Design Scope:

Calculations to determine the Load and Resistance Factor Design of the seismic restraint as detailed by 9.0 SeismicCo., 1/4" Floor & Wall Brackets (included within this calculation package for reference).

Prying of Piece #33143A - L3" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

AISC 14 Edition Part 9, p.9-10 of Specification

Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Tensile Strength: F_t = 60 ksi *(Carbon Steel)*

Ultimate Strength: F_u = 58 ksi

Anchor Spacing s = 0.00

Anchor Diameter: [redacted] d_b = 0.375 in

Steel strength in tension: N_{sa} = *6.500 kip*

Max distance from bolt to applied force: b = 1.375 in

Tributary length to each bolt: p = max 2b, but ≤ s 2.75 in

Adjusted prying distance: $b' = \left[b - \frac{d_b}{2}\right] =$ 1.19 in (Eq. 9-21)

Resistance factor for prying:
Ω_{pr} = *1.67 ASD*
Φ_{pr} = *0.90 LRFD*
Φ_t = *0.75 LRFD*

Maximum bolt force for prying: $T = \frac{\Phi_{pr} * F_u * th_{bracket}{}^2 * p}{2*b} =$ 3.26 kip (Eq. 9-22a)

Available tensile strength of single bolt: $B = \Phi_t * N_{sa} =$ *4.88 kip* *(per ESR-1917)*

$t_c = \sqrt{\frac{4*B*b'}{\Phi_{LRFD} * p * F_u}} =$ 0.440 in (Eq. 9-30a)

T_{avail} = BQ = *2.86 kip* (Eq. 9-31)

Q = *0.587*

a'<, Q = *1*

0 ≤ a' ≤ 1, Q = $\left(\frac{t}{t_c}\right)^2 (1+\delta*\alpha') =$ *0.587* (Eq. 9-33)

a'>1, Q = $\left(\frac{t}{t_c}\right)^2 (1+\delta) =$ *0.587* (Eq. 34)

Width of hole along length of plate: d' = *0.500 in*

Distance from bolt centerline to edge of plate: a = *1.50 in*

Additional variables for prying calculation:

$\delta = 1 - \frac{d'}{p} =$ *0.82* *Eq. (9-24)*

$a' = a + \frac{d_b}{2} =$ *1.69 in* $\leq \left(1.25*b*\frac{d_b}{2}\right) =$ *1.91 in* *Eq. (9-27)*

$\rho = \frac{b'}{a'} =$ *0.70* *Eq. (9-26)*

$\beta = \frac{1}{\rho}*\left(\frac{B}{T}-1\right) =$ *1.00 in* *Eq. (9-25)*

$\alpha' = if\left[\beta => 1, 1, \min\left[1, \frac{1}{\delta}*\left(\frac{\beta}{1-\beta}\right)\right]\right] =$ *1.00*

Required bracket thickness to ensure an acceptable combination of fitting strength, stiffness, and bolt strength:

$t_{min} = \sqrt{\frac{4*T*b'}{\Phi_{pr} * p * F_u * (1+\delta*\alpha')}} =$ *0.23 in LRFD* *(Eq. 9-23a)*

Thickness of Bracket is 0.25 in - therefore, Prying OK

Piece #33143A - L3" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness:	$th_{bracket}$ = 0.2500 in		
Yield Strength:	F_y = 36 ksi		*(Table 2-4)*
Ultimate Strength:	F_u = 58 ksi		
Gross Area:	A_g = **(3.0in)*(0.25in)** = 0.75 in2		
	$\phi_{t\text{-}y}$ = 0.9	LRFD	(Eqn D2.1)
Tensile Yielding:	$T_{allow\text{-}yielding} = \phi_{t\text{-}y} * F_y * A_g$ = 24.30 kip		(Eqn D2-1)
Shear Lag Factor:	U = 1.0		(Table D3.1)
Net Area:	A_n = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2		(Sec B4.3)
Effective Net Area:	A_e = $A_n * U$ = 0.59 in2		(Eqn D3-1)
	ϕ_{tr} = 0.75	LRFD	(Eqn D2-2)
Tensile Rupture:	$T_{allow\text{-}rupture} = \phi_{t\text{-}r} * F_u * A_e$ = 25.83 kip		(Eqn D2-2)
	$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) = 24.30 kip LRFD		(Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area:	A_{gv} =(3.0in)*(0.25in) = 0.75 in2		
	Φ_{yv} = 1.00	LRFD	*(Eqn J4-3)*
Shear Yielding:	$V_{allow\text{-}yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 16.20 kip		*(Eqn J4-3)*
	Φ_{rv} = 0.75	LRFD	*(Eqn J4-4)*
Net Area:	A_{nv} = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2		
Shear Rupture:	$V_{allow\text{-}rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 20.66 kip		*(Eqn J4-4)*
	V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) = 16.20 kip LRFD		*(Horizontal Component)*

**Note: Bending of Bracket is Considered within the Prying Calculation

Bending Moment on Vertical Leg (Side A):

Plastic Modulus:	$Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ 0.0469 in3		
	ϕ_b = 0.9	LRFD	*(Sec F1)*
	$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in		
Moment Arm:	$Moment_{arm}$ = 1.375 in		*(Eqn F11-1)*
Allowable Load:	$P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 1.105 kip LRFD	*(Vertical Component)*	

Bending Moment on Lower Leg (Side B):

Plastic Modulus:	$Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ 0.0469 in3		
	ϕ_b = 0.9	LRFD	*(Sec F1)*
	$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in		*(Eqn F11-1)*
Moment Arm:	$Moment_{arm}$ = 1.375 in		
Allowable Load:	$P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 1.105 kip LRFD	*(Horizontal Component)*	

Piece #33143A - L3" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity
(ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Design Thickness (in)	V_{allow}	*Design Thickness (in)*	T_{allow}	Number of Screws $N = 2$ $V_{allow}*N$	$T_{allow}*N$
0.048-0.048	603 lbf	0.048	210 lbf	**1206 lbf**	**420 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**2002 lbf**	**662 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**1666 lbf**	**818 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**2116 lbf**	**1096 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**2042 lbf**	**1794 lbf**
		3/16"	1439 lbf		**2878 lbf**

Bolts thru Angle Bracket to Concrete Slab or Concrete-Filled Profile Steel Deck Failure Modes:

Hilti Kwik Bolt-TZ anchors may be installed in cracked or uncracked concrete or concrete-filled steel deck

Bolt type: *A307 Gr. A (Common Bolts), bearing type connection*

Nominal Tensile Strength: $F_t =$ 45 ksi

Bracket Thickness: $th_{bracket} =$ 0.25 in

Nominal Shear Strength, Threads Excluded: $F_v =$ 27 ksi
Excluded: *(Table J3.2 AISC 14th)*

Bolt Diameter: $d_{bcd} =$ 0.50 in

Bolt Area: $A_{bcd} = 0.25*\pi*d_{bcd}^2 =$ 0.20 in2

Resistance factor for bolt tension or shear: $\phi =$ 0.75 LRFD

Shear Capacity of single bearing type bolt: $V_{allow\text{-}bolt} = \phi*F_v*A_{bcd} =$ 3.98 kip

Tension Capacity of single bearing type bolt: $T_{allow\text{-}bolt} = \phi*F_t*A_{bcd} =$ 6.63 kip

Bolt bearing strength at bracket connection: (Section J3.10) $F_u =$ 58 ksi

Bolt edge distance: edge-dist = 1.50 in

Bolt hole diameter: bh = 0.625 in

Clear distance between edge of hole and edge of adjacent hole or edge of plate: L_c = edge-dist -0.5*bh = 1.19 in2

Single end bolt bearing capacity: $Bolt_{br'g} = \min[(1.5*L_c*th_{plate}*F_u),(3.0*d_{bcd}*th_{plate}*F_u)] =$ 21.75 kip

$Bolt_{allow\text{-}bolt} = \phi*Bolt_{bearing}$ 16.31 kip LRFD

Piece #33143A - L3" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

See Hilti Excel output for Allowable Combined Tension and Shear Loads for Concrete Over Metal Deck (LRFD)
See Hilti Profis output for Allowable Combined Tension and Shear Loads for Concrete Slab (LRFD)

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on Concrete over Metal Deck

$\phi N_n =$ 390 lbf

$\phi V_n =$ 440 lbf

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on 4' min Concrete Slab

$\phi N_n =$ 950 lbf

$\phi V_n =$ 1,322 lbf

Given that the Load and Resistance Factor Design calculated above for the angle brackets and bolts far outweigh the capacity of the concrete anchors, the allowable loading to the concrete anchors govern.
Note also that the capacity of the concrete anchors shown here is based on utilizing Section D.3.3.4.3 (d) of ACI 318-11, which requires the inclusion of the Omega factor when determining the loads applied to the anchorage.
Do to the complication of the requirement (per ACI 318-11) to determine the concrete anchorage capacity utilizing LRFD as well as Section 4.2 in ESR-1917 the allowable load for this Piece is given in LRFD only.

Overall Capacity of Seismic Load - Piece #33143A - 3" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	390 lbf	Tension	Vertical & Horizontal Allowable Load - (LRFD)
$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	440 lbf	Shear	
$Load_{allowable\text{-}total\text{-}on\text{-}4"\ min\text{-}concrete\text{-}slab}$ =	950 lbf	Tension	
$Load_{allowable\text{-}total\text{-}on\text{-}4"\ min\text{-}concrete\text{-}slab}$ =	1,322 lbf	Shear	

Design Scope:

Calculations to determine the Load and Resistance Factor Design of the seismic restraint as detailed by 9.0 SeismicCo., 1/4" Floor & Wall Brackets (included within this calculation package for reference).

Prying of Piece #33144A - L3" x 3" x 1/4" x 0'-4" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

AISC 14 Edition Part 9, p.9-10 of Specification

Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Tensile Strength: F_t = 60 ksi *(Carbon Steel)*

Ultimate Strength: F_u = 58 ksi

Anchor Spacing s = 0.00

Anchor Diameter: [redacted] d_b = 0.375 in

Steel strength in tension: N_{sa} = *6.500 kip*

Max distance from bolt to applied force: b = 1.375 in

Tributary length to each bolt: *p = max 2b, but ≤ s* 2.75 in

Adjusted prying distance: $b' = \left[b - \frac{d_b}{2}\right] =$ 1.19 in (Eq. 9-21)

Resistance factor for prying: Ω_{pr} = *1.67 ASD*
Φ_{pr} = *0.90 LRFD*
Φ_t = *0.75 LRFD*

Maximum bolt force for prying: $T = \frac{\Phi_{pr} * F_u * th_{bracket}{}^2 * p}{2*b} =$ 3.26 kip (Eq. 9-22a)

Available tensile strength of single bolt: $B = \Phi_t * N_{sa} =$ *4.88 kip* *(per ESR-1917)*

$t_c = \sqrt{\frac{4*B*b'}{\Phi_{LRFD} * p * F_u}} =$ 0.440 in (Eq. 9-30a)

T_{avail} = *BQ* = *2.86 kip* (Eq. 9-31)

Q = *0.587* *a'<, Q* = *1*

0 ≤ a' ≤ 1, Q = $\left(\frac{t}{t_c}\right)^2 (1+\delta*\alpha') =$ *0.587* (Eq. 9-33)

a'>1, Q = $\left(\frac{t}{t_c}\right)^2 (1+\delta) =$ *0.587* (Eq. 34)

Width of hole along length of plate: d' = *0.500 in*

Distance from bolt centerline to edge of plate: a = *1.50 in*

Additional variables for prying calculation:

$\delta = 1 - \frac{d'}{p} =$ *0.82* *Eq. (9-24)*

$a' = a + \frac{d_b}{2} =$ *1.69 in* $\leq \left(1.25*b*\frac{d_b}{2}\right) =$ *1.91 in* *Eq. (9-27)*

$\rho = \frac{b'}{a'} =$ *0.70* *Eq. (9-26)*

$\beta = \frac{1}{\rho}*\left(\frac{B}{T}-1\right) =$ *1.00 in* *Eq. (9-25)*

$\alpha' = if\left[\beta => 1, 1, \min\left[1, \frac{1}{\delta}*\left(\frac{\beta}{1-\beta}\right)\right]\right] =$ *1.00*

Required bracket thickness to ensure an acceptable combination of fitting strength, stiffness, and bolt strength:

$t_{min} = \sqrt{\frac{4*T*b'}{\Phi_{pr} * p * F_u * (1+\delta*\alpha')}} =$ *0.23 in LRFD* *(Eq. 9-23a)*

Thickness of Bracket is 0.25 in - therefore, Prying OK

Piece #33144A - L3" x 3" x 1/4" x 0'-4" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness:	$th_{bracket}$ = 0.2500 in		
Yield Strength:	F_y = 36 ksi		(Table 2-4)
Ultimate Strength:	F_u = 58 ksi		
Gross Area:	A_g = **(4.0in)*(0.25in)** = 1.00 in2		
	$\phi_{t\text{-}y}$ = 0.9	LRFD	(Eqn D2.1)
Tensile Yielding:	$T_{allow\text{-}yielding} = \phi_{t\text{-}y} * F_y * A_g$ = 32.40 kip		(Eqn D2-1)
Shear Lag Factor:	U = 1.0		(Table D3.1)
Net Area:	A_n = (4.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.84 in2		(Sec B4.3)
Effective Net Area:	A_e = A_n*U = 0.84 in2		(Eqn D3-1)
	ϕ_{tr} = 0.75	LRFD	(Eqn D2-2)
Tensile Rupture:	$T_{allow\text{-}rupture} = \phi_{t\text{-}r} * F_u * A_e$ = 36.70 kip		(Eqn D2-2)
	$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) = 32.40 kip LRFD		(Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area:	A_{gv} =(4.0in)*(0.25in) = 1.00 in2		
	Φ_{yv} = 1.00	LRFD	(Eqn J4-3)
Shear Yielding:	$V_{allow\text{-}yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 21.60 kip		(Eqn J4-3)
	Φ_{rv} = 0.75	LRFD	(Eqn J4-4)
Net Area:	A_{nv} = (4.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.84 in2		(Sec B4.3)
Shear Rupture:	$V_{allow\text{-}rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 29.36 kip		(Eqn J4-4)
	V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) = 21.60 kip LRFD		(Horizontal Component)

**Note: Bending of Bracket is Considered within the Prying Calculation

Bending Moment on Vertical Leg:

Plastic Modulus:	$Z = \frac{bd^2}{4} = \frac{4*0.25^2}{4}$ = 0.0625 in3		
	ϕ_b = 0.9	LRFD	(Sec F1)
	$M_{allow} = \phi * F_y * Z$ = 2.025 kip-in		
Moment Arm:	$Moment_{arm}$ = 1.375 in		(Eqn F11-1)
Allowable Load:	$P_{allow} = \frac{M_{allow}}{Moment_{arm}}$ = 1.473 kip LRFD	(Vertical Component)	

Bending Moment on Lower Leg (Side B):

Plastic Modulus:	$Z = \frac{bd^2}{4} = \frac{4*0.25^2}{4}$ = 0.0625 in3		
	ϕ_b = 0.9	LRFD	(Sec F1)
	$M_{allow} = \phi * F_y * Z$ = 2.025 kip-in		(Eqn F11-1)
Moment Arm:	$Moment_{arm}$ = 1.375 in		
Allowable Load:	$P_{allow} = \frac{M_{allow}}{Moment_{arm}}$ = 1.473 kip LRFD	(Horizontal Component)	

Piece #33144A - L3" x 3" x 1/4" x 0'-4" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity (ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 2 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**1206 lbf**	**420 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**2002 lbf**	**662 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**1666 lbf**	**818 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**2116 lbf**	**1096 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**2042 lbf**	**1794 lbf**
		3/16"	1439 lbf		2878 lbf

Bolts thru Angle Bracket to Concrete Slab or Concrete-Filled Profile Steel Deck Failure Modes:

Hilti Kwik Bolt-TZ anchors may be installed in cracked or uncracked concrete or concrete-filled steel deck

Bolt type: *A307 Gr. A (Common Bolts), bearing type connection*

Nominal Tensile Strength: F_t = 45 ksi

Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Shear Strength, Threads Excluded: F_v = 27 ksi (Table J3.2 AISC 14th)

Bolt Diameter: d_{bcd} = 0.50 in

Bolt Area: $A_{bcd} = 0.25*\pi*d_{bcd}^2$ = 0.20 in2

Resistance factor for bolt tension or shear: ϕ= 0.75 LRFD

Shear Capacity of single bearing type bolt: $V_{allow\text{-}bolt} = \phi*F_v*A_{bcd}$ = 6.63 kip

Tension Capacity of single bearing type bolt: $T_{allow\text{-}bolt} = \phi*F_t*A_{bcd}$ = 3.98 kip

Bolt bearing strength at bracket connection: (Section J3.10) F_u = 58 ksi

Bolt edge distance: edge-dist = 2.00 in

Bolt hole diameter: bh = 0.625 in

Clear distance between edge of hole and edge of adjacent hole or edge of plate: L_c = edge-dist -0.5*bh = 1.69 in2

Single end bolt bearing capacity: $Bolt_{br'g} = min[(1.5*L_c*th_{plate}*F_u),(3.0*d_{bcd}*th_{plate}*F_u)]$ = 21.75 kip

$Bolt_{allow\text{-}bolt} = \phi*Bolt_{bearing}$ 16.31 kip LRFD

Piece #33144A - L3" x 3" x 1/4" x 0'-4" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

See Hilti Excel output for Allowable Combined Tension and Shear Loads for Concrete Over Metal Deck (LRFD)
See Hilti Profis output for Allowable Combined Tension and Shear Loads (LRFD)

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on Concrete over Metal Deck

$\phi N_n =$ *390 lbf*

$\phi V_n =$ *440 lbf*

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on 4' min Concrete Slab

$\phi N_n =$ *950 lbf*

$\phi V_n =$ *1322 lbf*

Given that the Load and Resistance Factor Design calculated above for the angle brackets and bolts far outweigh the capacity of the concrete anchors, the allowable loading to the concrete anchors govern.
Note also that the capacity of the concrete anchors shown here is based on utilizing Section D.3.3.4.3 (d) of ACI 318-11, which requires the inclusion of the Omega factor when determining the loads applied to the anchorage.
Do to the complication of the requirement (per ACI 318-11) to determine the concrete anchorage capacity utilizing LRFD as well as Section 4.2 in ESR-1917 the allowable load for this Piece is given in LRFD only.

Overall Capacity of Seismic Load - Piece #33143A - 3" x 3" x 1/4" x 0'-4" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	390 lbf	Tension	Vertical & Horizontal Allowable Load - (LRFD)
$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	440 lbf	Shear	
$Load_{allowable\text{-}total\text{-}on\text{-}4''\ min\text{-}concrete\text{-}slab}$ =	950 lbf	Tension	
$Load_{allowable\text{-}total\text{-}on\text{-}4''\ min\text{-}concrete\text{-}slab}$ =	1322 lbf	Shear	

R. F. NELSON
& ASSOCIATES
Structural Engineers

1/4" BRACKETS

Date:	5/7/2019
Job No.:	18-001
Sheet:	3 (1)

Design Scope:

Calculations to determine the Load and Resistance Factor Design of the seismic restraint as detailed by 9.0 SeismicCo., 1/4" Floor & Wall Brackets (included within this calculation package for reference).

Prying of Piece #33146A - L3" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

AISC 14 Edition Part 9, p.9-10 of Specification

Bracket Thickness:	$th_{bracket}$ =	0.25 in	
Nominal Tensile Strength:	F_t =	60 ksi	*(Carbon Steel)*
Ultimate Strength:	F_u =	58 ksi	
Anchor Spacing	s =	4.00	
Anchor Diameter: [redacted]	d_b =	0.375 in	
Steel strength in tension:	N_{sa} =	*6.500 kip*	
Max distance from bolt to applied force:	b =	1.375 in	
Tributary length to each bolt:	*p = max 2b, but ≤ s*	2.75 in	
Adjusted prying distance:	$b' = \left[b - \frac{d_b}{2}\right] =$	1.19 in	(Eq. 9-21)

Resistance factor for prying:
Ω_{pr} = *1.67 ASD*
Φ_{pr} = *0.90 LRFD*
Φ_t = *0.75 LRFD*

Maximum bolt force for prying: $T = \dfrac{\Phi_{pr} * F_u * th_{bracket}^2 * p}{2 * b} =$ 3.26 kip (Eq. 9-22a)

Available tensile strength of single bolt: $B = \Phi_t * N_{sa} =$ *4.88 kip* *(per ESR-1917)*

$$t_c = \sqrt{\frac{4 * B * b'}{\Phi_{LRFD} * p * F_u}} = 0.440 \text{ in}$$ (Eq. 9-30a)

T_{avail} = *BQ = 2.86 kip* (Eq. 9-31)

Q = 0.587

0 ≤ a' ≤ 1, Q = $\left(\frac{t}{t_c}\right)^2 (1 + \delta * \alpha') =$ *0.587* (Eq. 9-33)

a'<, Q = 1

a'>1, Q = $\left(\frac{t}{t_c}\right)^2 (1 + \delta) =$ *0.587* (Eq. 34)

Width of hole along length of plate: d' = *0.500 in*

Distance from bolt centerline to edge of plate: a = *1.50 in*

Additional variables for prying calculation:

$\delta = 1 - \frac{d'}{p} =$ *0.82* *Eq. (9-24)*

$a' = a + \frac{d_b}{2} =$ *1.69 in* $\leq \left(1.25 * b * \frac{d_b}{2}\right) =$ *1.91 in* *Eq. (9-27)*

$\rho = \frac{b'}{a'} =$ *0.70* *Eq. (9-26)*

$\beta = \frac{1}{\rho} * \left(\frac{B}{T} - 1\right) =$ *1.00 in* *Eq. (9-25)*

$\alpha' = if\left[\beta => 1, 1, \min\left[1, \frac{1}{\delta} * \left(\frac{\beta}{1-\beta}\right)\right]\right] =$ *1.00*

Required bracket thickness to ensure an acceptable combination of fitting strength, stiffness, and bolt strength:

$$t_{min} = \sqrt{\frac{4 * T * b'}{\Phi_{pr} * p * F_u * (1 + \delta * \alpha')}} =$$ *0.23 in LRFD* *(Eq. 9-23a)*

Thickness of Bracket is 0.25 in - therefore, Prying OK

Piece #33146A - L3" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness: $th_{bracket}$ = 0.2500 in

Yield Strength: F_y = 36 ksi (Table 2-4)

Ultimate Strength: F_u = 58 ksi

Gross Area: A_g = **(6.0in)*(0.25in)** = 1.50 in2

$\phi_{t\text{-}y}$ = 0.9 LRFD (Eqn D2.1)

Tensile Yielding: $T_{allow\text{-}yielding} = \phi_{t\text{-}y} * F_y * A_g$ = 48.60 kip (Eqn D2-1)

Shear Lag Factor: $U =$ 1.0 (Table D3.1)

Net Area: A_n = (6.0in)*(0.25in)-(4*0.3125in)*(0.25in) = 1.19 in2 (Sec B4.3)

Effective Net Area: A_e = $A_n * U$ = 1.19 in2 (Eqn D3-1)

ϕ_{tr} = 0.75 LRFD (Eqn D2-2)

Tensile Rupture: $T_{allow\text{-}rupture} = \phi_{t\text{-}r} * F_u * A_e$ = 51.66 kip (Eqn D2-2)

$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) = 48.60 kip LRFD (Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area: A_{gv} =(6.0in)*(0.25in) = 1.50 in2

Φ_{yv} = 1.00 LRFD (Eqn J4-3)

Shear Yielding: $V_{allow\text{-}yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 32.40 kip (Eqn J4-3)

Φ_{rv} = 0.75 LRFD (Eqn J4-4)

Net Area: A_{nv} = (6.0in)*(0.25in)-(4*0.3125in)*(0.25in) = 1.19 in2 (Sec B4.3)

Shear Rupture: $V_{allow\text{-}rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 41.33 kip (Eqn J4-4)

V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) = 32.40 kip LRFD *(Horizontal Component)*

**Note: Bending of Bracket is Considered within the Prying Calculation

Bending Moment on Vertical Leg:

Plastic Modulus: $Z = \frac{bd^2}{4} : \frac{6*0.25^2}{4} =$ 0.0938 in3

ϕ_b = 0.9 LRFD (Sec F1)

$M_{allow} = \phi * F_y * Z$ = 3.038 kip-in

Moment Arm: $Moment_{arm}$ = 1.375 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 2.209 kip LRFD (Vertical Component)

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{6*0.25^2}{4} =$ 0.0938 in3

ϕ_b = 0.9 LRFD (Sec F1)

$M_{allow} = \phi * F_y * Z$ = 3.038 kip-in (Eqn F11-1)

Moment Arm: $Moment_{arm}$ = 1.375 in

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 2.209 kip LRFD (Horizontal Component)

Piece #33146A - L3" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity
(ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 4 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**2412 lbf**	**840 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	4004 lbf	1324 lbf
0.060-0.060	833 lbf	0.075	409 lbf	3332 lbf	1636 lbf
0.075-0.078	1058 lbf	0.105	548 lbf	4232 lbf	2192 lbf
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	4084 lbf	3588 lbf
		3/16"	1439 lbf		5756 lbf

Bolts thru Angle Bracket to Concrete Slab or Concrete-Filled Profile Steel Deck Failure Modes:

Hilti Kwik Bolt-TZ anchors may be installed in cracked or uncracked concrete or concrete-filled steel deck

Bolt type: *A307 Gr. A (Common Bolts), bearing type connection*

Nominal Tensile Strength: F_t = 45 ksi

Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Shear Strength, Threads Excluded: F_v = 27 ksi (Table J3.2 AISC 14th)

Bolt Diameter: d_{bcd} = 0.50 in

Bolt Area: $A_{bcd} = 0.25*\pi*d_{bcd}^2$ = 0.20 in2

Resistance factor for bolt tension or shear: ϕ= 0.75 LRFD

Shear Capacity of single bearing type bolt: $V_{allow\text{-}bolt} = \phi*F_v*A_{bcd}$ = 3.98 kip

Tension Capacity of single bearing type bolt: $T_{allow\text{-}bolt} = \phi*F_t*A_{bcd}$ = 6.63 kip

Bolt bearing strength at bracket connection: (Section J3.10) F_u = 58 ksi

Bolt edge distance: edge-dist = 1.00 in

Bolt hole diameter: bh = 0.625 in

Clear distance between edge of hole and edge of adjacent hole or edge of plate: L_c = edge-dist -0.5*bh = 0.69 in2

Single end bolt bearing capacity: $Bolt_{br'g} = min[(1.5*L_c*th_{plate}*F_u),(3.0*d_{bcd}*th_{plate}*F_u)]$ = 14.95 kip

2*$Bolt_{allow\text{-}bolt}$ = $2*\phi*Bolt_{bearing}$ 22.43 kip LRFD

Piece #33146A - L3" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

See Hilti Excel output for Allowable Combined Tension and Shear Loads for Concrete Over Metal Deck (LRFD)
See Hilti Profis output for Allowable Combined Tension and Shear Loads for Concrete Slab (LRFD)

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on Concrete over Metal Deck

$\phi N_n =$ 570 lbf

$\phi V_n =$ 1100 lbf

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on 4' min Concrete Slab

$\phi N_n =$ 1275 lbf

$\phi V_n =$ 2552 lbf

Given that the Load and Resistance Factor Design calculated above for the angle brackets and bolts far outweigh the capacity of the concrete anchors, the allowable loading to the concrete anchors govern.
Note also that the capacity of the concrete anchors shown here is based on utilizing Section D.3.3.4.3 (d) of ACI 318-11, which requires the inclusion of the Omega factor when determining the loads applied to the anchorage.
Do to the complication of the requirement (per ACI 318-11) to determine the concrete anchorage capacity utilizing LRFD as well as Section 4.2 in ESR-1917 the allowable load for this Piece is given in LRFD only.

Overall Capacity of Seismic Load - Piece #33146A - 3" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	570 lbf	Tension	Vertical & Horizontal Allowable Load - (LRFD)
$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	1100 lbf	Shear	
$Load_{allowable\text{-}total\text{-}on\text{-}4"\ min\text{-}concrete\text{-}slab}$ =	1275 lbf	Tension	
$Load_{allowable\text{-}total\text{-}on\text{-}4"\ min\text{-}concrete\text{-}slab}$ =	2552 lbf	Shear	

Design Scope:

Calculations to determine the Load and Resistance Factor Design of the seismic restraint as detailed by 9.0 SeismicCo., 1/4" Floor & Wall Brackets (included within this calculation package for reference).

Prying of Piece #33148A - L3" x 3" x 1/4" x 0'-8" Steel Angle Bracket (A36 min)
w/ (5) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (3) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

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Bracket Thickness:	$th_{bracket}$ =	0.25 in	
Nominal Tensile Strength:	F_t =	60 ksi	*(Carbon Steel)*
Ultimate Strength:	F_u =	58 ksi	
Anchor Spacing	s =	3.00	
Anchor Diameter: [redacted]	d_b =	0.375 in	
Steel strength in tension:	N_{sa} =	*6.500 kip*	
Max distance from bolt to applied force:	b =	1.375 in	
Tributary length to each bolt:	*p = max 2b, but ≤ s*	2.75 in	
Adjusted prying distance:	$b' = \left[b - \frac{d_b}{2}\right] =$	1.19 in	(Eq. 9-21)

Resistance factor for prying:
Ω_{pr} = *1.67 ASD*
Φ_{pr} = *0.90 LRFD*
Φ_t = *0.75 LRFD*

Maximum bolt force for prying: $T = \frac{\Phi_{pr} * F_u * th_{bracket}^2 * p}{2 * b} =$ 3.26 kip (Eq. 9-22a)

Available tensile strength of single bolt: $B = \Phi_t * N_{sa} =$ *4.88 kip* *(per ESR-1917)*

$$t_c = \sqrt{\frac{4 * B * b'}{\Phi_{LRFD} * p * F_u}} = 0.440 \text{ in}$$ (Eq. 9-30a)

T_{avail} = BQ = *2.86 kip* (Eq. 9-31)

Q = *0.587*

a'<, Q = *1*

0 ≤ a' ≤ 1, Q = $\left(\frac{t}{t_c}\right)^2 (1 + \delta * \alpha') =$ *0.587* (Eq. 9-33)

a'>1, Q = $\left(\frac{t}{t_c}\right)^2 (1 + \delta) =$ *0.587* (Eq. 34)

Width of hole along length of plate: d' = *0.500 in*

Distance from bolt centerline to edge of plate: a = *1.50 in*

Additional variables for prying calculation:

$\delta = 1 - \frac{d'}{p} =$ *0.82* *Eq. (9-24)*

$a' = a + \frac{d_b}{2} =$ *1.69 in* $\le \left(1.25 * b * \frac{d_b}{2}\right) =$ *1.91 in* *Eq. (9-27)*

$\rho = \frac{b'}{a'} =$ *0.70* *Eq. (9-26)*

$\beta = \frac{1}{\rho} * \left(\frac{B}{T} - 1\right) =$ *1.00 in* *Eq. (9-25)*

$\alpha' = if\left[\beta => 1, 1, \min\left[1, \frac{1}{\delta} * \left(\frac{\beta}{1-\beta}\right)\right]\right] =$ *1.00*

Required bracket thickness to ensure an acceptable combination of fitting strength, stiffness, and bolt strength:

$$t_{min} = \sqrt{\frac{4 * T * b'}{\Phi_{pr} * p * F_u * (1 + \delta * \alpha')}} =$$ *0.23 in LRFD* *(Eq. 9-23a)*

Thickness of Bracket is 0.25 in - therefore, Prying OK

Piece #33148A - L3" x 3" x 1/4" x 0'-8" Steel Angle Bracket (A36 min)
w/ (5) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (3) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness: $th_{bracket}$ = 0.2500 in

Yield Strength: F_y = 36 ksi (Table 2-4)

Ultimate Strength: F_u = 58 ksi

Gross Area: A_g = **(8.0in)*(0.25in)** = 2.00 in2

$\phi_{t\text{-}y}$ = 0.9 LRFD (Eqn D2.1)

Tensile Yielding: $T_{allow\text{-}yielding} = \phi_{t\text{-}y} * F_y * A_g$ = 64.80 kip (Eqn D2-1)

Shear Lag Factor: $U =$ 1.0 (Table D3.1)

Net Area: A_n = (8.0in)*(0.25in)-(5*0.3125in)*(0.25in) = 1.61 in2 (Sec B4.3)

Effective Net Area: A_e = $A_n * U$ = 1.61 in2 (Eqn D3-1)

ϕ_{tr} = 0.75 LRFD (Eqn D2-2)

Tensile Rupture: $T_{allow\text{-}rupture} = \phi_{t\text{-}r} * F_u * A_e$ = 70.01 kip (Eqn D2-2)

$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) = 64.80 kip LRFD (Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area: A_{gv} =(8.0in)*(0.25in) = 2.00 in2

Φ_{yv} = 1.00 LRFD (Eqn J4-3)

Shear Yielding: $V_{allow\text{-}yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 43.20 kip (Eqn J4-3)

Φ_{rv} = 0.75 LRFD (Eqn J4-4)

Net Area: A_{nv} = (8.0in)*(0.25in)-(5*0.3125in)*(0.25in) = 1.61 in2 (Sec B4.3)

Shear Rupture: $V_{allow\text{-}rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 56.01 kip (Eqn J4-4)

V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) = 43.20 kip LRFD (Horizontal Component)

**Note: Bending of Bracket is Considered within the Prying Calculation

Bending Moment on Vertical Leg (Side A):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{8*0.25^2}{4} =$ 0.1250 in3

ϕ_b = 0.9 LRFD (Sec F1)

$M_{allow} = \phi * F_y * Z$ = 4.050 kip-in

Moment Arm: $Moment_{arm}$ = 1.375 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 2.945 kip LRFD (Vertical Component)

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{8*0.25^2}{4} =$ 0.1250 in3

ϕ_b = 0.9 LRFD (Sec F1)

$M_{allow} = \phi * F_y * Z$ = 4.050 kip-in (Eqn F11-1)

Moment Arm: $Moment_{arm}$ = 1.375 in

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 2.945 kip LRFD (Horizontal Component)

Piece #33148A - L3" x 3" x 1/4" x 0'-8" Steel Angle Bracket (A36 min)
w/ (5) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (3) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity (ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 5 $V_{allow}*N$	$T_{allow}*N$
0.048-0.048	603 lbf	0.048	210 lbf	**3015 lbf**	**1050 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**5005 lbf**	**1655 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**4165 lbf**	**2045 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	5290 lbf	2740 lbf
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	5105 lbf	4485 lbf
		3/16"	1439 lbf		7195 lbf

Bolts thru Angle Bracket to Concrete Slab or Concrete-Filled Profile Steel Deck Failure Modes:

Hilti Kwik Bolt-TZ anchors may be installed in cracked or uncracked concrete or concrete-filled steel deck

Bolt type: *A307 Gr. A (Common Bolts), bearing type connection*

Nominal Tensile Strength: F_t = 45 ksi

Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Shear Strength, Threads Excluded: F_v = 27 ksi (Table J3.2 AISC 14th)

Bolt Diameter: d_{bcd} = 0.50 in

Bolt Area: $A_{bcd} = 0.25*\pi*d_{bcd}^2$ = 0.20 in2

Resistance factor for bolt tension or shear: ϕ= 0.75 LRFD

Shear Capacity of single bearing type bolt: $V_{allow\text{-}bolt} = \phi*F_v*A_{bcd}$ = 7.07 kip

Tension Capacity of single bearing type bolt: $T_{allow\text{-}bolt} = \phi*F_t*A_{bcd}$ = 11.78 kip

Bolt bearing strength at bracket connection: (Section J3.10) F_u = 58 ksi

Bolt edge distance: edge-dist = 1.00 in

Bolt hole diameter: bh = 0.625 in

Clear distance between edge of hole and edge of adjacent hole or edge of plate: L_c = edge-dist -0.5*bh = 0.69 in2

Single bolt bearing capacity: $Bolt_{br'g} = \min[(1.5*L_c*th_{plate}*F_u),(3.0*d_{bcd}*th_{plate}*F_u)]$ = 14.95 kip

$3*Bolt_{allow\text{-}bolt} = 3*\phi*Bolt_{bearing}$ 33.64 kip LRFD

Piece #33148A - L3" x 3" x 1/4" x 0'-8" Steel Angle Bracket (A36 min)
w/ (5) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (3) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

See Hilti Excel output for Allowable Combined Tension and Shear Loads for Concrete Over Metal Deck (LRFD)
See Hilti Profis output for Allowable Combined Tension and Shear Loads for Concrete Slab (LRFD)

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on Concrete over Metal Deck

$\phi N_n =$ 650 lbf

$\phi V_n =$ 1220 lbf

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on 4' min Concrete Slab

$\phi N_n =$ 1400 lbf

$\phi V_n =$ 3130 lbf

Given that the Load and Resistance Factor Design calculated above for the angle brackets and bolts far outweigh the capacity of the concrete anchors, the allowable loading to the concrete anchors govern.
Note also that the capacity of the concrete anchors shown here is based on utilizing Section D.3.3.4.3 (d) of ACI 318-11, which requires the inclusion of the Omega factor when determining the loads applied to the anchorage.
Do to the complication of the requirement (per ACI 318-11) to determine the concrete anchorage capacity utilizing LRFD as well as Section 4.2 in ESR-1917 the allowable load for this Piece is given in LRFD only.

Overall Capacity of Seismic Load - Piece #33148A - 3" x 3" x 1/4" x 0'-8" Steel Angle Bracket (A36 min)
w/ (5) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (3) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ = 650 lbf	Tension	Vertical & Horizontal Allowable Load - (LRFD)
$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ = 1220 lbf	Shear	
$Load_{allowable\text{-}total\text{-}on\text{-}4\text{"}\ min\text{-}concrete\text{-}slab}$ = 1400 lbf	Tension	
$Load_{allowable\text{-}total\text{-}on\text{-}4\text{"}\ min\text{-}concrete\text{-}slab}$ = 3130 lbf	Shear	

Design Scope:

Calculations to determine the Load and Resistance Factor Design of the seismic restraint as detailed by 9.0 SeismicCo., 1/4" Floor & Wall Brackets (included within this calculation package for reference).

Prying of Piece #43143A - L4" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

AISC 14 Edition Part 9, p.9-10 of Specification

Bracket Thickness:	$th_{bracket}$ =	0.25 in	
Nominal Tensile Strength:	F_t =	60 ksi	*(Carbon Steel)*
Ultimate Strength:	F_u =	58 ksi	
Anchor Spacing	s =	0.00	
Anchor Diameter: [redacted]	d_b =	0.375 in	
Steel strength in tension:	N_{sa} =	*6.500 kip*	
Max distance from bolt to applied force:	b =	1.375 in	
Tributary length to each bolt:	*p = max 2b, but ≤ s*	2.75 in	
Adjusted prying distance:	$b' = \left[b - \frac{d_b}{2}\right] =$	1.19 in	(Eq. 9-21)

Resistance factor for prying:
Ω_{pr} = *1.67 ASD*
Φ_{pr} = *0.90 LRFD*
Φ_t = *0.75 LRFD*

Maximum bolt force for prying: $T = \frac{\Phi_{pr} * F_u * th_{bracket}^2 * p}{2*b} =$ 3.26 kip (Eq. 9-22a)

Available tensile strength of single bolt: $B = \Phi_t * N_{sa} =$ *4.88 kip* *(per ESR-1917)*

$t_c = \sqrt{\frac{4*B*b'}{\Phi_{LRFD} * p * F_u}} =$ 0.440 in (Eq. 9-30a)

T_{avail} = BQ = *2.86 kip* (Eq. 9-31)

Q = *0.587*

a'<, Q = *1*

0 ≤ a' ≤ 1, Q = $\left(\frac{t}{t_c}\right)^2 (1+\delta*\alpha') =$ *0.587* (Eq. 9-33)

a'>1, Q = $\left(\frac{t}{t_c}\right)^2 (1+\delta) =$ *0.587* (Eq. 34)

Width of hole along length of plate:	d' =	*0.500 in*
Distance from bolt centerline to edge of plate:	a =	*1.50 in*

Additional variables for prying calculation:

$\delta = 1 - \frac{d'}{p} =$ 0.82 *Eq. (9-24)*

$a' = a + \frac{d_b}{2} =$ 1.69 in *Eq. (9-27)* $\leq \left(1.25*b*\frac{d_b}{2}\right) =$ *1.91 in*

$\rho = \frac{b'}{a'} =$ 0.70 *Eq. (9-26)*

$\beta = \frac{1}{\rho} * \left(\frac{B}{T} - 1\right) =$ *1.00 in* *Eq. (9-25)*

$\alpha' = if\left[\beta => 1, 1, \min\left[1, \frac{1}{\delta} * \left(\frac{\beta}{1-\beta}\right)\right]\right] =$ *1.00*

Required bracket thickness to ensure an acceptable combination of fitting strength, stiffness, and bolt strength:

$t_{min} = \sqrt{\frac{4*T*b'}{\Phi_{pr} * p * F_u * (1+\delta*\alpha')}} =$ *0.23 in LRFD* *(Eq. 9-23a)*

Thickness of Bracket is 0.25 in - therefore, Prying OK

Piece #43143A - L4" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness:	$th_{bracket}$ = 0.2500 in		
Yield Strength:	F_y = *36 ksi*		*(Table 2-4)*
Ultimate Strength:	F_u = *58 ksi*		
Gross Area:	A_g = ***(3.0in)*(0.25in)*** = *0.75 in2*		
	ϕ_{t-y} = *0.9*	*LRFD*	(Eqn D2.1)
Tensile Yielding:	$T_{allow-yielding} = \phi_{t-y} * F_y * A_g$ = 24.30 kip		(Eqn D2-1)
Shear Lag Factor:	U = *1.0*		(Table D3.1)
Net Area:	A_n = *(3.0in)*(0.25in)-(2*0.3125in)*(0.25in)* = *0.59 in2*		(Sec B4.3)
Effective Net Area:	A_e = $A_n * U$ =	*0.59 in2*	(Eqn D3-1)
	ϕ_{tr} = *0.75*	*LRFD*	(Eqn D2-2)
Tensile Rupture:	$T_{allow-rupture} = \phi_{t-r} * F_u * A_e$ = 25.83 kip		(Eqn D2-2)
	$T_{allow-bracket}$ = min($T_{allow-yielding}$, $T_{allow-rupture}$) =	24.30 kip LRFD	(Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area:	A_{gv} =*(3.0in)*(0.25in)* = *0.75 in2*		
	Φ_{yv} = *1.00*	*LRFD*	*(Eqn J4-3)*
Shear Yielding:	$V_{allow-yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = *16.20 kip*		*(Eqn J4-3)*
	Φ_{rv} = *0.75*	*LRFD*	*(Eqn J4-4)*
Net Area:	A_{nv} = *(3.0in)*(0.25in)-(2*0.3125in)*(0.25in)* = *0.59 in2*		*(Sec B4.3)*
Shear Rupture:	$V_{allow-rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = *20.66 kip*		*(Eqn J4-4)*
	V_{allow} = min($V_{allow-yielding}$, $V_{allow-rupture}$) = 16.20 kip LRFD		*(Horizontal Component)*

**Note: Bending of Bracket is Considered within the Prying Calculation

Bending Moment on Vertical Leg:

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ *0.0469 in3*

ϕ_b = *0.9* *LRFD* *(Sec F1)*

$M_{allow} = \phi * F_y * Z$ = *1.519 kip-in*

Moment Arm: $Moment_{arm}$ = *2.875 in* *(Eqn F11-1)*

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ *0.528 kip LRFD* *(Vertical Component)*

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ *0.0469 in3*

ϕ_b = *0.9* *LRFD* *(Sec F1)*

$M_{allow} = \phi * F_y * Z$ = *1.519 kip-in* *(Eqn F11-1)*

Moment Arm: $Moment_{arm}$ = *1.375 in*

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ *1.105 kip LRFD* *(Horizontal Component)*

Piece #43143A - L4" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity
(ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 2 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**1206 lbf**	**420 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**2002 lbf**	**662 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**1666 lbf**	**818 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**2116 lbf**	**1096 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**2042 lbf**	1794 lbf
		3/16"	1439 lbf		2878 lbf

Bolts thru Angle Bracket to Concrete Slab or Concrete-Filled Profile Steel Deck Failure Modes:

Hilti Kwik Bolt-TZ anchors may be installed in cracked or uncracked concrete or concrete-filled steel deck

Bolt type: *A307 Gr. A (Common Bolts), bearing type connection*

Nominal Tensile Strength: F_t = 45 ksi

Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Shear Strength, Threads Excluded: F_v = 27 ksi (Table J3.2 AISC 14th)

Bolt Diameter: d_{bcd} = 0.50 in

Bolt Area: $A_{bcd} = 0.25 * \pi * d_{bcd}^2$ = 0.20 in2

Resistance factor for bolt tension or shear: ϕ = 0.75 LRFD

Shear Capacity of single bearing type bolt: $V_{allow\text{-}bolt} = \phi * F_v * A_{bcd}$ = 3.98 kip

Tension Capacity of single bearing type bolt: $T_{allow\text{-}bolt} = \phi * F_t * A_{bcd}$ = 6.63 kip

Bolt bearing strength at bracket connection: (Section J3.10) F_u = 58 ksi

Bolt edge distance: edge-dist = 1.50 in

Bolt hole diameter: bh = 0.625 in

Clear distance between edge of hole and edge of adjacent hole or edge of plate: L_c = edge-dist -0.5*bh = 1.19 in2

Single end bolt bearing capacity: $Bolt_{br'g} = min[(1.5*L_c*th_{plate}*F_u),(3.0*d_{bcd}*th_{plate}*F_u)]$ = 21.75 kip

$Bolt_{allow\text{-}bolt} = \phi * Bolt_{bearing}$ 16.31 kip LRFD

Piece #43143A - L4" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

See Hilti Excel output for Allowable Combined Tension and Shear Loads for Concrete Over Metal Deck (LRFD)
See Hilti Profis output for Allowable Combined Tension and Shear Loads for Concrete Slab (LRFD)

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on Concrete over Metal Deck

$\phi N_n =$ 390 lbf

$\phi V_n =$ 440 lbf

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on 4' min Concrete Slab

$\phi N_n =$ 950 lbf

$\phi V_n =$ 1322 lbf

Given that the Load and Resistance Factor Design calculated above for the angle brackets and bolts far outweigh the capacity of the concrete anchors, the allowable loading to the concrete anchors govern.
Note also that the capacity of the concrete anchors shown here is based on utilizing Section D.3.3.4.3 (d) of ACI 318-11, which requires the inclusion of the Omega factor when determining the loads applied to the anchorage.
Do to the complication of the requirement (per ACI 318-11) to determine the concrete anchorage capacity utilizing LRFD as well as Section 4.2 in ESR-1917 the allowable load for this Piece is given in LRFD only.

Overall Capacity of Seismic Load - Piece #43143A - 4" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	390 lbf	Tension	Vertical & Horizontal Allowable Load - (LRFD)
$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	440 lbf	Shear	
$Load_{allowable\text{-}total\text{-}on\text{-}4\text{"}\ min\text{-}concrete\text{-}slab}$ =	950 lbf	Tension	
$Load_{allowable\text{-}total\text{-}on\text{-}4\text{"}\ min\text{-}concrete\text{-}slab}$ =	1322 lbf	Shear	

Design Scope:

Calculations to determine the Load and Resistance Factor Design of the seismic restraint as detailed by 9.0 SeismicCo., 1/4" Floor & Wall Brackets (included within this calculation package for reference).

Prying of Piece #43146A - L4" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

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Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Tensile Strength: F_t = 60 ksi *(Carbon Steel)*

Ultimate Strength: F_u = 58 ksi

Anchor Spacing s = 4.00

Anchor Diameter: [redacted] d_b = 0.375 in

Steel strength in tension: N_{sa} = *6.500 kip*

Max distance from bolt to applied force: b = 1.375 in

Tributary length to each bolt: *p = max 2b, but ≤ s* 2.75 in

Adjusted prying distance: $b' = \left[b - \frac{d_b}{2}\right] =$ 1.19 in (Eq. 9-21)

Resistance factor for prying:
Ω_{pr} = *1.67 ASD*
Φ_{pr} = *0.90 LRFD*
Φ_t = *0.75 LRFD*

Maximum bolt force for prying: $T = \frac{\Phi_{pr} * F_u * th_{bracket}{}^2 * p}{2*b} =$ 3.26 kip (Eq. 9-22a)

Available tensile strength of single bolt: $B = \Phi_t * N_{sa} =$ *4.88 kip* *(per ESR-1917)*

$t_c = \sqrt{\frac{4*B*b'}{\Phi_{LRFD} * p * F_u}} =$ 0.440 in (Eq. 9-30a)

T_{avail} *= BQ = 2.86 kip* (Eq. 9-31)

Q = 0.587 *a'<, Q = 1*

0 ≤ a' ≤ 1, Q = $\left(\frac{t}{t_c}\right)^2 (1+\delta*\alpha') =$ *0.587* (Eq. 9-33)

a'>1, Q = $\left(\frac{t}{t_c}\right)^2 (1+\delta) =$ *0.587* (Eq. 34)

Width of hole along length of plate: d' = *0.500 in*

Distance from bolt centerline to edge of plate: a = *1.50 in*

Additional variables for prying calculation:

$\delta = 1 - \frac{d'}{p} =$ *0.82* *Eq. (9-24)*

$a' = a + \frac{d_b}{2} =$ *1.69 in* $\leq \left(1.25*b*\frac{d_b}{2}\right) =$ *1.91 in* *Eq. (9-27)*

$\rho = \frac{b'}{a'} =$ *0.70* *Eq. (9-26)*

$\beta = \frac{1}{\rho}*\left(\frac{B}{T}-1\right) =$ *1.00 in* *Eq. (9-25)*

$\alpha' = if\left[\beta => 1, 1, \min\left[1, \frac{1}{\delta}*\left(\frac{\beta}{1-\beta}\right)\right]\right] =$ *1.00*

Required bracket thickness to ensure an acceptable combination of fitting strength, stiffness, and bolt strength:

$t_{min} = \sqrt{\frac{4*T*b'}{\Phi_{pr} * p * F_u * (1+\delta*\alpha')}} =$ *0.23 in LRFD* *(Eq. 9-23a)*

Thickness of Bracket is 0.25 in - therefore, Prying OK

Piece #43146A - L4" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness:	$th_{bracket}$ = 0.2500 in		
Yield Strength:	F_y = 36 ksi		(Table 2-4)
Ultimate Strength:	F_u = 58 ksi		
Gross Area:	A_g = **(6.0in)*(0.25in)** = 1.50 in2		
	$\phi_{t\text{-}y}$ = 0.9	LRFD	(Eqn D2.1)
Tensile Yielding:	$T_{allow\text{-}yielding}$ = $\phi_{t\text{-}y}$ * F_y * A_g = 48.60 kip		(Eqn D2-1)
Shear Lag Factor:	U = 1.0		(Table D3.1)
Net Area:	A_n = (6.0in)*(0.25in)-(4*0.3125in)*(0.25in) = 1.19 in2		(Sec B4.3)
Effective Net Area:	A_e = A_n*U =	1.19 in2	(Eqn D3-1)
	ϕ_{tr} = 0.75	LRFD	(Eqn D2-2)
Tensile Rupture:	$T_{allow\text{-}rupture}$ = $\phi_{t\text{-}r}$ * F_u * A_e = 51.66 kip		(Eqn D2-2)
	$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) =	48.60 kip LRFD	(Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area:	A_{gv} =(6.0in)*(0.25in) = 1.50 in2		
	Φ_{yv} = 1.00	LRFD	(Eqn J4-3)
Shear Yielding:	$V_{allow\text{-}yielding}$ = ϕ_{yv} *0.60* F_y * A_{gv} =	32.40 kip	(Eqn J4-3)
	Φ_{rv} = 0.75	LRFD	(Eqn J4-4)
Net Area:	A_{nv} = (6.0in)*(0.25in)-(4*0.3125in)*(0.25in) = 1.19 in2		(Sec B4.3)
Shear Rupture:	$V_{allow\text{-}rupture}$ = ϕ_{rv} *0.60* F_u * A_{nv} =	41.33 kip	(Eqn J4-4)
	V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) =	32.40 kip LRFD	(Horizontal Component)

**Note: Bending of Bracket is Considered within the Prying Calculation

Bending Moment on Vertical Leg:

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{6*0.25^2}{4} =$ 0.0938 in3

ϕ_b = 0.9 LRFD (Sec F1)

M_{allow} = ϕ * F_y *Z = 3.038 kip-in

Moment Arm: $Moment_{arm}$ = 2.875 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 1.057 kip LRFD (Vertical Component)

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{6*0.25^2}{4} =$ 0.0938 in3

ϕ_b = 0.9 LRFD (Sec F1)

M_{allow} = ϕ * F_y *Z = 3.038 kip-in (Eqn F11-1)

Moment Arm: $Moment_{arm}$ = 1.375 in

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 2.209 kip LRFD (Horizontal Component)

Piece #43146A - L4" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity
(ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 4 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**2412 lbf**	**840 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**4004 lbf**	**1324 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**3332 lbf**	**1636 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**4232 lbf**	**2192 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**4084 lbf**	3588 lbf
		3/16"	1439 lbf		5756 lbf

Bolts thru Angle Bracket to Concrete Slab or Concrete-Filled Profile Steel Deck Failure Modes:

Hilti Kwik Bolt-TZ anchors may be installed in cracked or uncracked concrete or concrete-filled steel deck

Bolt type: *A307 Gr. A (Common Bolts), bearing type connection*

Nominal Tensile Strength: F_t = 45 ksi

Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Shear Strength, Threads Excluded: F_v = 27 ksi (Table J3.2 AISC 14th)

Bolt Diameter: d_{bcd} = 0.50 in

Bolt Area: $A_{bcd} = 0.25*\pi*d_{bcd}^2 =$ 0.20 in2

Resistance factor for bolt tension or shear: ϕ= 0.75 LRFD

Shear Capacity of single bearing type bolt: $V_{allow\text{-}bolt} = \phi*F_v*A_{bcd} =$ 3.98 kip

Tension Capacity of single bearing type bolt: $T_{allow\text{-}bolt} = \phi*F_t*A_{bcd} =$ 6.63 kip

Bolt bearing strength at bracket connection: (Section J3.10) F_u = 58 ksi

Bolt edge distance: edge-dist = 1.00 in

Bolt hole diameter: bh = 0.625 in

Clear distance between edge of hole and edge of adjacent hole or edge of plate: L_c = edge-dist -0.5*bh = 0.69 in2

Single bolt bearing capacity: $Bolt_{br'g} = min[(1.5*L_c*th_{plate}*F_u),(3.0*d_{bcd}*th_{plate}*F_u)] =$ 14.95 kip

$2*Bolt_{allow\text{-}bolt} = 2*\phi*Bolt_{bearing}$ 22.43 kip LRFD

Piece #43146A - L4" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

See Hilti Excel output for Allowable Combined Tension and Shear Loads for Concrete Over Metal Deck (LRFD)
See Hilti Profis output for Allowable Combined Tension and Shear Loads for Concrete Slab (LRFD)

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on Concrete over Metal Deck

$\phi N_n =$ *570 lbf*

$\phi V_n =$ *1100 lbf*

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on 4' min Concrete Slab

$\phi N_n =$ *1275 lbf*

$\phi V_n =$ *2552 lbf*

Given that the Load and Resistance Factor Design calculated above for the angle brackets and bolts far outweigh the capacity of the concrete anchors, the allowable loading to the concrete anchors govern.
Note also that the capacity of the concrete anchors shown here is based on utilizing Section D.3.3.4.3 (d) of ACI 318-11, which requires the inclusion of the Omega factor when determining the loads applied to the anchorage.
Do to the complication of the requirement (per ACI 318-11) to determine the concrete anchorage capacity utilizing LRFD as well as Section 4.2 in ESR-1917 the allowable load for this Piece is given in LRFD only.

Overall Capacity of Seismic Load - Piece #43146A - 4" x 3" x 1/4" x 0'-6" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (2) 0.4375" dia Hole for Hilti KB-TZ 3/8" x 3-3/4"

$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	**570 lbf**	**Tension**	**Vertical & Horizontal Allowable Load - (LRFD)**
$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	**1100 lbf**	**Shear**	
$Load_{allowable\text{-}total\text{-}on\text{-}4"\ min\text{-}concrete\text{-}slab}$ =	**1275 lbf**	**Tension**	
$Load_{allowable\text{-}total\text{-}on\text{-}4"\ min\text{-}concrete\text{-}slab}$ =	**2552 lbf**	**Shear**	

Design Scope:

Calculations to determine the Load and Resistance Factor Design of the seismic restraint as detailed by 9.0 SeismicCo., 1/4" Floor & Wall Brackets (included within this calculation package for reference).

Prying of Piece #63143A - L6" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8"x3-3/4"

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Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Tensile Strength: F_t = 60 ksi *(Carbon Steel)*

Ultimate Strength: F_u = 58 ksi

Anchor Spacing s = 0.00

Anchor Diameter: [redacted] d_b = 0.375 in

Steel strength in tension: N_{sa} = *6.500 kip*

Max distance from bolt to applied force: b = 1.375 in

Tributary length to each bolt: *p = max 2b, but ≤ s* 2.75 in

Adjusted prying distance: $b' = \left[b - \frac{d_b}{2}\right] =$ 1.19 in (Eq. 9-21)

Resistance factor for prying:
Ω_{pr} = *1.67 ASD*
Φ_{pr} = *0.90 LRFD*
Φ_t = *0.75 LRFD*

Maximum bolt force for prying: $T = \frac{\Phi_{pr} * F_u * th_{bracket}^2 * p}{2*b} =$ 3.26 kip (Eq. 9-22a)

Available tensile strength of single bolt: $B = \Phi_t * N_{sa} =$ *4.88 kip* *(per ESR-1917)*

$t_c = \sqrt{\frac{4*B*b'}{\Phi_{LRFD} * p * F_u}} =$ 0.440 in (Eq. 9-30a)

T_{avail} = BQ = *2.86 kip* (Eq. 9-31)

Q = *0.587*

a'<, Q = *1*

0 ≤ a' ≤ 1, Q = $\left(\frac{t}{t_c}\right)^2 (1 + \delta * \alpha') =$ *0.587* (Eq. 9-33)

a'>1, Q = $\left(\frac{t}{t_c}\right)^2 (1 + \delta) =$ *0.587* (Eq. 34)

Width of hole along length of plate: d' = *0.500 in*

Distance from bolt centerline to edge of plate: a = *1.50 in*

Additional variables for prying calculation:

$\delta = 1 - \frac{d'}{p} =$ *0.82* *Eq. (9-24)*

$a' = a + \frac{d_b}{2} =$ *1.69 in* $\leq \left(1.25 * b * \frac{d_b}{2}\right) =$ *1.91 in* *Eq. (9-27)*

$\rho = \frac{b'}{a'} =$ *0.70* *Eq. (9-26)*

$\beta = \frac{1}{\rho} * \left(\frac{B}{T} - 1\right) =$ *1.00 in* *Eq. (9-25)*

$\alpha' = if\left[\beta => 1, 1, \min\left[1, \frac{1}{\delta} * \left(\frac{\beta}{1-\beta}\right)\right]\right] =$ *1.00*

Required bracket thickness to ensure an acceptable combination of fitting strength, stiffness, and bolt strength:

$t_{\min} = \sqrt{\frac{4*T*b'}{\Phi_{pr} * p * F_u * (1 + \delta * \alpha')}} =$ *0.23 in LRFD* *(Eq. 9-23a)*

Thickness of Bracket is 0.25 in - therefore, Prying OK

Piece #63143A - L6" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8"x3-3/4"

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness: $th_{bracket}$ = 0.2500 in

Yield Strength: F_y = 36 ksi *(Table 2-4)*

Ultimate Strength: F_u = 58 ksi

Gross Area: A_g = ***(3.0in)*(0.25in)*** = 0.75 in2

$\phi_{t\text{-}y}$ = 0.9 LRFD (Eqn D2.1)

Tensile Yielding: $T_{allow\text{-}yielding} = \phi_{t\text{-}y} * F_y * A_g$ = 24.30 kip (Eqn D2-1)

Shear Lag Factor: U = 1.0 (Table D3.1)

Net Area: A_n = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2 (Sec B4.3)

Effective Net Area: A_e = A_n*U = 0.59 in2 (Eqn D3-1)

ϕ_{tr} = 0.75 LRFD (Eqn D2-2)

Tensile Rupture: $T_{allow\text{-}rupture} = \phi_{t\text{-}r} * F_u * A_e$ = 25.83 kip (Eqn D2-2)

$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) = 24.30 kip LRFD (Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area: A_{gv} =(3.0in)*(0.25in) = 0.75 in2

Φ_{yv} = 1.00 LRFD *(Eqn J4-3)*

Shear Yielding: $V_{allow\text{-}yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 16.20 kip *(Eqn J4-3)*

Φ_{rv} = 0.75 LRFD *(Eqn J4-4)*

Net Area: A_{nv} = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2 *(Sec B4.3)*

Shear Rupture: $V_{allow\text{-}rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 20.66 kip *(Eqn J4-4)*

V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) = 16.20 kip LRFD *(Horizontal Component)*

***Note: Bending of Bracket is Considered within the Prying Calculation*

Bending Moment on Vertical Leg (Side A):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ 0.0469 in3

ϕ_b = 0.9 LRFD *(Sec F1)*

$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in

Moment Arm: $Moment_{arm}$ = 4.375 in *(Eqn F11-1)*

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 0.347 kip LRFD *(Vertical Component)*

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ 0.0469 in3

ϕ_b = 0.9 LRFD *(Sec F1)*

$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in *(Eqn F11-1)*

Moment Arm: $Moment_{arm}$ = 1.375 in

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 1.105 kip LRFD *(Horizontal Component)*

Piece #63143A - L6" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8"x3-3/4"

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity
(ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 4 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**2412 lbf**	**840 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**4004 lbf**	**1324 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**3332 lbf**	**1636 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**4232 lbf**	**2192 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**4084 lbf**	**3588 lbf**
		3/16"	1439 lbf		**5756 lbf**

Bolts thru Angle Bracket to Concrete Slab or Concrete-Filled Profile Steel Deck Failure Modes:

Hilti Kwik Bolt-TZ anchors may be installed in cracked or uncracked concrete or concrete-filled steel deck

Bolt type: A307 Gr. A (Common Bolts), bearing type connection

Nominal Tensile Strength: F_t = 45 ksi

Bracket Thickness: $th_{bracket}$ = 0.25 in

Nominal Shear Strength, Threads Excluded: F_v = 27 ksi (Table J3.2 AISC 14th)

Bolt Diameter: d_{bcd} = 0.50 in

Bolt Area: $A_{bcd} = 0.25 * \pi * d_{bcd}^2$ = 0.20 in2

Resistance factor for bolt tension or shear: ϕ = 0.75 LRFD

Shear Capacity of single bearing type bolt: $V_{allow\text{-}bolt} = \phi * F_v * A_{bcd}$ = 3.98 kip

Tension Capacity of single bearing type bolt: $T_{allow\text{-}bolt} = \phi * F_t * A_{bcd}$ = 6.63 kip

Bolt bearing strength at bracket connection: (Section J3.10) F_u = 58 ksi

Bolt edge distance: edge-dist = 1.50 in

Bolt hole diameter: bh = 0.625 in

Clear distance between edge of hole and edge of adjacent hole or edge of plate: L_c = edge-dist -0.5*bh = 1.19 in2

Single end bolt bearing capacity: $Bolt_{br'g} = min[(1.5*L_c*th_{plate}*F_u),(3.0*d_{bcd}*th_{plate}*F_u)]$ = 21.75 kip

$Bolt_{allow\text{-}bolt} = \phi * Bolt_{bearing}$ 16.31 kip LRFD

Piece #63143A - L6" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8"x3-3/4"

See Hilti Excel output for Allowable Combined Tension and Shear Loads for Concrete Over Metal Deck (LRFD)
See Hilti Profis output for Allowable Combined Tension and Shear Loads for Concrete Slab (LRFD)

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on Concrete over Metal Deck

$\phi N_n =$ 390 lbf

$\phi V_n =$ 440 lbf

3/8" dia Hilti Kwik Bolt-TZ Expansion Anchors (ESR-1917) w/ 2" Embedment on 4' min Concrete Slab

$\phi N_n =$ 950 lbf

$\phi V_n =$ 1322 lbf

Given that the Load and Resistance Factor Design calculated above for the angle brackets and bolts far outweigh the capacity of the concrete anchors, the allowable loading to the concrete anchors govern.
Note also that the capacity of the concrete anchors shown here is based on utilizing Section D.3.3.4.3 (d) of ACI 318-11, which requires the inclusion of the Omega factor when determining the loads applied to the anchorage.
Do to the complication of the requirement (per ACI 318-11) to determine the concrete anchorage capacity utilizing LRFD as well as Section 4.2 in ESR-1917 the allowable load for this Piece is given in LRFD only.

Overall Capacity of Seismic Load - Piece #63143A - L6" x 3" x 1/4" x 0'-3" Steel Angle Bracket (A36 min)
w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816 & (1) 0.4375" dia Hole for Hilti KB-TZ 3/8"x3-3/4"

$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	390 lbf	Tension	Vertical & Horizontal Allowable Load - (LRFD)
$Load_{allowable\text{-}total\text{-}on\text{-}concrete\text{-}ove\text{-}metal\text{-}deck}$ =	440 lbf	Shear	
$Load_{allowable\text{-}total\text{-}on\text{-}4"\ min\text{-}concrete\text{-}slab}$ =	950 lbf	Tension	
$Load_{allowable\text{-}total\text{-}on\text{-}4"\ min\text{-}concrete\text{-}slab}$ =	1322 lbf	Shear	

Piece #36143A - L3" x 6" x 1/4" x 0'-3" Steel Angle Bracket (A36 min) w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness:	$th_{bracket}$ = 0.2500 in		
Yield Strength:	F_y = 36 ksi		(Table 2-4)
Ultimate Strength:	F_u = 58 ksi		
Gross Area:	A_g = **(3.0in)*(0.25in)** = 0.75 in2		
	$\phi_{t\text{-}y}$ = 0.9	LRFD	(Eqn D2.1)
Tensile Yielding:	$T_{allow\text{-}yielding} = \phi_{t\text{-}y} * F_y * A_g$ = 24.30 kip		(Eqn D2-1)
Shear Lag Factor:	U = 1.0		(Table D3.1)
Net Area:	A_n = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2		(Sec B4.3)
Effective Net Area:	A_e = A_n*U = 0.59 in2		(Eqn D3-1)
	ϕ_{tr} = 0.75	LRFD	(Eqn D2-2)
Tensile Rupture:	$T_{allow\text{-}rupture} = \phi_{t\text{-}r} * F_u * A_e$ = 25.83 kip		(Eqn D2-2)
	$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) = 24.30 kip LRFD		(Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area:	A_{gv} =(3.0in)*(0.25in) = 0.75 in2		
	Φ_{yv} = 1.00	LRFD	(Eqn J4-3)
Shear Yielding:	$V_{allow\text{-}yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 16.20 kip		(Eqn J4-3)
Net Area:	A_{nv} = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2		(Sec B4.3)
	Φ_{rv} = 0.75	LRFD	(Eqn J4-4)
Shear Rupture:	$V_{allow\text{-}rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 20.66 kip		(Eqn J4-4)
	V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) = 16.20 kip LRFD		(Horizontal Component)

Bending Moment on Lower Leg (Side B):

Plastic Modulus:	$Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ 0.0469 in3		
	ϕ_b = 0.9	LRFD	(Sec F1)
	$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in		(Eqn F11-1)
Moment Arm:	$Moment_{arm}$ = 4.875 in		
Allowable Load:	$P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 0.312 kip LRFD	(Horizontal Component)	

Bending Moment on Vertical Leg (Side A):

Plastic Modulus:	$Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ 0.0469 in3		
	ϕ_b = 0.9	LRFD	(Sec F1)
	$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in		
Moment Arm:	$Moment_{arm}$ = 1.375 in		(Eqn F11-1)
Allowable Load:	$P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 1.105 kip LRFD	(Vertical Component)	

Piece #36143A - L3" x 6" x 1/4" x 0'-3" Steel Angle Bracket (A36 min) w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity (ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)

Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets

Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).

Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).

Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Vertical Leg:

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 2 V_{allow} *N	T_{allow} *N
0.048-0.048	603 lbf	0.048	210 lbf	**1206 lbf**	**420 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**2002 lbf**	**662 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**1666 lbf**	**818 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**2116 lbf**	**1096 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**2042 lbf**	1794 lbf
		3/16"	1439 lbf		2878 lbf

Horizontal Leg:

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 2 V_{allow} *N	T_{allow} *N
0.048-0.048	603 lbf	0.048	210 lbf	**1206 lbf**	**420 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**2002 lbf**	**662 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**1666 lbf**	**818 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**2116 lbf**	**1096 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**2042 lbf**	**1794 lbf**
		3/16"	1439 lbf		**2878 lbf**

Piece #36143B - L3" x 6" x 1/4" x 0'-3" Steel Angle Bracket (A36 min) w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness:	$th_{bracket}$ = 0.2500 in		
Yield Strength:	F_y = 36 ksi		(Table 2-4)
Ultimate Strength:	F_u = 58 ksi		
Gross Area:	A_g = **(3.0in)*(0.25in)** = 0.75 in2		
	$\phi_{t\text{-}y}$ = 0.9	LRFD	(Eqn D2.1)
Tensile Yielding:	$T_{allow\text{-}yielding} = \phi_{t\text{-}y} * F_y * A_g$ = 24.30 kip		(Eqn D2-1)
Shear Lag Factor:	U = 1.0		(Table D3.1)
Net Area:	A_n = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2		(Sec B4.3)
Effective Net Area:	A_e = $A_n * U$ = 0.59 in2		(Eqn D3-1)
	ϕ_{tr} = 0.75	LRFD	(Eqn D2-2)
Tensile Rupture:	$T_{allow\text{-}rupture} = \phi_{t\text{-}r} * F_u * A_e$ = 25.83 kip		(Eqn D2-2)
	$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) = 24.30 kip LRFD		(Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area:	A_{gv} =(3.0in)*(0.25in) = 0.75 in2		
	Φ_{yv} = 1.00	LRFD	(Eqn J4-3)
Shear Yielding:	$V_{allow\text{-}yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 16.20 kip		(Eqn J4-3)
Net Area:	A_{nv} = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2		(Sec B4.3)
	Φ_{rv} = 0.75	LRFD	(Eqn J4-4)
Shear Rupture:	$V_{allow\text{-}rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 20.66 kip		(Eqn J4-4)
	V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) = 16.20 kip LRFD		(Horizontal Component)

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4}$ = 0.0469 in3

ϕ_b = 0.9 LRFD (Sec F1)

$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in

Moment Arm: $Moment_{arm}$ = 4.375 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}}$ = 0.347 kip LRFD (Horizontal Component)

Bending Moment on Vertical Leg (Side A):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4}$ = 0.0469 in3

ϕ_b = 0.9 LRFD (Sec F1)

$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in

Moment Arm: $Moment_{arm}$ = 1.375 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}}$ = 1.105 kip LRFD (Vertical Component)

Piece #36143B- L3" x 6" x 1/4" x 0'-3" Steel Angle Bracket (A36 min) w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity (ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Vertical Leg:

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 2 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**1206 lbf**	**420 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**2002 lbf**	**662 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**1666 lbf**	**818 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**2116 lbf**	**1096 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**2042 lbf**	**1794 lbf**
		3/16"	1439 lbf		**2878 lbf**

Horizontal Leg:

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 4 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**2412 lbf**	**840 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**4004 lbf**	**1324 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**3332 lbf**	**1636 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**4232 lbf**	**2192 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**4084 lbf**	**3588 lbf**
		3/16"	1439 lbf		**5756 lbf**

Piece #36143C - L3" x 6" x 1/4" x 0'-3" Steel Angle Bracket (A36 min) w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness:	$th_{bracket}$ = 0.2500 in		
Yield Strength:	F_y = 36 ksi		(Table 2-4)
Ultimate Strength:	F_u = 58 ksi		
Gross Area:	A_g = **(3.0in)*(0.25in)** = 0.75 in2		
	$\phi_{t\text{-}y}$ = 0.9	LRFD	(Eqn D2.1)
Tensile Yielding:	$T_{allow\text{-}yielding} = \phi_{t\text{-}y} * F_y * A_g$ = 24.30 kip		(Eqn D2-1)
Shear Lag Factor:	U = 1.0		(Table D3.1)
Net Area:	A_n = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2		(Sec B4.3)
Effective Net Area:	$A_e = A_n * U$ = 0.59 in2		(Eqn D3-1)
	ϕ_{tr} = 0.75	LRFD	(Eqn D2-2)
Tensile Rupture:	$T_{allow\text{-}rupture} = \phi_{t\text{-}r} * F_u * A_e$ = 25.83 kip		(Eqn D2-2)
	$T_{allow\text{-}bracket}$ = min($T_{allow\text{-}yielding}$, $T_{allow\text{-}rupture}$) = 24.30 kip LRFD		(Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area:	A_{gv} =(3.0in)*(0.25in) = 0.75 in2		
	Φ_{yv} = 1.00	LRFD	(Eqn J4-3)
Shear Yielding:	$V_{allow\text{-}yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 16.20 kip		(Eqn J4-3)
Net Area:	A_{nv} = (3.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.59 in2		(Sec B4.3)
	Φ_{rv} = 0.75	LRFD	(Eqn J4-4)
Shear Rupture:	$V_{allow\text{-}rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 20.66 kip		(Eqn J4-4)
	V_{allow} = min($V_{allow\text{-}yielding}$, $V_{allow\text{-}rupture}$) = 16.20 kip		(Horizontal Component)

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ 0.0469 in3

ϕ_b = 0.9 LRFD (Sec F1)

$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in

Moment Arm: $Moment_{arm}$ = 4.375 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 0.347 kip LRFD (Horizontal Component)

Bending Moment on Vertical Leg (Side A):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{3*0.25^2}{4} =$ 0.0469 in3

ϕ_b = 0.9 LRFD (Sec F1)

$M_{allow} = \phi * F_y * Z$ = 1.519 kip-in

Moment Arm: $Moment_{arm}$ = 1.375 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 1.105 kip LRFD (Vertical Component)

Piece #36143C- L3" x 6" x 1/4" x 0'-3" Steel Angle Bracket (A36 min) w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity (ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Vertical Leg:

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 4 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**2412 lbf**	**840 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**4004 lbf**	**1324 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**3332 lbf**	**1636 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**4232 lbf**	**2192 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**4084 lbf**	**3588 lbf**
		3/16"	1439 lbf		**5756 lbf**

Horizontal Leg:

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 4 V_{allow}*N	T_{allow}*N
0.048-0.048	603 lbf	0.048	210 lbf	**2412 lbf**	**840 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**4004 lbf**	**1324 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**3332 lbf**	**1636 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**4232 lbf**	**2192 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**4084 lbf**	**3588 lbf**
		3/16"	1439 lbf		**5756 lbf**

Piece #36144A - L3" x 6" x 1/4" x 0'-4" Steel Angle Bracket (A36 min) w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness: $th_{bracket}$ = 0.2500 in

Yield Strength: F_y = 36 ksi *(Table 2-4)*

Ultimate Strength: F_u = 58 ksi

Gross Area: A_g = **(4.0in)*(0.25in)** = 1.00 in2

ϕ_{t-y} = 0.9 LRFD (Eqn D2.1)

Tensile Yielding: $T_{allow-yielding} = \phi_{t-y} * F_y * A_g$ = 32.40 kip (Eqn D2-1)

Shear Lag Factor: U = 1.0 (Table D3.1)

Net Area: A_n = (4.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.84 in2 (Sec B4.3)

Effective Net Area: A_e = A_n*U = 0.84 in2 (Eqn D3-1)

ϕ_{tr} = 0.75 LRFD (Eqn D2-2)

Tensile Rupture: $T_{allow-rupture} = \phi_{t-r} * F_u * A_e$ = 36.70 kip (Eqn D2-2)

$T_{allow-bracket}$ = min($T_{allow-yielding}$, $T_{allow-rupture}$) = 32.40 kip LRFD (Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area: A_{gv} =(4.0in)*(0.25in) = 1.00 in2

Φ_{yv} = 1.00 LRFD *(Eqn J4-3)*

Shear Yielding: $V_{allow-yielding} = \phi_{yv} * 0.60 * F_y * A_{gv}$ = 21.60 kip *(Eqn J4-3)*

Net Area: A_{nv} = (4.0in)*(0.25in)-(2*0.3125in)*(0.25in) = 0.84 in2 *(Sec B4.3)*

Φ_{rv} = 0.75 LRFD *(Eqn J4-4)*

Shear Rupture: $V_{allow-rupture} = \phi_{rv} * 0.60 * F_u * A_{nv}$ = 29.36 kip

V_{allow} = min($V_{allow-yielding}$, $V_{allow-rupture}$) = 21.60 kip LRFD *(Horizontal Component)*

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{4*0.25^2}{4} =$ 0.0625 in3

ϕ_b = 0.9 LRFD *(Sec F1)*

$M_{allow} = \phi * F_y * Z$ = 2.025 kip-in *(Eqn F11-1)*

Moment Arm: $Moment_{arm}$ = 4.875 in *(Eqn F11-1)*

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 0.415 kip LRFD *(Horizontal Component)*

Bending Moment on Vertical Leg (Side A):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{6*0.25^2}{4} =$ 0.0625 in3

ϕ_b = 0.9 LRFD *(Sec F1)*

$M_{allow} = \phi * F_y * Z$ = 2.025 kip-in

Moment Arm: $Moment_{arm}$ = 1.375 in *(Eqn F11-1)*

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 1.473 kip LRFD *(Vertical Component)*

Piece #36144A- L3" x 6" x 1/4" x 0'-4" Steel Angle Bracket (A36 min) w/ (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (2) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity (ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)
Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets
Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).
Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).
Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Vertical Leg:

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 2 V_{allow} *N	T_{allow} *N
0.048-0.048	603 lbf	0.048	210 lbf	**1206 lbf**	**420 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**2002 lbf**	**662 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**1666 lbf**	**818 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**2116 lbf**	**1096 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**2042 lbf**	**1794 lbf**
		3/16"	1439 lbf		**2878 lbf**

Horizontal Leg:

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	Number of Screws N = 2 V_{allow} *N	T_{allow} *N
0.048-0.048	603 lbf	0.048	210 lbf	**1206 lbf**	**420 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**2002 lbf**	**662 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**1666 lbf**	**818 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**2116 lbf**	**1096 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**2042 lbf**	**1794 lbf**
		3/16"	1439 lbf		**2878 lbf**

Piece #36146A - L3" x 6" x 1/4" x 0'-6" Steel Angle Bracket (A36 min) w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (8) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Tension on Bracket Vertical Leg:

AISC 14th - Chapter D of Specification:

Bracket Thickness:	$th_{bracket}$ = 0.2500 in		
Yield Strength:	F_y = 36 ksi		(Table 2-4)
Ultimate Strength:	F_u = 58 ksi		
Gross Area:	694	1.50 in2	
	ϕ_{t-y} = 0.9	LRFD	(Eqn D2.1)
Tensile Yielding:	$T_{allow-yielding}$ = ϕ_{t-y} * F_y * A_g = 48.60 kip		(Eqn D2-1)
Shear Lag Factor:	U = 1.0		(Table D3.1)
Net Area:	A_n = (6.0in)*(0.25in)-(4*0.3125in)*(0.25in) = 1.19 in2		(Sec B4.3)
Effective Net Area:	A_e = A_n*U =	1.19 in2	(Eqn D3-1)
	ϕ_{tr} = 0.75	LRFD	(Eqn D2-2)
Tensile Rupture:	$T_{allow-rupture}$ = ϕ_{t-r} * F_u * A_e = 51.66 kip		(Eqn D2-2)
	$T_{allow-bracket}$ = min($T_{allow-yielding}$, $T_{allow-rupture}$) =	48.60 kip LRFD	(Vertical & Horizontal Component))

Shear on Bracket Vertical Leg:

Gross Area:	A_{gv} =(6.0in)*(0.25in) = 1.50 in2		
	Φ_{yv} = 1.00	LRFD	(Eqn J4-3)
Shear Yielding:	$V_{allow-yielding}$ = ϕ_{yv} *0.60* F_y * A_{gv} =	32.40 kip	(Eqn J4-3)
Net Area:	A_{nv} = (6.0in)*(0.25in)-(4*0.3125in)*(0.25in) = 1.19 in2		(Sec B4.3)
	Φ_{rv} = 0.75	LRFD	(Eqn J4-4)
Shear Rupture:	$V_{allow-rupture}$ = ϕ_{rv} *0.60* F_u * A_{nv} =	41.33 kip	(Eqn J4-4)
	V_{allow} = min($V_{allow-yielding}$, $V_{allow-rupture}$) =	32.40 kip LRFD	(Horizontal Component)

Bending Moment on Lower Leg (Side B):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{6*0.25^2}{4} =$ 0.0938 in3

ϕ_b = 0.9 LRFD (Sec F1)

M_{allow} = ϕ * F_y *Z = 3.038 kip-in

Moment Arm: $Moment_{arm}$ = 4.375 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 0.694 kip LRFD (Horizontal Component)

Bending Moment on Vertical Leg (Side A):

Plastic Modulus: $Z = \frac{bd^2}{4} = \frac{6*0.25^2}{4} =$ 0.0938 in3

ϕ_b = 0.9 LRFD (Sec F1)

M_{allow} = ϕ * F_y *Z = 3.038 kip-in

Moment Arm: $Moment_{arm}$ = 1.375 in (Eqn F11-1)

Allowable Load: $P_{allow} = \frac{M_{allow}}{Moment_{arm}} =$ 2.209 kip LRFD (Vertical Component)

Piece #3614A- L3" x 6" x 1/4" x 0'-6" Steel Angle Bracket (A36 min) w/ (4) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-846 & (8) 0.3125" dia Holes for 1/4" Hilti Kwik Flex #EAF-816

Screws from Angle Bracket to Steel Sheet:

Hilti Kwik Flex #EAF-816 & #EAF-846 : (Screw Type 6, LRFD Shear (Bearing) & Tension (Pull-Out) Capacity (ICC-ESR-3332) Based on a Steel Member (min yield strength, Fy = 33 ksi & min tensile strength Fu = 45 ksi)

Capacity of (1) Screw from 1/4", 3/8" & 1/2" Brackets to various design thickness steel sheets

Shear Bearing Capacity first number is the minimum thickness of the steel in contact with the screw head (top sheet). The second number is the thickness of the steel sheet not in contact with the screw head (bottom sheet).

Tensile Pull-out Capacity the number is for the steel sheet not in contact with the screw head (bottom sheet).

Screw Capacities (Shear Bearing per ESR-3332, Table 3 & Tensile Pull-out per Table 5 per ESR-3332) LRFD

Vertical Leg:

Number of Screws $N = 4$

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	V_{allow} *N	T_{allow} *N
0.048-0.048	603 lbf	0.048	210 lbf	**2412 lbf**	**840 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**4004 lbf**	**1324 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**3332 lbf**	**1636 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**4232 lbf**	**2192 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**4084 lbf**	**3588 lbf**
		3/16"	1439 lbf		**5756 lbf**

Horizontal Leg:

Number of Screws $N = 8$

Design Thickness (in)	V_{allow}	Design Thickness (in)	T_{allow}	V_{allow} *N	T_{allow} *N
0.048-0.048	603 lbf	0.048	210 lbf	**4824 lbf**	**1680 lbf**
0.048-0.075	1001 lbf	0.06	331 lbf	**8008 lbf**	**2648 lbf**
0.060-0.060	833 lbf	0.075	409 lbf	**6664 lbf**	**3272 lbf**
0.075-0.078	1058 lbf	0.105	548 lbf	**8464 lbf**	**4384 lbf**
1/8" - 3/16"	1021 lbf	1/8"	897 lbf	**8168 lbf**	**7176 lbf**
		3/16"	1439 lbf		**11512 lbf**