PROJECT: ***HD500-T HURRICANE IMPACT***

MIAMI DADE, FL

CLIENT: ***ATLAS INC.***

SUBJECT: ***STRUCTURAL CALCULATIONS–ENVIRONMENTAL LOAD RESISTANCE "NON THERMALLY BROKEN"***

DATE: ***APRIL 7TH, 2020***

PREVIOUS SUBMITTALS: ***MARCH 20TH, 2020***

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April 7, 2020

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Note: This calculation package is performed to confirm structural adequacy of framing and anchorage of Atlas HD500-T storefront system. The system has been determined to handle wind pressures shown on the following design criteria page when using non-thermally broken vertical framing members.

Thermal Performance and impact resistance for this glazed framing system are not addressed and are beyond the scope of this analysis.

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DESIGN CRITERIA

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WIND LOADS (Ref. following ASCE calculations)

- System Wind Pressure Capacity: (ASD)	60 PSF

DEAD LOAD

- Glass: (Per ¼'' Thickness)	3.25 PSF
- Aluminum Framing & Misc. Components:	2 PSF

FRAMING DEFLECTION LIMITS

- Framing Members Supporting Glass
    - Normal To Surface:
        - Individual Glass Edge: Lesser of L/175 or ¾''
        - Jamb Condition: Same as above with no damage to sealant
    - In-Plane To Surface: Lesser of L/360 or 1/8"

PRIMARY STRUCTRE TOLERANCE

- General Installation Tolerance:: ± 1/4"

GENERAL NOTES

- Glass analysis is not included in these calculations; glass manufacturer must verify the structural integrity of the glass.
- Unless otherwise noted, all stud framing used in attachment of curtain wall to be 16 gauge minimum for fastener pullout. Stud manufacturer to confirm adequacy of stud system to withstand imposed loading from curtain wall.

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MULLION ANALYSIS

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Mullion 01	5	

Load Origination

Trib Width: $TW_1 := 4 \cdot ft + 9 \cdot in$

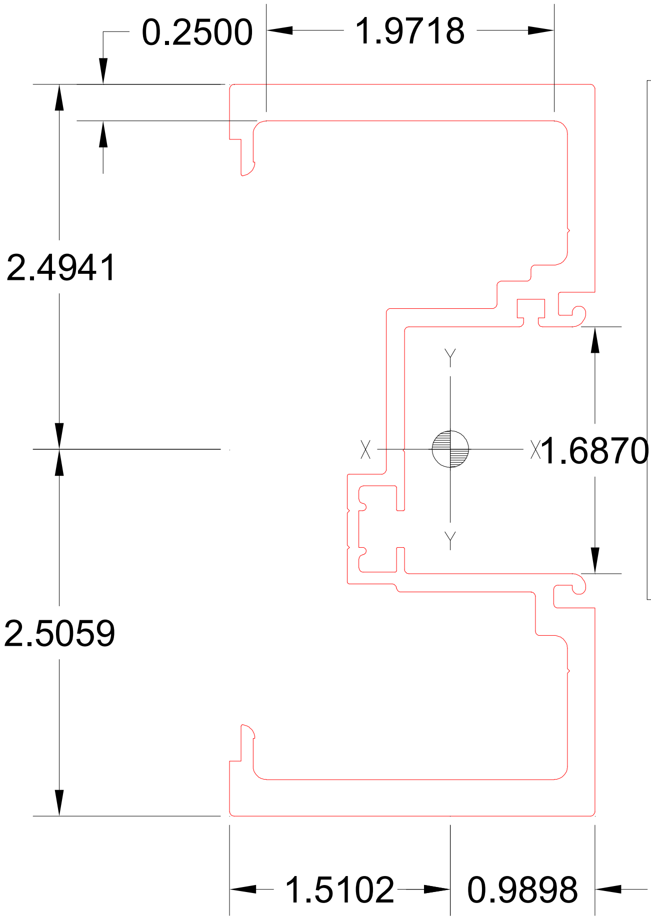
$TW_2 := 4 \cdot ft + 9 \cdot in$

Wind Pressure: (Corner Zone 10 ft^2) $W_n := 60 \cdot psf$

Span Length: $L_s := 10 \cdot ft + 0 \cdot in$

$q_w := 0.5 \cdot (TW_1 + TW_2) \cdot W_n$ $q_w = 23.75 \cdot lbf \cdot in^{-1}$

Beam Section Properties



CDC SECTION PROPERTIES

Area	2.490	IN^2
Perim.	29.078	IN
Weight	2.928	LBS/FT
X–X AXIS		
Ixx	9.222	IN^4
Sxx(max)	3.698	IN^3
Sxx(min)	3.680	IN^3
Rxx	1.925	IN
Y–Y AXIS		
Iyy	1.436	IN^4
Syy(max)	1.450	IN^3
Syy(min)	0.951	IN^3
Ryy	0.759	IN

Mullion Section Properties:

$I_{x1} := 9.222 \cdot in^4$ $\qquad$ $I_{y1} := 1.436 \cdot in^4$

$S_{x1} := 3.680 \cdot in^3$ $\qquad$ $S_{y1} := 0.951 \cdot in^3$

$r_{y1} := 0.759 \cdot in$

Aluminum Elastic Modulus:

$E_a := 10100 \cdot ksi$

Check Deflection:

Deflection: $\Delta_y := 5 \cdot q_w \cdot L_s^{4} \cdot (384 \cdot E_a \cdot I_{x1})^{-1}$ $\Delta_y = 0.688 \cdot in$

Allowable Deflection: $\Delta_{ay} := L_s \cdot 175^{-1}$ $\Delta_{ay} = 0.686 \cdot in$

$Deflection := if(\Delta_y \le \Delta_{ay}, \text{"OK"}, \text{"NOT OK"}) = \text{"NOT OK"}$

Note: Deflection exceeds allowable by less then 1/32 in and is considered "OK" by inspection.

Check Bending Stress in Mullion Section:

Max. Bending Moment: $M_x := q_w \cdot L_s^{2} \cdot 8^{-1}$ $M_x = 42750 \cdot lbf \cdot in$

Stress in Male Mullion: $f_{bx} := M_x \cdot S_{x1}^{-1} \cdot \left(I_{x1} \cdot I_{x1}^{-1}\right)$ $f_{bx} = 11.6 \cdot ksi$

Check of Bending on Male Mullion

Unbraced Length: $L_b := 0 \cdot in$

Flat Element Width: $b := 1.972 \cdot in$

Flat Element Thickness: $t := 0.25 \cdot in$

Slenderness: $S_1 := L_b \cdot r_{y1}^{-1}$ $S_1 = 0$

$S_2 := b \cdot t^{-1}$ $S_2 = 7.9$

Allowable Bending Stresses for 6063-T6 Aluminum:

$$F_{b1} := \begin{cases} (16.7 - 0.073 \cdot S_1)\,ksi & \text{if } S_1 \le 94 \\ 15.2 \cdot ksi & \text{if } S_1 \le 0.0 \\ \left(\dfrac{86996}{S_1^{2}}\right) ksi & \text{otherwise} \end{cases}$$

ADM 2010 F.2.1

$F_{b1} = 15.2 \cdot ksi$

ADM 2010 B.5.4.1

$$F_{b2} := \begin{cases} (19 - 0.530 \cdot S_2)\,ksi & \text{if } S_2 \le 12.6 \\ 15.2 \cdot ksi & \text{if } S_2 \le 7.3 \\ \left(\dfrac{155}{S_2}\right) ksi & \text{otherwise} \end{cases}$$

$F_{b2} = 14.8 \cdot ksi$

$F_{bx} := \min(F_{b1}, F_{b2})$ $F_{bx} = 14.8 \cdot ksi$

$I := f_{bx} \cdot F_{bx}^{-1}$ $I = 0.784$

$Interaction := if(I < 1.0, \text{"OK"}, \text{"NOT OK"}) = \text{"OK"}$

Jamb Mullion 01	4	

Load Origination

Trib Width: $TW_1 := 4 \cdot ft + 9 \cdot in$

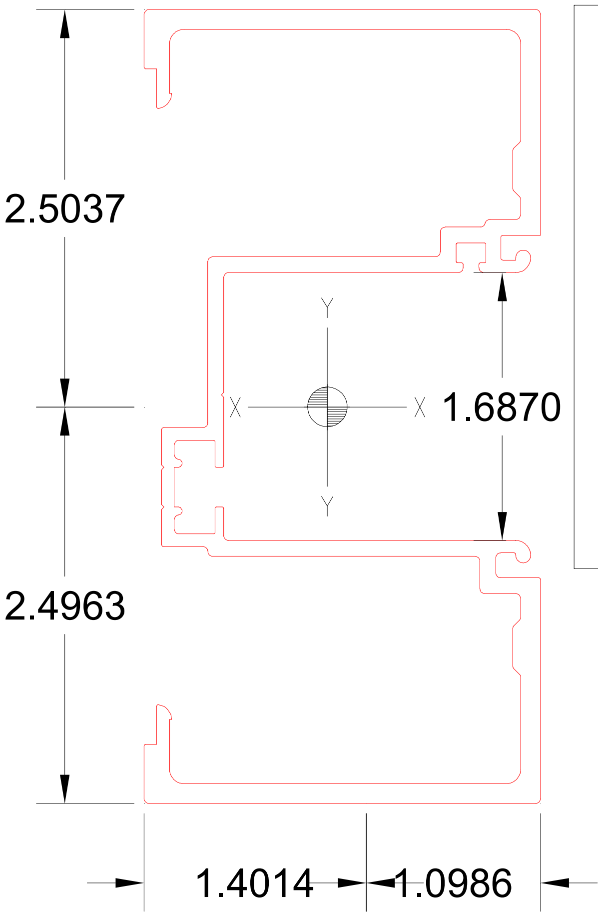
$TW_2 := 0 \cdot ft + 0 \cdot in$

Wind Pressure: (Corner Zone 10 ft^2) $W_n := 60 \cdot psf$

Span Length: $L_s := 10 \cdot ft + 0 \cdot in$

$q_w := 0.5 \cdot (TW_1 + TW_2) \cdot W_n$ $q_w = 11.88 \cdot lbf \cdot in^{-1}$

Beam Section Properties



CDC SECTION PROPERTIES

Area	1.891	IN^2
Perim.	34.307	IN
Weight	2.224	LBS/FT
X–X AXIS		
Ixx	6.023	IN^4
Sxx(max)	2.413	IN^3
Sxx(min)	2.406	IN^3
Rxx	1.785	IN
Y–Y AXIS		
Iyy	1.420	IN^4
Syy(max)	1.293	IN^3
Syy(min)	1.013	IN^3
Ryy	0.867	IN

Mullion Section Properties:

$I_{x1} := 6.023 \cdot in^4$ $\qquad$ $I_{y1} := 1.884 \cdot in^4$

$S_{x1} := 3.406 \cdot in^3$ $\qquad$ $S_{y1} := 1.199 \cdot in^3$

$r_{y1} := 0.698 \cdot in$

Aluminum Elastic Modulus: $E_a := 10100 \cdot ksi$

Check Deflection:

Deflection: $\Delta_y := 5 \cdot q_w \cdot L_s^4 \cdot (384 \cdot E_a \cdot I_{x1})^{-1}$ $\Delta_y = 0.527 \cdot in$

Allowable Deflection: $\Delta_{ay} := L_s \cdot 175^{-1}$ $\Delta_{ay} = 0.686 \cdot in$

Deflection := if($\Delta_y \leq \Delta_{ay}$, "OK" , "NOT OK") = "OK"

Check Bending Stress in Mullion Section:

Max. Bending Moment: $M_x := q_w \cdot L_s^2 \cdot 8^{-1}$ $M_x = 21375 \cdot lbf \cdot in$

Stress in Male Mullion: $f_{bx} := M_x \cdot S_{x1}^{-1} \cdot (I_{x1} \cdot I_{x1}^{-1})$ $f_{bx} = 6.3 \cdot ksi$

Check of Bending on Male Mullion

Unbraced Length: $L_b := 0 \cdot in$

Flat Element Width: $b := 2.5 \cdot in$

Flat Element Thickness: $t := 0.125 \cdot in$

Slenderness: $S_1 := L_b \cdot r_{y1}^{-1}$ $S_1 = 0$

$S_2 := b \cdot t^{-1}$ $S_2 = 20.0$

Allowable Bending Stresses for 6063-T6 Aluminum:

$$F_{b1} := \begin{cases} (16.7 - 0.073 \cdot S_1)\,ksi & \text{if } S_1 \leq 94 \\ 15.2 \cdot ksi & \text{if } S_1 \leq 0.0 \\ \left(\dfrac{86996}{S_1^2}\right) ksi & \text{otherwise} \end{cases}$$

ADM 2010 F.2.1

$F_{b1} = 15.2 \cdot ksi$

ADM 2010 B.5.4.1

$$F_{b2} := \begin{cases} (19 - 0.17 \cdot S_2)\,ksi & \text{if } S_2 \leq 39 \\ 15.2 \cdot ksi & \text{if } S_2 \leq 22.8 \\ \left(\dfrac{484}{S_2}\right) ksi & \text{otherwise} \end{cases}$$

$F_{b2} = 15.2 \cdot ksi$

$F_{bx} := \min(F_{b1}, F_{b2})$ $F_{bx} = 15.2 \cdot ksi$

$I := f_{bx} \cdot F_{bx}^{-1}$ $I = 0.413$

Interaction := if(I < 1.0 , "OK" , "NOT OK") = "OK"

Check of Bending Stress on Leg of Horizontal (6063-T6)

Effective Depth:		$d := 12in$
Thickness:		$t_1 := 0.103 \cdot in$
Bending Eccentricity:	$e_1 := 1.69in$	$e_1 = 1.69 \cdot in$
Section modulus:	$S_{x1} := \left(t_1{}^2 \cdot d\right) \cdot 6^{-1}$	$S_{x1} = 0.021 \cdot in^3$
Bending Moment:	$M_{b1} := \left(q_w \cdot e_1 \cdot d\right)$	$M_{b1} = 241 \cdot lbf \cdot in$
Bending Stress:	$f_{b1} := M_{b1} \cdot \left(S_{x1}\right)^{-1}$	$f_{b1} = 11.4 \cdot ksi$
Allowable Bending Stress:		$F_{ba} := 19.7ksi$
Interaction:	$I := f_{b1} \cdot F_{ba}{}^{-1}$	$I = 0.58$

Interaction := if(I ≤ 1.00 , "OK" , "NOT OK") = "OK"

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HORIZONTAL ANALYSIS

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Head Horizontal	1	

Load Origination

Wind Pressure: $WL := 60 \cdot psf$

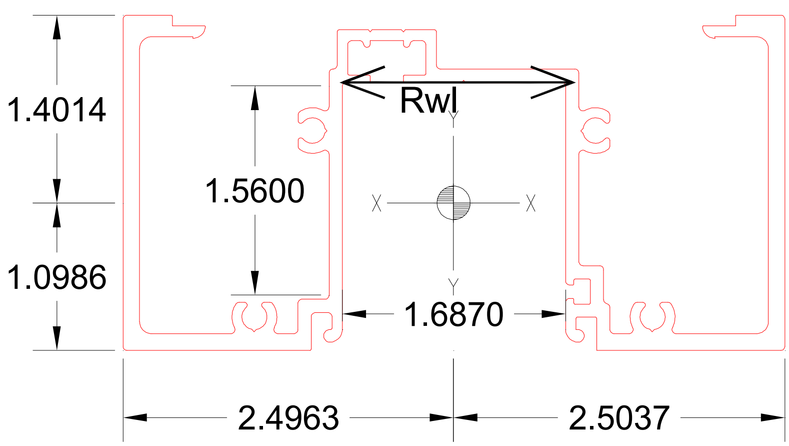
Weight of Glass: $D_g := 6.5 \cdot psf$

Trib Heights: $TH_1 := 49in$

$TH_2 := 14 \cdot in$

Horizontal Length: $L := 54in$

Aluminum Elastic Modulus: $E_a := 10100 \cdot ksi$



CDC SECTION PROPERTIES

Area	1.891	IN^2
Perim.	34.307	IN
Weight	2.224	LBS/FT
X–X AXIS		
Ixx	1.420	IN^4
Sxx(max)	1.293	IN^3
Sxx(min)	1.013	IN^3
Rxx	0.867	IN
Y–Y AXIS		
Iyy	6.023	IN^4
Syy(max)	2.413	IN^3
Syy(min)	2.406	IN^3
Ryy	1.785	IN

Beam Section Properties

$I_x := 1.42 \cdot in^4$ $\quad I_y := 6.0230 \cdot in^4$

$S_x := 1.013 \cdot in^3$ $\quad S_y := 2.406 \cdot in^3$

$r_x := 0.867 \cdot in$ $\quad A := 1.891 \cdot in^2$

Wind Load on Horizontal

$a_1 := 0.5 \cdot \min(TH_1, L)$ $\quad a_1 = 24.5 \cdot in$

$a_2 := 0.5 \cdot \min(TH_2, L)$ $\quad a_2 = 7 \cdot in$

$q_1 := WL \cdot a_1$ $\quad q_1 = 10.2 \cdot lbf \cdot in^{-1}$

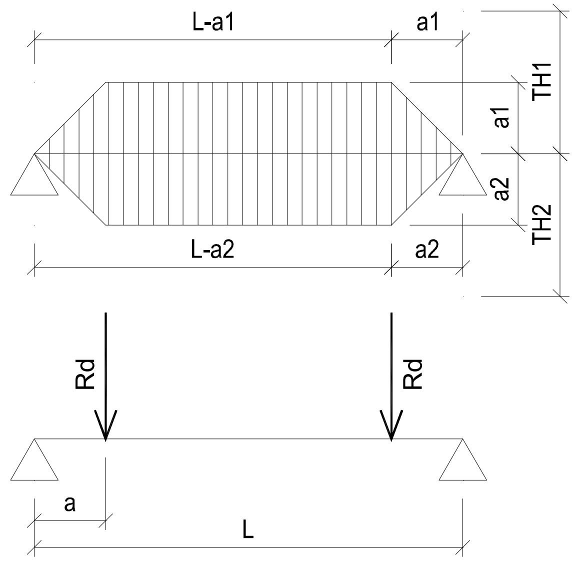
$q_2 := WL \cdot a_2$ $\quad q_2 = 2.9 \cdot lbf \cdot in^{-1}$

$q_w := q_1 + q_2$ $\quad q_w = 13.1 \cdot lbf \cdot in^{-1}$

$R_w := 0.5 \cdot \left[q_1 \cdot (L - a_1) + q_2 \cdot (L - a_2)\right]$ $\quad R_w = 219 \cdot lbf$

$R_{w1} := 0.5 \cdot q_1 \cdot (L - a_1)$ $\quad R_{w1} = 151 \cdot lbf$

$R_{w2} := 0.5 \cdot q_2 \cdot (L - a_2)$ $\quad R_{w2} = 69 \cdot lbf$



Check Deflection

Wind Load Deflection:

$$\Delta_y := q_1 \cdot L^4 \cdot (1920 \cdot E_a \cdot I_y)^{-1} \cdot \left[25 - 40 \cdot (a_1 \cdot L^{-1})^2 + 16 \cdot (a_1 \cdot L^{-1})^4\right] \ldots + q_2 \cdot L^4 \cdot (1920 \cdot E_a \cdot I_y)^{-1} \cdot \left[25 - 40 \cdot (a_2 \cdot L^{-1})^2 + 16 \cdot (a_2 \cdot L^{-1})^4\right]$$

$\Delta_y = 0.018 \cdot in$

Allowable Deflection: $\Delta_{ay} := \frac{L}{175}$ $\quad \Delta_{ay} = 0.309 \cdot in$

Deflection := if$(\Delta_y < \Delta_{ay}, \text{"OK"}, \text{"NOT OK"})$ = "OK"

Note: Assemby screws to be checked in Anchor Analysis section.

Check Bending Stress

Bending Moment on Assembly:

$M_y := q_1 \cdot 24^{-1} \cdot \left(3 \cdot L^2 - 4 \cdot a_1^2\right) + q_2 \cdot 24^{-1} \cdot \left(3 \cdot L^2 - 4 \cdot a_2^2\right)$ $M_y = 3739 \cdot lbf \cdot in$

Max Stress on Horizontal: $f_{by} := \left(M_y \cdot S_y^{-1}\right)$ $f_{by} = 1.55 \cdot ksi$

Unbraced Length: $L_b := L$

Flat Element Width: $b := 2.11 \cdot in$

Flat Element Thickness: $t := 0.08 \cdot in$

Slenderness: $S_1 := L_b \cdot r_x^{-1}$ $S_1 = 62.3$

$S_2 := b \cdot t^{-1}$ $S_2 = 26.4$

Allowable Bending Stresses for 6063-T6 Aluminum:

$F_{b1} := \begin{cases} (16.7 - 0.073 \cdot S_1) \cdot ksi & \text{if } S_1 \le 94 \\ 86996 \cdot S_1^{-2} \cdot ksi & \text{otherwise} \end{cases}$ ADM 2010 F.2.1

$F_{b1} = 12.2 \cdot ksi$

$F_{b2} := \begin{cases} (19.0 - 0.530 \cdot S_2) \cdot ksi & \text{if } S_2 \le 12.6 \\ 15.2 \cdot ksi & \text{if } S_2 < 7.3 \\ 155 \cdot S_2^{-1} \cdot ksi & \text{otherwise} \end{cases}$ ADM 2010 B.5.4.1

$F_{b2} = 5.9 \cdot ksi$

$F_{by} := \min\left(F_{b1}, F_{b2}\right)$ $F_{by} = 5.9 \cdot ksi$

$I := \frac{f_{by}}{F_{by}}$ $I = 0.26$

Interaction := if(I < 1.0 , "OK" , "NOT OK") = "OK"

Check of Bending Stress on Leg of Horizontal (6063-T6)

Effective Depth:		$d := 12in$
Thickness:		$t_1 := 0.103 \cdot in$
Bending Eccentricity:	$e_1 := 1.56in$	$e_1 = 1.56 \cdot in$
Section modulus:	$S_{x1} := \left(t_1^{\,2} \cdot d\right) \cdot 6^{-1}$	$S_{x1} = 0.021 \cdot in^3$
Bending Moment:	$M_{b1} := \left(q_w \cdot e_1 \cdot d\right)$	$M_{b1} = 246 \cdot lbf \cdot in$
Bending Stress:	$f_{b1} := M_{b1} \cdot \left(S_{x1}\right)^{-1}$	$f_{b1} = 11.6 \cdot ksi$
Allowable Bending Stress:		$F_{ba} := 19.7ksi$
Interaction:	$I := f_{b1} \cdot F_{ba}^{-1}$	$I = 0.59$

Interaction := if(I ≤ 1.00 , "OK" , "NOT OK") = "OK"

Intermediate Horizontal	2	

Load Origination

Wind Pressure: $WL := 60 \cdot psf$

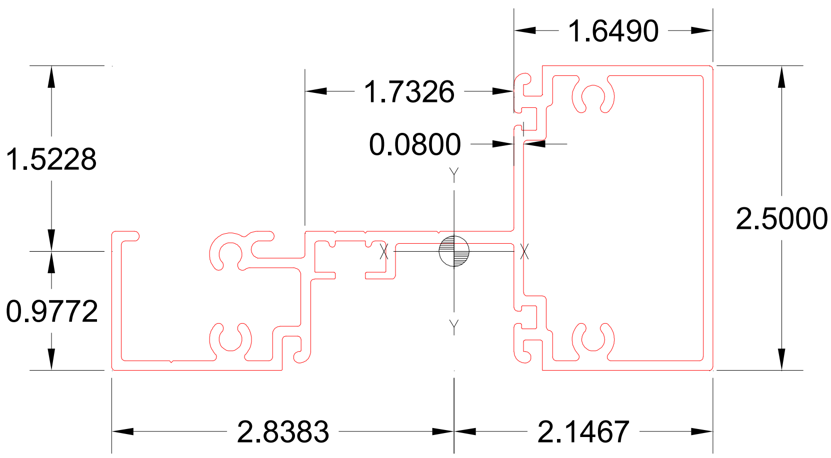
Weight of Glass: $D_g := 6.5 \cdot psf$

Trib Heights: $TH_1 := 92in$

$TH_2 := 28 \cdot in$

Horizontal Length: $L := 54in$

Aluminum Elastic Modulus: $E_a := 10100 \cdot ksi$



CDC SECTION PROPERTIES

Area	1.548	IN^2
Perim.	26.545	IN
Weight	1.821	LBS/FT
X–X AXIS		
Ixx	0.996	IN^4
Sxx(max)	1.019	IN^3
Sxx(min)	0.654	IN^3
Rxx	0.802	IN
Y–Y AXIS		
Iyy	3.699	IN^4
Syy(max)	1.723	IN^3
Syy(min)	1.303	IN^3
Ryy	1.546	IN

Beam Section Properties

$I_x := 0.996 \cdot in^4$ $\quad I_y := 3.699 \cdot in^4$

$S_x := 0.654 \cdot in^3$ $\quad S_y := 1.303 \cdot in^3$

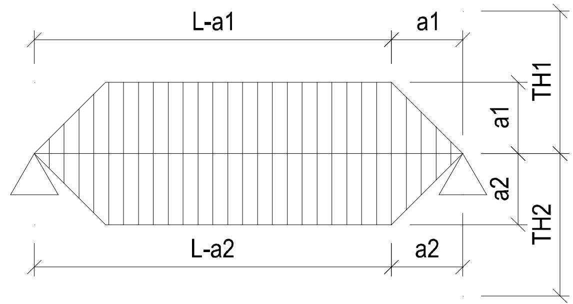
$r_x := 0.802 \cdot in$ $\quad A := 1.548 \cdot in^2$

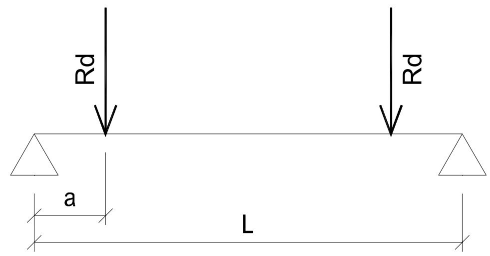
$h := 2.5in$ $\quad b := 1.649in$

$t_1 := 0.080in$ $\quad t_2 := 0.080in$

$$J := \frac{2 \cdot t_1 \cdot t_2 \cdot (b - t_1)^2 \cdot (h - t_2)^2}{b \cdot t_1 + h \cdot t_2 - t_1^2 - t_2^2} = 0.578 \cdot in^4$$

Wind Load on Horizontal





$a_1 := 0.5 \cdot \min(TH_1, L)$ — $a_1 = 27 \cdot in$

$a_2 := 0.5 \cdot \min(TH_2, L)$ — $a_2 = 14 \cdot in$

$q_1 := WL \cdot a_1$ — $q_1 = 11.2 \cdot lbf \cdot in^{-1}$

$q_2 := WL \cdot a_2$ — $q_2 = 5.8 \cdot lbf \cdot in^{-1}$

$q_w := q_1 + q_2$ — $q_w = 17.1 \cdot lbf \cdot in^{-1}$

$R_w := 0.5 \cdot \left[q_1 \cdot (L - a_1) + q_2 \cdot (L - a_2) \right]$ — $R_w = 269 \cdot lbf$

$R_{w1} := 0.5 \cdot q_1 \cdot (a_1)$ — $R_{w1} = 152 \cdot lbf$

$R_{w2} := 0.5 \cdot q_2 \cdot (L - a_2)$ — $R_{w2} = 117 \cdot lbf$

Check Deflection

Wind Load Deflection:

$$\Delta_y := q_1 \cdot L^4 \cdot (1920 \cdot E_a \cdot I_y)^{-1} \cdot \left[25 - 40 \cdot \left(a_1 \cdot L^{-1}\right)^2 + 16 \cdot \left(a_1 \cdot L^{-1}\right)^4 \right] \ldots$$
$$+ q_2 \cdot L^4 \cdot (1920 \cdot E_a \cdot I_y)^{-1} \cdot \left[25 - 40 \cdot \left(a_2 \cdot L^{-1}\right)^2 + 16 \cdot \left(a_2 \cdot L^{-1}\right)^4 \right]$$

$\Delta_y = 0.037 \cdot in$

Allowable Deflection: $\Delta_{ay} := L \cdot 175^{-1}$ — $\Delta_{ay} = 0.309 \cdot in$

Dead Load at Setting Blocks: $a := L \cdot 4^{-1}$ — $a = 13.5 \cdot in$

$P_d := 0.5 \cdot TH_1 \cdot L \cdot D_g$ — $P_d = 112 \cdot lbf$

Dead Load End Reactions: $R_d := P_d$ — $R_d = 112\ lbf$

Dead Load Deflection: $\Delta_x := P_d \cdot a \cdot (24 \cdot E_a \cdot I_x)^{-1} \cdot \left(3 \cdot L^2 - 4 \cdot a^2\right)$ — $\Delta_x = 0.050 \cdot in$

Allowable Deflection: $\Delta_{ax} := 0.125 in$

$Deflection := \text{if}\left(\Delta_y < \Delta_{ay} \wedge \Delta_x < \Delta_{ax}, \text{"OK"}, \text{"NOT OK"}\right) = \text{"OK"}$

Check Bending Stress

Bending Moment on Assembly:

$M_y := q_1 \cdot 24^{-1} \cdot \left(3 \cdot L^2 - 4 \cdot a_1^{\,2}\right) + q_2 \cdot 24^{-1} \cdot \left(3 \cdot L^2 - 4 \cdot a_2^{\,2}\right)$ $M_y = 4669 \cdot lbf \cdot in$

Max Stress on Horizontal:

$M_x := R_d \cdot a$ $M_x = 1514 \cdot lbf \cdot in$

$f_{bx} := M_x \cdot S_x^{-1}$ $f_{bx} = 2.3 \cdot ksi$

$f_{by} := \left(M_y \cdot S_y^{-1}\right)$ $f_{by} = 3.58 \cdot ksi$

Unbraced Length: $L_b := L$

Slenderness: $S_1 := \dfrac{2 \cdot L_b \cdot S_x}{1 \cdot \left(I_y \cdot J\right)^{0.5}}$ $S_1 = 48.3$

Allowable Bending Stresses for 6063-T6 Aluminum

$$F_{b1} := \begin{cases} \left(16.7 - 0.140 \cdot S_1^{\,0.5}\right) \cdot ksi & \text{if } S_1 \le 2400 \\ \dfrac{23599}{S_1} \cdot ksi & \text{otherwise} \end{cases}$$

ADM 2010 F.3.1

$F_{b1} = 15.7 \cdot ksi$

$F_{b2} := 15.2 \cdot ksi$ ADM 2010 B.5.4.1

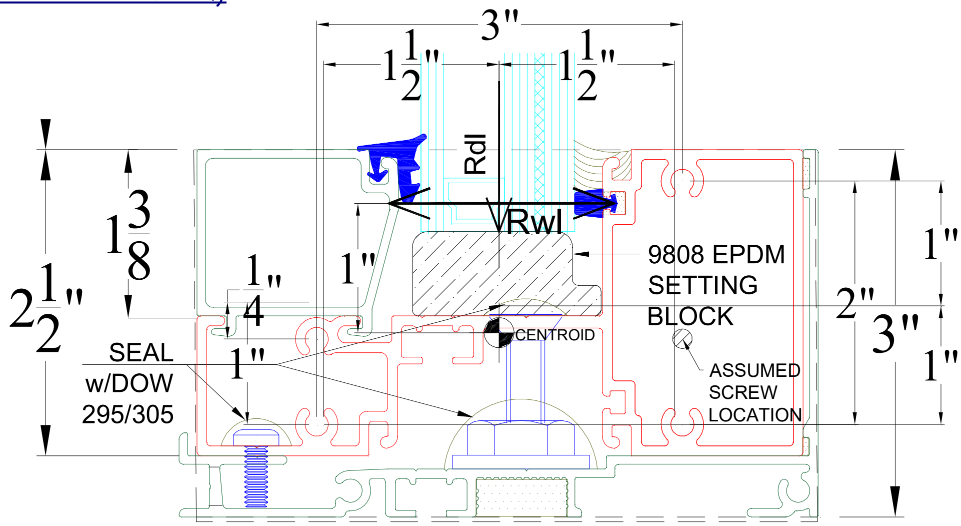
$F_{ba} := \min\left(F_{b1}, F_{b2}\right)$ $F_{ba} = 15.2 \cdot ksi$

Interaction

$Int := \left(\dfrac{f_{bx}}{F_{ba}}\right) + \left(\dfrac{f_{by}}{F_{ba}}\right)$ $Int = 0.39$

Interaction := if(Int < 1.00 , "OK" , "NOT OK") = "OK"

Check Shear on Horizontal Fasteners 12-24 SS CW Fasteners (Assembly Screws; Horizontal to Vertical Mullion)



Number of Fasteners:		$n := 4$
		$e_1 := 1.0 \cdot in$
Horizontal Spacing:		$s_x := 1.5 \cdot in$
Vertical Spacing:		$s_y := 1.0 \cdot in$
J-Value of Fasteners:	$J := n \cdot (s_x)^2 + n \cdot (0.5 \cdot s_y)^2$	$J = 10 \cdot in^2$
Horizontal Shear:	$V_h := R_w \cdot n^{-1} + R_w \cdot e_1 \cdot (0.5 \cdot s_y) \cdot J^{-1}$	$V_h = 81 \cdot lbf$
Vertical Shear:	$V_v := R_d \cdot n^{-1} + R_w \cdot e_1 \cdot (s_x) \cdot J^{-1}$	$V_v = 68 \cdot lbf$
Resultant Shear:	$V_r := \sqrt{V_h^2 + V_v^2}$	$V_r = 106 \cdot lbf$
Allowable Shear:		$V_a := 411 \cdot lbf$
Allowable Bearing Stress:	$V_{ab} := 30.8 \cdot ksi \cdot (0.216 \cdot in \cdot 0.09 \cdot in)$	$V_{ab} = 599 \cdot lbf$
Interaction:	$I := \frac{V_r}{\min(V_a, V_{ab})}$	$I = 0.26$

Fasteners := if(I < 1.0 , "OK" , "NOT OK") = "OK"

Note: For calculation simplicity, top assembly screw considered at hatch location to conservatively confirm adequacy of fastener assembly having smaller J-Value shown above.

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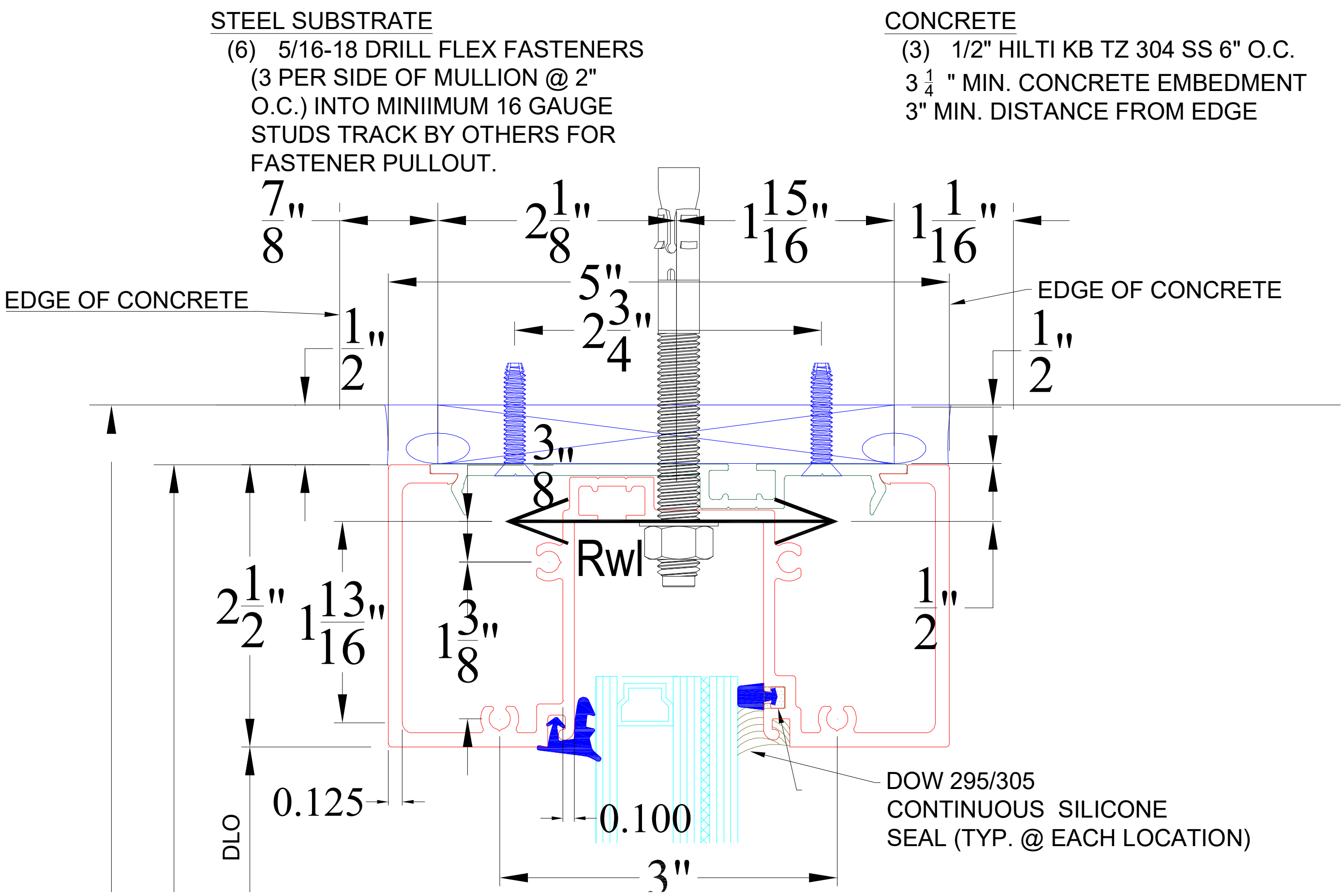
Head Anchor

1	1
E-6.1	D-1



Load Origination

Trib Width: $TW_1 := 57 \cdot in$

$TW_2 := 57 \cdot in$

Trib Height: $TH := 120 \cdot in$

Glass Weight: $D_g := 6.5 \cdot psf$

Framing Weight: $D_f := 2 \cdot psf$

Wind Load: $W_n := 60 \cdot psf$

Wind Load Reaction: $R_w := 0.25 \cdot (TW_1 + TW_2) \cdot TH \cdot W_n$ $\quad R_w = 1425 \cdot lbf$

Anchor Tolerance: $tol := 0.25 \cdot in$

Check of Fasteners Attaching Mullion to Horizontal (#12 300 Series SS)

Number of Fasteners: $n := 4$

Centroid Location: $x_b := (3in \cdot 2) \cdot n^{-1}$ $x_b = 1.5 \cdot in$

$y_b := (1.375in \cdot 2) \cdot n^{-1}$ $y_b = 0.688 \cdot in$

Eccentricities: $e_1 := 1.75in$ $e_1 = 1.750 \cdot in$

$e_2 := (1.8125in - y_b)$ $e_2 = 1.125 \cdot in$

$c_1 := 3in$ $c_1 = 3 \cdot in$

J-Value: $J := (n \cdot x_b^2) + (n \cdot y_b^2)$ $J = 10.891 \cdot in^2$

Moments: $M_h := e_2 \cdot (0.5R_w)$ $M_h = 801.562 \cdot lbf \cdot in$

Vertical Shear on Fasteners: $V_v := (M_h \cdot x_b) \cdot J^{-1}$ $V_v = 110.4 \cdot lbf$

$V_h := (0.5R_w) \cdot n^{-1} + (M_h \cdot y_b) \cdot J^{-1}$ $V_h = 228.7 \cdot lbf$

Shear on Fasteners: $V := (V_v^2 + V_h^2)^{0.5}$ $V = 254 \cdot lbf$

Allowable Shear (Ref: AMMA Table 20.9): $V_a := 411 \cdot lbf$
Interaction:

Interaction: $Int := V \cdot V_a^{-1}$ $Int = 0.62$

Interaction := if(Int ≤ 1.00 , "OK" , "NOT OK") = "OK"

Check of Bending Stress on Leg of Horizontal (6063-T6)

Effective Depth: $d := 15in$

Thickness: $t_1 := 0.125 \cdot in$

Bending Eccentricity: $e_1 := 0.375in$ $e_1 = 0.375 \cdot in$

Section modulus: $S_{x1} := \left(t_1^{\,2} \cdot d\right) \cdot 6^{-1}$ $S_{x1} = 0.039 \cdot in^3$

Moment of Inertia: $I_{x1} := \left(t_1^{\,2} \cdot d\right) \cdot (12)^{-1}$ $I_{x1} = 0.02 \cdot in^3$

Bending Moment: $M_{b1} := \left(0.5R_w \cdot e_1\right)$ $M_{b1} = 267 \cdot lbf \cdot in$

Bending Stress: $f_{b1} := M_{b1} \cdot \left(S_{x1}\right)^{-1}$ $f_{b1} = 6.8 \cdot ksi$

Allowable Bending Stress: $F_{ba} := 19.7ksi$

Interaction: $I := max\left(f_{b1}\right) \cdot F_{ba}^{-1}$ $I = 0.35$

Interaction := if(I ≤ 1.00 , "OK" , "NOT OK") = "OK"

Check of Fasteners into Steel Substrate (5/16" DRILL FLEX)

Number of Fasteners: $n := 6$

Eccentricities: $e_1 := 0.5in + 0.5in + tol$ $e_1 = 1.250 \cdot in$

$c_1 := min(2.125in, 1.9375in)$ $c_1 = 1.938 \cdot in$

Tension on Fasteners: $T := R_w \cdot e_1 \cdot (n \cdot 0.85c_1)^{-1}$ $T = 180 \cdot lbf$

Shear on Fasteners: $V := R_w \cdot n^{-1}$ $V = 237 \cdot lbf$

Allowable Tension: $T_a := 2690lbf$

Allowable Shear: $V_a := 897lbf$

Bending

Root Diameter: $d := 0.2443in$

Bending Eccentricity: $e_b := 0.5in + tol$ $e_b = 0.75 \cdot in$

Allowable Bending Strength: $Y_s := 92ksi$

Bending Moment: $M := 0.5 \cdot V \cdot e_b$ $M = 89.1 \cdot lbf \cdot in$

Allowable Bending Moment: $M_a := \left(\frac{1.6}{1.67}\right) Y_s \cdot \frac{(\pi \cdot d^3)}{32}$ $M_a = 126.2 \cdot lbf \cdot in$

Interaction: $I := \left(T \cdot T_a^{-1} + M \cdot M_a^{-1}\right)^2 + \left(V \cdot V_a^{-1}\right)^2$ $I = 0.667$

Interaction := if(I ≤ 1.00 , "OK" , "NOT OK") = "OK"

Check Pullout of Fasteners from Studs (16 Gauge Studs by Others)

Tension on Fasteners: $T = 180 \cdot lbf$

Nominal Diameter: $d := 0.3125 \cdot in$

Base Metal Thickness: $t := 0.06 \cdot in$

Ultimate Strength: $F_u := 50 \cdot ksi$

Factor of Safety: $FS := 3$

Pullout Capacity: $T_{a2} := 0.85 \cdot F_u \cdot d \cdot t \cdot FS^{-1}$ $T_{a2} = 266 \cdot lbf$

Interaction: $I := T \cdot T_{a2}^{-1}$ $I = 0.68$

Interaction := if(I ≤ 1.00 , "OK" , "NOT OK") = "OK"

Check of Connection to Concrete Substrate (1/2" HILTI KB TZ 304 SS):

LRFD Loads:	$R_{wl} := R_w \cdot 0.6^{-1}$	$R_{wl} = 2375 \cdot lbf$
Eccentricities:	$e_1 := 0.5in + tol$	$e_1 = 0.750 \cdot in$
	$c_1 := \min(2.125in, 1.9375in)$	$c_1 = 1.938 \cdot in$
Tension on Fasteners:	$T := R_{wl} \cdot e_1 \cdot (0.85c_1)^{-1}$	$T = 1082 \cdot lbf$
Shear on Fasteners:	$V := R_{wl}$	$V = 2375 \cdot lbf$

Note: Reference following PROFIS analysis for confirmation of adequacy.

Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Header Anchor	Date:	4/21/2020
Fastening point:			

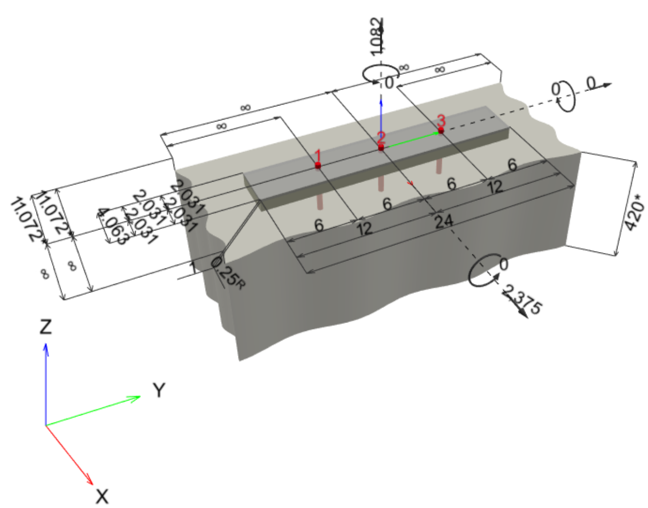
Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS 1/2 (3 1/4)**
Item number:	not available
Effective embedment depth:	$h_{ef,act}$ = 3.250 in., h_{nom} = 3.625 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	5/1/2019 | 5/1/2021
Proof:	Design Method ACI 318-14 / Mech
Stand-off installation:	without clamping (anchor); restraint level (anchor plate): 2.00; e_b = 1.000 in.; t = 0.250 in.
	Hilti Grout: CB-G EG, epoxy, $f_{c,Grout}$ = 14,939 psi
Anchor plate^R :	l_x x l_y x t = 4.063 in. x 24.000 in. x 0.250 in.; (Recommended plate thickness: not calculated)
Profile:	Round bars (AISC), 1/16; (L x W x T) = 0.063 in. x 0.063 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 420.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar

^{R} - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



Company:		Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Header Anchor	Date:	4/21/2020
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 1,082; V_x = 2,375; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	no	98

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Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Header Anchor	Date:	4/21/2020
Fastening point:			

2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	β_N / β_V [%]	**Status**
Tension	Concrete Breakout Failure	1,082	7,910	14 / -	OK
Shear	Steel failure (with lever arm)	792	816	- / 98	OK

Loading	β_N	β_V	ζ	**Utilization** $\beta_{N,V}$ **[%]**	**Status**
Combined tension and shear loads	0.137	0.970	1.000	93	OK

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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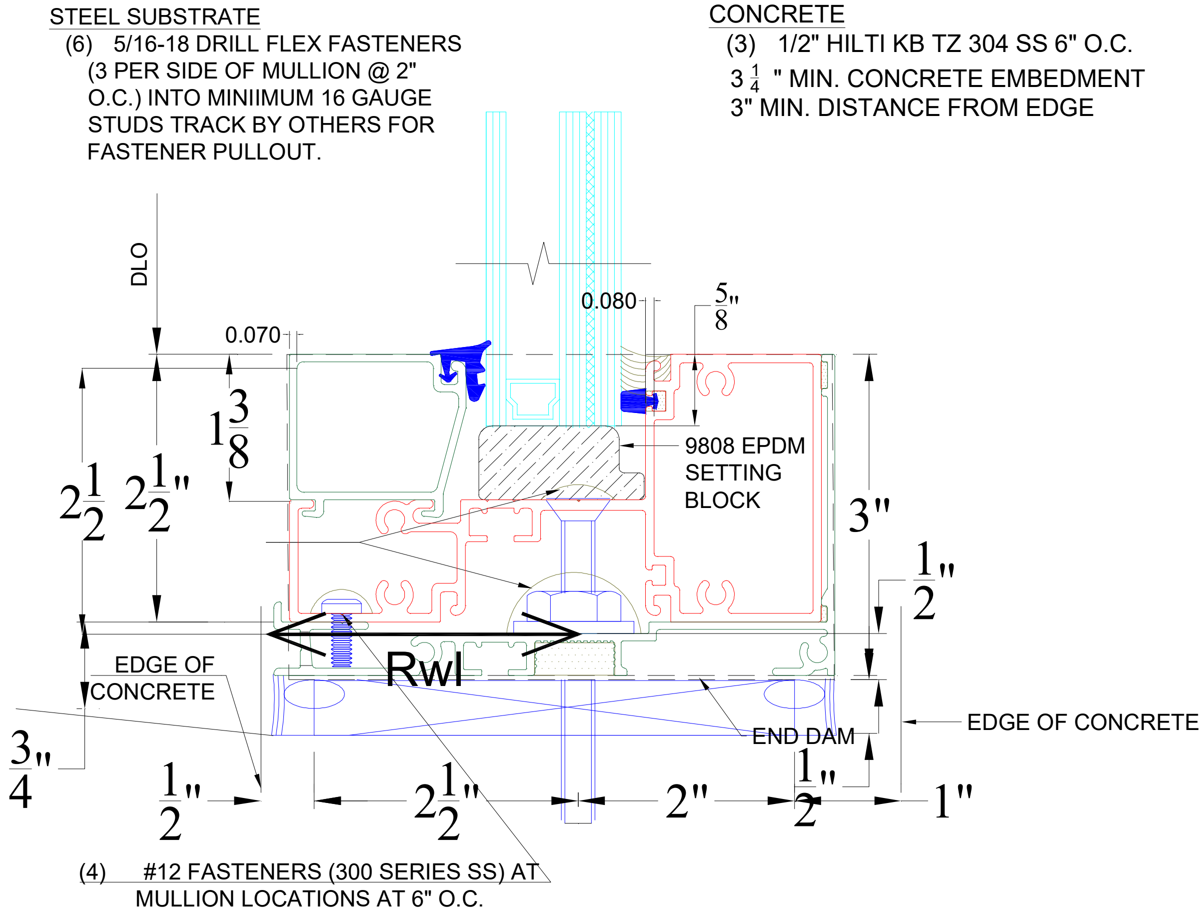
Sill Anchor

3



Load Origination

Trib Width: $TW_1 := 57 \cdot in$

$TW_2 := 57 \cdot in$

Trib Height: $TH := 120 \cdot in$

Glass Weight: $D_g := 6.5 \cdot psf$

Framing Weight: $D_f := 2 \cdot psf$

Wind Load: $W_n := 60 \cdot psf$

Wind Load Reaction: $R_w := 0.25 \cdot (TW_1 + TW_2) \cdot TH \cdot W_n$ $R_w = 1425 \cdot lbf$

Anchor Tolerance: $tol := 0.25 \cdot in$

Check of Fasteners Attaching Framing to Subsill (#12 300 Series SS)

Number of Fasteners: $n := 4$

Shear on Fasteners: $V := R_w \cdot n^{-1}$ $V = 356.3 \cdot lbf$

Allowable Shear (Ref: AMMA Table 20.9): $V_a := 411 \cdot lbf$

Interaction: $Int := V \cdot V_a^{-1}$ $Int = 0.87$

Interaction := if(Int ≤ 1.00 , "OK" , "NOT OK") = "OK"

Check Bearing Stress of Fastner into Aluminum (6061-T6)

Bolt Diameter: $d := 0.216 \cdot in$

Bracket Thickness: $t := 0.5 \cdot in$

Max Bearing Stress: $f_b := R_w \cdot (d \cdot t)^{-1}$ $f_b = 13.194 \cdot ksi$

Allowable Bearing Stress: $F_{ba} := 39.0 \cdot ksi$

Interaction: $I := f_b \cdot F_{ba}^{-1}$ $I = 0.338$

Interaction := if(I < 1.0 , "OK" , "NOT OK") = "OK"

Check of Fasteners into Steel Substrate (5/16" DRILL FLEX)

Number of Fasteners: $n := 6$

Eccentricities: $e_1 := 0.5in + 0.5in + tol$ — $e_1 = 1.250 \cdot in$

$c_1 := \min(2.5in, 2in)$ — $c_1 = 2 \cdot in$

Tension on Fasteners: $T := R_w \cdot e_1 \cdot (n \cdot 0.85 c_1)^{-1}$ — $T = 174.6 \cdot lbf$

Shear on Fasteners: $V := R_w \cdot n^{-1}$ — $V = 237.5 \cdot lbf$

Allowable Tension: $T_a := 2690 lbf$

Allowable Shear: $V_a := 897 lbf$

Bending

Root Diameter: $d := 0.313 in$

Bending Eccentricity: $e_b := 0.5in + tol$ — $e_b = 0.75 \cdot in$

Allowable Bending Strength: $Y_s := 92 ksi$

Bending Moment: $M := 0.5 \cdot V \cdot e_b$ — $M = 89.1 \cdot lbf \cdot in$

Allowable Bending Moment: $M_a := \left(\frac{1.6}{1.67}\right) Y_s \cdot \frac{(\pi \cdot d^3)}{32}$ — $M_a = 265.4 \cdot lbf \cdot in$

Interaction: $I := \left(T \cdot T_a^{-1} + M \cdot M_a^{-1}\right)^2 + \left(V \cdot V_a^{-1}\right)^2$ — $I = 0.231$

Interaction := if(I ≤ 1.00 , "OK" , "NOT OK") = "OK"

Check Pullout of Fasteners from Studs (16 Gauge Studs by Others)

Tension on Fasteners: $T := 88.2lbf$

Nominal Diameter: $d := 0.3125 \cdot in$

Base Metal Thickness: $t := 0.06 \cdot in$

Ultimate Strength: $F_u := 30.8 \cdot ksi$

Factor of Safety: $FS := 3$

Pullout Capacity: $T_{a2} := 0.85 \cdot F_u \cdot d \cdot t \cdot FS^{-1}$ $T_{a2} = 164 \cdot lbf$

Interaction: $I := T \cdot T_{a2}^{-1}$ $I = 0.54$

Interaction := if(I ≤ 1.00 , "OK" , "NOT OK") = "OK"

Check of Connection to Concrete Substrate (1/2" HILTI KB TZ 304 SS):

LRFD Loads: $R_{wl} := R_w \cdot 0.6^{-1}$ $R_{wl} = 2375 \cdot lbf$

Eccentricities: $e_1 := 0.5in + tol$ $e_1 = 0.750 \cdot in$

$c_1 := \min(2.125in, 1.9375in)$ $c_1 = 1.938 \cdot in$

Tension on Fasteners: $T := R_{wl} \cdot e_1 \cdot (0.85c_1)^{-1}$ $T = 1082 \cdot lbf$

Shear on Fasteners: $V := R_{wl}$ $V = 2375 \cdot lbf$

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DIVISION: 05 00 00—METALS
Section: 05 05 23—Metal Fastenings

REPORT HOLDER:

ELCO CONSTRUCTION PRODUCTS

EVALUATION SUBJECT:

DRIL-FLEX® SELF-DRILLING STRUCTURAL FASTENERS

ADDITIONAL LISTEE:

HILTI, INC.
PRODUCT NAME: KWIK-FLEX® SELF DRILLING SCREWS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2015, 2012 and 2009 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

Elco Dril-Flex® and Hilti Kwik-Flex® Self-Drilling Structural Fasteners are used in engineered connections of cold-formed steel members. The fasteners may be used under the IRC when an engineered design is submitted for review in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 General:

Elco Dril-Flex® and Hilti Kwik-Flex® Self-Drilling Structural Fasteners are proprietary, self-drilling tapping screws that have a dual heat treatment and that are coated with a corrosion-preventive coating identified as Silver Stalgard®. The drill point and lead threads of the screws are heat-treated to a relatively high hardness to facilitate drilling and thread forming. The balance of the fastener is treated to a lower hardness complying with the hardness limits for SAE J429 Grade 5 screws and the hardness limits for ASTM A449-10 Type 1 screws. The threaded portion of the screw with the lower hardness is considered the load-bearing area, used to transfer loads between connected elements. See Figures 10, 11 and 12. Table 1 provides screw descriptions (size, tpi, length), nominal diameters, head styles, head diameters, point styles, drilling capacities and length of load-bearing area.

3.1.1 EDX445 (Type 1): The EDX445 screw is a #10, coarse threaded screw with a phillips pan head. See Figure 1.

3.1.2 EAF430, EAF460, EAF470, EAF480 (Type 2): These screws are #10, coarse threaded screws with an indented hex washer head. See Figure 2.

3.1.3 EAF621, EAF641, EAF681, EAF690, EAF715 (Types 3 and 4): These screws are #12, coarse threaded screws with an indented hex washer head. See Figure 3.

3.1.4 EAF755 (Type 5): The EAF755 screw is a #12, fine threaded screw with an indented hex washer head. See Figure 4.

3.1.5 EAF816, EAF841, EAF846 (Type 6): These screws are $^{1}/_{4}$-inch-diameter, coarse threaded screws with an indented hex washer head. See Figure 5.

3.1.6 EAF865, EAF876, EAF886, EAF890 (Type 7): These screws are $^{1}/_{4}$-inch-diameter, fine threaded screws with an indented hex washer head. See Figure 6.

3.1.7 EAF888 (Type 8): The EAF888 screw is a $^{1}/_{4}$-inch-diameter, fine threaded screw with an indented hex washer head. The lead threads have a design identified by the manufacturer as Round Body Taptite®. See Figure 7.

3.1.8 EAF900, EAF910 (Types 9 and 10): These screws are $^{1}/_{4}$-inch-diameter, partially threaded, fine threaded screws with an indented hex washer head.

3.1.9 EAF940 (Type 11): The EAF940 screw is a $^{5}/_{16}$-inch-diameter, fine threaded screw with an indented hex washer head. The lead threads have a design identified by the manufacturer as Round Body Taptite®. See Figure 8.

3.1.10 EAF960, EAF970 (Type 12): These screws are $^{5}/_{16}$-inch-diameter, fine threaded screws with an indented hex washer head. At the lead end of the screw, the shank of the screw is notched to form a shank slot. See Figure 9.

3.2 Screw Material:

The screws are formed from alloy steel wire complying with the manufacturer's specifications. The screws are heat-treated to a through-hardness of 28 to 34 HRC. The drilling point and lead threads are heat-treated to a minimum of 52 HRC.

3.3 Connected Material:

The connected steel materials must comply with one of the standards listed in Section A2.1.1 of AISI S100-12 (Section A2 of AISI S100-07 for the 2012 and 2009 IBC, AISI-NAS for the 2006 IBC) and must have the minimum thickness, yield strength and tensile strength shown in the tables in this report.

4.0 DESIGN AND INSTALLATION

4.1 Design:

Elco Dril-Flex® and Hilti Kwik-Flex® Self-Drilling Structural Fasteners are recognized for use in engineered connections of cold-formed steel construction. Design of the connections must comply with Section E4 of AISI S100 (AISI-NAS for the 2006 IBC). Nominal and available fastener tension and shear strengths for the screws are shown in Table 2. Available connection shear, pull-over and pull-out capacities are given in Tables 3, 4 and 5, respectively. For tension connections, the lowest of the available fastener tension strength, pull-over strength and pull-out strength, in accordance with Tables 2, 4 and 5, respectively, must be used for design. For shear connections, the lower of the available fastener shear strength and the shear (bearing) strength, in accordance with Tables 2 and 3, respectively, must be used for design. Design provisions for tapping screw connections subjected to combined shear and torsion loading are outside the scope of the report. The connection shear strength is for connections where the connected steel elements are in direct contact with one another.

For screws used in framing connections, in order for the screws to be considered fully effective, the minimum spacing between the fasteners and the minimum edge distance must be three times the nominal diameter of the screws, except when the edge is parallel to the direction of the applied force, the minimum edge distance must be 1.5 times the nominal screw diameter. When the spacing between screws is 2 times the fastener diameter, the connection shear strength values in Table 3 must be reduced by 20 percent (Refer to Section D1.5 of AISI S200).

For screws used in applications other than framing connections, the minimum spacing between fasteners must be three times the nominal screws diameter and the minimum edge and end distance must be 1.5 times the nominal screw diameter. Additionally, under the 2009 and 2006 IBC, when the distance to the end of the connected part is parallel to the line of the applied force, the allowable connection shear strength determined in accordance with Section E4.3.2 of Appendix A of AISI S100-07 (AISI – NAS for the 2006 IBC) must be considered.

Connected members must be checked for rupture in accordance with Section E6 of AISI S100-12 for the 2015 IBC (Section E5 of AISI S100-07/S2-10 for the 2012 IBC; Section E5 of AISI S100-07 for the 2009 IBC).

When tested for corrosion resistance in accordance with ASTM B117, the screws meet the minimum requirement listed in ASTM F1941, as required by ASTM C1513, with no white corrosion after three hours and no red rust after twelve hours.

4.2 Installation:

Installation of Elco Dril-Flex® and Hilti Kwik-Flex® Self-Drilling Structural Fasteners must be in accordance with the manufacturer's published installation instructions and this report. The manufacturer's published installation instructions must be available at the jobsite at all times during installation.

Screw length and point style must be selected by considering, respectively, the length of load-bearing area and the drilling capacities shown in Table 1. The fasteners must be installed without predrilling holes in the receiving member of the connection. The drilling function of the fastener must be completed prior to the lead threads of the fastener engaging the metal. When the total connection thickness exceeds the maximum drilling capacity shown in Table 1, clearance holes must be provided in the attached material to reduce the thickness to be drilled by the screw. Clearance holes must be $^{13}/_{64}$, $^{15}/_{64}$, $^{17}/_{64}$ and $^{21}/_{64}$ inch (5.2, 5.9, 6.7 and 8.3 mm) in diameter for #10, #12, $^{1}/_{4}$-inch-diameter and $^{5}/_{16}$-inch-diameter (4.7, 5.3, 6.4 and 7.9 mm) fasteners, respectively. The screw must be installed perpendicular to the work surface using a 1,200 to 2,500 rpm screw gun incorporating a depth-sensitive or torque-limiting nose piece. The screw must penetrate through the supporting metal with a minimum of three threads protruding past the back side of the supporting metal.

5.0 CONDITIONS OF USE

The Elco Dril-Flex® and Hilti Kwik-Flex® Self-Drilling Structural Fasteners described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The fasteners must be installed in accordance with the manufacturer's published installation instructions and this report. If there is a conflict between the manufacturer's published installation instructions and this report, the more severe requirements govern.

5.2 The allowable connection capacities specified in Section 4.1 are not to be increased when the fasteners are used to resist short-duration loads, such as wind or seismic forces.

5.3 The utilization of the nominal connection capacities contained in this evaluation report, for the design of cold-formed steel diaphragms, is outside the scope of this report.

5.4 Drawings and calculations verifying compliance with this report and the applicable code must be submitted to the code official for approval. The drawings and calculations are to be prepared by a registered design professional when required by the statutes of the jurisdiction in which the project is to be constructed.

5.5 The fasteners are manufactured under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Tapping Screw Fasteners (AC118), dated February 2016.

7.0 IDENTIFICATION

7.1 The Elco Dril-Flex® and Hilti Kwik-Flex® self-drilling tapping screws are marked with a "" on the top surface of the screw heads, as shown in Figures 1 through 9. Packages of self-drilling tapping screws are labeled with the report holder or listee name (Elco Construction Products or Hilti, Inc.) and address, product brand name (Dril-Flex® or Kwik-Flex®), product number or item number, size and length, point style and the evaluation report number (ESR-3332).

7.2 The report holder's contact information is the following:

ELCO CONSTRUCTION PRODUCTS
1302 KERR DRIVE
DECORAH, IOWA 52101
(800) 435-7213
www.elcoconstruction.com
infoElco@sbdinc.com

7.3 The Additional Listee's contact information is the following:

HILTI, INC.
7250 DALLAS PARKWAY, SUITE 1000
PLANO, TEXAS 75024
(800) 879-8000
www.us.hilti.com

TABLE 1—ELCO DRIL-FLEX SELF-DRILLING STRUCTURAL FASTENERS

SCREW TYPE	ELCO PRODUCT NUMBER	HILTI ITEM NUMBER	DESCRIPTION (nom. size-tpi x length)	NOMINAL DIAMETER (in.)	HEAD STYLE[1]	HEAD DIAMETER (in.)	POINT STYLE	DRILLING CAPACITY (in.)		LENGTH OF LOAD BEARING AREA[2] (in.)
								Min.	Max.	
1	EDX445	03409732	#10-16x$^{3}/_{4}$	0.190	PPH	0.365	2	0.11	0.110	0.38
2	EAF430	00408123	#10-16x$^{3}/_{4}$	0.190	IHWH	0.399	3	0.11	0.150	0.38
	EAF460	03489672	#10-16x1$^{1}/_{2}$	0.190	IHWH	0.399	3	0.11	0.150	1.00
	EAF470	03458234	#10-16x2	0.190	IHWH	0.415	3	0.11	0.150	1.50
	EAF480	03492651	#10-16x2$^{1}/_{2}$	0.190	IHWH	0.399	3	0.11	0.150	1.83
3	EAF621	00087572	#12-14x$^{7}/_{8}$	0.216	IHWH	0.415	3	0.11	0.187	0.38
	EAF641	00087646	#12-14x1	0.216	IHWH	0.415	3	0.11	0.187	0.50
	EAF681	00087647	#12-14x1$^{1}/_{2}$	0.216	IHWH	0.415	3	0.11	0.187	1.00
	EAF690	00008595	#12-14x2	0.216	IHWH	0.415	3	0.11	0.187	1.50
4	EAF715	03011177	#12-14x3	0.216	IHWH	0.500	2	0.11	0.110	2.35
5	EAF755	03458235	#12-24x1$^{3}/_{4}$	0.216	IHWH	0.415	5	0.11	0.500	0.80
6	EAF816	00087648	$^{1}/_{4}$-14x1	0.250	IHWH	0.500	3	0.11	0.210	0.45
	EAF841	00087649	$^{1}/_{4}$-14x1$^{1}/_{2}$	0.250	IHWH	0.500	3	0.11	0.210	0.95
	EAF846	00008598	$^{1}/_{4}$-14x2	0.250	IHWH	0.500	3	0.11	0.210	1.45
7	EAF865	03011203	$^{1}/_{4}$-20x1$^{1}/_{8}$	0.250	IHWH	0.500	4	0.11	0.312	0.50
	EAF876	00000451	$^{1}/_{4}$-20x1$^{1}/_{2}$	0.250	IHWH	0.500	4	0.11	0.312	0.83
	EAF886	00000452	$^{1}/_{4}$-20x2	0.250	IHWH	0.500	4	0.11	0.312	1.33
	EAF890	00010436	$^{1}/_{4}$-20x2$^{1}/_{2}$	0.250	IHWH	0.500	4	0.11	0.312	1.83
8	EAF888	03458236	$^{1}/_{4}$-20x1$^{3}/_{4}$	0.250	IHWH	0.500	5	0.11	0.500	0.80
9	EAF900	03414194	$^{1}/_{4}$-20x3$^{3}/_{8}$	0.250	IHWH	0.500	3	0.11	0.210	2.70
10	EAF910	03463594	$^{1}/_{4}$-20x4	0.250	IHWH	0.500	4	0.11	0.312	3.50
11	EAF940	03011230	$^{5}/_{16}$-18x1$^{1}/_{2}$	0.313	IHWH	0.600	3	0.11	0.312	0.80
12	EAF960	03006009	$^{5}/_{16}$-24x1$^{1}/_{2}$	0.313	IHWH	0.600	4	0.11	0.312	0.80
	EAF970	03432628	$^{5}/_{16}$-24x2	0.313	IHWH	0.600	4	0.11	0.312	1.25

For **SI:** 1 inch = 25.4 mm.

[1]Head styles: IHWH = Indented Hex Washer Head; PPH = Phillips Pan Head.
[2]The Length of Load Bearing Area is based on the length of the threaded portion of the screw that is heat treated to HRC 28-34, and represents the limit of the total thickness of the connected elements. See Sections 3.1 and 4.2 and Figures 10 through 12 for further clarification.

TABLE 2—FASTENER SHEAR AND TENSION STRENGTH, pounds-force[1,2,3]

SCREW TYPE	SCREW SIZE	NOMINAL STRENGTH (TESTED)		ALLOWABLE STRENGTH (ASD) Ω=3		DESIGN STRENGTH (LRFD) Φ=0.5	
		Shear, P_{ss}	Tension, P_{ts}	Shear, P_{ss}/Ω	Tension, P_{ts}/Ω	Shear, ΦP_{ss}	Tension, ΦP_{ts}
1	#10-16	1526	2273	509	758	763	1136
2	#10-16	1463	2276	488	759	732	1138
3, 4	#12-14	1992	3216	664	1072	996	1608
5	#12-24	2503	4177	834	1392	1252	2088
6	$^{1}/_{4}$-14	2692	4363	897	1454	1346	2182
7, 9, 10	$^{1}/_{4}$-20	2659	4729	886	1576	1330	2364
8	$^{1}/_{4}$-20	2617	4619	872	1540	1308	2309
11	$^{5}/_{16}$-18	4568	8070	1523	2690	2284	4035
12	$^{5}/_{16}$-24	5471	8757	1824	2919	2736	4379

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.4 N.

[1]For tension connections, the lower of the available fastener tension strength, pullover strength, and pull-out strength found in Tables 2, 4 and 5, respectively, must be used for design.
[2]For shear connections, the lower of the available fastener shear strength and the allowable shear (bearing) capacity found in Tables 2 and 3, respectively, must be used for design.
[3]Nominal strengths are based on laboratory tests.

TABLE 3—SHEAR (BEARING) CAPACITY OF SCREW CONNECTIONS, pounds-force[1,2,3,4,5]

SCREW TYPE	SCREW DESIGNATION	NOMINAL DIAMETER (in.)	DESIGN THICKNESS (in.)[6]						
			0.048-0.048	0.048-0.075	0.060-0.060	0.075-0.075	1/8"-3/16"	3/16"-1/4"	1/4"-0.105"
ALLOWABLE STRENGTH (ASD)									
1	#10-16	0.190	289	289	404	-	-	-	-
2	#10-16	0.190	369	395	453	-	-	-	-
3, 4	#12-14	0.216	356	573	513	497	-	-	-
6	1/4-14	0.250	377	626	520	661	638	-	-
7, 8	1/4-20	0.250	386[7,8]	526[7,8]	533[8]	670[8]	595[9]	624[9]	554[9]
11	5/16-18	0.313	408	622	561	891	-	-	-
12	5/16-24	0.313	-	-	-	-	1347	984	887
DESIGN STRENGTH (LRFD)									
1	#10-16	0.190	433	433	605	-	-	-	-
2	#10-16	0.190	590	631	724	-	-	-	-
3, 4	#12-14	0.216	569	917	820	795	-	-	-
6	1/4-14	0.250	603	1001	833	1058	1021		
7, 8	1/4-20	0.250	617[7,8]	842[7,8]	852[8]	1072[8]	952[9]	999[9]	886[9]
11	5/16-18	0.313	653	996	897	1425	-	-	-
12	5/16-24	0.313	-	-	-	-	2155	1575	1419

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.4 N, 1 ksi = 6.89 Mpa.

[1]Available strengths are based on laboratory tests, with safety factors/resistance factors calculated in accordance with AISI S100.
[2]For shear connections, the lower of the available fastener shear strength and the available shear (bearing) capacity must be used for design.
[3]Values are based on steel members with a minimum yield strength of F_y = 33 ksi and a minimum tensile strength of F_u = 45 ksi.
[4]Available capacity for other member thickness may be determined by interpolating within the table.
[5]Unless otherwise noted, when both steel sheets have a minimum specified tensile strength $F_u \geq 58$ ksi, multiply tabulated values by 1.29 and when both steel sheets have a minimum tensile strength $F_u \geq 65$ ksi steel, multiply tabulated values by 1.44.
[6]The first number is the thickness of the steel sheet in 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).
[7]When both steel sheets have a minimum specified tensile strength of $F_u \geq 55$ ksi (e.g. ASTM A653 SS Grade 40), multiply tabulated values by 1.22.
[8]When both steel sheets have a minimum specified tensile strength of $F_u \geq 52$ ksi (e.g. ASTM A653 SS Grade 37), multiply tabulated values by 1.15.
[9]When both steel sheets have a minimum specified tensile strength of $F_u \geq 58$ ksi (e.g. ASTM A36), multiply tabulated values by 1.29.

TABLE 4—TENSILE PULL-OVER CAPACITY OF SCREW CONNECTIONS, pounds-force[1,3,4,5,6]

SCREW TYPE	SCREW DESIGNATION	NOMINAL DIAMETER (in.)	MINIMUM EFFECTIVE PULL-OVER DIAMETER (in.)	DESIGN THICKNESS OF MEMBER IN CONTACT WITH SCREW HEAD (in.)							
				0.048	0.060	0.075	0.105	1/8"	3/16"	1/4"	5/16"
ALLOWABLE STRENGTH (ASD)											
1	#10-16	0.190	0.357	386	481[2]	481[2]	481[2]	481[2]	-	-	-
2	#10-16	0.190	0.384	415	481[2]	481[2]	481[2]	481[2]	-	-	-
3, 4	#12-14	0.216	0.398	430	537	672	734[2]	734[2]	734[2]	-	-
5	#12-24	0.216	0.398	430	537	672	734[2]	734[2]	734[2]	734[2]	734[2]
6	1/4-14	0.250	0.480	518	648	810	1126[2]	1126[2]	1126[2]	-	-
7, 8	1/4-20	0.250	0.480	-	648	810	1126[2]	1126[2]	1126[2]	1126[2]	1126[2]
11	5/16-18	0.313	n/a[2]	-	-	-	1169[2]	1169[2]	-	-	-
12	5/16-24	0.313	n/a[2]	-	-	-	1326[2]	1326[2]	1326[2]	1326[2]	1326[2]
DESIGN STRENGTH (LRFD)											
1	#10-16	0.190	0.357	578	723	781[2]	781[2]	781[2]	-	-	-
2	#10-16	0.190	0.384	622	778	781[2]	781[2]	781[2]	-	-	-
3, 4	#12-14	0.216	0.398	645	806	1007	1192[2]	1192[2]	1192[2]	-	-
5	#12-24	0.216	0.398	645	806	1007	1192[2]	1192[2]	1192[2]	1192[2]	1192[2]
6	1/4-14	0.250	0.480	778	972	1215	1701	1830[2]	1830[2]	-	-
7, 8	1/4-20	0.250	0.480	-	972	1215	1701	1830[2]	1830[2]	1830[2]	1830[2]
11	5/16-18	0.313	n/a[2]	-	-	-	1871[2]	1871[2]	-	-	-
12	5/16-24	0.313	n/a[2]	-	-	-	2121[2]	2121[2]	2121[2]	2121[2]	2121[2]

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.4 N, 1 ksi = 6.89 Mpa.

[1]Available strengths are based on calculations in accordance with AISI S100, unless otherwise noted.
[2]Available strengths are based on laboratory tests, with safety factors/resistance factors calculated in accordance with AISI S100, or on the shear strength of the integral washer. Increasing values for higher steel tensile strength per Note 6 is not allowed.
[3]For tension connections, the lowest of the available pull-out, pull-over, and fastener tension strength must be used for design.
[4]Values are based on steel members with a minimum yield strength of F_y = 33 ksi and a minimum tensile strength of F_u = 45 ksi.
[5]Available capacity for other member thickness may be determined by interpolating within the table.
[6]For steel with a minimum tensile strength $F_u \geq 58$ ksi, multiply tabulated values by 1.29 and for steel with a minimum tensile strength $F_u \geq 65$ ksi steel, multiply tabulated values by 1.44.

TABLE 5—TENSILE PULL-OUT CAPACITY OF SCREW CONNECTIONS, pounds-force[1,2,3,4,5]

SCREW TYPE	SCREW DESIGNATION	NOMINAL DIAMETER (in.)	DESIGN THICKNESS OF MEMBER NOT IN CONTACT WITH SCREW HEAD (in.)							
			0.048	0.060	0.075	0.105	1/8"	3/16"	1/4"	5/16"
ALLOWABLE STRENGTH (ASD)										
1	#10-16	0.190	136	193	236	307	297	-	-	-
2	#10-16	0.190	136	193	236	307	297	-	-	-
3, 4	#12-14	0.216	132	205	264	328	510	665	-	-
6	1/4-14	0.250	131	207	255	342	561	899	-	-
7, 8, 9, 10	1/4-20	0.250	-	204[6]	260[6]	423[6]	524[7]	914[7]	1044	1206
11	5/16-18	0.313	-	-	-	520	707	-	-	-
12	5/16-24	0.313	-	-	-	459	637	724	1189	1424
DESIGN STRENGTH (LRFD)										
1	#10-16	0.190	217	309	378	492	476	-	-	-
2	#10-16	0.190	217	309	378	492	476	-	-	-
3, 4	#12-14	0.216	211	328	423	525	816	1064	-	-
6	1/4-14	0.250	210	331	409	548	897	1439	-	-
7, 8, 9, 10	1/4-20	0.250	-	326[6]	416[6]	677[6]	838[7]	1462[7]	1670	1930
11	5/16-18	0.313	-	-	-	832	1131	-	-	-
12	5/16-24	0.313	-	-	-	735	1019	1159	1903	2279

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.4 N, 1 ksi = 6.89 Mpa.

[1]Available strengths are based on laboratory tests, with safety factors/resistance factors calculated in accordance with AISI S100.
[2]For tension connections, the lowest of the available pull-out, pull-over, and fastener tension strength must be used for design.
[3]Values are based on steel members with a minimum yield strength of F_y = 33 ksi and a minimum tensile strength of F_u = 45 ksi.
[4]Available capacity for other member thickness may be determined by interpolating within the table.
[5]Unless otherwise noted, for steel with a minimum tensile strength $F_u \geq$ 58 ksi, multiply tabulated values by 1.29 and for steel with a minimum tensile strength $F_u \geq$ 65 ksi steel, multiply tabulated values by 1.44.
[6]When both steel sheets have a minimum specified tensile strength of $F_u \geq$ 52 ksi (e.g. ASTM A653 SS Grade 37), multiply tabulated values by 1.15.
[7]When both steel sheets have a minimum specified tensile strength of $F_u \geq$ 58 ksi (e.g. ASTM A36), multiply tabulated values by 1.29.

FIGURE 1—#10-16 PHILLIPS PAN HEAD (TYPE 1 SCREW)

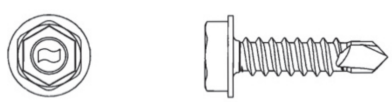

FIGURE 2—#10-16 INDENTED HEX WASHER HEAD (TYPE 2 SCREW)

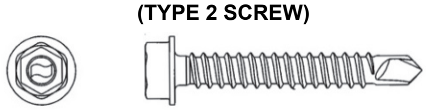

FIGURE 3—#12-14 INDENTED HEX WASHER HEAD (TYPE 3 AND 4 SCREW)

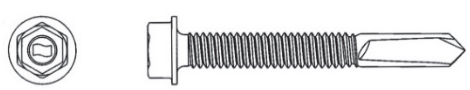

FIGURE 4—#12-24 INDENTED HEX WASHER HEAD (TYPE 5 SCREW)

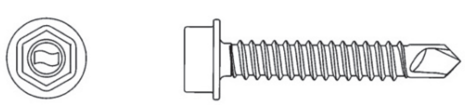

FIGURE 5—1/4-14 INDENTED HEX WASHER HEAD (TYPE 6 SCREW)

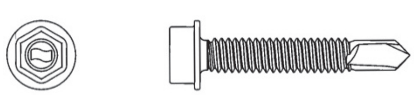

FIGURE 6—1/4-20 INDENTED HEX WASHER HEAD TYPE 7 SCREW

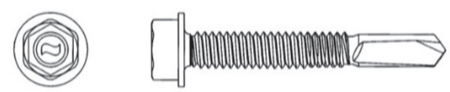

FIGURE 7—1/4-20 INDENTED HEX WASHER HEAD ROUND BODY TAPTITE (TYPE 8 SCREW)

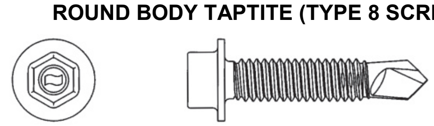

FIGURE 8—5/16-18 INDENTED HEX WASHER HEAD ROUND BODY TAPTITE (TYPE 11 SCREW)

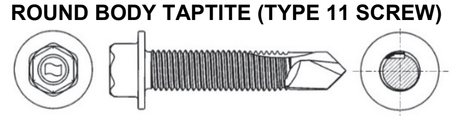

FIGURE 9—5/16-24 INDENTED HEX WASHER HEAD WITH SHANK SLOT (TYPE 12 SCREW)

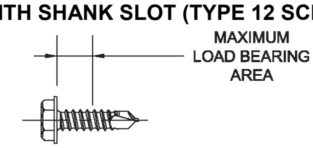

FIGURE 10—PHILLIPS PAN HEAD AND INDENTED HEX WASHER HEAD LOAD BEARING AREA

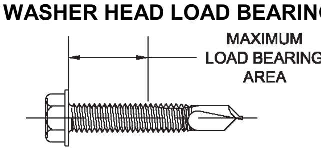

FIGURE 11—INDENTED HEX WASHER HEAD WITH SHANK SLOT LOAD BEARING AREA

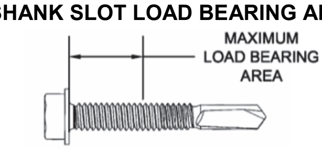

FIGURE 12—INDENTED HEX WASHER HEAD ROUND BODY TAPTITE LOAD BEARING AREA

ICC-ES Evaluation Report

ESR-3332 FBC Supplement

Reissued September 2019

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DIVISION: 05 00 00—METALS
Section: 05 05 23—Metal Fastenings

REPORT HOLDER:

ELCO CONSTRUCTION PRODUCTS

EVALUATION SUBJECT:

DRIL-FLEX® SELF-DRILLING STRUCTURAL FASTENERS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the fasteners, recognized in ICC-ES master evaluation report ESR-3332, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2014 *Florida Building Code—Building* (FBC-B)
- 2014 *Florida Building Code—Residential* (FBC-R)

2.0 CONCLUSIONS

The fasteners, described in Sections 2.0 through 7.0 of the master evaluation report, ESR-3332, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential* when designed and installed in accordance with the *International Building Code* (IBC) provisions noted in the master evaluation report, and the following conditions apply:

- Design wind loads must be based on Section 1609 of the *Florida Building Code—Building* or Section 301.2.1.1 of the *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the *Florida Building Code—Building*, as applicable.

Use of the fasteners have also been found to be in compliance with the High-Velocity Hurricane Zone provisions on the *Florida Building Code—Building* and the *Florida Building Code—Residential* under the condition that the design wind loads must be based on Section 1620 of the *Florida Building Code—Building*, as applicable.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, reissued September 2019.

TABLE 20.3: Fastener Capacity

SAE Grade 5 Steel for Diameters up thru 9/16" (UNC Threads) / ASTM A 449 Steel for Diameters 5/8" and Over (UNC Threads)

Nominal Fastener Diameter & Threads per Inch	D Nominal Thread Diameter (in)	A(S) Tensile Stress Area (in2)	A(R) Thread Root Area (in2)	Allowable Tension (lbs)	Allowable Shear Single (lbs)	Allowable Shear Double (lbs)	Allowable Bearing (lbs) 1/8" Steel A36	Allowable Bearing (lbs) 1/8" Aluminum 6063-T5	Allowable Bearing (lbs) 1/8" Aluminum 6063-T6	Minimum Material Thickness (lbs) to Equal Tensile Capacity of Fastener (in) A36	Min. Thickness 6063-T5	Min. Thickness 6063-T6	Maximum Tensile Load (lbs) for Available 3/8" Plate Thickness 3/8" Steel A36	Max. Tensile Load 3/8" Aluminum 6063-T5	Max. Tensile Load 3/8" Aluminum 6063-T6
#6-32	0.1380	0.0091	0.0078	363	180	360	900	253	345	0.1602	0.3046	0.2268	363	363	363
#8-32	0.1640	0.0140	0.0124	560	286	573	1,070	301	410	0.2079	> 3/8"	0.2953	560	522	560
#10-24	0.1900	0.0175	0.0151	701	350	700	1,240	348	475	0.2246	> 3/8"	0.3001	701	643	701
#12-24	0.2160	0.0242	0.0214	967	493	986	1,409	396	540	0.2594	> 3/8"	0.3619	967	734	967
1/4-20	0.2500	0.0318	0.0280	1,273	646	1,291	1,631	458	625	0.2745	> 3/8"	> 3/8"	1,273	865	1,179
5/16-18	0.3125	0.0524	0.0469	2,517	1,299	2,599	2,039	573	781	0.3144	> 3/8"	> 3/8"	2,517	1,303	1,776
3/8-16	0.3750	0.0775	0.0699	3,719	1,937	3,874	2,447	688	938	0.3518	> 3/8"	> 3/8"	3,719	1,572	2,144
7/16-14	0.4375	0.1063	0.0961	5,103	2,664	5,328	2,855	802	1,094	> 3/8"	> 3/8"	> 3/8"	4,937	1,873	2,554
1/2-13	0.5000	0.1419	0.1292	6,811	3,581	7,162	3,263	917	1,250	> 3/8"	> 3/8"	> 3/8"	5,642	2,140	2,918
9/16-12	0.5625	0.1819	0.1664	8,733	4,611	9,222	3,670	1,031	1,406	> 3/8"	> 3/8"	> 3/8"	6,444	2,444	3,333
5/8-11	0.6250	0.2260	0.2071	10,848	5,738	11,477	4,078	1,146	1,563	> 3/8"	> 3/8"	> 3/8"	7,148	2,711	3,697
3/4-10	0.7500	0.3345	0.3091	16,054	8,565	17,130	4,894	1,375	1,875	> 3/8"	> 3/8"	> 3/8"	8,612	3,266	4,454
7/8-9	0.8750	0.4617	0.4285	22,163	11,876	23,753	5,709	1,604	2,188	> 3/8"	> 3/8"	> 3/8"	10,158	3,853	5,254
1-8	1.0000	0.6057	0.5630	29,076	15,601	31,203	6,525	1,833	2,500	> 3/8"	> 3/8"	> 3/8"	11,696	4,437	6,050

SAE Grade 5 Steel (Spaced Threads)

Nominal Fastener Diameter & Threads per Inch	D Nominal Thread Diameter (in)	K Basic Minor Diameter (in)	A(R) Thread Root Area (in2)	Allowable Tension (lbs)	Allowable Shear Single (lbs)	Allowable Shear Double (lbs)	Allowable Bearing (lbs) 1/8" Steel A36	Allowable Bearing (lbs) 1/8" Aluminum 6063-T5	Allowable Bearing (lbs) 1/8" Aluminum 6063-T6	Minimum Material Thickness (lbs) to Equal Tensile Capacity of Fastener (in) A36	Min. Thickness 6063-T5	Min. Thickness 6063-T6	Maximum Tensile Load (lbs) for Available 3/8" Plate Thickness 3/8" Steel A36	Max. Tensile Load 3/8" Aluminum 6063-T5	Max. Tensile Load 3/8" Aluminum 6063-T6
#6-20	0.1380	0.0990	0.0077	308	178	356	900	253	345	0.1358	0.1907	0.1543	308	308	308
#8-18	0.1640	0.1160	0.0106	423	244	488	1,070	301	410	0.1569	0.2175	0.1758	423	423	423
#10-16	0.1900	0.1350	0.0143	573	331	661	1,240	348	475	0.1834	0.2517	0.2028	573	573	573
#12-14	0.2160	0.1570	0.0194	774	447	894	1,409	396	540	0.2182	0.2995	0.2380	774	774	774
1/4-14	0.2500	0.1850	0.0269	1,075	621	1,242	1,631	458	625	0.2617	0.3593	0.2696	1,075	1,075	1,075
5/16-12	0.3125	0.2360	0.0437	2,100	1,212	2,425	2,039	573	781	0.3407	> 3/8"	0.3430	2,100	1,681	2,100
3/8-12	0.3750	0.2990	0.0702	3,370	1,946	3,892	2,447	688	938	> 3/8"	> 3/8"	> 3/8"	2,773	2,017	2,751

	SAE Grade 5 (≤ 9/16")	ASTM A449 (≥ 5/8")	For All Diameters	Effective Area (UNC Threads)	Effective Area (Spaced Threads)
Fu (Min. Ultimate Tensile Strength)	120,000 psi	120,000 psi	$F_T = F_U/SF$	$A(R) = \pi\ (D-1.2269/N)^2 / 4$	$A(R) = \pi K^2/4$
Ft (Allow. Tensile Stress, D≤1/4")	40,000 psi	N/A	Allowable Tension = $F_T[A(S)]$	$A(S) = \pi\ (D-0.9743/N)^2 / 4$	$A(S) = \pi K^2/4$
F_T (Allow. Tensile Stress, D> 1/4")	48,000 psi	48,000 psi	$F_V = Fu / (SF \times \text{sq rt}(3))$		
F_V (Allowable Shear Stress, D≤1/4")	23,094 psi	N/A	Allowable Single Shear = $F_V[A(R)]$		
F_V (Allowable Shear Stress, D>1/4")	27,713 psi	27,713 psi			

NOTE 5:

1. *Values are taken from AISC, ASTM, IFI, SAE and AA documents. K values for spaced threads are taken as the minimum values in IFI Fastener Handbook, 6th Ed.*
2. *Safety Factor used for fasteners with diameters 1/4" or less is 3.0, Safety Factor used for fasteners with diameters 5/16" or greater is 2.5.*
3. *Fasteners with diameters of 5/8" or greater are fabricated from carbon steel complying with ASTM A449 Type*

TABLE 20.9: Fastener Capacity

STAINLESS STEEL - Alloy Groups 1, 2 and 3, Condition CW (UNC Treads)																
Nominal Fastener Diameter & Threads per Inch	D Nominal Thread Diameter (in)	A(S) Tensile Stress Area (in2)	A(R) Thread Root Area (in2)	Allowable Tension (lbs)	Allowable Shear		Allowable Bearing (lbs)			Minimum Material Thickness (lbs) to Equal Tensile Capacity of Fastener (in)			Maximum Tensile Load (lbs) for Available 3/8" Plate Thickness		
					Single (lbs)	Double (lbs)	1/8" Steel A36	1/8" Aluminum 6063-T5	1/8" Aluminum 6063-T6	A36	6063-T5	6063-T6	3/8" Steel A36	3/8" Aluminum 6063-T5	3/8" Aluminum 6063-T6
#6-32	0.1380	0.0091	0.0078	303	150	300	900	253	345	0.1335	0.2538	0.1943	303	303	303
#8-32	0.1640	0.0140	0.0124	467	239	477	1,070	301	410	0.1733	0.3356	0.2466	467	467	467
#10-24	0.1900	0.0175	0.0151	584	292	583	1,240	348	475	0.1872	0.3410	0.2501	584	584	584
#12-24	0.2160	0.0242	0.0214	805	411	822	1,409	396	540	0.2269	> 3/8"	0.3016	805	734	805
1/4-20	0.2500	0.0318	0.0280	1,061	538	1,076	1,631	458	625	0.2534	> 3/8"	0.3373	1,061	865	1,061
5/16-18	0.3125	0.0524	0.0469	2,097	1,083	2,166	2,039	573	781	0.2867	> 3/8"	> 3/8"	2,097	1,303	1,776
3/8-16	0.3750	0.0775	0.0699	3,100	1,614	3,228	2,447	688	938	0.3181	> 3/8"	> 3/8"	3,100	1,572	2,144
7/16-14	0.4375	0.1063	0.0961	4,252	2,220	4,440	2,855	802	1,094	0.3442	> 3/8"	> 3/8"	4,252	1,873	2,554
1/2-13	0.5000	0.1419	0.1292	5,676	2,984	5,968	3,263	917	1,250	> 3/8"	> 3/8"	> 3/8"	5,642	2,140	2,918
9/16-12	0.5625	0.1819	0.1664	7,278	3,842	7,685	3,670	1,031	1,406	> 3/8"	> 3/8"	> 3/8"	6,444	2,444	3,333
5/8-11	0.6250	0.2260	0.2071	9,040	4,782	9,564	4,078	1,146	1,563	> 3/8"	> 3/8"	> 3/8"	7,148	2,711	3,697
3/4-10	0.7500	0.3345	0.3091	11,372	6,022	12,045	4,894	1,375	1,875	> 3/8"	> 3/8"	> 3/8"	8,612	3,266	4,454
7/8-9	0.8750	0.4617	0.4285	15,583	8,351	16,701	5,709	1,604	2,188	> 3/8"	> 3/8"	> 3/8"	10,158	3,853	5,254
1-8	1.0000	0.6057	0.5630	20,444	10,970	21,940	6,525	1,833	2,500	> 3/8"	> 3/8"	> 3/8"	11,696	4,437	6,050

STAINLESS STEEL - Alloy Groups 1, 2 and 3, Condition CW (Spaced Threads)																
Nominal Fastener Diameter & Threads per Inch	D Nominal Thread Diameter (in)	K Basic Minor Diameter (in)	A(R) Thread Root Area (in2)	Allowable Tension (lbs)	Allowable Shear		Allowable Bearing (lbs)			Minimum Material Thickness (lbs) to Equal Tensile Capacity of Fastener (in)			Maximum Tensile Load (lbs) for Available 3/8" Plate Thickness		
					Single (lbs)	Double (lbs)	1/8" Steel A36	1/8" Aluminum 6063-T5	1/8" Aluminum 6063-T6	A36	6063-T5	6063-T6	3/8" Steel A36	3/8" Aluminum 6063-T5	3/8" Aluminum 6063-T6
#6-20	0.1380	0.0990	0.0077	257	148	296	900	253	345	0.1191	0.1695	0.1378	257	257	257
#8-18	0.1640	0.1160	0.0106	352	203	407	1,070	301	410	0.1437	0.1930	0.1567	352	352	352
#10-16	0.1900	0.1350	0.0143	477	275	551	1,240	348	475	0.1628	0.2225	0.1805	477	477	477
#12-14	0.2160	0.1570	0.0194	645	373	745	1,409	396	540	0.1820	0.2610	0.2115	645	645	645
1/4-14	0.2500	0.1850	0.0269	896	517	1,035	1,631	458	625	0.2181	0.2994	0.2379	896	896	896
5/16-12	0.3125	0.2360	0.0437	1,750	1,010	2,020	2,039	573	781	0.2839	> 3/8"	0.2990	1,750	1,681	1,750
3/8-12	0.3750	0.2990	0.0702	2,809	1,622	3,243	2,447	688	938	> 3/8"	> 3/8"	> 3/8"	2,773	2,017	2,751

Group 1,2,3-Cond. CW	≤ 5/8" Dia.	≥ 3/4" Dia.	For Diameters < 3/4"	Effective Area (UNC Threads)	Effective Area (Spaced Threads)
Fu (Min. Ultimate Tensile Strength)	100,000 psi	85,000 psi	$F_T = F_U/SF$	$A(R) = \pi\ (D-1.2269/N)^2 / 4$	$A(R) = \pi K^2/4$
F_T (Allow. Tensile Stress, D≤1/4")	33,333 psi	N/A psi	Allowable Tension = $F_T[A(S)]$	$A(S) = \pi\ (D-0.9743/N)^2 / 4$	$A(S) = \pi K^2/4$
F_T (Allow. Tensile Stress, D> 1/4")	40,000 psi	33,750 psi	$F_V = Fu / (SF \times \text{sq rt}(3))$		
Fv (Allowable Shear Stress, D≤1/4")	19,245 psi	N/A psi	Allowable Single Shear = $F_V[A(R)]$		
Fv (Allowable Shear Stress, D>1/4")	23,094 psi	19,486 psi			

NOTE 11:

1. Values are taken from AISC, ASTM, IFI, SAE and AA documents. K values for spaced threads are taken as the minimum values in IFI Fastener Handbook, 6th Ed. 2. Safety Factor used for fasteners with diameters 1/4" or less is 3.0, Safety Factor used for fasteners with diameters 5/16" or greater is 2.5.

3. Fasteners with diameters of 3/4" and greater are fabricated from different material than fasteners less than 3/4" in diameter.

4. For diameters of 3/4" and greater, F_y=45,00 psi. For these, tensile and shear yields govern the allowable tension and shear values (i.e., 0.75 F_y<F_u/SF

TABLE 22.5 (UNC)

6063-T6												
Nominal Thread Diameter & Thread Per Inch	D Nominal Thread Diameter (Inch)	TSA(I) Internal Thread Stripping Area Sq. In./Thread	Aluminum Thickness (Inches)									
			0.060	0.072	0.080	0.094	0.125	0.156	0.188	0.250	0.312	0.375
			Allowable Pullout (Pounds)									
#8-32	0.1640	0.010270	83	100	132	155	206	273	341	474	592	712
#10-24	0.1900	0.016864	96	116	153	180	239	324	413	584	729	876
#12-24	0.2160	0.019273	110	132	174	204	271	370	471	668	833	1001
1/4-20	0.2500	0.027234	127	152	201	236	314	431	552	786	981	1179
5/16-18	0.3125	0.037983	--	--	--	354	(471)	648	831	1184	1478	1776
3/8-16	0.3750	0.051581	--	--	--	--	565	780	1001	1429	1784	2144
7/16-14	0.4375	0.070205	--	--	--	--	--	918	1185	1702	2125	2554
1/2-13	0.5000	0.086405	--	--	--	--	--	1049	1354	1946	2428	2918

	6063-T6	
F_U (Tensile Ultimate Strength)	30000	psi
F_Y (Tensile Yield Strength)	25000	psi

Shading indicates transition region.

NOTE 26:

1. *Each table lists allowable pull-out (internal threads) values. SF = 3.0 for D ≤ 0.25"; SF = 2.5 for D ≥ 0.3125". Fastener allowable strength (basic tension and external threads) needs to be checked separately.*
2. *For pilot hole sizes refer to tables 21.1 to 21.7*
3. *Fastener pullout not shown for aluminum thickness less than approximately 2 threads, unless tested at a lesser thickness.*
4. *Multiple fastener connections and embrittlement need to be checked separately.*