_u$                     | OK                 |                                  |      |

| Web Plate - Gusset PL Side - Bolt Shear |                                 | ratio = 60.00 / 143.14        |                    | = 0.42                           | PASS |
|-----------------------------------------|---------------------------------|-------------------------------|--------------------|----------------------------------|------|
| Bolt shear stress                       | bolt grade = A325-N             | $F_{nv} = 54.0$               | [ksi]              | AISC 14 <sup>th</sup> Table J3.2 |      |
|                                         | bolt dia $d_b = 0.750$ [in]     | bolt area $A_b = 0.442$       | [in <sup>2</sup> ] |                                  |      |
| Number of bolt carried shear            | $n_s = 4.0$                     | shear plane $m = 2$           |                    |                                  |      |
| Required shear strength                 | $V_u =$                         | = 60.00                       | [kips]             |                                  |      |
| Bolt shear strength                     | $R_n = F_{nv} A_b n_s m C_{ec}$ | = 190.85                      | [kips]             | AISC 14 <sup>th</sup> Eq J3-1    |      |
| Bolt resistance factor-LRFD             | $\phi = 0.75$                   | AISC 14 <sup>th</sup> Eq J3-1 |                    |                                  |      |
|                                         | $\phi R_n =$                    | = 143.14                      | [kips]             |                                  |      |
|                                         | ratio = 0.42                    | > $V_u$                       | OK                 |                                  |      |

| Web Plate - Gusset PL Side - Slip Critical - Web Plate / Gusset PL |                                              | ratio = 60.00 / 75.94           | = 0.79 | PASS                             |
|--------------------------------------------------------------------|----------------------------------------------|---------------------------------|--------|----------------------------------|
| Bolt dia & bolt pretension                                         | dia $d_b = \frac{3}{4}$ [in]                 | Pretension $T_b = 28.00$ [kips] |        | AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                                      | = Class A                                    | Slip coeff. $\mu = 0.30$        |        | AISC 14 <sup>th</sup> J3.8       |
| Min. bolt pretension                                               | $D_u = 1.13$                                 | Filler factor $h_f = 1.00$      |        | AISC 14 <sup>th</sup> J3.8       |
| No of bolt row & column                                            | $n_r = 2$                                    | $n_c = 2$                       |        |                                  |
| No of slip plane                                                   | $n_s = 2$                                    |                                 |        |                                  |
| Bolt group eccentricity coefficient                                | $C_{ec} =$                                   | = 1.000                         |        |                                  |
| Required shear strength                                            | $V_u =$                                      | = 60.00 [kips]                  |        |                                  |
| Slip resistance                                                    | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$   | = 75.94 [kips]                  |        | AISC 14 <sup>th</sup> Eq J3-4    |
| Resistance factor-LRFD                                             | $\phi = 1.00$ for standard size or SSLT hole |                                 |        | AISC 14 <sup>th</sup> J3.8       |
|                                                                    | $\phi R_n =$                                 | = 75.94 [kips]                  |        |                                  |
|                                                                    | ratio = 0.79                                 | > $V_u$                         | OK     |                                  |

| Web Plate - Gusset PL Side - Bolt Bearing on Web Plate |                                                      | ratio = 30.00 / 71.57                      | = 0.42 | PASS                             |
|--------------------------------------------------------|------------------------------------------------------|--------------------------------------------|--------|----------------------------------|
| <b>Single Bolt Shear Strength</b>                      |                                                      |                                            |        |                                  |
| Bolt shear stress                                      | bolt grade = A325-N                                  | $F_{nv} = 54.0$ [ksi]                      |        | AISC 14 <sup>th</sup> Table J3.2 |
|                                                        | bolt dia $d_b = 0.750$ [in]                          | bolt area $A_b = 0.442$ [in <sup>2</sup> ] |        |                                  |
| Single bolt shear strength                             | $R_{n-bolt} = F_{nv} A_b$                            | = 23.86 [kips]                             |        | AISC 14 <sup>th</sup> Eq J3-1    |
| <b>Bolt Bearing / TearOut Strength on Plate</b>        |                                                      |                                            |        |                                  |
| Bolt hole diameter                                     | bolt dia $d_b = \frac{3}{4}$ [in]                    | bolt hole dia $d_h = \frac{13}{16}$ [in]   |        | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing                                           | spacing $L_s = 3.000$ [in]                           |                                            |        |                                  |
| Plate tensile strength                                 | $F_u = 65.0$ [ksi]                                   |                                            |        |                                  |
| Plate thickness                                        | $t = 0.375$ [in]                                     |                                            |        |                                  |
| <b>Interior Bolt</b>                                   |                                                      |                                            |        |                                  |
| Bolt hole edge clear distance                          | $L_c = L_s - d_h$                                    | = 2.188 [in]                               |        |                                  |
| Bolt tear out/bearing strength                         | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$ |                                            |        | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                        | = 79.98 ≤ 54.84                                      | = 54.84 [kips]                             |        |                                  |
| Bolt strength at interior                              | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$     | = 23.86 [kips]                             |        |                                  |
| Number of bolt                                         | interior $n_{in} = 4$                                |                                            |        |                                  |
| Bolt bearing strength for all bolts                    | $R_n = n_{in} R_{n-in}$                              | = 95.43 [kips]                             |        |                                  |
| Required shear strength                                | $V_u =$                                              | = 30.00 [kips]                             |        |                                  |
| Bolt resistance factor-LRFD                            | $\phi = 0.75$                                        |                                            |        | AISC 14 <sup>th</sup> J3-10      |
|                                                        | $\phi R_n =$                                         | = 71.57 [kips]                             |        |                                  |
|                                                        | ratio = 0.42                                         | > $V_u$                                    | OK     |                                  |

| Web Plate - Gusset PL Side - Bolt Bearing on Gusset Plate |                                                      | ratio = 60.00 / 143.14      |                                | = 0.42                           | PASS                             |
|-----------------------------------------------------------|------------------------------------------------------|-----------------------------|--------------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                                |                                                      |                             |                                |                                  |                                  |
| Bolt shear stress                                         | bolt grade = A325-N                                  | $F_{nv} = 54.0$             | [ksi]                          | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                           | bolt dia $d_b = 0.750$                               | [in]                        | bolt area $A_b = 0.442$        | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                                | $R_{n-bolt} = 2 \times F_{nv} A_b$                   | = 47.71                     | [kips]                         | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate                  |                                                      |                             |                                |                                  |                                  |
| Bolt hole diameter                                        | bolt dia $d_b = 3/4$                                 | [in]                        | bolt hole dia $d_h = 13/16$    | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing                                              | spacing $L_s = 3.000$                                | [in]                        |                                |                                  |                                  |
| Plate tensile strength                                    | $F_u = 65.0$                                         | [ksi]                       |                                |                                  |                                  |
| Plate thickness                                           | $t = 0.375$                                          | [in]                        |                                |                                  |                                  |
| Interior Bolt                                             |                                                      |                             |                                |                                  |                                  |
| Bolt hole edge clear distance                             | $L_c = L_s - d_h$                                    | = 2.188                     | [in]                           |                                  |                                  |
| Bolt tear out/bearing strength                            | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$ |                             | AISC 14 <sup>th</sup> Eq J3-6b |                                  |                                  |
|                                                           | = 79.98 ≤ 54.84                                      | = 54.84                     | [kips]                         |                                  |                                  |
| Bolt strength at interior                                 | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$     | = 47.71                     | [kips]                         |                                  |                                  |
| Number of bolt                                            | interior $n_{in} = 4$                                |                             |                                |                                  |                                  |
| Bolt bearing strength for all bolts                       | $R_n = n_{in} R_{n-in}$                              | = 190.85                    | [kips]                         |                                  |                                  |
| Required shear strength                                   | $V_u =$                                              | = 60.00                     | [kips]                         |                                  |                                  |
| Bolt resistance factor-LRFD                               | $\phi = 0.75$                                        | AISC 14 <sup>th</sup> J3-10 |                                |                                  |                                  |
|                                                           | $\phi R_n =$                                         | = 143.14                    | [kips]                         |                                  |                                  |
|                                                           | ratio = 0.42                                         | > $V_u$                     | OK                             |                                  |                                  |

| Web Plate - Compression Buckling |                                                                           | ratio = 30.00 / 76.20        |                                | = 0.39 |  | PASS |  |
|----------------------------------|---------------------------------------------------------------------------|------------------------------|--------------------------------|--------|--|------|--|
| Plate Compression Check          |                                                                           |                              |                                |        |  |      |  |
| Plate size                       | width $b_p = 6.000$ [in]                                                  | thickness $t_p = 0.375$ [in] |                                |        |  |      |  |
|                                  | $F_y = 50.0$ [ksi]                                                        | $E = 29000$ [ksi]            |                                |        |  |      |  |
| Plate gross area in compression  | $A_g = b_p t_p$                                                           | $= 2.250$ [in <sup>2</sup> ] |                                |        |  |      |  |
| Plate radius of gyration         | $r = t_p / \sqrt{12}$                                                     | $= 0.108$ [in]               |                                |        |  |      |  |
| Plate effective length factor    | $K =$                                                                     | $= 1.00$                     | AISC DG29 Page 196             |        |  |      |  |
| Plate unbraced length            | $L_u =$                                                                   | $= 6.750$ [in]               |                                |        |  |      |  |
| Plate slenderness                | $KL/r = 1.00 \times L_u / r$                                              | $= 62.35$                    |                                |        |  |      |  |
|                                  | when $\frac{KL}{r} > 25$ , use Chapter E                                  |                              | AISC 14 <sup>th</sup> J4.4 (b) |        |  |      |  |
| Elastic buckling stress          | $F_e = \frac{\pi^2 E}{(KL/r)^2}$                                          | $= 73.62$ [ksi]              | AISC 14 <sup>th</sup> Eq E3-4  |        |  |      |  |
|                                  | when $\frac{KL}{r} \leq 4.71 \left( \frac{E}{F_y} \right)^{0.5} = 113.43$ |                              | AISC 14 <sup>th</sup> E3 (a)   |        |  |      |  |
| Critical stress                  | $F_{cr} = 0.658^{(F_y/F_e)} F_y$                                          | $= 37.63$ [ksi]              | AISC 14 <sup>th</sup> Eq E3-2  |        |  |      |  |
| Plate compression required       | $P_u =$                                                                   | $= 30.00$ [kips]             |                                |        |  |      |  |
| Plate compression provided       | $R_n = F_{cr} \times A_g$                                                 | $= 84.66$ [kips]             | AISC 14 <sup>th</sup> Eq E3-1  |        |  |      |  |
| Bolt resistance factor-LRFD      | $\phi = 0.90$                                                             |                              | AISC 14 <sup>th</sup> E1       |        |  |      |  |
|                                  | $\phi R_n =$                                                              | $= 76.20$ [kips]             |                                |        |  |      |  |
|                                  | ratio = 0.39                                                              | $> P_u$                      | OK                             |        |  |      |  |

| Gusset Plate - Compression (Whitmore) |                                                                           | ratio = 60.00 / 107.58       |  | = 0.56 | PASS                           |
|---------------------------------------|---------------------------------------------------------------------------|------------------------------|--|--------|--------------------------------|
| Plate Compression Check               |                                                                           |                              |  |        |                                |
| Plate size                            | width $b_p = 6.964$ [in]                                                  | thickness $t_p = 0.375$ [in] |  |        |                                |
|                                       | $F_y = 50.0$ [ksi]                                                        | $E = 29000$ [ksi]            |  |        |                                |
| Plate gross area in compression       | $A_g = b_p t_p$                                                           | $= 2.612$ [in <sup>2</sup> ] |  |        |                                |
| Plate radius of gyration              | $r = t_p / \sqrt{12}$                                                     | $= 0.108$ [in]               |  |        |                                |
| Plate effective length factor         | $K =$                                                                     | $= 0.65$                     |  |        | AISC DG29 Page 196             |
| Plate unbraced length                 | $L_u =$                                                                   | $= 5.789$ [in]               |  |        |                                |
| Plate slenderness                     | $KL/r = 0.65 \times L_u / r$                                              | $= 34.76$                    |  |        |                                |
|                                       | when $\frac{KL}{r} > 25$ , use Chapter E                                  |                              |  |        | AISC 14 <sup>th</sup> J4.4 (b) |
| Elastic buckling stress               | $F_e = \frac{\pi^2 E}{(KL/r)^2}$                                          | $= 236.89$ [ksi]             |  |        | AISC 14 <sup>th</sup> Eq E3-4  |
|                                       | when $\frac{KL}{r} \leq 4.71 \left( \frac{E}{F_y} \right)^{0.5} = 113.43$ |                              |  |        | AISC 14 <sup>th</sup> E3 (a)   |
| Critical stress                       | $F_{cr} = 0.658^{(F_y/F_e)} F_y$                                          | $= 45.77$ [ksi]              |  |        | AISC 14 <sup>th</sup> Eq E3-2  |
| Plate compression required            | $P_u =$                                                                   | $= 60.00$ [kips]             |  |        |                                |
| Plate compression provided            | $R_n = F_{cr} \times A_g$                                                 | $= 119.53$ [kips]            |  |        | AISC 14 <sup>th</sup> Eq E3-1  |
| Bolt resistance factor-LRFD           | $\phi = 0.90$                                                             |                              |  |        | AISC 14 <sup>th</sup> E1       |
|                                       | $\phi R_n =$                                                              | $= 107.58$ [kips]            |  |        |                                |
|                                       | ratio = 0.56                                                              | $> P_u$                      |  |        | OK                             |

Left Brace - Brace to Gusset      Sect=HSS 5 x 5 x  $\frac{5}{16}$        $P_{LC1}$  =60.00 kips (C)     $P_{LC2}$  =-60.00 kips (T)    Code=AISC 360-10 LRFD

**Result Summary**geometries & weld limitations = **PASS**limit states max ratio = **0.93****PASS****Geometry Restriction Checks - Lap Plate to Gusset****PASS****Min Bolt Edge Distance - Lap Plate to Gusset**

|                                          |               |                |           |                                  |
|------------------------------------------|---------------|----------------|-----------|----------------------------------|
| Bolt diameter                            | $d_b$ =       | = 0.750        | [in]      |                                  |
| Min edge distance allowed                | $L_{e-min}$ = | = <b>1.000</b> | [in]      | AISC 14 <sup>th</sup> Table J3.4 |
| Min edge distance in Lap Plate to Gusset | $L_e$ =       | = <b>1.375</b> | [in]      |                                  |
|                                          |               | > $L_{e-min}$  | <b>OK</b> |                                  |

**Min Bolt Spacing - Lap Plate to Gusset**

|                                         |                         |                |           |                            |
|-----------------------------------------|-------------------------|----------------|-----------|----------------------------|
| Bolt diameter                           | $d_b$ =                 | = 0.750        | [in]      |                            |
| Min bolt spacing allowed                | $L_{s-min} = 2.667 d_b$ | = <b>2.000</b> | [in]      | AISC 14 <sup>th</sup> J3.3 |
| Min Bolt spacing in Lap Plate to Gusset | $L_s$ =                 | = <b>3.000</b> | [in]      |                            |
|                                         |                         | > $L_{s-min}$  | <b>OK</b> |                            |

**Weld Limitation Checks - Knife Plate to Brace****PASS****Min Fillet Weld Size**

|                               |             |                |           |                                  |
|-------------------------------|-------------|----------------|-----------|----------------------------------|
| Thinner part joined thickness | $t$ =       | = 0.291        | [in]      |                                  |
| Min fillet weld size allowed  | $w_{min}$ = | = <b>0.188</b> | [in]      | AISC 14 <sup>th</sup> Table J2.4 |
| Fillet weld size provided     | $w$ =       | = <b>0.313</b> | [in]      |                                  |
|                               |             | > $w_{min}$    | <b>OK</b> |                                  |

**Min Fillet Weld Length**

|                                |                        |                |           |                             |
|--------------------------------|------------------------|----------------|-----------|-----------------------------|
| Fillet weld size provided      | $w$ =                  | = 0.313        | [in]      |                             |
| Min fillet weld length allowed | $L_{min} = 4 \times w$ | = <b>1.250</b> | [in]      | AISC 14 <sup>th</sup> J2.2b |
| Min fillet weld length         | $L$ =                  | = <b>6.000</b> | [in]      |                             |
|                                |                        | > $L_{min}$    | <b>OK</b> |                             |

**Brace Force Load Case 1**Sect=HSS 5 x 5 x  $\frac{5}{16}$  $P$  =60.00 kipsratio = **0.93****PASS****Knife Plate - Bolt Shear**ratio = 60.00 / 143.14 = **0.42****PASS**

|                              |                                 |                     |                         |                                  |
|------------------------------|---------------------------------|---------------------|-------------------------|----------------------------------|
| Bolt shear stress            | bolt grade = A325-N             | $F_{nv} = 54.0$     | [ksi]                   | AISC 14 <sup>th</sup> Table J3.2 |
|                              | bolt dia $d_b = 0.750$          | [in]                | bolt area $A_b = 0.442$ | [in <sup>2</sup> ]               |
| Number of bolt carried shear | $n_s = 4.0$                     | shear plane $m = 2$ |                         |                                  |
| Required shear strength      | $V_u$ =                         | = <b>60.00</b>      | [kips]                  |                                  |
| Bolt shear strength          | $R_n = F_{nv} A_b n_s m C_{ec}$ | = 190.85            | [kips]                  | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt resistance factor-LRFD  | $\phi = 0.75$                   |                     |                         | AISC 14 <sup>th</sup> Eq J3-1    |
|                              | $\phi R_n$ =                    | = <b>143.14</b>     | [kips]                  |                                  |
|                              | ratio = <b>0.42</b>             | > $V_u$             | <b>OK</b>               |                                  |

| Knife Plate - Slip Critical - Knife Plate /Lap PL |                                              | ratio = 60.00 / 75.94           | = 0.79 | PASS                             |
|---------------------------------------------------|----------------------------------------------|---------------------------------|--------|----------------------------------|
| Bolt dia & bolt pretension                        | dia $d_b = \frac{3}{4}$ [in]                 | Pretension $T_b = 28.00$ [kips] |        | AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                     | = Class A                                    | Slip coeff. $\mu = 0.30$        |        | AISC 14 <sup>th</sup> J3.8       |
| Min. bolt pretension                              | $D_u = 1.13$                                 | Filler factor $h_f = 1.00$      |        | AISC 14 <sup>th</sup> J3.8       |
| No of bolt row & column                           | $n_r = 2$                                    | $n_c = 2$                       |        |                                  |
| No of slip plane                                  | $n_s = 2$                                    |                                 |        |                                  |
| Bolt group eccentricity coefficient               | $C_{ec} =$                                   | = 1.000                         |        |                                  |
| Required shear strength                           | $V_u =$                                      | = 60.00 [kips]                  |        |                                  |
| Slip resistance                                   | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$   | = 75.94 [kips]                  |        | AISC 14 <sup>th</sup> Eq J3-4    |
| Resistance factor-LRFD                            | $\phi = 1.00$ for standard size or SSLT hole |                                 |        | AISC 14 <sup>th</sup> J3.8       |
|                                                   | $\phi R_n =$                                 | = 75.94 [kips]                  |        |                                  |
|                                                   | ratio = 0.79                                 | > $V_u$                         | OK     |                                  |

| Knife Plate - Bolt Bearing on Knife Plate       |                                                      | ratio = 60.00 / 143.14                     | = 0.42 | PASS                             |
|-------------------------------------------------|------------------------------------------------------|--------------------------------------------|--------|----------------------------------|
| <b>Single Bolt Shear Strength</b>               |                                                      |                                            |        |                                  |
| Bolt shear stress                               | bolt grade = A325-N                                  | $F_{nv} = 54.0$ [ksi]                      |        | AISC 14 <sup>th</sup> Table J3.2 |
|                                                 | bolt dia $d_b = 0.750$ [in]                          | bolt area $A_b = 0.442$ [in <sup>2</sup> ] |        |                                  |
| Single bolt shear strength                      | $R_{n-bolt} = 2 \times F_{nv} A_b$                   | = 47.71 [kips]                             |        | AISC 14 <sup>th</sup> Eq J3-1    |
| <b>Bolt Bearing / TearOut Strength on Plate</b> |                                                      |                                            |        |                                  |
| Bolt hole diameter                              | bolt dia $d_b = \frac{3}{4}$ [in]                    | bolt hole dia $d_h = \frac{13}{16}$ [in]   |        | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing                                    | spacing $L_s = 3.000$ [in]                           |                                            |        |                                  |
| Plate tensile strength                          | $F_u = 65.0$ [ksi]                                   |                                            |        |                                  |
| Plate thickness                                 | $t = 0.375$ [in]                                     |                                            |        |                                  |
| <b>Interior Bolt</b>                            |                                                      |                                            |        |                                  |
| Bolt hole edge clear distance                   | $L_c = L_s - d_h$                                    | = 2.188 [in]                               |        |                                  |
| Bolt tear out/bearing strength                  | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$ |                                            |        | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                 | = 79.98 ≤ 54.84                                      | = 54.84 [kips]                             |        |                                  |
| Bolt strength at interior                       | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$     | = 47.71 [kips]                             |        |                                  |
| Number of bolt                                  | interior $n_{in} = 4$                                |                                            |        |                                  |
| Bolt bearing strength for all bolts             | $R_n = n_{in} R_{n-in}$                              | = 190.85 [kips]                            |        |                                  |
| Required shear strength                         | $V_u =$                                              | = 60.00 [kips]                             |        |                                  |
| Bolt resistance factor-LRFD                     | $\phi = 0.75$                                        |                                            |        | AISC 14 <sup>th</sup> J3-10      |
|                                                 | $\phi R_n =$                                         | = 143.14 [kips]                            |        |                                  |
|                                                 | ratio = 0.42                                         | > $V_u$                                    | OK     |                                  |

| Knife Plate - Bolt Bearing on Lap Plate  |                                                      | ratio = 30.00 / 71.57       |                                | = 0.42                           | PASS                             |
|------------------------------------------|------------------------------------------------------|-----------------------------|--------------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength               |                                                      |                             |                                |                                  |                                  |
| Bolt shear stress                        | bolt grade = A325-N                                  | $F_{nv} = 54.0$             | [ksi]                          | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                          | bolt dia $d_b = 0.750$                               | [in]                        | bolt area $A_b = 0.442$        | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength               | $R_{n-bolt} = F_{nv} A_b$                            | = 23.86                     | [kips]                         | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate |                                                      |                             |                                |                                  |                                  |
| Bolt hole diameter                       | bolt dia $d_b = 3/4$                                 | [in]                        | bolt hole dia $d_h = 13/16$    | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing                             | spacing $L_s = 3.000$                                | [in]                        |                                |                                  |                                  |
| Plate tensile strength                   | $F_u = 65.0$                                         | [ksi]                       |                                |                                  |                                  |
| Plate thickness                          | $t = 0.375$                                          | [in]                        |                                |                                  |                                  |
| Interior Bolt                            |                                                      |                             |                                |                                  |                                  |
| Bolt hole edge clear distance            | $L_c = L_s - d_h$                                    | = 2.188                     | [in]                           |                                  |                                  |
| Bolt tear out/bearing strength           | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$ |                             | AISC 14 <sup>th</sup> Eq J3-6b |                                  |                                  |
|                                          | = 79.98 ≤ 54.84                                      | = 54.84                     | [kips]                         |                                  |                                  |
| Bolt strength at interior                | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$     | = 23.86                     | [kips]                         |                                  |                                  |
| Number of bolt                           | interior $n_{in} = 4$                                |                             |                                |                                  |                                  |
| Bolt bearing strength for all bolts      | $R_n = n_{in} R_{n-in}$                              | = 95.43                     | [kips]                         |                                  |                                  |
| Required shear strength                  | $V_u =$                                              | = 30.00                     | [kips]                         |                                  |                                  |
| Bolt resistance factor-LRFD              | $\phi = 0.75$                                        | AISC 14 <sup>th</sup> J3-10 |                                |                                  |                                  |
|                                          | $\phi R_n =$                                         | = 71.57                     | [kips]                         |                                  |                                  |
|                                          | ratio = 0.42                                         | > $V_u$                     | OK                             |                                  |                                  |

| Knife Plate - Compression Buckling |                                                                           | ratio = 60.00 / 64.19 |                         | = 0.93             |  | PASS                  |          |
|------------------------------------|---------------------------------------------------------------------------|-----------------------|-------------------------|--------------------|--|-----------------------|----------|
| Plate Compression Check            |                                                                           |                       |                         |                    |  |                       |          |
| Plate size                         | width $b_p = 5.750$                                                       | [in]                  | thickness $t_p = 0.375$ | [in]               |  |                       |          |
|                                    | $F_y = 50.0$                                                              | [ksi]                 | $E = 29000$             | [ksi]              |  |                       |          |
| Plate gross area in compression    | $A_g = b_p t_p$                                                           |                       | $= 2.156$               | [in <sup>2</sup> ] |  |                       |          |
| Plate radius of gyration           | $r = t_p / \sqrt{12}$                                                     |                       | $= 0.108$               | [in]               |  |                       |          |
| Plate effective length factor      | $K =$                                                                     |                       | $= 2.10$                |                    |  | AISC DG29             | Page 196 |
| Plate unbraced length              | $L_u =$                                                                   |                       | $= 3.875$               | [in]               |  |                       |          |
| Plate slenderness                  | $KL/r = 2.10 \times L_u / r$                                              |                       | $= 75.17$               |                    |  |                       |          |
|                                    | when $\frac{KL}{r} > 25$ , use Chapter E                                  |                       |                         |                    |  | AISC 14 <sup>th</sup> | J4.4 (b) |
| Elastic buckling stress            | $F_e = \frac{\pi^2 E}{(KL/r)^2}$                                          |                       | $= 50.65$               | [ksi]              |  | AISC 14 <sup>th</sup> | Eq E3-4  |
|                                    | when $\frac{KL}{r} \leq 4.71 \left( \frac{E}{F_y} \right)^{0.5} = 113.43$ |                       |                         |                    |  | AISC 14 <sup>th</sup> | E3 (a)   |
| Critical stress                    | $F_{cr} = 0.658 \left( F_y / F_e \right) F_y$                             |                       | $= 33.08$               | [ksi]              |  | AISC 14 <sup>th</sup> | Eq E3-2  |
| Plate compression required         | $P_u =$                                                                   |                       | $= 60.00$               | [kips]             |  |                       |          |
| Plate compression provided         | $R_n = F_{cr} \times A_g$                                                 |                       | $= 71.32$               | [kips]             |  | AISC 14 <sup>th</sup> | Eq E3-1  |
| Bolt resistance factor-LRFD        | $\phi = 0.90$                                                             |                       |                         |                    |  | AISC 14 <sup>th</sup> | E1       |
|                                    | $\phi R_n =$                                                              |                       | $= 64.19$               | [kips]             |  |                       |          |
|                                    | ratio = 0.93                                                              |                       | $> P_u$                 |                    |  | OK                    |          |

| Lap Plate - Brace Side - Bolt Shear |                                 | ratio = 60.00 / 143.14 = 0.42              |    | PASS                             |
|-------------------------------------|---------------------------------|--------------------------------------------|----|----------------------------------|
| Bolt shear stress                   | bolt grade = A325-N             | $F_{nv} = 54.0$ [ksi]                      |    | AISC 14 <sup>th</sup> Table J3.2 |
|                                     | bolt dia $d_b = 0.750$ [in]     | bolt area $A_b = 0.442$ [in <sup>2</sup> ] |    |                                  |
| Number of bolt carried shear        | $n_s = 4.0$                     | shear plane $m = 2$                        |    |                                  |
| Required shear strength             | $V_u =$                         | $= 60.00$ [kips]                           |    |                                  |
| Bolt shear strength                 | $R_n = F_{nv} A_b n_s m C_{ec}$ | $= 190.85$ [kips]                          |    | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt resistance factor-LRFD         | $\phi = 0.75$                   |                                            |    | AISC 14 <sup>th</sup> Eq J3-1    |
|                                     | $\phi R_n =$                    | $= 143.14$ [kips]                          |    |                                  |
|                                     | ratio = 0.42                    | $> V_u$                                    | OK |                                  |

| Lap Plate - Brace Side - Slip Critical - Lap Plate / Knife Plate |                                              | ratio = 60.00 / 75.94           | = 0.79 | PASS                             |
|------------------------------------------------------------------|----------------------------------------------|---------------------------------|--------|----------------------------------|
| Bolt dia & bolt pretension                                       | dia $d_b = \frac{3}{4}$ [in]                 | Pretension $T_b = 28.00$ [kips] |        | AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                                    | = Class A                                    | Slip coeff. $\mu = 0.30$        |        | AISC 14 <sup>th</sup> J3.8       |
| Min. bolt pretension                                             | $D_u = 1.13$                                 | Filler factor $h_f = 1.00$      |        | AISC 14 <sup>th</sup> J3.8       |
| No of bolt row & column                                          | $n_r = 2$                                    | $n_c = 2$                       |        |                                  |
| No of slip plane                                                 | $n_s = 2$                                    |                                 |        |                                  |
| Bolt group eccentricity coefficient                              | $C_{ec} =$                                   | = 1.000                         |        |                                  |
| Required shear strength                                          | $V_u =$                                      | = 60.00 [kips]                  |        |                                  |
| Slip resistance                                                  | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$   | = 75.94 [kips]                  |        | AISC 14 <sup>th</sup> Eq J3-4    |
| Resistance factor-LRFD                                           | $\phi = 1.00$ for standard size or SSLT hole |                                 |        | AISC 14 <sup>th</sup> J3.8       |
|                                                                  | $\phi R_n =$                                 | = 75.94 [kips]                  |        |                                  |
|                                                                  | ratio = 0.79                                 | > $V_u$                         | OK     |                                  |

| Lap Plate - Brace Side - Bolt Bearing on Lap Plate |                                                    | ratio = 30.00 / 71.57                      | = 0.42 | PASS                             |
|----------------------------------------------------|----------------------------------------------------|--------------------------------------------|--------|----------------------------------|
| <b>Single Bolt Shear Strength</b>                  |                                                    |                                            |        |                                  |
| Bolt shear stress                                  | bolt grade = A325-N                                | $F_{nv} = 54.0$ [ksi]                      |        | AISC 14 <sup>th</sup> Table J3.2 |
|                                                    | bolt dia $d_b = 0.750$ [in]                        | bolt area $A_b = 0.442$ [in <sup>2</sup> ] |        |                                  |
| Single bolt shear strength                         | $R_{n-bolt} = F_{nv} A_b$                          | = 23.86 [kips]                             |        | AISC 14 <sup>th</sup> Eq J3-1    |
| <b>Bolt Bearing / TearOut Strength on Plate</b>    |                                                    |                                            |        |                                  |
| Bolt hole diameter                                 | bolt dia $d_b = \frac{3}{4}$ [in]                  | bolt hole dia $d_h = \frac{13}{16}$ [in]   |        | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance                       | spacing $L_s = 3.000$ [in]                         | edge distance $L_e = 1.375$ [in]           |        |                                  |
| Plate tensile strength                             | $F_u = 65.0$ [ksi]                                 |                                            |        |                                  |
| Plate thickness                                    | $t = 0.375$ [in]                                   |                                            |        |                                  |
| <b>Interior Bolt</b>                               |                                                    |                                            |        |                                  |
| Bolt hole edge clear distance                      | $L_c = L_s - d_h$                                  | = 2.188 [in]                               |        |                                  |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                                            |        | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                    | = 79.98 ≤ 54.84                                    | = 54.84 [kips]                             |        |                                  |
| Bolt strength at interior                          | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 23.86 [kips]                             |        |                                  |
| <b>Edge Bolt</b>                                   |                                                    |                                            |        |                                  |
| Bolt hole edge clear distance                      | $L_c = L_e - d_h / 2$                              | = 0.969 [in]                               |        |                                  |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                                            |        | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                    | = 35.42 ≤ 54.84                                    | = 35.42 [kips]                             |        |                                  |
| Bolt strength at edge                              | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 23.86 [kips]                             |        |                                  |
| Number of bolt                                     | interior $n_{in} = 2$                              | edge $n_{ed} = 2$                          |        |                                  |
| Bolt bearing strength for all bolts                | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 95.43 [kips]                             |        |                                  |
| Required shear strength                            | $V_u =$                                            | = 30.00 [kips]                             |        |                                  |
| Bolt resistance factor-LRFD                        | $\phi = 0.75$                                      |                                            |        | AISC 14 <sup>th</sup> J3-10      |
|                                                    | $\phi R_n =$                                       | = 71.57 [kips]                             |        |                                  |
|                                                    | ratio = 0.42                                       | > $V_u$                                    | OK     |                                  |

| Lap Plate - Brace Side - Bolt Bearing on Knife Plate |                                                      | ratio = 60.00 / 143.14 = 0.42 PASS |                    |                                  |
|------------------------------------------------------|------------------------------------------------------|------------------------------------|--------------------|----------------------------------|
| Single Bolt Shear Strength                           |                                                      |                                    |                    |                                  |
| Bolt shear stress                                    | bolt grade = A325-N                                  | $F_{nv} = 54.0$                    | [ksi]              | AISC 14 <sup>th</sup> Table J3.2 |
|                                                      | bolt dia $d_b = 0.750$ [in]                          | bolt area $A_b = 0.442$            | [in <sup>2</sup> ] |                                  |
| Single bolt shear strength                           | $R_{n-bolt} = 2 \times F_{nv} A_b$                   | = 47.71                            | [kips]             | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt Bearing / TearOut Strength on Plate             |                                                      |                                    |                    |                                  |
| Bolt hole diameter                                   | bolt dia $d_b = 3/4$ [in]                            | bolt hole dia $d_h = 13/16$        | [in]               | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing                                         | spacing $L_s = 3.000$ [in]                           |                                    |                    |                                  |
| Plate tensile strength                               | $F_u = 65.0$ [ksi]                                   |                                    |                    |                                  |
| Plate thickness                                      | $t = 0.375$ [in]                                     |                                    |                    |                                  |
| Interior Bolt                                        |                                                      |                                    |                    |                                  |
| Bolt hole edge clear distance                        | $L_c = L_s - d_h$                                    | = 2.188                            | [in]               |                                  |
| Bolt tear out/bearing strength                       | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$ |                                    |                    | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                      | = 79.98 ≤ 54.84                                      | = 54.84                            | [kips]             |                                  |
| Bolt strength at interior                            | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$     | = 47.71                            | [kips]             |                                  |
| Number of bolt                                       | interior $n_{in} = 4$                                |                                    |                    |                                  |
| Bolt bearing strength for all bolts                  | $R_n = n_{in} R_{n-in}$                              | = 190.85                           | [kips]             |                                  |
| Required shear strength                              | $V_u =$                                              | = 60.00                            | [kips]             |                                  |
| Bolt resistance factor-LRFD                          | $\phi = 0.75$                                        |                                    |                    | AISC 14 <sup>th</sup> J3-10      |
|                                                      | $\phi R_n =$                                         | = 143.14                           | [kips]             |                                  |
|                                                      | ratio = 0.42                                         | > $V_u$                            | OK                 |                                  |

| Lap Plate - Gusset PL Side - Bolt Shear |                                 | ratio = 60.00 / 143.14 = 0.42 PASS |                    |                                  |
|-----------------------------------------|---------------------------------|------------------------------------|--------------------|----------------------------------|
| Bolt shear stress                       | bolt grade = A325-N             | $F_{nv} = 54.0$                    | [ksi]              | AISC 14 <sup>th</sup> Table J3.2 |
|                                         | bolt dia $d_b = 0.750$ [in]     | bolt area $A_b = 0.442$            | [in <sup>2</sup> ] |                                  |
| Number of bolt carried shear            | $n_s = 4.0$                     | shear plane $m = 2$                |                    |                                  |
| Required shear strength                 | $V_u =$                         | = 60.00                            | [kips]             |                                  |
| Bolt shear strength                     | $R_n = F_{nv} A_b n_s m C_{ec}$ | = 190.85                           | [kips]             | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt resistance factor-LRFD             | $\phi = 0.75$                   |                                    |                    | AISC 14 <sup>th</sup> Eq J3-1    |
|                                         | $\phi R_n =$                    | = 143.14                           | [kips]             |                                  |
|                                         | ratio = 0.42                    | > $V_u$                            | OK                 |                                  |

| Lap Plate - Gusset PL Side - Slip Critical - Lap Plate /Gusset PL |                                              |                                 | ratio = 60.00 / 75.94 | = 0.79 | PASS                             |
|-------------------------------------------------------------------|----------------------------------------------|---------------------------------|-----------------------|--------|----------------------------------|
| Bolt dia & bolt pretension                                        | dia $d_b = \frac{3}{4}$ [in]                 | Pretension $T_b = 28.00$ [kips] |                       |        | AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                                     | = Class A                                    | Slip coeff. $\mu = 0.30$        |                       |        | AISC 14 <sup>th</sup> J3.8       |
| Min. bolt pretension                                              | $D_u = 1.13$                                 | Filler factor $h_f = 1.00$      |                       |        | AISC 14 <sup>th</sup> J3.8       |
| No of bolt row & column                                           | $n_r = 2$                                    | $n_c = 2$                       |                       |        |                                  |
| No of slip plane                                                  | $n_s = 2$                                    |                                 |                       |        |                                  |
| Bolt group eccentricity coefficient                               | $C_{ec} =$                                   | $= 1.000$                       |                       |        |                                  |
| Required shear strength                                           | $V_u =$                                      | $= 60.00$ [kips]                |                       |        |                                  |
| Slip resistance                                                   | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$   | $= 75.94$ [kips]                |                       |        | AISC 14 <sup>th</sup> Eq J3-4    |
| Resistance factor-LRFD                                            | $\phi = 1.00$ for standard size or SSLT hole |                                 |                       |        | AISC 14 <sup>th</sup> J3.8       |
|                                                                   | $\phi R_n =$                                 | $= 75.94$ [kips]                |                       |        |                                  |
|                                                                   | ratio = 0.79                                 | $> V_u$                         |                       | OK     |                                  |

| Lap Plate - Gusset PL Side - Bolt Bearing on Lap Plate |                                                      |                                            | ratio = 30.00 / 71.57 | = 0.42 | PASS                             |
|--------------------------------------------------------|------------------------------------------------------|--------------------------------------------|-----------------------|--------|----------------------------------|
| <b>Single Bolt Shear Strength</b>                      |                                                      |                                            |                       |        |                                  |
| Bolt shear stress                                      | bolt grade = A325-N                                  | $F_{nv} = 54.0$ [ksi]                      |                       |        | AISC 14 <sup>th</sup> Table J3.2 |
|                                                        | bolt dia $d_b = 0.750$ [in]                          | bolt area $A_b = 0.442$ [in <sup>2</sup> ] |                       |        |                                  |
| Single bolt shear strength                             | $R_{n-bolt} = F_{nv} A_b$                            | $= 23.86$ [kips]                           |                       |        | AISC 14 <sup>th</sup> Eq J3-1    |
| <b>Bolt Bearing / TearOut Strength on Plate</b>        |                                                      |                                            |                       |        |                                  |
| Bolt hole diameter                                     | bolt dia $d_b = \frac{3}{4}$ [in]                    | bolt hole dia $d_h = \frac{13}{16}$ [in]   |                       |        | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing                                           | spacing $L_s = 3.000$ [in]                           |                                            |                       |        |                                  |
| Plate tensile strength                                 | $F_u = 65.0$ [ksi]                                   |                                            |                       |        |                                  |
| Plate thickness                                        | $t = 0.375$ [in]                                     |                                            |                       |        |                                  |
| <b>Interior Bolt</b>                                   |                                                      |                                            |                       |        |                                  |
| Bolt hole edge clear distance                          | $L_c = L_s - d_h$                                    | $= 2.188$ [in]                             |                       |        |                                  |
| Bolt tear out/bearing strength                         | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$ | $= 54.84$ [kips]                           |                       |        | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                                        | $= 79.98 \leq 54.84$                                 |                                            |                       |        |                                  |
| Bolt strength at interior                              | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$     | $= 23.86$ [kips]                           |                       |        |                                  |
| Number of bolt                                         | interior $n_{in} = 4$                                |                                            |                       |        |                                  |
| Bolt bearing strength for all bolts                    | $R_n = n_{in} R_{n-in}$                              | $= 95.43$ [kips]                           |                       |        |                                  |
| Required shear strength                                | $V_u =$                                              | $= 30.00$ [kips]                           |                       |        |                                  |
| Bolt resistance factor-LRFD                            | $\phi = 0.75$                                        |                                            |                       |        | AISC 14 <sup>th</sup> J3-10      |
|                                                        | $\phi R_n =$                                         | $= 71.57$ [kips]                           |                       |        |                                  |
|                                                        | ratio = 0.42                                         | $> V_u$                                    |                       | OK     |                                  |

| Lap Plate - Gusset PL Side - Bolt Bearing on Gusset Plate |                                                      | ratio = 60.00 / 143.14      |                                | = 0.42                           | PASS                             |
|-----------------------------------------------------------|------------------------------------------------------|-----------------------------|--------------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                                |                                                      |                             |                                |                                  |                                  |
| Bolt shear stress                                         | bolt grade = A325-N                                  | $F_{nv} = 54.0$             | [ksi]                          | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                           | bolt dia $d_b = 0.750$                               | [in]                        | bolt area $A_b = 0.442$        | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                                | $R_{n-bolt} = 2 \times F_{nv} A_b$                   | = 47.71                     | [kips]                         | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate                  |                                                      |                             |                                |                                  |                                  |
| Bolt hole diameter                                        | bolt dia $d_b = 3/4$                                 | [in]                        | bolt hole dia $d_h = 13/16$    | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing                                              | spacing $L_s = 3.000$                                | [in]                        |                                |                                  |                                  |
| Plate tensile strength                                    | $F_u = 65.0$                                         | [ksi]                       |                                |                                  |                                  |
| Plate thickness                                           | $t = 0.375$                                          | [in]                        |                                |                                  |                                  |
| Interior Bolt                                             |                                                      |                             |                                |                                  |                                  |
| Bolt hole edge clear distance                             | $L_c = L_s - d_h$                                    | = 2.188                     | [in]                           |                                  |                                  |
| Bolt tear out/bearing strength                            | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t m F_u$ |                             | AISC 14 <sup>th</sup> Eq J3-6b |                                  |                                  |
|                                                           | = 79.98 ≤ 54.84                                      | = 54.84                     | [kips]                         |                                  |                                  |
| Bolt strength at interior                                 | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$     | = 47.71                     | [kips]                         |                                  |                                  |
| Number of bolt                                            | interior $n_{in} = 4$                                |                             |                                |                                  |                                  |
| Bolt bearing strength for all bolts                       | $R_n = n_{in} R_{n-in}$                              | = 190.85                    | [kips]                         |                                  |                                  |
| Required shear strength                                   | $V_u =$                                              | = 60.00                     | [kips]                         |                                  |                                  |
| Bolt resistance factor-LRFD                               | $\phi = 0.75$                                        | AISC 14 <sup>th</sup> J3-10 |                                |                                  |                                  |
|                                                           | $\phi R_n =$                                         | = 143.14                    | [kips]                         |                                  |                                  |
|                                                           | ratio = 0.42                                         | > $V_u$                     | OK                             |                                  |                                  |

| Lap Plate - Compression Buckling |                                                                           | ratio = 30.00 / 73.02        |  | = 0.41 | PASS                           |
|----------------------------------|---------------------------------------------------------------------------|------------------------------|--|--------|--------------------------------|
| Plate Compression Check          |                                                                           |                              |  |        |                                |
| Plate size                       | width $b_p = 5.750$ [in]                                                  | thickness $t_p = 0.375$ [in] |  |        |                                |
|                                  | $F_y = 50.0$ [ksi]                                                        | $E = 29000$ [ksi]            |  |        |                                |
| Plate gross area in compression  | $A_g = b_p t_p$                                                           | $= 2.156$ [in <sup>2</sup> ] |  |        |                                |
| Plate radius of gyration         | $r = t_p / \sqrt{12}$                                                     | $= 0.108$ [in]               |  |        |                                |
| Plate effective length factor    | $K =$                                                                     | $= 1.00$                     |  |        | AISC DG29 Page 196             |
| Plate unbraced length            | $L_u =$                                                                   | $= 6.750$ [in]               |  |        |                                |
| Plate slenderness                | $KL/r = 1.00 \times L_u / r$                                              | $= 62.35$                    |  |        |                                |
|                                  | when $\frac{KL}{r} > 25$ , use Chapter E                                  |                              |  |        | AISC 14 <sup>th</sup> J4.4 (b) |
| Elastic buckling stress          | $F_e = \frac{\pi^2 E}{(KL/r)^2}$                                          | $= 73.62$ [ksi]              |  |        | AISC 14 <sup>th</sup> Eq E3-4  |
|                                  | when $\frac{KL}{r} \leq 4.71 \left( \frac{E}{F_y} \right)^{0.5} = 113.43$ |                              |  |        | AISC 14 <sup>th</sup> E3 (a)   |
| Critical stress                  | $F_{cr} = 0.658^{(F_y/F_e)} F_y$                                          | $= 37.63$ [ksi]              |  |        | AISC 14 <sup>th</sup> Eq E3-2  |
| Plate compression required       | $P_u =$                                                                   | $= 30.00$ [kips]             |  |        |                                |
| Plate compression provided       | $R_n = F_{cr} \times A_g$                                                 | $= 81.13$ [kips]             |  |        | AISC 14 <sup>th</sup> Eq E3-1  |
| Bolt resistance factor-LRFD      | $\phi = 0.90$                                                             |                              |  |        | AISC 14 <sup>th</sup> E1       |
|                                  | $\phi R_n =$                                                              | $= 73.02$ [kips]             |  |        |                                |
|                                  | ratio = 0.41                                                              | $> P_u$                      |  | OK     |                                |

| Gusset Plate - Compression (Whitmore) |                                                                           | ratio = 60.00 / 100.23       |  | = 0.60 | PASS                           |
|---------------------------------------|---------------------------------------------------------------------------|------------------------------|--|--------|--------------------------------|
| Plate Compression Check               |                                                                           |                              |  |        |                                |
| Plate size                            | width $b_p = 6.464$ [in]                                                  | thickness $t_p = 0.375$ [in] |  |        |                                |
|                                       | $F_y = 50.0$ [ksi]                                                        | $E = 29000$ [ksi]            |  |        |                                |
| Plate gross area in compression       | $A_g = b_p t_p$                                                           | $= 2.424$ [in <sup>2</sup> ] |  |        |                                |
| Plate radius of gyration              | $r = t_p / \sqrt{12}$                                                     | $= 0.108$ [in]               |  |        |                                |
| Plate effective length factor         | $K =$                                                                     | $= 0.65$                     |  |        | AISC DG29 Page 196             |
| Plate unbraced length                 | $L_u =$                                                                   | $= 5.664$ [in]               |  |        |                                |
| Plate slenderness                     | $KL/r = 0.65 \times L_u / r$                                              | $= 34.01$                    |  |        |                                |
|                                       | when $\frac{KL}{r} > 25$ , use Chapter E                                  |                              |  |        | AISC 14 <sup>th</sup> J4.4 (b) |
| Elastic buckling stress               | $F_e = \frac{\pi^2 E}{(KL/r)^2}$                                          | $= 247.46$ [ksi]             |  |        | AISC 14 <sup>th</sup> Eq E3-4  |
|                                       | when $\frac{KL}{r} \leq 4.71 \left( \frac{E}{F_y} \right)^{0.5} = 113.43$ |                              |  |        | AISC 14 <sup>th</sup> E3 (a)   |
| Critical stress                       | $F_{cr} = 0.658 \left( F_y / F_e \right) F_y$                             | $= 45.95$ [ksi]              |  |        | AISC 14 <sup>th</sup> Eq E3-2  |
| Plate compression required            | $P_u =$                                                                   | $= 60.00$ [kips]             |  |        |                                |
| Plate compression provided            | $R_n = F_{cr} \times A_g$                                                 | $= 111.37$ [kips]            |  |        | AISC 14 <sup>th</sup> Eq E3-1  |
| Bolt resistance factor-LRFD           | $\phi = 0.90$                                                             |                              |  |        | AISC 14 <sup>th</sup> E1       |
|                                       | $\phi R_n =$                                                              | $= 100.23$ [kips]            |  |        |                                |
|                                       | ratio = 0.60                                                              | $> P_u$                      |  | OK     |                                |

| Knife Plate to Brace Weld Strength                                                                   |                                                           | ratio = 60.00 / 131.63 = 0.46 |    | PASS                            |
|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------|----|---------------------------------|
| Fillet Weld Strength Check                                                                           |                                                           |                               |    |                                 |
| Fillet weld leg size                                                                                 | $w = 5/16$ [in]                                           | load angle $\theta = 0.0$ [°] |    |                                 |
| Electrode strength                                                                                   | $F_{EXX} = 70.0$ [ksi]                                    | strength coeff $C_1 = 1.00$   |    | AISC 14 <sup>th</sup> Table 8-3 |
| Number of weld line                                                                                  | $n = 2$ for double fillet                                 |                               |    |                                 |
| Load angle coefficient                                                                               | $C_2 = (1 + 0.5 \sin^{1.5} \theta)$                       | $= 1.00$                      |    | AISC 14 <sup>th</sup> Page 8-9  |
| Fillet weld shear strength                                                                           | $R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$ | $= 18.559$ [kip/in]           |    | AISC 14 <sup>th</sup> Eq 8-1    |
| Base metal - brace                                                                                   | thickness $t = 0.375$ [in]                                | tensile $F_u = 65.0$ [ksi]    |    |                                 |
| Base metal - brace is in shear, <u>shear</u> rupture as per AISC 14 <sup>th</sup> Eq J4-4 is checked |                                                           |                               |    | AISC 14 <sup>th</sup> J2.4      |
| Base metal shear rupture                                                                             | $R_{n-b} = 0.6 F_u t$                                     | $= 14.625$ [kip/in]           |    | AISC 14 <sup>th</sup> Eq J4-4   |
| Double fillet linear shear strength                                                                  | $R_n = \min (R_{n-w}, R_{n-b})$                           | $= 14.625$ [kip/in]           |    | AISC 14 <sup>th</sup> Eq 9-2    |
| Resistance factor-LRFD                                                                               | $\phi = 0.75$                                             |                               |    | AISC 14 <sup>th</sup> Eq 8-1    |
|                                                                                                      | $\phi R_n =$                                              | $= 10.969$ [kip/in]           |    |                                 |
| Shear resistance required                                                                            | $V_u =$                                                   | $= 60.00$ [kips]              |    |                                 |
| Fillet weld length - double fillet                                                                   | $L =$                                                     | $= 12.000$ [in]               |    |                                 |
| Shear resistance provided                                                                            | $\phi F_n = \phi R_n \times L$                            | $= 131.63$ [kips]             |    |                                 |
|                                                                                                      | ratio = 0.46                                              | $> V_u$                       | OK |                                 |

**Brace Force Load Case 2**Sect=HSS 5 x 5 x  $\frac{5}{16}$ 

P = -60.00 kips (T)

ratio = **0.79****PASS****HSS Brace - Tensile Yield**ratio = 60.00 / 217.76 = **0.28****PASS**

|                               |                     |                 |                    |                               |
|-------------------------------|---------------------|-----------------|--------------------|-------------------------------|
| Gross area subject to tension | $A_g =$             | = 5.260         | [in <sup>2</sup> ] |                               |
| Steel yield strength          | $F_y =$             | = 46.0          | [ksi]              |                               |
| Tensile force required        | $P_u =$             | = <b>60.00</b>  | [kips]             |                               |
| Tensile yielding strength     | $R_n = F_y A_g$     | = 241.96        | [kips]             | AISC 14 <sup>th</sup> Eq D2-1 |
| Resistance factor-LRFD        | $\phi = 0.90$       |                 |                    | AISC 14 <sup>th</sup> D2 (a)  |
|                               | $\phi R_n =$        | = <b>217.76</b> | [kips]             | AISC 14 <sup>th</sup> Eq D2-1 |
|                               | ratio = <b>0.28</b> | > $P_u$         | <b>OK</b>          |                               |

**HSS Brace - Tensile Rupture**ratio = 60.00 / 148.60 = **0.40****PASS**

|                            |                                       |                 |                    |                                  |
|----------------------------|---------------------------------------|-----------------|--------------------|----------------------------------|
| Section gross area         | $A_g = \text{HSS5X5X} \frac{5}{16}$   | = 5.260         | [in <sup>2</sup> ] |                                  |
| HSS wall thickness         | $t =$                                 | = 0.291         | [in]               |                                  |
| HSS cut slot width         | $w = \text{knife plate thick} + 1/8"$ | = 0.500         | [in]               |                                  |
| Tensile net area           | $A_n = A_g - 2 w t$                   | = 4.969         | [in <sup>2</sup> ] |                                  |
| Length of connection       | $L =$                                 | = 6.000         | [in]               |                                  |
| Eccentricity of connection | $\bar{x} =$                           | = 1.875         | [in]               |                                  |
| Shear lag factor           | $U = 1 - \bar{x} / L$                 | = 0.688         |                    | AISC 14 <sup>th</sup> Table D3.1 |
| Tensile force required     | $P_u =$                               | = <b>60.00</b>  | [kips]             |                                  |
| Tensile effective net area | $A_e = A_n U$                         | = 3.416         | [in <sup>2</sup> ] |                                  |
| Plate tensile strength     | $F_u =$                               | = 58.0          | [ksi]              |                                  |
| Tensile rupture strength   | $R_n = F_u A_e$                       | = 198.14        | [kips]             | AISC 14 <sup>th</sup> Eq D2-2    |
| Resistance factor-LRFD     | $\phi = 0.75$                         |                 |                    | AISC 14 <sup>th</sup> D2 (b)     |
|                            | $\phi R_n =$                          | = <b>148.60</b> | [kips]             | AISC 14 <sup>th</sup> Eq D2-2    |
|                            | ratio = <b>0.40</b>                   | > $P_u$         | <b>OK</b>          |                                  |

**Knife Plate - Tensile Yield**ratio = 30.00 / 97.03 = **0.31****PASS****Plate Tensile Yielding Check**

|                                 |                     |       |                         |                    |                               |
|---------------------------------|---------------------|-------|-------------------------|--------------------|-------------------------------|
| Plate size                      | width $b_p = 5.750$ | [in]  | thickness $t_p = 0.375$ | [in]               |                               |
| Plate yield strength            | $F_y = 50.0$        | [ksi] |                         |                    |                               |
| Plate gross area in shear       | $A_g = b_p t_p$     |       | = 2.156                 | [in <sup>2</sup> ] |                               |
| Tensile force required          | $P_u =$             |       | = <b>30.00</b>          | [kips]             |                               |
| Plate tensile yielding strength | $R_n = F_y A_g$     |       | = 107.81                | [kips]             | AISC 14 <sup>th</sup> Eq J4-1 |
| Resistance factor-LRFD          | $\phi = 0.90$       |       |                         |                    | AISC 14 <sup>th</sup> Eq J4-1 |
|                                 | $\phi R_n =$        |       | = <b>97.03</b>          | [kips]             |                               |
|                                 | ratio = <b>0.31</b> |       | > $P_u$                 | <b>OK</b>          |                               |

| Knife Plate - Tensile Rupture  |                                                                        | ratio = 30.00 / 73.13 |                                    | = 0.41             | PASS                          |
|--------------------------------|------------------------------------------------------------------------|-----------------------|------------------------------------|--------------------|-------------------------------|
| Plate Tensile Rupture Check    |                                                                        |                       |                                    |                    |                               |
| Bolt hole diameter             | bolt dia d <sub>b</sub> = 3/4                                          | [in]                  | bolt hole dia d <sub>h</sub> = 7/8 | [in]               | AISC 14 <sup>th</sup> B4.3b   |
| Number of bolt                 | n = 2                                                                  |                       |                                    |                    |                               |
| Plate size                     | width b <sub>p</sub> = 5.750                                           | [in]                  | thickness t <sub>p</sub> = 0.375   | [in]               |                               |
| Plate tensile strength         | F <sub>u</sub> = 65.0                                                  | [ksi]                 |                                    |                    |                               |
| Plate net area in tension      | A <sub>nt</sub> = ( b <sub>p</sub> - n d <sub>h</sub> ) t <sub>p</sub> |                       | = 1.500                            | [in <sup>2</sup> ] |                               |
| Tensile force required         | P <sub>u</sub> =                                                       |                       | = 30.00                            | [kips]             |                               |
| Plate tensile rupture strength | R <sub>n</sub> = F <sub>u</sub> A <sub>nt</sub>                        |                       | = 97.50                            | [kips]             | AISC 14 <sup>th</sup> Eq J4-2 |
| Resistance factor-LRFD         | φ = 0.75                                                               |                       | AISC 14 <sup>th</sup> Eq J4-2      |                    |                               |
|                                | φ R <sub>n</sub> =                                                     |                       | = 73.13                            | [kips]             | AISC 14 <sup>th</sup> Eq J4-2 |
|                                | ratio = 0.41                                                           |                       | > P <sub>u</sub>                   | OK                 |                               |

| Knife Plate - Bolt Shear     |                                                                                  | ratio = 60.00 / 143.14 |                                  | = 0.42             | PASS                             |
|------------------------------|----------------------------------------------------------------------------------|------------------------|----------------------------------|--------------------|----------------------------------|
| Bolt shear stress            | bolt grade = A325-N                                                              |                        | F <sub>nv</sub> = 54.0           | [ksi]              | AISC 14 <sup>th</sup> Table J3.2 |
|                              | bolt dia d <sub>b</sub> = 0.750                                                  | [in]                   | bolt area A <sub>b</sub> = 0.442 | [in <sup>2</sup> ] |                                  |
| Number of bolt carried shear | n <sub>s</sub> = 4.0                                                             |                        | shear plane m = 2                |                    |                                  |
| Required shear strength      | V <sub>u</sub> =                                                                 |                        | = 60.00                          | [kips]             |                                  |
| Bolt shear strength          | R <sub>n</sub> = F <sub>nv</sub> A <sub>b</sub> n <sub>s</sub> m C <sub>ec</sub> |                        | = 190.85                         | [kips]             | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt resistance factor-LRFD  | φ = 0.75                                                                         |                        | AISC 14 <sup>th</sup> Eq J3-1    |                    |                                  |
|                              | φ R <sub>n</sub> =                                                               |                        | = 143.14                         | [kips]             |                                  |
|                              | ratio = 0.42                                                                     |                        | > V <sub>u</sub>                 | OK                 |                                  |

| Knife Plate - Slip Critical - Knife Plate / Lap PL |                                                                                                                              | ratio = 60.00 / 75.94          |                                     | = 0.79 | PASS                             |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------------|--------|----------------------------------|
| Bolt dia & bolt pretension                         | dia d <sub>b</sub> = 3/4                                                                                                     | [in]                           | Pretension T <sub>b</sub> = 28.00   | [kips] | AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                      | = Class A                                                                                                                    |                                | Slip coeff. μ = 0.30                |        | AISC 14 <sup>th</sup> J3.8       |
| Min. bolt pretension                               | D <sub>u</sub> = 1.13                                                                                                        |                                | Filler factor h <sub>f</sub> = 1.00 |        | AISC 14 <sup>th</sup> J3.8       |
| No of bolt row & column                            | n <sub>r</sub> = 2                                                                                                           |                                | n <sub>c</sub> = 2                  |        |                                  |
| No of slip plane                                   | n <sub>s</sub> = 2                                                                                                           |                                |                                     |        |                                  |
| Bolt group eccentricity coefficient                | C <sub>ec</sub> =                                                                                                            |                                | = 1.000                             |        |                                  |
| Required shear strength                            | V <sub>u</sub> =                                                                                                             |                                | = 60.00                             | [kips] |                                  |
| Slip resistance                                    | R <sub>n</sub> = μ D <sub>u</sub> h <sub>f</sub> T <sub>b</sub> n <sub>s</sub> n <sub>r</sub> n <sub>c</sub> C <sub>ec</sub> |                                | = 75.94                             | [kips] | AISC 14 <sup>th</sup> Eq J3-4    |
| Resistance factor-LRFD                             | φ = 1.00                                                                                                                     | for standard size or SSLT hole | AISC 14 <sup>th</sup> J3.8          |        |                                  |
|                                                    | φ R <sub>n</sub> =                                                                                                           |                                | = 75.94                             | [kips] |                                  |
|                                                    | ratio = 0.79                                                                                                                 |                                | > V <sub>u</sub>                    | OK     |                                  |

| Knife Plate - Bolt Bearing on Knife Plate |                                                    | ratio = 60.00 / 138.41 = 0.43 |                             |                                  | PASS                             |
|-------------------------------------------|----------------------------------------------------|-------------------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                |                                                    |                               |                             |                                  |                                  |
| Bolt shear stress                         | bolt grade = A325-N                                | $F_{nv} = 54.0$               | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                           | bolt dia $d_b = 0.750$                             | [in]                          | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                | $R_{n-bolt} = 2 \times F_{nv} A_b$                 | $= 47.71$                     | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate  |                                                    |                               |                             |                                  |                                  |
| Bolt hole diameter                        | bolt dia $d_b = 3/4$                               | [in]                          | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance              | spacing $L_s = 3.000$                              | [in]                          | edge distance $L_e = 1.625$ | [in]                             |                                  |
| Plate tensile strength                    | $F_u = 65.0$                                       | [ksi]                         |                             |                                  |                                  |
| Plate thickness                           | $t = 0.375$                                        | [in]                          |                             |                                  |                                  |
| Interior Bolt                             |                                                    |                               |                             |                                  |                                  |
| Bolt hole edge clear distance             | $L_c = L_s - d_h$                                  | $= 2.188$                     | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength            | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ | $= 54.84$                     | [kips]                      | AISC 14 <sup>th</sup> Eq J3-6b   |                                  |
|                                           | $= 79.98 \leq 54.84$                               |                               |                             |                                  |                                  |
| Bolt strength at interior                 | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | $= 47.71$                     | [kips]                      |                                  |                                  |
| Edge Bolt                                 |                                                    |                               |                             |                                  |                                  |
| Bolt hole edge clear distance             | $L_c = L_e - d_h / 2$                              | $= 1.219$                     | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength            | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ | $= 44.56$                     | [kips]                      | AISC 14 <sup>th</sup> Eq J3-6b   |                                  |
|                                           | $= 44.56 \leq 54.84$                               |                               |                             |                                  |                                  |
| Bolt strength at edge                     | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | $= 44.56$                     | [kips]                      |                                  |                                  |
| Number of bolt                            | interior $n_{in} = 2$                              | edge $n_{ed} = 2$             |                             |                                  |                                  |
| Bolt bearing strength for all bolts       | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | $= 184.55$                    | [kips]                      |                                  |                                  |
| Required shear strength                   | $V_u =$                                            | $= 60.00$                     | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD               | $\phi = 0.75$                                      |                               |                             | AISC 14 <sup>th</sup> J3-10      |                                  |
|                                           | $\phi R_n =$                                       | $= 138.41$                    | [kips]                      |                                  |                                  |
|                                           | ratio = 0.43                                       | $> V_u$                       | OK                          |                                  |                                  |

| Knife Plate - Bolt Bearing on Lap Plate  |                                                    | ratio = 30.00 / 71.57 |                             | = 0.42                           | PASS                             |
|------------------------------------------|----------------------------------------------------|-----------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength               |                                                    |                       |                             |                                  |                                  |
| Bolt shear stress                        | bolt grade = A325-N                                | $F_{nv} = 54.0$       | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                          | bolt dia $d_b = 0.750$                             | [in]                  | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength               | $R_{n-bolt} = F_{nv} A_b$                          | = 23.86               | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate |                                                    |                       |                             |                                  |                                  |
| Bolt hole diameter                       | bolt dia $d_b = 3/4$                               | [in]                  | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance             | spacing $L_s = 3.000$                              | [in]                  | edge distance $L_e = 1.375$ | [in]                             |                                  |
| Plate tensile strength                   | $F_u = 65.0$                                       | [ksi]                 |                             |                                  |                                  |
| Plate thickness                          | $t = 0.375$                                        | [in]                  |                             |                                  |                                  |
| Interior Bolt                            |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance            | $L_c = L_s - d_h$                                  | = 2.188               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength           | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                          | = 79.98 ≤ 54.84                                    | = 54.84               | [kips]                      |                                  |                                  |
| Bolt strength at interior                | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 23.86               | [kips]                      |                                  |                                  |
| Edge Bolt                                |                                                    |                       |                             |                                  |                                  |
| Bolt hole edge clear distance            | $L_c = L_e - d_h / 2$                              | = 0.969               | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength           | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                       |                             |                                  | AISC 14 <sup>th</sup> Eq J3-6b   |
|                                          | = 35.42 ≤ 54.84                                    | = 35.42               | [kips]                      |                                  |                                  |
| Bolt strength at edge                    | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 23.86               | [kips]                      |                                  |                                  |
| Number of bolt                           | interior $n_{in} = 2$                              | edge $n_{ed} = 2$     |                             |                                  |                                  |
| Bolt bearing strength for all bolts      | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 95.43               | [kips]                      |                                  |                                  |
| Required shear strength                  | $V_u =$                                            | = 30.00               | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD              | $\phi = 0.75$                                      |                       |                             |                                  | AISC 14 <sup>th</sup> J3-10      |
|                                          | $\phi R_n =$                                       | = 71.57               | [kips]                      |                                  |                                  |
|                                          | ratio = 0.42                                       | > $V_u$               | OK                          |                                  |                                  |

| Knife Plate - Block Shear - Center Strip |                                                                 |       | ratio = 60.00 / 111.52            | = 0.54             | PASS                             |
|------------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| Plate Block Shear - Center Strip         |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                       | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                          | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                           | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir                 | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir            | $s_v = 3.000$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir          | $e_v = 1.375$                                                   | [in]  | $e_h = 1.625$                     | [in]               |                                  |
| Gross area subject to shear              | $A_{gv} = [ (n_h - 1) s_h + e_h ] t_p \times 2$                 |       | = 3.469                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear                | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$          |       | = 2.484                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension              |                                                                 |       |                                   |                    |                                  |
| when sheared out by center strip         | $A_{nt} = (n_v - 1) (s_v - d_h) t_p$                            |       | = 0.797                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required            | $V_u =$                                                         |       | = 60.00                           | [kips]             |                                  |
| Uniform tension stress factor            | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided           | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 148.69                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                   | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                          | $\phi R_n =$                                                    |       | = 111.52                          | [kips]             |                                  |
|                                          | ratio = 0.54                                                    |       | > $V_u$                           | OK                 |                                  |

| Knife Plate - Block Shear - 1-Side Strip |                                                                 |       | ratio = 60.00 / 92.32             | = 0.65             | PASS                             |
|------------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| Plate Block Shear - Side Strip           |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                       | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                          | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                           | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir                 | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir            | $s_v = 3.000$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir          | $e_v = 1.375$                                                   | [in]  | $e_h = 1.625$                     | [in]               |                                  |
| Gross area subject to shear              | $A_{gv} = [ (n_h - 1) s_h + e_h ] t_p$                          |       | = 1.734                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear                | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$                   |       | = 1.242                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension              |                                                                 |       |                                   |                    |                                  |
| when sheared out by side strip           | $A_{nt} = [(n_v - 1)s_v + e_v - ((n_v - 1) + 0.5)d_h] t_p$      |       | = 1.148                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required            | $V_u =$                                                         |       | = 60.00                           | [kips]             |                                  |
| Uniform tension stress factor            | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided           | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 123.09                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                   | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                          | $\phi R_n =$                                                    |       | = 92.32                           | [kips]             |                                  |
|                                          | ratio = 0.65                                                    |       | > $V_u$                           | OK                 |                                  |

| Knife Plate - Block Shear - 2-Side Strip |                                                                   |       | ratio = 60.00 / 106.95            |                    | = 0.56                           | PASS |
|------------------------------------------|-------------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|------|
| Plate Block Shear - 2 Side Strips        |                                                                   |       |                                   |                    |                                  |      |
| Bolt hole diameter                       | bolt dia $d_b = \frac{3}{4}$                                      | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |      |
| Plate thickness                          | $t_p = 0.375$                                                     | [in]  |                                   |                    |                                  |      |
| Plate strength                           | $F_y = 50.0$                                                      | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |      |
| Bolt no in ver & hor dir                 | $n_v = 2$                                                         |       | $n_h = 2$                         |                    |                                  |      |
| Bolt spacing in ver & hor dir            | $s_v = 3.000$                                                     | [in]  | $s_h = 3.000$                     | [in]               |                                  |      |
| Bolt edge dist in ver & hor dir          | $e_v = 1.375$                                                     | [in]  | $e_h = 1.625$                     | [in]               |                                  |      |
| Gross area subject to shear              | $A_{gv} = [ (n_h - 1) s_h + e_h ] t_p \times 2$                   |       | = 3.469                           | [in <sup>2</sup> ] |                                  |      |
| Net area subject to shear                | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$            |       | = 2.484                           | [in <sup>2</sup> ] |                                  |      |
| Net area subject to tension              |                                                                   |       |                                   |                    |                                  |      |
| when sheared out by 2 side strips        | $A_{nt} = ( e_v - 0.5 d_h ) t_p \times 2$                         |       | = 0.703                           | [in <sup>2</sup> ] |                                  |      |
| Block shear strength required            | $V_u =$                                                           |       | = 60.00                           | [kips]             |                                  |      |
| Uniform tension stress factor            | $U_{bs} = 1.00$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |      |
| Bolt shear resistance provided           | $R_n = \min (0.6F_u A_{nv} , 0.6F_y A_{gv} ) + U_{bs} F_u A_{nt}$ |       | = 142.59                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |      |
| Resistance factor-LRFD                   | $\phi = 0.75$                                                     |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |      |
|                                          | $\phi R_n =$                                                      |       | = 106.95                          | [kips]             |                                  |      |
|                                          | ratio = 0.56                                                      |       | > $V_u$                           | OK                 |                                  |      |

| Lap Plate - Tensile Yield       |                     | ratio = 30.00 / 97.03 |                         | = 0.31             |                               | PASS |                               |
|---------------------------------|---------------------|-----------------------|-------------------------|--------------------|-------------------------------|------|-------------------------------|
| Plate Tensile Yielding Check    |                     |                       |                         |                    |                               |      |                               |
| Plate size                      | width $b_p = 5.750$ | [in]                  | thickness $t_p = 0.375$ | [in]               |                               |      |                               |
| Plate yield strength            | $F_y = 50.0$        | [ksi]                 |                         |                    |                               |      |                               |
| Plate gross area in shear       | $A_g = b_p t_p$     |                       | = 2.156                 | [in <sup>2</sup> ] |                               |      |                               |
| Tensile force required          | $P_u =$             |                       | = 30.00                 | [kips]             |                               |      |                               |
| Plate tensile yielding strength | $R_n = F_y A_g$     |                       | = 107.81                | [kips]             | AISC 14 <sup>th</sup> Eq J4-1 |      |                               |
| Resistance factor-LRFD          | $\phi = 0.90$       |                       |                         |                    |                               |      | AISC 14 <sup>th</sup> Eq J4-1 |
|                                 | $\phi R_n =$        |                       | = 97.03                 | [kips]             |                               |      |                               |
|                                 | ratio = 0.31        |                       | > $P_u$                 | OK                 |                               |      |                               |

| Lap Plate - Tensile Rupture    |                              | ratio = 30.00 / 73.13 |                                   | = 0.41             | PASS                          |
|--------------------------------|------------------------------|-----------------------|-----------------------------------|--------------------|-------------------------------|
| Plate Tensile Rupture Check    |                              |                       |                                   |                    |                               |
| Bolt hole diameter             | bolt dia $d_b = \frac{3}{4}$ | [in]                  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b   |
| Number of bolt                 | $n = 2$                      |                       |                                   |                    |                               |
| Plate size                     | width $b_p = 5.750$          | [in]                  | thickness $t_p = 0.375$           | [in]               |                               |
| Plate tensile strength         | $F_u = 65.0$                 | [ksi]                 |                                   |                    |                               |
| Plate net area in tension      | $A_{nt} = (b_p - n d_h) t_p$ |                       | = 1.500                           | [in <sup>2</sup> ] |                               |
| Tensile force required         | $P_u =$                      |                       | = 30.00                           | [kips]             |                               |
| Plate tensile rupture strength | $R_n = F_u A_{nt}$           |                       | = 97.50                           | [kips]             | AISC 14 <sup>th</sup> Eq J4-2 |
| Resistance factor-LRFD         | $\phi = 0.75$                |                       | AISC 14 <sup>th</sup> Eq J4-2     |                    |                               |
|                                | $\phi R_n =$                 |                       | = 73.13                           | [kips]             | AISC 14 <sup>th</sup> Eq J4-2 |
|                                | ratio = 0.41                 |                       | > $P_u$                           | OK                 |                               |

| Lap Plate - Brace Side - Bolt Shear |                                 | ratio = 60.00 / 143.14 = 0.42              |                                  | PASS |
|-------------------------------------|---------------------------------|--------------------------------------------|----------------------------------|------|
| Bolt shear stress                   | bolt grade = A325-N             | $F_{nv} = 54.0$ [ksi]                      | AISC 14 <sup>th</sup> Table J3.2 |      |
|                                     | bolt dia $d_b = 0.750$ [in]     | bolt area $A_b = 0.442$ [in <sup>2</sup> ] |                                  |      |
| Number of bolt carried shear        | $n_s = 4.0$                     | shear plane $m = 2$                        |                                  |      |
| Required shear strength             | $V_u =$                         | = 60.00 [kips]                             |                                  |      |
| Bolt shear strength                 | $R_n = F_{nv} A_b n_s m C_{ec}$ | = 190.85 [kips]                            | AISC 14 <sup>th</sup> Eq J3-1    |      |
| Bolt resistance factor-LRFD         | $\phi = 0.75$                   |                                            | AISC 14 <sup>th</sup> Eq J3-1    |      |
|                                     | $\phi R_n =$                    | = 143.14 [kips]                            |                                  |      |
|                                     | ratio = 0.42                    | > $V_u$                                    | OK                               |      |

| Lap Plate - Brace Side - Slip Critical - Lap Plate / Knife Plate |                                              | ratio = 60.00 / 75.94 = 0.79    |                                  | PASS |
|------------------------------------------------------------------|----------------------------------------------|---------------------------------|----------------------------------|------|
| Bolt dia & bolt pretension                                       | dia $d_b = \frac{3}{4}$ [in]                 | Pretension $T_b = 28.00$ [kips] | AISC 14 <sup>th</sup> Table J3.1 |      |
| Surface class                                                    | = Class A                                    | Slip coeff. $\mu = 0.30$        | AISC 14 <sup>th</sup> J3.8       |      |
| Min. bolt pretension                                             | $D_u = 1.13$                                 | Filler factor $h_f = 1.00$      | AISC 14 <sup>th</sup> J3.8       |      |
| No of bolt row & column                                          | $n_r = 2$                                    | $n_c = 2$                       |                                  |      |
| No of slip plane                                                 | $n_s = 2$                                    |                                 |                                  |      |
| Bolt group eccentricity coefficient                              | $C_{ec} =$                                   | = 1.000                         |                                  |      |
| Required shear strength                                          | $V_u =$                                      | = 60.00 [kips]                  |                                  |      |
| Slip resistance                                                  | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$   | = 75.94 [kips]                  | AISC 14 <sup>th</sup> Eq J3-4    |      |
| Resistance factor-LRFD                                           | $\phi = 1.00$ for standard size or SSLT hole |                                 | AISC 14 <sup>th</sup> J3.8       |      |
|                                                                  | $\phi R_n =$                                 | = 75.94 [kips]                  |                                  |      |
|                                                                  | ratio = 0.79                                 | > $V_u$                         | OK                               |      |

| Lap Plate - Brace Side - Bolt Bearing on Lap Plate |                                                    | ratio = 30.00 / 71.57       |                    | = 0.42                           | PASS |
|----------------------------------------------------|----------------------------------------------------|-----------------------------|--------------------|----------------------------------|------|
| Single Bolt Shear Strength                         |                                                    |                             |                    |                                  |      |
| Bolt shear stress                                  | bolt grade = A325-N                                | $F_{nv} = 54.0$             | [ksi]              | AISC 14 <sup>th</sup> Table J3.2 |      |
|                                                    | bolt dia $d_b = 0.750$ [in]                        | bolt area $A_b = 0.442$     | [in <sup>2</sup> ] |                                  |      |
| Single bolt shear strength                         | $R_{n-bolt} = F_{nv} A_b$                          | = 23.86                     | [kips]             | AISC 14 <sup>th</sup> Eq J3-1    |      |
| Bolt Bearing / TearOut Strength on Plate           |                                                    |                             |                    |                                  |      |
| Bolt hole diameter                                 | bolt dia $d_b = 3/4$ [in]                          | bolt hole dia $d_h = 13/16$ | [in]               | AISC 14 <sup>th</sup> Table J3.3 |      |
| Bolt spacing & edge distance                       | spacing $L_s = 3.000$ [in]                         | edge distance $L_e = 1.375$ | [in]               |                                  |      |
| Plate tensile strength                             | $F_u = 65.0$                                       | [ksi]                       |                    |                                  |      |
| Plate thickness                                    | $t = 0.375$                                        | [in]                        |                    |                                  |      |
| Interior Bolt                                      |                                                    |                             |                    |                                  |      |
| Bolt hole edge clear distance                      | $L_c = L_s - d_h$                                  | = 2.188                     | [in]               |                                  |      |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                             |                    | AISC 14 <sup>th</sup> Eq J3-6b   |      |
|                                                    | = 79.98 ≤ 54.84                                    | = 54.84                     | [kips]             |                                  |      |
| Bolt strength at interior                          | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 23.86                     | [kips]             |                                  |      |
| Edge Bolt                                          |                                                    |                             |                    |                                  |      |
| Bolt hole edge clear distance                      | $L_c = L_e - d_h / 2$                              | = 0.969                     | [in]               |                                  |      |
| Bolt tear out/bearing strength                     | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                             |                    | AISC 14 <sup>th</sup> Eq J3-6b   |      |
|                                                    | = 35.42 ≤ 54.84                                    | = 35.42                     | [kips]             |                                  |      |
| Bolt strength at edge                              | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 23.86                     | [kips]             |                                  |      |
| Number of bolt                                     | interior $n_{in} = 2$                              | edge $n_{ed} = 2$           |                    |                                  |      |
| Bolt bearing strength for all bolts                | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 95.43                     | [kips]             |                                  |      |
| Required shear strength                            | $V_u =$                                            | = 30.00                     | [kips]             |                                  |      |
| Bolt resistance factor-LRFD                        | $\phi = 0.75$                                      |                             |                    | AISC 14 <sup>th</sup> J3-10      |      |
|                                                    | $\phi R_n =$                                       | = 71.57                     | [kips]             |                                  |      |
|                                                    | ratio = 0.42                                       | > $V_u$                     | OK                 |                                  |      |

| Lap Plate - Brace Side - Bolt Bearing on Knife Plate |                                                    | ratio = 60.00 / 138.41 = 0.43 |                             |                                  | PASS                             |
|------------------------------------------------------|----------------------------------------------------|-------------------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                           |                                                    |                               |                             |                                  |                                  |
| Bolt shear stress                                    | bolt grade = A325-N                                | $F_{nv} = 54.0$               | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                      | bolt dia $d_b = 0.750$                             | [in]                          | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                           | $R_{n-bolt} = 2 \times F_{nv} A_b$                 | = 47.71                       | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate             |                                                    |                               |                             |                                  |                                  |
| Bolt hole diameter                                   | bolt dia $d_b = 3/4$                               | [in]                          | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance                         | spacing $L_s = 3.000$                              | [in]                          | edge distance $L_e = 1.625$ | [in]                             |                                  |
| Plate tensile strength                               | $F_u = 65.0$                                       | [ksi]                         |                             |                                  |                                  |
| Plate thickness                                      | $t = 0.375$                                        | [in]                          |                             |                                  |                                  |
| Interior Bolt                                        |                                                    |                               |                             |                                  |                                  |
| Bolt hole edge clear distance                        | $L_c = L_s - d_h$                                  | = 2.188                       | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                       | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                               |                             | AISC 14 <sup>th</sup> Eq J3-6b   |                                  |
|                                                      | = 79.98 ≤ 54.84                                    | = 54.84                       | [kips]                      |                                  |                                  |
| Bolt strength at interior                            | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 47.71                       | [kips]                      |                                  |                                  |
| Edge Bolt                                            |                                                    |                               |                             |                                  |                                  |
| Bolt hole edge clear distance                        | $L_c = L_e - d_h / 2$                              | = 1.219                       | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                       | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                               |                             | AISC 14 <sup>th</sup> Eq J3-6b   |                                  |
|                                                      | = 44.56 ≤ 54.84                                    | = 44.56                       | [kips]                      |                                  |                                  |
| Bolt strength at edge                                | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 44.56                       | [kips]                      |                                  |                                  |
| Number of bolt                                       | interior $n_{in} = 2$                              | edge $n_{ed} = 2$             |                             |                                  |                                  |
| Bolt bearing strength for all bolts                  | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 184.55                      | [kips]                      |                                  |                                  |
| Required shear strength                              | $V_u =$                                            | = 60.00                       | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD                          | $\phi = 0.75$                                      | AISC 14 <sup>th</sup> J3-10   |                             |                                  |                                  |
|                                                      | $\phi R_n =$                                       | = 138.41                      | [kips]                      |                                  |                                  |
|                                                      | ratio = 0.43                                       | > $V_u$                       | OK                          |                                  |                                  |

| Lap Plate - Block Shear - Center Strip |                                                                 |       | ratio = 30.00 / 106.03            | = 0.28             | PASS                             |
|----------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| Plate Block Shear - Center Strip       |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                     | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                        | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                         | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir               | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir          | $s_v = 3.000$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir        | $e_v = 1.375$                                                   | [in]  | $e_h = 1.375$                     | [in]               |                                  |
| Gross area subject to shear            | $A_{gv} = [ (n_h - 1) s_h + e_h ] t_p \times 2$                 |       | = 3.281                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear              | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$          |       | = 2.297                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension            |                                                                 |       |                                   |                    |                                  |
| when sheared out by center strip       | $A_{nt} = (n_v - 1) (s_v - d_h) t_p$                            |       | = 0.797                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required          | $V_u =$                                                         |       | = 30.00                           | [kips]             |                                  |
| Uniform tension stress factor          | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided         | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 141.38                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                 | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                        | $\phi R_n =$                                                    |       | = 106.03                          | [kips]             |                                  |
|                                        | ratio = 0.28                                                    |       | > $V_u$                           | OK                 |                                  |

| Lap Plate - Block Shear - 1-Side Strip |                                                                 |       | ratio = 30.00 / 89.58             | = 0.33             | PASS                             |
|----------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| Plate Block Shear - Side Strip         |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                     | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                        | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                         | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir               | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir          | $s_v = 3.000$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir        | $e_v = 1.375$                                                   | [in]  | $e_h = 1.375$                     | [in]               |                                  |
| Gross area subject to shear            | $A_{gv} = [ (n_h - 1) s_h + e_h ] t_p$                          |       | = 1.641                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear              | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p$                   |       | = 1.148                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension            |                                                                 |       |                                   |                    |                                  |
| when sheared out by side strip         | $A_{nt} = [(n_v - 1)s_v + e_v - ((n_v - 1) + 0.5)d_h] t_p$      |       | = 1.148                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required          | $V_u =$                                                         |       | = 30.00                           | [kips]             |                                  |
| Uniform tension stress factor          | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided         | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 119.44                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                 | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                        | $\phi R_n =$                                                    |       | = 89.58                           | [kips]             |                                  |
|                                        | ratio = 0.33                                                    |       | > $V_u$                           | OK                 |                                  |

| Lap Plate - Block Shear - 2-Side Strip |                                                                 |       | ratio = 30.00 / 101.46            | = 0.30             | PASS                             |
|----------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| Plate Block Shear - 2 Side Strips      |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                     | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                        | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                         | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir               | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir          | $s_v = 3.000$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir        | $e_v = 1.375$                                                   | [in]  | $e_h = 1.375$                     | [in]               |                                  |
| Gross area subject to shear            | $A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$                   |       | = 3.281                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear              | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$          |       | = 2.297                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension            |                                                                 |       |                                   |                    |                                  |
| when sheared out by 2 side strips      | $A_{nt} = (e_v - 0.5 d_h) t_p \times 2$                         |       | = 0.703                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required          | $V_u =$                                                         |       | = 30.00                           | [kips]             |                                  |
| Uniform tension stress factor          | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided         | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 135.28                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                 | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                        | $\phi R_n =$                                                    |       | = 101.46                          | [kips]             |                                  |
|                                        | ratio = 0.30                                                    |       | > $V_u$                           | OK                 |                                  |

| Knife Plate - Block Shear - Center Strip |                                                                 |       | ratio = 60.00 / 111.52            | = 0.54             | PASS                             |
|------------------------------------------|-----------------------------------------------------------------|-------|-----------------------------------|--------------------|----------------------------------|
| Plate Block Shear - Center Strip         |                                                                 |       |                                   |                    |                                  |
| Bolt hole diameter                       | bolt dia $d_b = \frac{3}{4}$                                    | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]               | AISC 14 <sup>th</sup> B4.3b      |
| Plate thickness                          | $t_p = 0.375$                                                   | [in]  |                                   |                    |                                  |
| Plate strength                           | $F_y = 50.0$                                                    | [ksi] | $F_u = 65.0$                      | [ksi]              |                                  |
| Bolt no in ver & hor dir                 | $n_v = 2$                                                       |       | $n_h = 2$                         |                    |                                  |
| Bolt spacing in ver & hor dir            | $s_v = 3.000$                                                   | [in]  | $s_h = 3.000$                     | [in]               |                                  |
| Bolt edge dist in ver & hor dir          | $e_v = 1.375$                                                   | [in]  | $e_h = 1.625$                     | [in]               |                                  |
| Gross area subject to shear              | $A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$                   |       | = 3.469                           | [in <sup>2</sup> ] |                                  |
| Net area subject to shear                | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$          |       | = 2.484                           | [in <sup>2</sup> ] |                                  |
| Net area subject to tension              |                                                                 |       |                                   |                    |                                  |
| when sheared out by center strip         | $A_{nt} = (n_v - 1) (s_v - d_h) t_p$                            |       | = 0.797                           | [in <sup>2</sup> ] |                                  |
| Block shear strength required            | $V_u =$                                                         |       | = 60.00                           | [kips]             |                                  |
| Uniform tension stress factor            | $U_{bs} = 1.00$                                                 |       |                                   |                    | AISC 14 <sup>th</sup> Fig C-J4.2 |
| Bolt shear resistance provided           | $R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$ |       | = 148.69                          | [kips]             | AISC 14 <sup>th</sup> Eq J4-5    |
| Resistance factor-LRFD                   | $\phi = 0.75$                                                   |       |                                   |                    | AISC 14 <sup>th</sup> Eq J4-5    |
|                                          | $\phi R_n =$                                                    |       | = 111.52                          | [kips]             |                                  |
|                                          | ratio = 0.54                                                    |       | > $V_u$                           | OK                 |                                  |

| Lap Plate - Gusset PL Side - Bolt Shear |                                 | ratio = 60.00 / 143.14 | = 0.42                  | PASS                             |
|-----------------------------------------|---------------------------------|------------------------|-------------------------|----------------------------------|
| Bolt shear stress                       | bolt grade = A325-N             | $F_{nv} = 54.0$        | [ksi]                   | AISC 14 <sup>th</sup> Table J3.2 |
|                                         | bolt dia $d_b = 0.750$          | [in]                   | bolt area $A_b = 0.442$ | [in <sup>2</sup> ]               |
| Number of bolt carried shear            | $n_s = 4.0$                     | shear plane $m = 2$    |                         |                                  |
| Required shear strength                 | $V_u =$                         | = 60.00                | [kips]                  |                                  |
| Bolt shear strength                     | $R_n = F_{nv} A_b n_s m C_{ec}$ | = 190.85               | [kips]                  | AISC 14 <sup>th</sup> Eq J3-1    |
| Bolt resistance factor-LRFD             | $\phi = 0.75$                   |                        |                         | AISC 14 <sup>th</sup> Eq J3-1    |
|                                         | $\phi R_n =$                    | = 143.14               | [kips]                  |                                  |
|                                         | ratio = 0.42                    | > $V_u$                | OK                      |                                  |

| Lap Plate - Gusset PL Side - Slip Critical - Lap Plate / Gusset PL |                                              | ratio = 60.00 / 75.94      | = 0.79                   | PASS                                    |
|--------------------------------------------------------------------|----------------------------------------------|----------------------------|--------------------------|-----------------------------------------|
| Bolt dia & bolt pretension                                         | dia $d_b = \frac{3}{4}$                      | [in]                       | Pretension $T_b = 28.00$ | [kips] AISC 14 <sup>th</sup> Table J3.1 |
| Surface class                                                      | = Class A                                    | Slip coeff. $\mu = 0.30$   |                          | AISC 14 <sup>th</sup> J3.8              |
| Min. bolt pretension                                               | $D_u = 1.13$                                 | Filler factor $h_f = 1.00$ |                          | AISC 14 <sup>th</sup> J3.8              |
| No of bolt row & column                                            | $n_r = 2$                                    | $n_c = 2$                  |                          |                                         |
| No of slip plane                                                   | $n_s = 2$                                    |                            |                          |                                         |
| Bolt group eccentricity coefficient                                | $C_{ec} =$                                   | = 1.000                    |                          |                                         |
| Required shear strength                                            | $V_u =$                                      | = 60.00                    | [kips]                   |                                         |
| Slip resistance                                                    | $R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$   | = 75.94                    | [kips]                   | AISC 14 <sup>th</sup> Eq J3-4           |
| Resistance factor-LRFD                                             | $\phi = 1.00$ for standard size or SSLT hole |                            |                          | AISC 14 <sup>th</sup> J3.8              |
|                                                                    | $\phi R_n =$                                 | = 75.94                    | [kips]                   |                                         |
|                                                                    | ratio = 0.79                                 | > $V_u$                    | OK                       |                                         |

| Lap Plate - Gusset PL Side - Bolt Bearing on Lap Plate |                                                    | ratio = 30.00 / 71.57       |                    | = 0.42                           | PASS |
|--------------------------------------------------------|----------------------------------------------------|-----------------------------|--------------------|----------------------------------|------|
| Single Bolt Shear Strength                             |                                                    |                             |                    |                                  |      |
| Bolt shear stress                                      | bolt grade = A325-N                                | $F_{nv} = 54.0$             | [ksi]              | AISC 14 <sup>th</sup> Table J3.2 |      |
|                                                        | bolt dia $d_b = 0.750$ [in]                        | bolt area $A_b = 0.442$     | [in <sup>2</sup> ] |                                  |      |
| Single bolt shear strength                             | $R_{n-bolt} = F_{nv} A_b$                          | = 23.86                     | [kips]             | AISC 14 <sup>th</sup> Eq J3-1    |      |
| Bolt Bearing / TearOut Strength on Plate               |                                                    |                             |                    |                                  |      |
| Bolt hole diameter                                     | bolt dia $d_b = 3/4$ [in]                          | bolt hole dia $d_h = 13/16$ | [in]               | AISC 14 <sup>th</sup> Table J3.3 |      |
| Bolt spacing & edge distance                           | spacing $L_s = 3.000$ [in]                         | edge distance $L_e = 1.375$ | [in]               |                                  |      |
| Plate tensile strength                                 | $F_u = 65.0$                                       | [ksi]                       |                    |                                  |      |
| Plate thickness                                        | $t = 0.375$                                        | [in]                        |                    |                                  |      |
| Interior Bolt                                          |                                                    |                             |                    |                                  |      |
| Bolt hole edge clear distance                          | $L_c = L_s - d_h$                                  | = 2.188                     | [in]               |                                  |      |
| Bolt tear out/bearing strength                         | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                             |                    | AISC 14 <sup>th</sup> Eq J3-6b   |      |
|                                                        | = 79.98 ≤ 54.84                                    | = 54.84                     | [kips]             |                                  |      |
| Bolt strength at interior                              | $R_{n-in} = \min ( R_{n-t\&b-in} , R_{n-bolt} )$   | = 23.86                     | [kips]             |                                  |      |
| Edge Bolt                                              |                                                    |                             |                    |                                  |      |
| Bolt hole edge clear distance                          | $L_c = L_e - d_h / 2$                              | = 0.969                     | [in]               |                                  |      |
| Bolt tear out/bearing strength                         | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ |                             |                    | AISC 14 <sup>th</sup> Eq J3-6b   |      |
|                                                        | = 35.42 ≤ 54.84                                    | = 35.42                     | [kips]             |                                  |      |
| Bolt strength at edge                                  | $R_{n-ed} = \min ( R_{n-t\&b-ed} , R_{n-bolt} )$   | = 23.86                     | [kips]             |                                  |      |
| Number of bolt                                         | interior $n_{in} = 2$                              | edge $n_{ed} = 2$           |                    |                                  |      |
| Bolt bearing strength for all bolts                    | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 95.43                     | [kips]             |                                  |      |
| Required shear strength                                | $V_u =$                                            | = 30.00                     | [kips]             |                                  |      |
| Bolt resistance factor-LRFD                            | $\phi = 0.75$                                      |                             |                    | AISC 14 <sup>th</sup> J3-10      |      |
|                                                        | $\phi R_n =$                                       | = 71.57                     | [kips]             |                                  |      |
|                                                        | ratio = 0.42                                       | > $V_u$                     | OK                 |                                  |      |

| Lap Plate - Gusset PL Side - Bolt Bearing on Gusset Plate |                                                    | ratio = 60.00 / 138.41 |                             | = 0.43                           | PASS                             |
|-----------------------------------------------------------|----------------------------------------------------|------------------------|-----------------------------|----------------------------------|----------------------------------|
| Single Bolt Shear Strength                                |                                                    |                        |                             |                                  |                                  |
| Bolt shear stress                                         | bolt grade = A325-N                                | $F_{nv} = 54.0$        | [ksi]                       | AISC 14 <sup>th</sup> Table J3.2 |                                  |
|                                                           | bolt dia $d_b = 0.750$                             | [in]                   | bolt area $A_b = 0.442$     | [in <sup>2</sup> ]               |                                  |
| Single bolt shear strength                                | $R_{n-bolt} = 2 \times F_{nv} A_b$                 | = 47.71                | [kips]                      | AISC 14 <sup>th</sup> Eq J3-1    |                                  |
| Bolt Bearing / TearOut Strength on Plate                  |                                                    |                        |                             |                                  |                                  |
| Bolt hole diameter                                        | bolt dia $d_b = 3/4$                               | [in]                   | bolt hole dia $d_h = 13/16$ | [in]                             | AISC 14 <sup>th</sup> Table J3.3 |
| Bolt spacing & edge distance                              | spacing $L_s = 3.000$                              | [in]                   | edge distance $L_e = 1.625$ | [in]                             |                                  |
| Plate tensile strength                                    | $F_u = 65.0$                                       | [ksi]                  |                             |                                  |                                  |
| Plate thickness                                           | $t = 0.375$                                        | [in]                   |                             |                                  |                                  |
| Interior Bolt                                             |                                                    |                        |                             |                                  |                                  |
| Bolt hole edge clear distance                             | $L_c = L_s - d_h$                                  | = 2.188                | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                            | $R_{n-t\&b-in} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ | = 54.84                | [kips]                      | AISC 14 <sup>th</sup> Eq J3-6b   |                                  |
|                                                           | = 79.98 ≤ 54.84                                    |                        |                             |                                  |                                  |
| Bolt strength at interior                                 | $R_{n-in} = \min ( R_{n-t\&b-in}, R_{n-bolt} )$    | = 47.71                | [kips]                      |                                  |                                  |
| Edge Bolt                                                 |                                                    |                        |                             |                                  |                                  |
| Bolt hole edge clear distance                             | $L_c = L_e - d_h / 2$                              | = 1.219                | [in]                        |                                  |                                  |
| Bolt tear out/bearing strength                            | $R_{n-t\&b-ed} = 1.5 L_c t F_u \leq 3.0 d_b t F_u$ | = 44.56                | [kips]                      | AISC 14 <sup>th</sup> Eq J3-6b   |                                  |
|                                                           | = 44.56 ≤ 54.84                                    |                        |                             |                                  |                                  |
| Bolt strength at edge                                     | $R_{n-ed} = \min ( R_{n-t\&b-ed}, R_{n-bolt} )$    | = 44.56                | [kips]                      |                                  |                                  |
| Number of bolt                                            | interior $n_{in} = 2$                              | edge $n_{ed} = 2$      |                             |                                  |                                  |
| Bolt bearing strength for all bolts                       | $R_n = n_{in} R_{n-in} + n_{ed} R_{n-ed}$          | = 184.55               | [kips]                      |                                  |                                  |
| Required shear strength                                   | $V_u =$                                            | = 60.00                | [kips]                      |                                  |                                  |
| Bolt resistance factor-LRFD                               | $\phi = 0.75$                                      |                        |                             | AISC 14 <sup>th</sup> J3-10      |                                  |
|                                                           | $\phi R_n =$                                       | = 138.41               | [kips]                      |                                  |                                  |
|                                                           | ratio = 0.43                                       | > $V_u$                | OK                          |                                  |                                  |

| Gusset Plate at Lap Plate - Block Shear - Center Strip |                                                                   |       |                                   | ratio = 60.00 / 111.52 | = 0.54                           | PASS                          |
|--------------------------------------------------------|-------------------------------------------------------------------|-------|-----------------------------------|------------------------|----------------------------------|-------------------------------|
| Plate Block Shear - Center Strip                       |                                                                   |       |                                   |                        |                                  |                               |
| Bolt hole diameter                                     | bolt dia $d_b = \frac{3}{4}$                                      | [in]  | bolt hole dia $d_h = \frac{7}{8}$ | [in]                   | AISC 14 <sup>th</sup> B4.3b      |                               |
| Plate thickness                                        | $t_p = 0.375$                                                     | [in]  |                                   |                        |                                  |                               |
| Plate strength                                         | $F_y = 50.0$                                                      | [ksi] | $F_u = 65.0$                      | [ksi]                  |                                  |                               |
| Bolt no in ver & hor dir                               | $n_v = 2$                                                         |       | $n_h = 2$                         |                        |                                  |                               |
| Bolt spacing in ver & hor dir                          | $s_v = 3.000$                                                     | [in]  | $s_h = 3.000$                     | [in]                   |                                  |                               |
| Bolt edge dist in ver & hor dir                        | $e_v = 1.375$                                                     | [in]  | $e_h = 1.625$                     | [in]                   |                                  |                               |
| Gross area subject to shear                            | $A_{gv} = [ (n_h - 1) s_h + e_h ] t_p \times 2$                   |       | = 3.469                           |                        | [in <sup>2</sup> ]               |                               |
| Net area subject to shear                              | $A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$            |       | = 2.484                           |                        | [in <sup>2</sup> ]               |                               |
| Net area subject to tension                            |                                                                   |       |                                   |                        |                                  |                               |
| when sheared out by center strip                       | $A_{nt} = ( n_v - 1 ) ( s_v - d_h ) t_p$                          |       | = 0.797                           |                        | [in <sup>2</sup> ]               |                               |
| Block shear strength required                          | $V_u =$                                                           |       | = 60.00                           |                        | [kips]                           |                               |
| Uniform tension stress factor                          | $U_{bs} = 1.00$                                                   |       |                                   |                        | AISC 14 <sup>th</sup> Fig C-J4.2 |                               |
| Bolt shear resistance provided                         | $R_n = \min (0.6F_u A_{nv} , 0.6F_y A_{gv} ) + U_{bs} F_u A_{nt}$ |       | = 148.69                          |                        | [kips]                           | AISC 14 <sup>th</sup> Eq J4-5 |
| Resistance factor-LRFD                                 | $\phi = 0.75$                                                     |       |                                   |                        | AISC 14 <sup>th</sup> Eq J4-5    |                               |
|                                                        | $\phi R_n =$                                                      |       | = 111.52                          |                        | [kips]                           |                               |
|                                                        | ratio = 0.54                                                      |       | > $V_u$                           |                        | OK                               |                               |

| Gusset Plate - Tensile Yield (Whitmore) |                     |       |                         | ratio = 60.00 / 109.08 | = 0.55                        | PASS                          |
|-----------------------------------------|---------------------|-------|-------------------------|------------------------|-------------------------------|-------------------------------|
| Plate Tensile Yielding Check            |                     |       |                         |                        |                               |                               |
| Plate size                              | width $b_p = 6.464$ | [in]  | thickness $t_p = 0.375$ | [in]                   |                               |                               |
| Plate yield strength                    | $F_y = 50.0$        | [ksi] |                         |                        |                               |                               |
| Plate gross area in shear               | $A_g = b_p t_p$     |       | = 2.424                 |                        | [in <sup>2</sup> ]            |                               |
| Tensile force required                  | $P_u =$             |       | = 60.00                 |                        | [kips]                        |                               |
| Plate tensile yielding strength         | $R_n = F_y A_g$     |       | = 121.20                |                        | [kips]                        | AISC 14 <sup>th</sup> Eq J4-1 |
| Resistance factor-LRFD                  | $\phi = 0.90$       |       |                         |                        | AISC 14 <sup>th</sup> Eq J4-1 |                               |
|                                         | $\phi R_n =$        |       | = 109.08                |                        | [kips]                        |                               |
|                                         | ratio = 0.55        |       | > $P_u$                 |                        | OK                            |                               |

| Gusset Plate - Tensile Rupture (Whitmore) |                                |      |                                   | ratio = 60.00 / 86.18 | = 0.70                        | PASS                          |
|-------------------------------------------|--------------------------------|------|-----------------------------------|-----------------------|-------------------------------|-------------------------------|
| Plate Tensile Rupture Check               |                                |      |                                   |                       |                               |                               |
| Bolt hole diameter                        | bolt dia $d_b = \frac{3}{4}$   | [in] | bolt hole dia $d_h = \frac{7}{8}$ | [in]                  | AISC 14 <sup>th</sup> B4.3b   |                               |
| Number of bolt                            | $n = 2$                        |      |                                   |                       |                               |                               |
| Plate size                                | width $b_p = 6.464$            | [in] | thickness $t_p = 0.375$           | [in]                  |                               |                               |
| Plate tensile strength                    | $F_u = 65.0$                   |      | [ksi]                             |                       |                               |                               |
| Plate net area in tension                 | $A_{nt} = ( b_p - n d_h ) t_p$ |      | = 1.768                           |                       | [in <sup>2</sup> ]            |                               |
| Tensile force required                    | $P_u =$                        |      | = 60.00                           |                       | [kips]                        |                               |
| Plate tensile rupture strength            | $R_n = F_u A_{nt}$             |      | = 114.90                          |                       | [kips]                        | AISC 14 <sup>th</sup> Eq J4-2 |
| Resistance factor-LRFD                    | $\phi = 0.75$                  |      |                                   |                       | AISC 14 <sup>th</sup> Eq J4-2 |                               |
|                                           | $\phi R_n =$                   |      | = 86.18                           |                       | [kips]                        | AISC 14 <sup>th</sup> Eq J4-2 |
|                                           | ratio = 0.70                   |      | > $P_u$                           |                       | OK                            |                               |

| Knife Plate to Brace Weld Strength                                                                   |                                                           | ratio = 60.00 / 131.63 |                             | = 0.46   | PASS                            |
|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------|-----------------------------|----------|---------------------------------|
| Fillet Weld Strength Check                                                                           |                                                           |                        |                             |          |                                 |
| Fillet weld leg size                                                                                 | $w = \frac{5}{16}$                                        | [in]                   | load angle $\theta = 0.0$   | [°]      |                                 |
| Electrode strength                                                                                   | $F_{EXX} = 70.0$                                          | [ksi]                  | strength coeff $C_1 = 1.00$ |          | AISC 14 <sup>th</sup> Table 8-3 |
| Number of weld line                                                                                  | $n = 2$                                                   | for double fillet      |                             |          |                                 |
| Load angle coefficient                                                                               | $C_2 = ( 1 + 0.5 \sin^{1.5} \theta )$                     |                        | $= 1.00$                    |          | AISC 14 <sup>th</sup> Page 8-9  |
| Fillet weld shear strength                                                                           | $R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$ |                        | $= 18.559$                  | [kip/in] | AISC 14 <sup>th</sup> Eq 8-1    |
| Base metal - brace                                                                                   | thickness $t = 0.375$                                     | [in]                   | tensile $F_u = 65.0$        | [ksi]    |                                 |
| Base metal - brace is in shear, <u>shear</u> rupture as per AISC 14 <sup>th</sup> Eq J4-4 is checked |                                                           |                        |                             |          | AISC 14 <sup>th</sup> J2.4      |
| Base metal shear rupture                                                                             | $R_{n-b} = 0.6 F_u t$                                     |                        | $= 14.625$                  | [kip/in] | AISC 14 <sup>th</sup> Eq J4-4   |
| Double fillet linear shear strength                                                                  | $R_n = \min ( R_{n-w}, R_{n-b} )$                         |                        | $= 14.625$                  | [kip/in] | AISC 14 <sup>th</sup> Eq 9-2    |
| Resistance factor-LRFD                                                                               | $\phi = 0.75$                                             |                        |                             |          | AISC 14 <sup>th</sup> Eq 8-1    |
|                                                                                                      | $\phi R_n =$                                              |                        | $= 10.969$                  | [kip/in] |                                 |
| Shear resistance required                                                                            | $V_u =$                                                   |                        | $= 60.00$                   | [kips]   |                                 |
| Fillet weld length - double fillet                                                                   | $L =$                                                     |                        | $= 12.000$                  | [in]     |                                 |
| Shear resistance provided                                                                            | $\phi F_n = \phi R_n \times L$                            |                        | $= 131.63$                  | [kips]   |                                 |
|                                                                                                      | ratio = 0.46                                              |                        | $> V_u$                     |          | OK                              |

Gusset to Beam

Direct Weld Connection

Code=AISC 360-10 LRFD

**Result Summary**geometries & weld limitations = **PASS**limit states max ratio = **0.45** **PASS****Weld Limitation Checks - Gusset to Beam****PASS****Min Fillet Weld Size**

|                               |             |                |                                  |
|-------------------------------|-------------|----------------|----------------------------------|
| Thinner part joined thickness | $t =$       | $= 0.375$ [in] |                                  |
| Min fillet weld size allowed  | $w_{min} =$ | $= 0.188$ [in] | AISC 14 <sup>th</sup> Table J2.4 |
| Fillet weld size provided     | $w =$       | $= 0.313$ [in] |                                  |
|                               |             | $> w_{min}$    | <b>OK</b>                        |

**Min Fillet Weld Length**

|                                |                        |                 |                             |
|--------------------------------|------------------------|-----------------|-----------------------------|
| Fillet weld size provided      | $w =$                  | $= 0.313$ [in]  |                             |
| Min fillet weld length allowed | $L_{min} = 4 \times w$ | $= 1.250$ [in]  | AISC 14 <sup>th</sup> J2.2b |
| Min fillet weld length         | $L =$                  | $= 32.108$ [in] |                             |
|                                |                        | $> L_{min}$     | <b>OK</b>                   |

**Brace Force Load Case 1** $P_R = -60.00$  kips (T) $P_L = 60.00$  kips (C)ratio = **0.45** **PASS****Gusset Plate - Shear Yielding (Sect a-a)**ratio =  $84.85 / 361.22 = 0.23$  **PASS****Plate Shear Yielding Check**

|                               |                           |                               |                               |
|-------------------------------|---------------------------|-------------------------------|-------------------------------|
| Plate size                    | width $b_p = 32.108$ [in] | thickness $t_p = 0.375$ [in]  |                               |
| Plate yield strength          | $F_y = 50.0$ [ksi]        |                               |                               |
| Plate gross area in shear     | $A_{gv} = b_p t_p$        | $= 12.041$ [in <sup>2</sup> ] |                               |
| Shear force required          | $V_u =$                   | $= 84.85$ [kips]              |                               |
| Plate shear yielding strength | $R_n = 0.6 F_y A_{gv}$    | $= 361.22$ [kips]             | AISC 14 <sup>th</sup> Eq J4-3 |
| Resistance factor-LRFD        | $\phi = 1.00$             |                               | AISC 14 <sup>th</sup> Eq J4-3 |
|                               | $\phi R_n =$              | $= 361.22$ [kips]             |                               |
|                               | ratio = <b>0.23</b>       | $> V_u$                       | <b>OK</b>                     |

**Gusset Plate - Shear Rupture (Sect a-a)**ratio =  $84.85 / 352.18 = 0.24$  **PASS****Plate Shear Rupture Check**

|                              |                           |                               |                               |
|------------------------------|---------------------------|-------------------------------|-------------------------------|
| Plate size                   | width $b_p = 32.108$ [in] | thickness $t_p = 0.375$ [in]  |                               |
| Plate tensile strength       | $F_u = 65.0$ [ksi]        |                               |                               |
| Plate net area in shear      | $A_{nv} = b_p t_p$        | $= 12.041$ [in <sup>2</sup> ] |                               |
| Shear force in demand        | $V_u =$                   | $= 84.85$ [kips]              |                               |
| Plate shear rupture strength | $R_n = 0.6 F_u A_{nv}$    | $= 469.58$ [kips]             | AISC 14 <sup>th</sup> Eq J4-4 |
| Resistance factor-LRFD       | $\phi = 0.75$             |                               | AISC 14 <sup>th</sup> Eq J4-4 |
|                              | $\phi R_n =$              | $= 352.18$ [kips]             |                               |
|                              | ratio = <b>0.24</b>       | $> V_u$                       | <b>OK</b>                     |

| Gusset Plate - Axial Tensile Yield (Sect a-a) |                           | ratio = 0.00 / 541.82        | = 0.00 | PASS                          |
|-----------------------------------------------|---------------------------|------------------------------|--------|-------------------------------|
| <b>Plate Tensile Yielding Check</b>           |                           |                              |        |                               |
| Plate size                                    | width $b_p = 32.108$ [in] | thickness $t_p = 0.375$ [in] |        |                               |
| Plate yield strength                          | $F_y = 50.0$ [ksi]        |                              |        |                               |
| Plate gross area in shear                     | $A_g = b_p t_p$           | = 12.041 [in <sup>2</sup> ]  |        |                               |
| Tensile force required                        | $P_u =$                   | = 0.00 [kips]                |        |                               |
| Plate tensile yielding strength               | $R_n = F_y A_g$           | = 602.03 [kips]              |        | AISC 14 <sup>th</sup> Eq J4-1 |
| Resistance factor-LRFD                        | $\phi = 0.90$             |                              |        | AISC 14 <sup>th</sup> Eq J4-1 |
|                                               | $\phi R_n =$              | = 541.82 [kips]              |        |                               |
|                                               | ratio = 0.00              | > $P_u$                      | OK     |                               |

| Gusset Plate - Flexural Yield Interact (Sect a-a) |                                                                       | ratio =                     | = 0.07 | PASS                          |
|---------------------------------------------------|-----------------------------------------------------------------------|-----------------------------|--------|-------------------------------|
| Gusset plate                                      | width $b_p = 32.108$ [in]                                             | thick $t_p = 0.375$ [in]    |        |                               |
|                                                   | yield $F_y = 50.0$ [ksi]                                              |                             |        |                               |
| Shear plate - gross area                          | $A_g = b_p \times t_p$                                                | = 12.041 [in <sup>2</sup> ] |        |                               |
| Shear plate - plastic modulus                     | $Z_p = (b_p \times t_p^2) / 4$                                        | = 96.649 [in <sup>3</sup> ] |        |                               |
| Flexural strength available                       | $M_c = \phi F_y Z_p \quad \phi=0.90$                                  | = 362.43 [kip-ft]           |        |                               |
| Flexural strength required                        | $M_r =$ from gusset interface forces calc                             | = 42.07 [kip-ft]            |        |                               |
| Axial strength available                          | $P_c =$ from axial tensile yield check                                | = 541.82 [kips]             |        |                               |
| Axial strength required                           | $P_r =$ from gusset interface forces calc                             | = 0.00 [kips]               |        |                               |
| Shear strength available                          | $V_c =$ from shear yielding check                                     | = 361.22 [kips]             |        |                               |
| Shear strength required                           | $V_r =$ from gusset interface forces calc                             | = 84.85 [kips]              |        |                               |
| Flexural yield interaction                        | ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$ | = 0.07                      |        | AISC 14 <sup>th</sup> Eq 10-5 |
|                                                   |                                                                       | < 1.0                       | OK     |                               |

| Gusset Plate - Flexural Rupture Interact (Sect a-a) |                                                     | ratio =                     | = 0.07 | PASS                          |
|-----------------------------------------------------|-----------------------------------------------------|-----------------------------|--------|-------------------------------|
| Gusset plate                                        | width $b_p = 32.108$ [in]                           | thick $t_p = 0.375$ [in]    |        |                               |
|                                                     | tensile $F_u = 65.0$ [ksi]                          |                             |        |                               |
| Net area of plate                                   | $A_n = b_p \times t_p$                              | = 12.041 [in <sup>2</sup> ] |        |                               |
| Plastic modulus of net section                      | $Z_{net} = (b_p \times t_p^2) / 4$                  | = 96.649 [in <sup>3</sup> ] |        |                               |
| Flexural strength available                         | $M_c = \phi F_u Z_{net} \quad \phi=0.75$            | = 392.64 [kip-ft]           |        |                               |
| Flexural strength required                          | $M_r =$ from gusset interface forces calc           | = 42.07 [kip-ft]            |        |                               |
| Shear strength available                            | $V_c =$ from shear rupture check                    | = 352.18 [kips]             |        |                               |
| Shear strength required                             | $V_r =$ from gusset interface forces calc           | = 84.85 [kips]              |        |                               |
| Flexural rupture interaction                        | ratio = $(\frac{V_r}{V_c})^2 + (\frac{M_r}{M_c})^2$ | = 0.07                      |        | AISC 14 <sup>th</sup> Eq 10-5 |
|                                                     |                                                     | < 1.0                       | OK     |                               |

| Gusset Plate - Shear Yielding (Sect b-b) |                           | ratio = 10.98 / 114.66        |                               | = 0.10 | PASS |
|------------------------------------------|---------------------------|-------------------------------|-------------------------------|--------|------|
| Plate Shear Yielding Check               |                           |                               |                               |        |      |
| Plate size                               | width $b_p = 10.192$ [in] | thickness $t_p = 0.375$ [in]  |                               |        |      |
| Plate yield strength                     | $F_y = 50.0$ [ksi]        |                               |                               |        |      |
| Plate gross area in shear                | $A_{gv} = b_p t_p$        | = 3.822 [in <sup>2</sup> ]    |                               |        |      |
| Shear force required                     | $V_u =$                   | = 10.98 [kips]                |                               |        |      |
| Plate shear yielding strength            | $R_n = 0.6 F_y A_{gv}$    | = 114.66 [kips]               | AISC 14 <sup>th</sup> Eq J4-3 |        |      |
| Resistance factor-LRFD                   | $\phi = 1.00$             | AISC 14 <sup>th</sup> Eq J4-3 |                               |        |      |
|                                          | $\phi R_n =$              | = 114.66 [kips]               |                               |        |      |
|                                          | ratio = 0.10              | > $V_u$                       | OK                            |        |      |

| Gusset Plate - Shear Rupture (Sect b-b) |                        | ratio = 10.98 / 111.79 |                         | = 0.10             | PASS                          |
|-----------------------------------------|------------------------|------------------------|-------------------------|--------------------|-------------------------------|
| Plate Shear Rupture Check               |                        |                        |                         |                    |                               |
| Plate size                              | width $b_p = 10.192$   | [in]                   | thickness $t_p = 0.375$ | [in]               |                               |
| Plate tensile strength                  | $F_u = 65.0$           | [ksi]                  |                         |                    |                               |
| Plate net area in shear                 | $A_{nv} = b_p t_p$     |                        | $= 3.822$               | [in <sup>2</sup> ] |                               |
| Shear force in demand                   | $V_u =$                |                        | $= 10.98$               | [kips]             |                               |
| Plate shear rupture strength            | $R_n = 0.6 F_u A_{nv}$ |                        | $= 149.06$              | [kips]             | AISC 14 <sup>th</sup> Eq J4-4 |
| Resistance factor-LRFD                  | $\phi = 0.75$          |                        |                         |                    | AISC 14 <sup>th</sup> Eq J4-4 |
|                                         | $\phi R_n =$           |                        | $= 111.79$              | [kips]             |                               |
|                                         | ratio = 0.10           |                        | $> V_u$                 | OK                 |                               |

| Gusset Plate - Axial Tensile Yield (Sect b-b) |                           | ratio = 0.00 / 171.99        | = 0.00                        | PASS |
|-----------------------------------------------|---------------------------|------------------------------|-------------------------------|------|
| Plate Tensile Yielding Check                  |                           |                              |                               |      |
| Plate size                                    | width $b_p = 10.192$ [in] | thickness $t_p = 0.375$ [in] |                               |      |
| Plate yield strength                          | $F_y = 50.0$ [ksi]        |                              |                               |      |
| Plate gross area in shear                     | $A_g = b_p t_p$           | = 3.822 [in <sup>2</sup> ]   |                               |      |
| Tensile force required                        | $P_u =$                   | = 0.00 [kips]                |                               |      |
| Plate tensile yielding strength               | $R_n = F_y A_g$           | = 191.10 [kips]              | AISC 14 <sup>th</sup> Eq J4-1 |      |
| Resistance factor-LRFD                        | $\phi = 0.90$             |                              | AISC 14 <sup>th</sup> Eq J4-1 |      |
|                                               | $\phi R_n =$              | = 171.99 [kips]              |                               |      |
|                                               | ratio = 0.00              | > $P_u$                      | OK                            |      |

| Gusset Plate - Flexural Yield Interact (Sect b-b) |                                                                                                        | ratio =                    | = 0.01 | PASS                          |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------|--------|-------------------------------|
| Gusset plate                                      | width $b_p = 10.192$ [in]<br>yield $F_y = 50.0$ [ksi]                                                  | thick $t_p = 0.375$ [in]   |        |                               |
| Shear plate - gross area                          | $A_g = b_p \times t_p$                                                                                 | = 3.822 [in <sup>2</sup> ] |        |                               |
| Shear plate - plastic modulus                     | $Z_p = (b_p \times t_p^2) / 4$                                                                         | = 9.738 [in <sup>3</sup> ] |        |                               |
| Flexural strength available                       | $M_c = \phi F_y Z_p \quad \phi=0.90$                                                                   | = 36.52 [kip-ft]           |        |                               |
| Flexural strength required                        | $M_r =$ from gusset interface forces calc                                                              | = 0.31 [kip-ft]            |        |                               |
| Axial strength available                          | $P_c =$ from axial tensile yield check                                                                 | = 171.99 [kips]            |        |                               |
| Axial strength required                           | $P_r =$ from gusset interface forces calc                                                              | = 0.00 [kips]              |        |                               |
| Shear strength available                          | $V_c =$ from shear yielding check                                                                      | = 114.66 [kips]            |        |                               |
| Shear strength required                           | $V_r =$ from gusset interface forces calc                                                              | = 10.98 [kips]             |        |                               |
| Flexural yield interaction                        | $\text{ratio} = \left( \frac{V_r}{V_c} \right)^2 + \left( \frac{P_r}{P_c} + \frac{M_r}{M_c} \right)^2$ | = 0.01                     |        | AISC 14 <sup>th</sup> Eq 10-5 |
|                                                   |                                                                                                        | < 1.0                      | OK     |                               |

| Gusset Plate - Flexural Rupture Interact (Sect b-b) |                                                                                      | ratio =                    | = 0.01 | PASS                          |
|-----------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------|--------|-------------------------------|
| Gusset plate                                        | width $b_p = 10.192$ [in]<br>tensile $F_u = 65.0$ [ksi]                              | thick $t_p = 0.375$ [in]   |        |                               |
| Net area of plate                                   | $A_n = b_p \times t_p$                                                               | = 3.822 [in <sup>2</sup> ] |        |                               |
| Plastic modulus of net section                      | $Z_{net} = (b_p \times t_p^2) / 4$                                                   | = 9.738 [in <sup>3</sup> ] |        |                               |
| Flexural strength available                         | $M_c = \phi F_u Z_{net} \quad \phi=0.75$                                             | = 39.56 [kip-ft]           |        |                               |
| Flexural strength required                          | $M_r =$ from gusset interface forces calc                                            | = 0.31 [kip-ft]            |        |                               |
| Shear strength available                            | $V_c =$ from shear rupture check                                                     | = 111.79 [kips]            |        |                               |
| Shear strength required                             | $V_r =$ from gusset interface forces calc                                            | = 10.98 [kips]             |        |                               |
| Flexural rupture interaction                        | $\text{ratio} = \left( \frac{V_r}{V_c} \right)^2 + \left( \frac{M_r}{M_c} \right)^2$ | = 0.01                     |        | AISC 14 <sup>th</sup> Eq 10-5 |
|                                                     |                                                                                      | < 1.0                      | OK     |                               |

|                                                                                                                                              |                                                             |                     |                             |                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|---------------------|-----------------------------|----------------------------------------|
| <b>Gusset to Beam Weld Strength</b>                                                                                                          |                                                             | ratio = 3.95 / 8.78 | = 0.45                      | PASS                                   |
| <b>Gusset to Beam Interface - Forces</b>                                                                                                     |                                                             |                     |                             |                                        |
|                                                                                                                                              | shear V = 84.85                                             | [kips]              | axial N = 0.00              | [kips]                                 |
|                                                                                                                                              | moment M = 42.07                                            | [kip-ft]            |                             |                                        |
| <b>Gusset to Beam Interface - Weld Length</b>                                                                                                |                                                             |                     |                             |                                        |
| Gusset-beam fillet weld length                                                                                                               | $L_w =$                                                     |                     | = 32.108                    | [in]                                   |
| <b>Gusset to Beam Interface - Combined Weld Stress</b>                                                                                       |                                                             |                     |                             |                                        |
| Weld stress from axial force                                                                                                                 | $f_a = N / L_w$                                             |                     | = 0.000                     | [kip/in]                               |
| Weld stress from shear force                                                                                                                 | $f_v = V / L_w$                                             |                     | = 2.643                     | [kip/in]                               |
| Weld stress from moment force                                                                                                                | $f_b = \frac{M}{L^2 / 6}$                                   |                     | = 2.938                     | [kip/in]                               |
| Weld stress combined - max                                                                                                                   | $f_{max} = [ (f_a - f_b)^2 + f_v^2 ]^{0.5}$                 |                     | = 3.952                     | [kip/in] AISC 14 <sup>th</sup> Eq 8-11 |
| Weld resultant load angle                                                                                                                    | $\theta = \tan^{-1} [ (f_b - f_a) / f_v ]$                  |                     | = 48.0                      | [°]                                    |
| <b>Fillet Weld Strength Calc</b>                                                                                                             |                                                             |                     |                             |                                        |
| Fillet weld leg size                                                                                                                         | $w = 5/16$                                                  | [in]                | load angle $\theta = 48.0$  | [°]                                    |
| Electrode strength                                                                                                                           | $F_{EXX} = 70.0$                                            | [ksi]               | strength coeff $C_1 = 1.00$ | AISC 14 <sup>th</sup> Table 8-3        |
| Number of weld line                                                                                                                          | $n = 2$                                                     | for double fillet   |                             |                                        |
| Load angle coefficient                                                                                                                       | $C_2 = ( 1 + 0.5 \sin^{1.5} \theta )$                       |                     | = 1.32                      | AISC 14 <sup>th</sup> Page 8-9         |
| Fillet weld shear strength                                                                                                                   | $R_{n-w} = 0.6 ( C_1 \times 70 \text{ ksi} ) 0.707 w n C_2$ |                     | = 24.508                    | [kip/in] AISC 14 <sup>th</sup> Eq 8-1  |
| Base metal - gusset plate                                                                                                                    | thickness $t = 0.375$                                       | [in]                | tensile $F_u = 65.0$        | [ksi]                                  |
| Base metal - gusset plate is in shear, <u>shear</u> rupture as per AISC 14 <sup>th</sup> Eq J4-4 is checked                                  |                                                             |                     |                             | AISC 14 <sup>th</sup> J2.4             |
| Base metal shear rupture                                                                                                                     | $R_{n-b} = 0.6 F_u t$                                       |                     | = 14.625                    | [kip/in] AISC 14 <sup>th</sup> Eq J4-4 |
| Double fillet linear shear strength                                                                                                          | $R_n = \min ( R_{n-w}, R_{n-b} )$                           |                     | = 14.625                    | [kip/in] AISC 14 <sup>th</sup> Eq 9-2  |
| Resistance factor-LRFD                                                                                                                       | $\phi = 0.75$                                               |                     |                             | AISC 14 <sup>th</sup> Eq 8-1           |
|                                                                                                                                              | $\phi R_n =$                                                |                     | = 10.969                    | [kip/in]                               |
| When gusset plate is directly welded to beam or column, apply 1.25 ductility factor to allow adequate force redistribution in the weld group |                                                             |                     |                             | AISC 14 <sup>th</sup> Page 13-11       |
| Weld strength used for design after applying ductility factor                                                                                | $\phi R_n = \phi R_n \times ( 1/1.25 )$                     |                     | = 8.775                     | [kip/in]                               |
|                                                                                                                                              | ratio = 0.45                                                |                     | > $f_{max}$                 | OK                                     |

| Beam Web Local Yielding                                                                        |                                      | ratio = 62.89 / 548.82 |               | = 0.11   | PASS                           |
|------------------------------------------------------------------------------------------------|--------------------------------------|------------------------|---------------|----------|--------------------------------|
| Gusset Edge Equivalent Normal Force                                                            |                                      |                        |               |          |                                |
| Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force |                                      |                        |               |          |                                |
| Gusset edge axial force                                                                        | N =                                  |                        | = 0.00        | [kips]   |                                |
| Gusset edge moment force                                                                       | M =                                  |                        | = 42.07       | [kip-ft] |                                |
| Gusset edge interface length                                                                   | L =                                  |                        | = 32.108      | [in]     |                                |
| Gusset edge equivalent normal force                                                            | $N_e = N + \frac{4 M}{L}$            |                        | = 62.89       | [kips]   | AISC DG29 Fig B-1              |
| Concentrated force from gusset                                                                 | $P_u =$                              |                        | = 62.89       | [kips]   |                                |
| Beam section                                                                                   | $d = 11.900$                         | [in]                   | $t_f = 0.515$ | [in]     |                                |
|                                                                                                | $t_w = 0.295$                        | [in]                   | $k = 1.020$   | [in]     |                                |
|                                                                                                | yield $F_y = 50.0$                   | [ksi]                  |               |          |                                |
| Length of bearing                                                                              | $l_b =$ Gusset/Beam interface length |                        | = 32.108      | [in]     |                                |
| Beam web local yielding strength                                                               | $R_n = F_y t_w ( 5 k + l_b )$        |                        | = 548.82      | [kips]   | AISC 14 <sup>th</sup> Eq J10-2 |
| Resistance factor-LRFD                                                                         | $\phi = 1.00$                        |                        |               |          |                                |
|                                                                                                | $\phi R_n =$                         |                        | = 548.82      | [kips]   |                                |
|                                                                                                | ratio = 0.11                         |                        | > $P_u$       | OK       |                                |

| Beam Web Local Crippling                                                                       |                                                                                                                                             | ratio = 62.89 / 374.60 = 0.17 |               | PASS                           |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------|--------------------------------|
| Gusset Edge Equivalent Normal Force                                                            |                                                                                                                                             |                               |               |                                |
| Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force |                                                                                                                                             |                               |               |                                |
| Gusset edge axial force                                                                        | N =                                                                                                                                         | = 0.00                        | [kips]        |                                |
| Gusset edge moment force                                                                       | M =                                                                                                                                         | = 42.07                       | [kip-ft]      |                                |
| Gusset edge interface length                                                                   | L =                                                                                                                                         | = 32.108                      | [in]          |                                |
| Gusset edge equivalent normal force                                                            | $N_e = N + \frac{4 M}{L}$                                                                                                                   | = 62.89                       | [kips]        | AISC DG29 Fig B-1              |
| Concentrated force from gusset                                                                 | $P_u =$                                                                                                                                     | = 62.89                       | [kips]        |                                |
| Beam section                                                                                   | $d = 11.900$                                                                                                                                | [in]                          | $t_f = 0.515$ | [in]                           |
|                                                                                                | $t_w = 0.295$                                                                                                                               | [in]                          | $k = 1.020$   | [in]                           |
|                                                                                                | yield $F_y = 50.0$                                                                                                                          | [ksi]                         | $E = 29000$   | [ksi]                          |
| Length of bearing                                                                              | $l_b =$ Gusset/Beam interface length                                                                                                        | = 32.108                      | [in]          |                                |
|                                                                                                | when $l_N \geq d/2$ , use Eq J10-4                                                                                                          |                               |               | AISC 14 <sup>th</sup> Eq J10-4 |
| Beam web local crippling strength                                                              | $R_n = 0.8 t_w^2 \left[ 1 + 3 \frac{l_b}{d} \left( \frac{t_w}{t_f} \right)^{1.5} \right] \times \left( \frac{E F_y t_f}{t_w} \right)^{0.5}$ | = 499.47                      | [kips]        | AISC 14 <sup>th</sup> Eq J10-4 |
| Resistance factor-LRFD                                                                         | $\phi = 0.75$                                                                                                                               |                               |               | AISC 14 <sup>th</sup> J10.3    |
|                                                                                                | $\phi R_n =$                                                                                                                                | = 374.60                      | [kips]        |                                |
|                                                                                                | ratio = 0.17                                                                                                                                | > $P_u$                       | OK            |                                |

| Beam Web Longitudinal Shear Yielding                                                                                                         |                                                                     |                             | ratio = 84.85 / 700.55 | = 0.12 | PASS                          |
|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------|------------------------|--------|-------------------------------|
| Beam Web Effective Length for Transmitting Shear                                                                                             |                                                                     |                             |                        |        |                               |
| Refer to AISC Design Example v14.2 Page IIC-70 for formula below to calculate beam web effective length in transmitting shear along Sect a-a |                                                                     |                             |                        |        |                               |
| Beam sect W12X40                                                                                                                             | d = 11.900 [in]                                                     | b <sub>f</sub> = 8.010 [in] |                        |        |                               |
|                                                                                                                                              | t <sub>f</sub> = 0.515 [in]                                         | t <sub>w</sub> = 0.295 [in] |                        |        |                               |
|                                                                                                                                              | k = 1.020 [in]                                                      | F <sub>y</sub> = 50.0 [ksi] |                        |        |                               |
| Gusset edge interface length                                                                                                                 | L =                                                                 | = 32.108 [in]               |                        |        |                               |
|                                                                                                                                              | φ <sub>t</sub> = 0.90                                               | φ <sub>v</sub> = 1.00       |                        |        |                               |
| Beam web effective length for transmitting shear                                                                                             | $L_{eff} = L + 5k + \frac{2 \phi_t b_f t_f}{\phi_v 0.6 t_w}$        |                             | = 79.159 [in]          |        |                               |
| Gusset edge shear (Sect a-a)                                                                                                                 | V <sub>u</sub> =                                                    | = 84.85 [kips]              |                        |        |                               |
| Beam web shear strength                                                                                                                      | R <sub>n</sub> = 0.6 F <sub>y</sub> t <sub>w</sub> L <sub>eff</sub> | = 700.55 [kips]             |                        |        | AISC 14 <sup>th</sup> Eq J4-3 |
| Resistance factor-LRFD                                                                                                                       | φ = 1.00                                                            |                             |                        |        | AISC 14 <sup>th</sup> Eq J4-3 |
|                                                                                                                                              | φ R <sub>n</sub> =                                                  | = 700.55 [kips]             |                        |        |                               |
|                                                                                                                                              | ratio = 0.12                                                        | > V <sub>u</sub>            |                        | OK     |                               |

| Beam Web Transverse Section Shear Yielding |                                                                     |                             | ratio = 31.45 / 105.32 | = 0.30 | PASS                          |
|--------------------------------------------|---------------------------------------------------------------------|-----------------------------|------------------------|--------|-------------------------------|
| Beam sect W12X40                           | d = 11.900 [in]                                                     | t <sub>w</sub> = 0.295 [in] |                        |        |                               |
| Right brace axial force                    | P <sub>1</sub> = from user input                                    | = -60.00 [kips]             |                        |        | in tension                    |
| Right brace to hor line angle              | θ <sub>1</sub> = from user input                                    | = 45.0 [°]                  |                        |        |                               |
| Right brace force ver component            | V <sub>1</sub> = P <sub>1</sub> sin θ <sub>1</sub>                  | = -42.43 [kips]             |                        |        |                               |
| Gusset edge shear (Sect b-b)               | V' =                                                                | = 10.98 [kips]              |                        |        |                               |
| Beam web transverse shear                  | V <sub>u</sub> = V <sub>1</sub> + V'                                | = -31.45 [kips]             |                        |        |                               |
| Beam web shear strength                    | R <sub>n</sub> = 0.6 F <sub>y</sub> d t <sub>w</sub> C <sub>v</sub> | = 105.32 [kips]             |                        |        | AISC 14 <sup>th</sup> Eq G2-1 |
|                                            | C <sub>v</sub> = 1.00                                               |                             |                        |        | AISC 14 <sup>th</sup> Eq G2-2 |
| Resistance factor-LRFD                     | φ = 1.00                                                            |                             |                        |        | AISC 14 <sup>th</sup> Eq G2-1 |
|                                            | φ R <sub>n</sub> =                                                  | = 105.32 [kips]             |                        |        |                               |
|                                            | ratio = 0.30                                                        | > V <sub>u</sub>            |                        | OK     |                               |

| Brace Force Load Case 2                  |                                                     |                                       | P <sub>R</sub> = 60.00 kips (C) | P <sub>L</sub> = -60.00 kips (T) | ratio = 0.45 | PASS                          |
|------------------------------------------|-----------------------------------------------------|---------------------------------------|---------------------------------|----------------------------------|--------------|-------------------------------|
| Gusset Plate - Shear Yielding (Sect a-a) |                                                     |                                       |                                 |                                  |              |                               |
| Plate Shear Yielding Check               |                                                     |                                       |                                 |                                  |              |                               |
| Plate size                               | width b <sub>p</sub> = 32.108 [in]                  | thickness t <sub>p</sub> = 0.375 [in] |                                 |                                  |              |                               |
| Plate yield strength                     | F <sub>y</sub> = 50.0 [ksi]                         |                                       |                                 |                                  |              |                               |
| Plate gross area in shear                | A <sub>gv</sub> = b <sub>p</sub> t <sub>p</sub>     | = 12.041 [in <sup>2</sup> ]           |                                 |                                  |              |                               |
| Shear force required                     | V <sub>u</sub> =                                    | = 84.85 [kips]                        |                                 |                                  |              |                               |
| Plate shear yielding strength            | R <sub>n</sub> = 0.6 F <sub>y</sub> A <sub>gv</sub> | = 361.22 [kips]                       |                                 |                                  |              | AISC 14 <sup>th</sup> Eq J4-3 |
| Resistance factor-LRFD                   | φ = 1.00                                            |                                       |                                 |                                  |              | AISC 14 <sup>th</sup> Eq J4-3 |
|                                          | φ R <sub>n</sub> =                                  | = 361.22 [kips]                       |                                 |                                  |              |                               |
|                                          | ratio = 0.23                                        | > V <sub>u</sub>                      |                                 |                                  | OK           |                               |

| Gusset Plate - Shear Rupture (Sect a-a) |                           | ratio = 84.85 / 352.18       | = 0.24 | PASS                          |
|-----------------------------------------|---------------------------|------------------------------|--------|-------------------------------|
| <b>Plate Shear Rupture Check</b>        |                           |                              |        |                               |
| Plate size                              | width $b_p = 32.108$ [in] | thickness $t_p = 0.375$ [in] |        |                               |
| Plate tensile strength                  | $F_u = 65.0$ [ksi]        |                              |        |                               |
| Plate net area in shear                 | $A_{nv} = b_p t_p$        | = 12.041 [in <sup>2</sup> ]  |        |                               |
| Shear force in demand                   | $V_u =$                   | = 84.85 [kips]               |        |                               |
| Plate shear rupture strength            | $R_n = 0.6 F_u A_{nv}$    | = 469.58 [kips]              |        | AISC 14 <sup>th</sup> Eq J4-4 |
| Resistance factor-LRFD                  | $\phi = 0.75$             |                              |        | AISC 14 <sup>th</sup> Eq J4-4 |
|                                         | $\phi R_n =$              | = 352.18 [kips]              |        |                               |
|                                         | ratio = 0.24              | > $V_u$                      | OK     |                               |

| Gusset Plate - Axial Tensile Yield (Sect a-a) |                           | ratio = 0.00 / 541.82        | = 0.00 | PASS                          |
|-----------------------------------------------|---------------------------|------------------------------|--------|-------------------------------|
| <b>Plate Tensile Yielding Check</b>           |                           |                              |        |                               |
| Plate size                                    | width $b_p = 32.108$ [in] | thickness $t_p = 0.375$ [in] |        |                               |
| Plate yield strength                          | $F_y = 50.0$ [ksi]        |                              |        |                               |
| Plate gross area in shear                     | $A_g = b_p t_p$           | = 12.041 [in <sup>2</sup> ]  |        |                               |
| Tensile force required                        | $P_u =$                   | = 0.00 [kips]                |        |                               |
| Plate tensile yielding strength               | $R_n = F_y A_g$           | = 602.03 [kips]              |        | AISC 14 <sup>th</sup> Eq J4-1 |
| Resistance factor-LRFD                        | $\phi = 0.90$             |                              |        | AISC 14 <sup>th</sup> Eq J4-1 |
|                                               | $\phi R_n =$              | = 541.82 [kips]              |        |                               |
|                                               | ratio = 0.00              | > $P_u$                      | OK     |                               |

| Gusset Plate - Flexural Yield Interact (Sect a-a) |                                                                       | ratio =                     | = 0.07 | PASS                          |
|---------------------------------------------------|-----------------------------------------------------------------------|-----------------------------|--------|-------------------------------|
| Gusset plate                                      | width $b_p = 32.108$ [in]                                             | thick $t_p = 0.375$ [in]    |        |                               |
|                                                   | yield $F_y = 50.0$ [ksi]                                              |                             |        |                               |
| Shear plate - gross area                          | $A_g = b_p \times t_p$                                                | = 12.041 [in <sup>2</sup> ] |        |                               |
| Shear plate - plastic modulus                     | $Z_p = (b_p \times t_p^2) / 4$                                        | = 96.649 [in <sup>3</sup> ] |        |                               |
| Flexural strength available                       | $M_c = \phi F_y Z_p \quad \phi=0.90$                                  | = 362.43 [kip-ft]           |        |                               |
| Flexural strength required                        | $M_r =$ from gusset interface forces calc                             | = 42.07 [kip-ft]            |        |                               |
| Axial strength available                          | $P_c =$ from axial tensile yield check                                | = 541.82 [kips]             |        |                               |
| Axial strength required                           | $P_r =$ from gusset interface forces calc                             | = 0.00 [kips]               |        |                               |
| Shear strength available                          | $V_c =$ from shear yielding check                                     | = 361.22 [kips]             |        |                               |
| Shear strength required                           | $V_r =$ from gusset interface forces calc                             | = 84.85 [kips]              |        |                               |
| Flexural yield interaction                        | ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$ | = 0.07                      |        | AISC 14 <sup>th</sup> Eq 10-5 |
|                                                   |                                                                       | < 1.0                       | OK     |                               |

| Gusset Plate - Flexural Rupture Interact (Sect a-a) |                                                                               | ratio =                  | = 0.07                      | PASS                          |
|-----------------------------------------------------|-------------------------------------------------------------------------------|--------------------------|-----------------------------|-------------------------------|
| Gusset plate                                        | width $b_p = 32.108$ [in]<br>tensile $F_u = 65.0$ [ksi]                       | thick $t_p = 0.375$ [in] |                             |                               |
| Net area of plate                                   | $A_n = b_p \times t_p$                                                        |                          | = 12.041 [in <sup>2</sup> ] |                               |
| Plastic modulus of net section                      | $Z_{net} = (b_p \times t_p^2) / 4$                                            |                          | = 96.649 [in <sup>3</sup> ] |                               |
| Flexural strength available                         | $M_c = \phi F_u Z_{net}$ $\phi=0.75$                                          |                          | = 392.64 [kip-ft]           |                               |
| Flexural strength required                          | $M_r =$ from gusset interface forces calc                                     |                          | = 42.07 [kip-ft]            |                               |
| Shear strength available                            | $V_c =$ from shear rupture check                                              |                          | = 352.18 [kips]             |                               |
| Shear strength required                             | $V_r =$ from gusset interface forces calc                                     |                          | = 84.85 [kips]              |                               |
| Flexural rupture interaction                        | $ratio = \left( \frac{V_r}{V_c} \right)^2 + \left( \frac{M_r}{M_c} \right)^2$ |                          | = 0.07                      | AISC 14 <sup>th</sup> Eq 10-5 |
|                                                     |                                                                               |                          | < 1.0                       | OK                            |

| Gusset Plate - Shear Yielding (Sect b-b) |                           | ratio = 10.98 / 114.66       | = 0.10                     | PASS                          |
|------------------------------------------|---------------------------|------------------------------|----------------------------|-------------------------------|
| Plate Shear Yielding Check               |                           |                              |                            |                               |
| Plate size                               | width $b_p = 10.192$ [in] | thickness $t_p = 0.375$ [in] |                            |                               |
| Plate yield strength                     | $F_y = 50.0$ [ksi]        |                              |                            |                               |
| Plate gross area in shear                | $A_{gv} = b_p t_p$        |                              | = 3.822 [in <sup>2</sup> ] |                               |
| Shear force required                     | $V_u =$                   |                              | = 10.98 [kips]             |                               |
| Plate shear yielding strength            | $R_n = 0.6 F_y A_{gv}$    |                              | = 114.66 [kips]            | AISC 14 <sup>th</sup> Eq J4-3 |
| Resistance factor-LRFD                   | $\phi = 1.00$             |                              |                            | AISC 14 <sup>th</sup> Eq J4-3 |
|                                          | $\phi R_n =$              |                              | = 114.66 [kips]            |                               |
|                                          | ratio = 0.10              |                              | > $V_u$                    | OK                            |

| Gusset Plate - Shear Rupture (Sect b-b) |                           | ratio = 10.98 / 111.79       | = 0.10                     | PASS                          |
|-----------------------------------------|---------------------------|------------------------------|----------------------------|-------------------------------|
| Plate Shear Rupture Check               |                           |                              |                            |                               |
| Plate size                              | width $b_p = 10.192$ [in] | thickness $t_p = 0.375$ [in] |                            |                               |
| Plate tensile strength                  | $F_u = 65.0$ [ksi]        |                              |                            |                               |
| Plate net area in shear                 | $A_{nv} = b_p t_p$        |                              | = 3.822 [in <sup>2</sup> ] |                               |
| Shear force in demand                   | $V_u =$                   |                              | = 10.98 [kips]             |                               |
| Plate shear rupture strength            | $R_n = 0.6 F_u A_{nv}$    |                              | = 149.06 [kips]            | AISC 14 <sup>th</sup> Eq J4-4 |
| Resistance factor-LRFD                  | $\phi = 0.75$             |                              |                            | AISC 14 <sup>th</sup> Eq J4-4 |
|                                         | $\phi R_n =$              |                              | = 111.79 [kips]            |                               |
|                                         | ratio = 0.10              |                              | > $V_u$                    | OK                            |

| Gusset Plate - Axial Tensile Yield (Sect b-b) |                           | ratio = 0.00 / 171.99        | = 0.00 | PASS                          |
|-----------------------------------------------|---------------------------|------------------------------|--------|-------------------------------|
| <b>Plate Tensile Yielding Check</b>           |                           |                              |        |                               |
| Plate size                                    | width $b_p = 10.192$ [in] | thickness $t_p = 0.375$ [in] |        |                               |
| Plate yield strength                          | $F_y = 50.0$ [ksi]        |                              |        |                               |
| Plate gross area in shear                     | $A_g = b_p t_p$           | = 3.822 [in <sup>2</sup> ]   |        |                               |
| Tensile force required                        | $P_u =$                   | = 0.00 [kips]                |        |                               |
| Plate tensile yielding strength               | $R_n = F_y A_g$           | = 191.10 [kips]              |        | AISC 14 <sup>th</sup> Eq J4-1 |
| Resistance factor-LRFD                        | $\phi = 0.90$             |                              |        | AISC 14 <sup>th</sup> Eq J4-1 |
|                                               | $\phi R_n =$              | = 171.99 [kips]              |        |                               |
|                                               | ratio = 0.00              | > $P_u$                      | OK     |                               |

| Gusset Plate - Flexural Yield Interact (Sect b-b) |                                                                       | ratio =                    | = 0.01 | PASS                          |
|---------------------------------------------------|-----------------------------------------------------------------------|----------------------------|--------|-------------------------------|
| Gusset plate                                      | width $b_p = 10.192$ [in]                                             | thick $t_p = 0.375$ [in]   |        |                               |
|                                                   | yield $F_y = 50.0$ [ksi]                                              |                            |        |                               |
| Shear plate - gross area                          | $A_g = b_p \times t_p$                                                | = 3.822 [in <sup>2</sup> ] |        |                               |
| Shear plate - plastic modulus                     | $Z_p = (b_p \times t_p^2) / 4$                                        | = 9.738 [in <sup>3</sup> ] |        |                               |
| Flexural strength available                       | $M_c = \phi F_y Z_p \quad \phi=0.90$                                  | = 36.52 [kip-ft]           |        |                               |
| Flexural strength required                        | $M_r =$ from gusset interface forces calc                             | = 0.31 [kip-ft]            |        |                               |
| Axial strength available                          | $P_c =$ from axial tensile yield check                                | = 171.99 [kips]            |        |                               |
| Axial strength required                           | $P_r =$ from gusset interface forces calc                             | = 0.00 [kips]              |        |                               |
| Shear strength available                          | $V_c =$ from shear yielding check                                     | = 114.66 [kips]            |        |                               |
| Shear strength required                           | $V_r =$ from gusset interface forces calc                             | = 10.98 [kips]             |        |                               |
| Flexural yield interaction                        | ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$ | = 0.01                     |        | AISC 14 <sup>th</sup> Eq 10-5 |
|                                                   |                                                                       | < 1.0                      | OK     |                               |

| Gusset Plate - Flexural Rupture Interact (Sect b-b) |                                                     | ratio =                    | = 0.01 | PASS                          |
|-----------------------------------------------------|-----------------------------------------------------|----------------------------|--------|-------------------------------|
| Gusset plate                                        | width $b_p = 10.192$ [in]                           | thick $t_p = 0.375$ [in]   |        |                               |
|                                                     | tensile $F_u = 65.0$ [ksi]                          |                            |        |                               |
| Net area of plate                                   | $A_n = b_p \times t_p$                              | = 3.822 [in <sup>2</sup> ] |        |                               |
| Plastic modulus of net section                      | $Z_{net} = (b_p \times t_p^2) / 4$                  | = 9.738 [in <sup>3</sup> ] |        |                               |
| Flexural strength available                         | $M_c = \phi F_u Z_{net} \quad \phi=0.75$            | = 39.56 [kip-ft]           |        |                               |
| Flexural strength required                          | $M_r =$ from gusset interface forces calc           | = 0.31 [kip-ft]            |        |                               |
| Shear strength available                            | $V_c =$ from shear rupture check                    | = 111.79 [kips]            |        |                               |
| Shear strength required                             | $V_r =$ from gusset interface forces calc           | = 10.98 [kips]             |        |                               |
| Flexural rupture interaction                        | ratio = $(\frac{V_r}{V_c})^2 + (\frac{M_r}{M_c})^2$ | = 0.01                     |        | AISC 14 <sup>th</sup> Eq 10-5 |
|                                                     |                                                     | < 1.0                      | OK     |                               |

|                                                                                                                                              |                                                             |                     |                             |                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|---------------------|-----------------------------|----------------------------------------|
| <b>Gusset to Beam Weld Strength</b>                                                                                                          |                                                             | ratio = 3.95 / 8.78 | = 0.45                      | PASS                                   |
| <b>Gusset to Beam Interface - Forces</b>                                                                                                     |                                                             |                     |                             |                                        |
|                                                                                                                                              | shear V = 84.85                                             | [kips]              | axial N = 0.00              | [kips]                                 |
|                                                                                                                                              | moment M = 42.07                                            | [kip-ft]            |                             |                                        |
| <b>Gusset to Beam Interface - Weld Length</b>                                                                                                |                                                             |                     |                             |                                        |
| Gusset-beam fillet weld length                                                                                                               | $L_w =$                                                     |                     | = 32.108                    | [in]                                   |
| <b>Gusset to Beam Interface - Combined Weld Stress</b>                                                                                       |                                                             |                     |                             |                                        |
| Weld stress from axial force                                                                                                                 | $f_a = N / L_w$                                             |                     | = 0.000                     | [kip/in]                               |
| Weld stress from shear force                                                                                                                 | $f_v = V / L_w$                                             |                     | = 2.643                     | [kip/in]                               |
| Weld stress from moment force                                                                                                                | $f_b = \frac{M}{L^2 / 6}$                                   |                     | = 2.938                     | [kip/in]                               |
| Weld stress combined - max                                                                                                                   | $f_{max} = [ (f_a - f_b)^2 + f_v^2 ]^{0.5}$                 |                     | = 3.952                     | [kip/in] AISC 14 <sup>th</sup> Eq 8-11 |
| Weld resultant load angle                                                                                                                    | $\theta = \tan^{-1} [ (f_b - f_a) / f_v ]$                  |                     | = 48.0                      | [°]                                    |
| <b>Fillet Weld Strength Calc</b>                                                                                                             |                                                             |                     |                             |                                        |
| Fillet weld leg size                                                                                                                         | $w = 5/16$                                                  | [in]                | load angle $\theta = 48.0$  | [°]                                    |
| Electrode strength                                                                                                                           | $F_{EXX} = 70.0$                                            | [ksi]               | strength coeff $C_1 = 1.00$ | AISC 14 <sup>th</sup> Table 8-3        |
| Number of weld line                                                                                                                          | $n = 2$                                                     | for double fillet   |                             |                                        |
| Load angle coefficient                                                                                                                       | $C_2 = ( 1 + 0.5 \sin^{1.5} \theta )$                       |                     | = 1.32                      | AISC 14 <sup>th</sup> Page 8-9         |
| Fillet weld shear strength                                                                                                                   | $R_{n-w} = 0.6 ( C_1 \times 70 \text{ ksi} ) 0.707 w n C_2$ |                     | = 24.508                    | [kip/in] AISC 14 <sup>th</sup> Eq 8-1  |
| Base metal - gusset plate                                                                                                                    | thickness $t = 0.375$                                       | [in]                | tensile $F_u = 65.0$        | [ksi]                                  |
| Base metal - gusset plate is in shear, <u>shear</u> rupture as per AISC 14 <sup>th</sup> Eq J4-4 is checked                                  |                                                             |                     |                             | AISC 14 <sup>th</sup> J2.4             |
| Base metal shear rupture                                                                                                                     | $R_{n-b} = 0.6 F_u t$                                       |                     | = 14.625                    | [kip/in] AISC 14 <sup>th</sup> Eq J4-4 |
| Double fillet linear shear strength                                                                                                          | $R_n = \min ( R_{n-w}, R_{n-b} )$                           |                     | = 14.625                    | [kip/in] AISC 14 <sup>th</sup> Eq 9-2  |
| Resistance factor-LRFD                                                                                                                       | $\phi = 0.75$                                               |                     |                             | AISC 14 <sup>th</sup> Eq 8-1           |
|                                                                                                                                              | $\phi R_n =$                                                |                     | = 10.969                    | [kip/in]                               |
| When gusset plate is directly welded to beam or column, apply 1.25 ductility factor to allow adequate force redistribution in the weld group |                                                             |                     |                             | AISC 14 <sup>th</sup> Page 13-11       |
| Weld strength used for design after applying ductility factor                                                                                | $\phi R_n = \phi R_n \times ( 1/1.25 )$                     |                     | = 8.775                     | [kip/in]                               |
|                                                                                                                                              | ratio = 0.45                                                |                     | > $f_{max}$                 | OK                                     |

| Beam Web Local Yielding                                                                        |                                      | ratio = 62.89 / 548.82 |               | = 0.11   | PASS                           |
|------------------------------------------------------------------------------------------------|--------------------------------------|------------------------|---------------|----------|--------------------------------|
| Gusset Edge Equivalent Normal Force                                                            |                                      |                        |               |          |                                |
| Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force |                                      |                        |               |          |                                |
| Gusset edge axial force                                                                        | N =                                  |                        | = 0.00        | [kips]   |                                |
| Gusset edge moment force                                                                       | M =                                  |                        | = 42.07       | [kip-ft] |                                |
| Gusset edge interface length                                                                   | L =                                  |                        | = 32.108      | [in]     |                                |
| Gusset edge equivalent normal force                                                            | $N_e = N + \frac{4 M}{L}$            |                        | = 62.89       | [kips]   | AISC DG29 Fig B-1              |
| Concentrated force from gusset                                                                 | $P_u =$                              |                        | = 62.89       | [kips]   |                                |
| Beam section                                                                                   | $d = 11.900$                         | [in]                   | $t_f = 0.515$ | [in]     |                                |
|                                                                                                | $t_w = 0.295$                        | [in]                   | $k = 1.020$   | [in]     |                                |
|                                                                                                | yield $F_y = 50.0$                   | [ksi]                  |               |          |                                |
| Length of bearing                                                                              | $l_b =$ Gusset/Beam interface length |                        | = 32.108      | [in]     |                                |
| Beam web local yielding strength                                                               | $R_n = F_y t_w ( 5 k + l_b )$        |                        | = 548.82      | [kips]   | AISC 14 <sup>th</sup> Eq J10-2 |
| Resistance factor-LRFD                                                                         | $\phi = 1.00$                        |                        |               |          |                                |
|                                                                                                | $\phi R_n =$                         |                        | = 548.82      | [kips]   |                                |
|                                                                                                | ratio = 0.11                         |                        | > $P_u$       | OK       |                                |

| Beam Web Local Crippling                                                                       |                                                                                                                                             | ratio = 62.89 / 374.60 = 0.17 |               | PASS                           |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------|--------------------------------|
| Gusset Edge Equivalent Normal Force                                                            |                                                                                                                                             |                               |               |                                |
| Refer to AISC DG29 Fig. B-1 for formula below to calculate gusset edge equivalent normal force |                                                                                                                                             |                               |               |                                |
| Gusset edge axial force                                                                        | N =                                                                                                                                         | = 0.00                        | [kips]        |                                |
| Gusset edge moment force                                                                       | M =                                                                                                                                         | = 42.07                       | [kip-ft]      |                                |
| Gusset edge interface length                                                                   | L =                                                                                                                                         | = 32.108                      | [in]          |                                |
| Gusset edge equivalent normal force                                                            | $N_e = N + \frac{4 M}{L}$                                                                                                                   | = 62.89                       | [kips]        | AISC DG29 Fig B-1              |
| Concentrated force from gusset                                                                 | $P_u =$                                                                                                                                     | = 62.89                       | [kips]        |                                |
| Beam section                                                                                   | $d = 11.900$                                                                                                                                | [in]                          | $t_f = 0.515$ | [in]                           |
|                                                                                                | $t_w = 0.295$                                                                                                                               | [in]                          | $k = 1.020$   | [in]                           |
|                                                                                                | yield $F_y = 50.0$                                                                                                                          | [ksi]                         | $E = 29000$   | [ksi]                          |
| Length of bearing                                                                              | $l_b =$ Gusset/Beam interface length                                                                                                        | = 32.108                      | [in]          |                                |
|                                                                                                | when $l_N \geq d/2$ , use Eq J10-4                                                                                                          |                               |               | AISC 14 <sup>th</sup> Eq J10-4 |
| Beam web local crippling strength                                                              | $R_n = 0.8 t_w^2 \left[ 1 + 3 \frac{l_b}{d} \left( \frac{t_w}{t_f} \right)^{1.5} \right] \times \left( \frac{E F_y t_f}{t_w} \right)^{0.5}$ | = 499.47                      | [kips]        | AISC 14 <sup>th</sup> Eq J10-4 |
| Resistance factor-LRFD                                                                         | $\phi = 0.75$                                                                                                                               |                               |               | AISC 14 <sup>th</sup> J10.3    |
|                                                                                                | $\phi R_n =$                                                                                                                                | = 374.60                      | [kips]        |                                |
|                                                                                                | ratio = 0.17                                                                                                                                | > $P_u$                       | OK            |                                |

| Beam Web Longitudinal Shear Yielding                                                                                                         |                                                                     |                             | ratio = 84.85 / 700.55 | = 0.12 | PASS                          |
|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------|------------------------|--------|-------------------------------|
| Beam Web Effective Length for Transmitting Shear                                                                                             |                                                                     |                             |                        |        |                               |
| Refer to AISC Design Example v14.2 Page IIC-70 for formula below to calculate beam web effective length in transmitting shear along Sect a-a |                                                                     |                             |                        |        |                               |
| Beam sect W12X40                                                                                                                             | d = 11.900 [in]                                                     | b <sub>f</sub> = 8.010 [in] |                        |        |                               |
|                                                                                                                                              | t <sub>f</sub> = 0.515 [in]                                         | t <sub>w</sub> = 0.295 [in] |                        |        |                               |
|                                                                                                                                              | k = 1.020 [in]                                                      | F <sub>y</sub> = 50.0 [ksi] |                        |        |                               |
| Gusset edge interface length                                                                                                                 | L =                                                                 | = 32.108 [in]               |                        |        |                               |
|                                                                                                                                              | φ <sub>t</sub> = 0.90                                               | φ <sub>v</sub> = 1.00       |                        |        |                               |
| Beam web effective length for transmitting shear                                                                                             | $L_{eff} = L + 5k + \frac{2 \phi_t b_f t_f}{\phi_v 0.6 t_w}$        |                             | = 79.159 [in]          |        |                               |
| Gusset edge shear (Sect a-a)                                                                                                                 | V <sub>u</sub> =                                                    | = 84.85 [kips]              |                        |        |                               |
| Beam web shear strength                                                                                                                      | R <sub>n</sub> = 0.6 F <sub>y</sub> t <sub>w</sub> L <sub>eff</sub> | = 700.55 [kips]             |                        |        | AISC 14 <sup>th</sup> Eq J4-3 |
| Resistance factor-LRFD                                                                                                                       | φ = 1.00                                                            |                             |                        |        | AISC 14 <sup>th</sup> Eq J4-3 |
|                                                                                                                                              | φ R <sub>n</sub> =                                                  | = 700.55 [kips]             |                        |        |                               |
|                                                                                                                                              | ratio = 0.12                                                        | > V <sub>u</sub>            |                        | OK     |                               |

| Beam Web Transverse Section Shear Yielding |                                                                     |                             | ratio = 31.45 / 105.32 | = 0.30 | PASS                          |
|--------------------------------------------|---------------------------------------------------------------------|-----------------------------|------------------------|--------|-------------------------------|
| Beam sect W12X40                           | d = 11.900 [in]                                                     | t <sub>w</sub> = 0.295 [in] |                        |        |                               |
| Right brace axial force                    | P <sub>1</sub> = from user input                                    | = 60.00 [kips]              |                        |        | in compression                |
| Right brace to hor line angle              | θ <sub>1</sub> = from user input                                    | = 45.0 [°]                  |                        |        |                               |
| Right brace force ver component            | V <sub>1</sub> = P <sub>1</sub> sin θ <sub>1</sub>                  | = 42.43 [kips]              |                        |        |                               |
| Gusset edge shear (Sect b-b)               | V' =                                                                | = -10.98 [kips]             |                        |        |                               |
| Beam web transverse shear                  | V <sub>u</sub> = V <sub>1</sub> + V'                                | = 31.45 [kips]              |                        |        |                               |
| Beam web shear strength                    | R <sub>n</sub> = 0.6 F <sub>y</sub> d t <sub>w</sub> C <sub>v</sub> | = 105.32 [kips]             |                        |        | AISC 14 <sup>th</sup> Eq G2-1 |
|                                            | C <sub>v</sub> = 1.00                                               |                             |                        |        | AISC 14 <sup>th</sup> Eq G2-2 |
| Resistance factor-LRFD                     | φ = 1.00                                                            |                             |                        |        | AISC 14 <sup>th</sup> Eq G2-1 |
|                                            | φ R <sub>n</sub> =                                                  | = 105.32 [kips]             |                        |        |                               |
|                                            | ratio = 0.30                                                        | > V <sub>u</sub>            |                        | OK     |                               |