STRUCTURAL CALCULATIONS

PRE-MANUFACTURED CANOPIES

FOR

Halsey 'QSR' Remodel

12035 NE Halsey St.
Portland, OR 97220

FOR

Schmidt Architects P.C.

16101 SW 72nd Ave., Suite 135
Portland, OR 97224

ALL COMPUTATION AND STRUCTURAL ENGINEERING FOR THIS PROJECT HAVE BEEN PERFORMED BY MYSELF OR UNDER MY DIRECT SUPERVISION. THESE CALCULATIONS ARE FOR THE ABOVE REFERENCED PROJCT SITE AND FOR THE CURRENT PHASE OF CONSTRUCTION ONLY. THESE CALCULATIONS DO NOT APPLY TO SAME OR SIMILAR CONFIGURATIONS AT THIS SITE OR AT A DIFFERENT SITE AND SHOULD BE VOID WITHOUT WET SIGNATURE.

02/23/2024

EXPIRES: 12-31-2025

Associated Consultants, Inc. Structural Engineers

100 East 13th Street • Suite 10 • Vancouver, WA 98660
Phone: (503) 384-0460 • (360) 699-0607

Design Criteria

Scope: Scope of work is design and analysis of Canopy and its connections to the structure.

Code: 2019 Oregon Structural Specialty Code

Gravity Loads

Roof Dead Load	10 psf	
Roof Live Load	20 psf	Per ASCE 7
Roof Snow load	25 psf	City Of Portland
Risk Category	II	

Wind

Speed (3 sec gust) - Ultimate	98 mph	Per Jurisdiction
Exposure	B	Per Jurisdiction

Seismic

I	1.0	
Site Class	D	Per ATC Hazard Maps
S_S	0.898	Per ATC Hazard Maps
S_1	0.381	Per ATC Hazard Maps
S_{ds}	0.683	Per ATC Hazard Maps
Seismic Response modification Factor- R (Light Framed Plywood shearwalls)	6.5	Per ASCE 7

LOADS

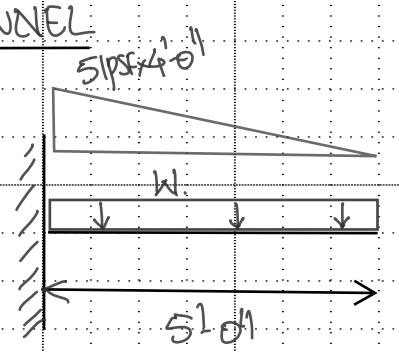
Roof Dead Load

Roofing Deck	2.5 psf
Framing	4.0 psf
Mech & Elec.	1.5 psf
Total	8 psf
Use Roof Dead Load	**10 psf**

Snow Load $=0.7 x \rho_g C_e C_t$ = 0.7 x 10 x 1 x 1.2 = 8.4 psf

Use 25 psf min per City of Portland

PRE MANUF. ALUMINIUM CHANNEL



CANOPY HSS REQ'D

$W_{MAX} = (10 + 25)\ \text{psf} \times 3'\text{-}3''$ (MAX)

$+ 51\ \text{psf} \times 3'\text{-}3''$

OVERHANG PRESSURE $= -\dfrac{[28.7 + 31.8]}{2} \times 0.82$ (HT FACTOR)

$= -30.25\ \text{psf} \times 0.82$

$= -24.81\ \text{psf}$

SUPPORT REACTION

DL	SL	M_{DL}	M_{SL}	WL	M_{WL}
0.163k	0.82k	0.41 kip/ft	1.71 kip/ft	−0.41k	−1.02 kip/ft

$P_{MAX\ DL+SL} = 0.985^{k}$

$M_{DL+SL} = 2.12\ \text{kip/ft}$

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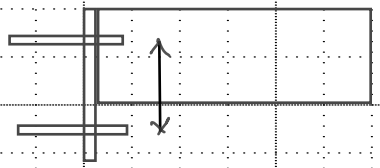
	Location 12035 NE Halsey St, Portland, OR 97220	Date
	Client TSA	Sheet No.

CONNECTION TO PL REQUIREMENT

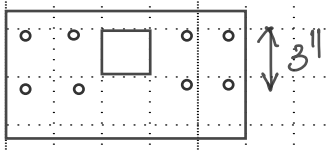


TYP BOLTS REQ'D

ASSUME 3/8" ϕ BOLTS - REQ'D

BOLT TYPE = SAE GRAD-5 ~ ASTM A325

SHEAR ON EA BOLT



$\frac{990}{8} = 124$ lbs << CAPACITY OK

TENSION ON EA BOLT

DUE TO DEMAND

$\frac{M}{D \times \#} = \frac{PL+SL}{} = \frac{2120 \times 12}{3 \times 4} = \frac{2120 \times 4}{4} = 2120$ lbs.

$T_{MAX} = 2120$ lbs

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CAPACITY OF ANCHOR BOLT THRU BOLT TO HSS

$R_n = 0.85\, d_w\, t\, F_u / \Omega$

$= 0.85 \times \frac{3}{8} \times \frac{3}{8}'' \times \frac{65}{3}$ ksi

$\frac{R_n}{\Omega} = 2.58$ kips (ASD) (TENSION CAPACITY)

USE MIN (8) 3/8"ϕ A307 THRU BOLTS

MIN THICKNESS OF HSS REQD – 3/8"

USE HSS 7x4x3/8" – USED (OK) ✓

$\frac{R_{nv}}{\Omega} = 1.8\, n F_y d t$

$= 1.8 \times 8 \times 36 \times \frac{3}{8}'' \times \frac{3}{8}''$

$\frac{R_{nv}}{\Omega} = 36.45$ kips >> DEMAND

SHEAR CAPACITY >> DEMAND (OK) ✓

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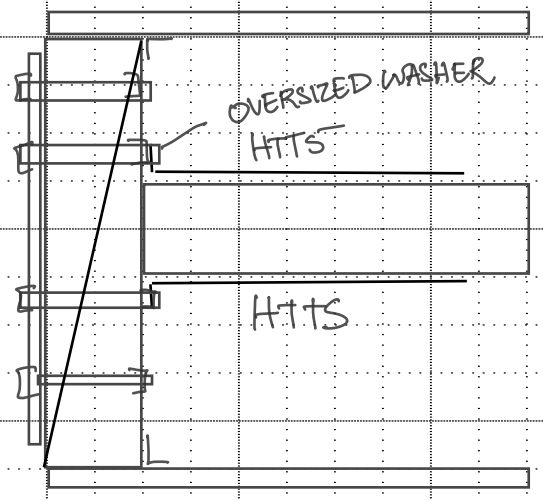
WOOD CONNECTION



$W_{DL} = 10PSF$

$W_{SL} = 25PSF$

$W_{DRIFT} = 33PSF \rightarrow 0$

TRIBUTARY = 2'-3" MAX.

REACTIONS	DL	SL	M_{DL}	M_{SL}	W_L	M_{WL}
=	0.113^k	0.468^k	0.282 kip/ft	.703 kip/ft + 0.309 kip/ft	−0.282^k	−0.703 kip/ft

$V_{DL+SL} = 0.113 + 0.468 = 0.581^k$

$M_{DL+SL} = 1300$ lb/ft MAX.

$T_{MAX} = \frac{1300 \times 12}{3 \times 4} = 1300$ lbs

$V_{CAPACITY\ NDS} = 510$ lbs PER BOLT $\times 1.15 = 586$ lbs PER BOLT

CAPACITY >> DEMAND.

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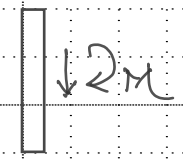
Project	Job No.
Halsey 'QSR' Remodel	21-194
Location: 12035 NE Halsey St, Portland, OR 97220	Date
Client: TSA	Sheet No.

THICKNESS OF STEEL PL

$T_{MAX} = 2120$ lbs (ASD)



$$t_{MIN} = \sqrt{\frac{4.44\,T\,b'}{P_{Fu}}}$$

$$= \frac{4.44 \times 2120 \times \left[\frac{2\frac{1}{2}}{2} - \frac{\frac{3}{8}}{2}\right]}{3'' \times 58\text{ ksi}}$$

$t_{MIN} = 1/4''$

USE MIN 3/8" PL THICKNESS OK✓

WELD CONNECTION REQ'D–

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100 East 13th Street • Suite 10 • Vancouver, Washington 98660
Portland: (503) 384-0460 • Vancouver: (360) 699-0607

Steel Beam

Project File: 21-194.ec6

LIC# : KW-06016028, Build:20.23.08.30 ASSOCIATED CONSULTANTS INC. (c) ENERCALC INC 1983-2023

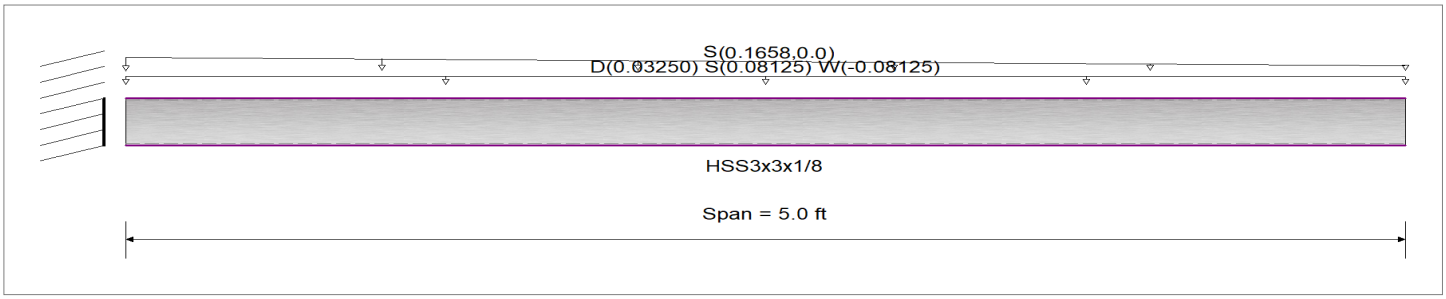
DESCRIPTION: Canopy HSS Beam

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	46.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.010, S = 0.0250, W = -0.0250 ksf, Tributary Width = 3.250 ft

Varying Uniform Load : S= 0.0510->0.0 ksf, Extent = 0.0 -->> 5.0 ft, Trib Width = 3.250 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.657 : 1	Maximum Shear Stress Ratio =	0.097 : 1
Section used for this span	HSS3x3x1/8	Section used for this span	HSS3x3x1/8
Ma : Applied	2.113 k-ft	Va : Applied	0.9831 k
Mn / Omega : Allowable	3.214 k-ft	Vn/Omega : Allowable	10.168 k
Load Combination	+D+S	Load Combination	+D+S
		Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.327 in	Ratio =	366	>=240.	Span: 1 : S Only
Max Upward Transient Deflection	-0.212 in	Ratio =	565	>=240.	Span: 1 : W Only
Max Downward Total Deflection	0.412 in	Ratio =	291	>=180	Span: 1 : +D+S
Max Upward Total Deflection	-0.076 in	Ratio =	1572	>=180	Span: 1 : +0.60D+0.60W

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 5.00 ft	1	0.126	0.016		-0.41	0.41	5.37	3.21	1.00	1.00	0.16	16.98	10.17
+D+S													
Dsgn. L = 5.00 ft	1	0.657	0.097		-2.11	2.11	5.37	3.21	1.00	1.00	0.98	16.98	10.17
+D+0.750S													
Dsgn. L = 5.00 ft	1	0.525	0.077		-1.69	1.69	5.37	3.21	1.00	1.00	0.78	16.98	10.17
+D+0.60W													
Dsgn. L = 5.00 ft	1	0.063	0.008	0.20		0.20	5.37	3.21	1.00	1.00	0.08	16.98	10.17
+D+0.450W													
Dsgn. L = 5.00 ft	1	0.016	0.002	0.05		0.05	5.37	3.21	1.00	1.00	0.02	16.98	10.17
+D+0.750S+0.450W													
Dsgn. L = 5.00 ft	1	0.382	0.059		-1.23	1.23	5.37	3.21	1.00	1.00	0.60	16.98	10.17
+0.60D+0.60W													
Dsgn. L = 5.00 ft	1	0.114	0.014	0.37		0.37	5.37	3.21	1.00	1.00	0.15	16.98	10.17
+0.60D													
Dsgn. L = 5.00 ft	1	0.076	0.010		-0.24	0.24	5.37	3.21	1.00	1.00	0.10	16.98	10.17

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.4123	5.000		0.0000	0.000

Steel Beam

Project File: 21-194.ec6

LIC# : KW-06016028, Build:20.23.08.30 ASSOCIATED CONSULTANTS INC. (c) ENERCALC INC 1983-2023

DESCRIPTION: Canopy HSS Beam

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.983	
Max Upward from Load Combinations	0.983	
Max Upward from Load Cases	0.821	
Max Downward from all Load Conditions (Resi	-0.406	
Max Downward from Load Combinations (Resi	-0.146	
Max Downward from Load Cases (Resisting U	-0.406	
D Only	0.163	
+D+S	0.983	
+D+0.750S	0.778	
+D+0.60W	-0.081	
+D+0.450W	-0.020	
+D+0.750S+0.450W	0.595	
+0.60D+0.60W	-0.146	
+0.60D	0.098	
S Only	0.821	
W Only	-0.406	

Calculated Section Properties (Fully Composite Always Assumed)

A = 0.83473

J = 0.0010860

xcg = 2.9891

zcg = 0.98648

Ixx = 1.022

Izz = 5.2221

Ixz = 0.19019

θ = -87.4126

I11 = 5.2307

I22 = 1.0134

Open Section Properties

Xs = 3.0506

Zs = -1.355

Cw = 5.6817

β1 = -0.055111

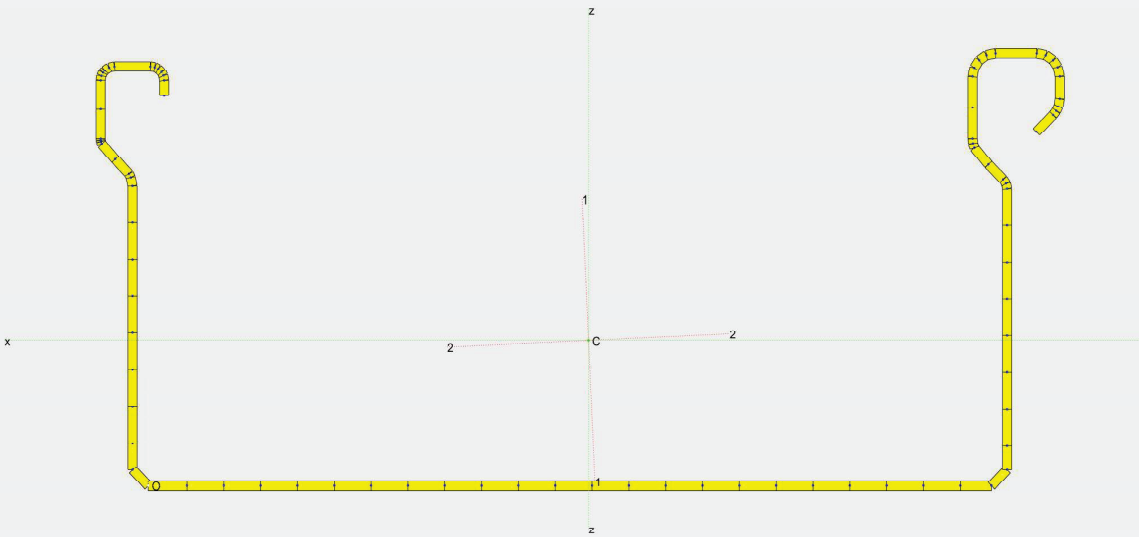
Basic Plot

ω

scale = 1

β2 = -7.5379

warping text out



Reference Applied Loads

for stress generation

P = 0 B = 0

principal or geometric restrained

M11 = 0 Mxx = 0

M22 = 0 Mzz = 0

Generate from Stress

First Yield Calculator

Fy = 21

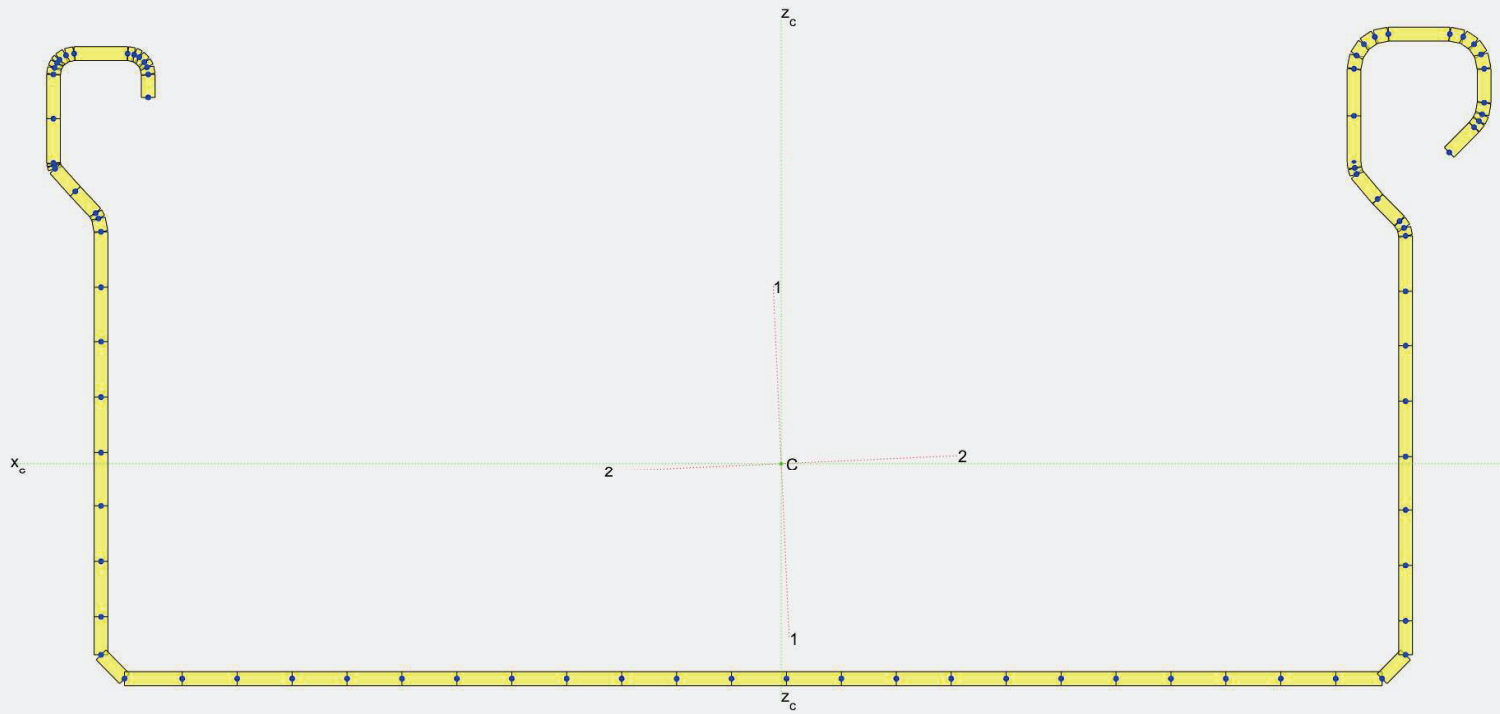
Py –	17.5294	By –	20.2309
principal:		geometric:	
M11y =	33.5179	Mxxy =	11.0007
M22y =	10.607	Mzzy =	33.1084

Push buttons to use first yield as demand

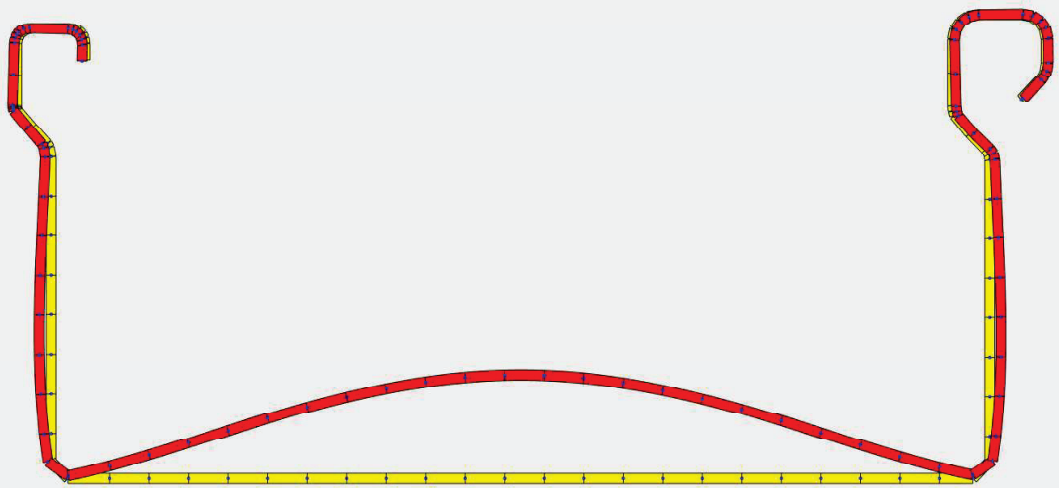
Submit Stress to input ? X

Reference Cross-section Stress

Plot Options:



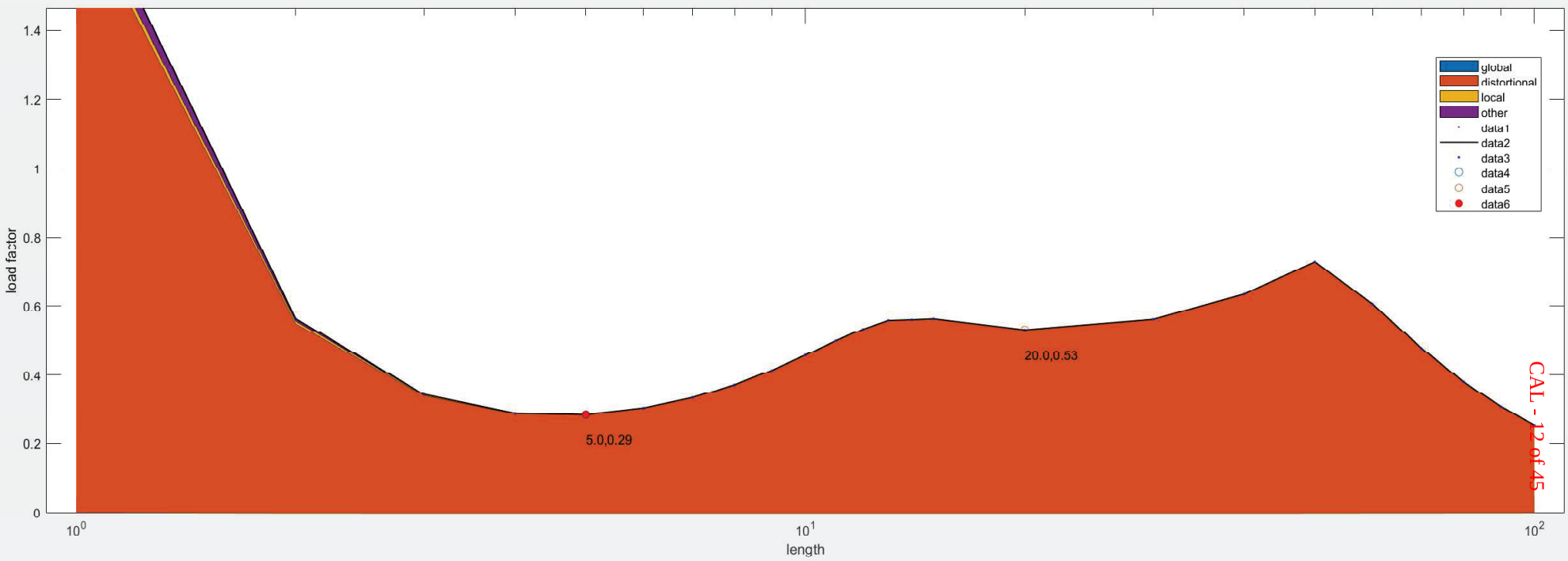
Scale = 1 Max Comp.= 0 Min Tens.= 0

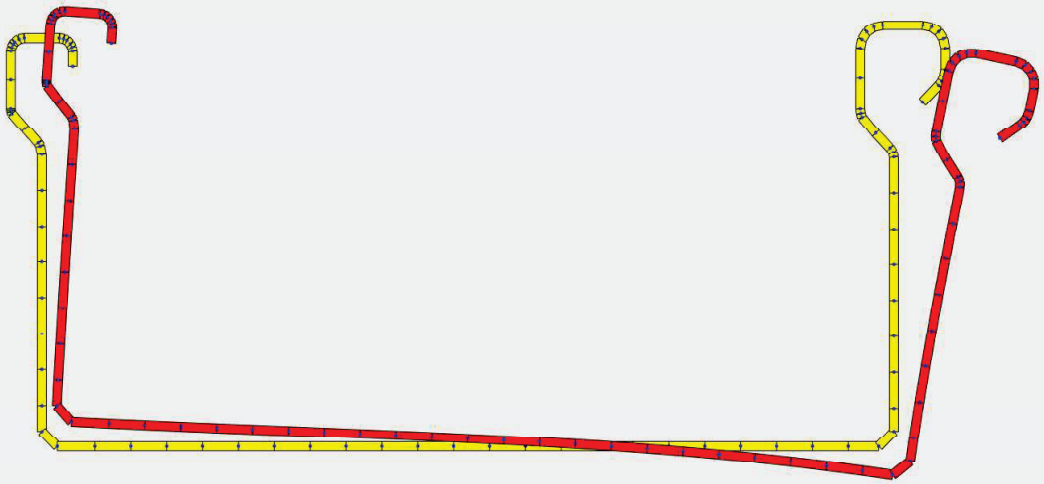


Buckled shape for CUFSM results

length = 5 load factor = 0.28508 mode = 1

cFSM classification results: vector norm G=0.0% D=99.8% L=0.2% O=0.0%

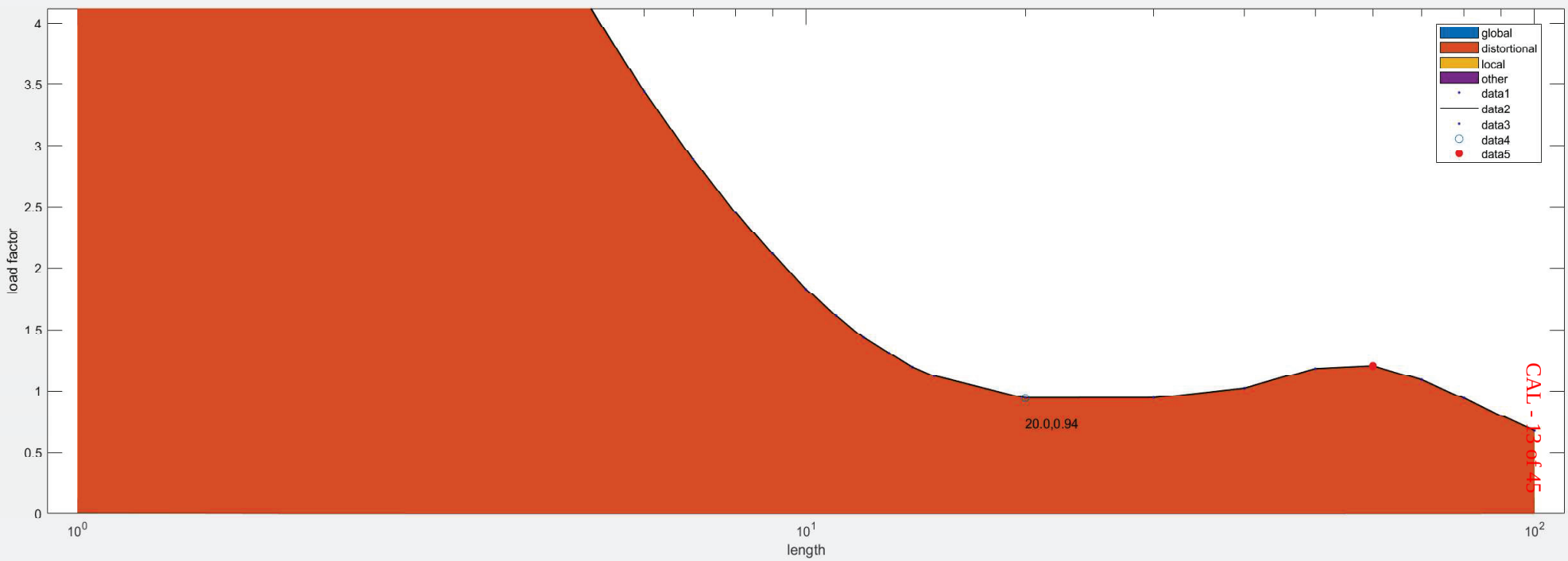


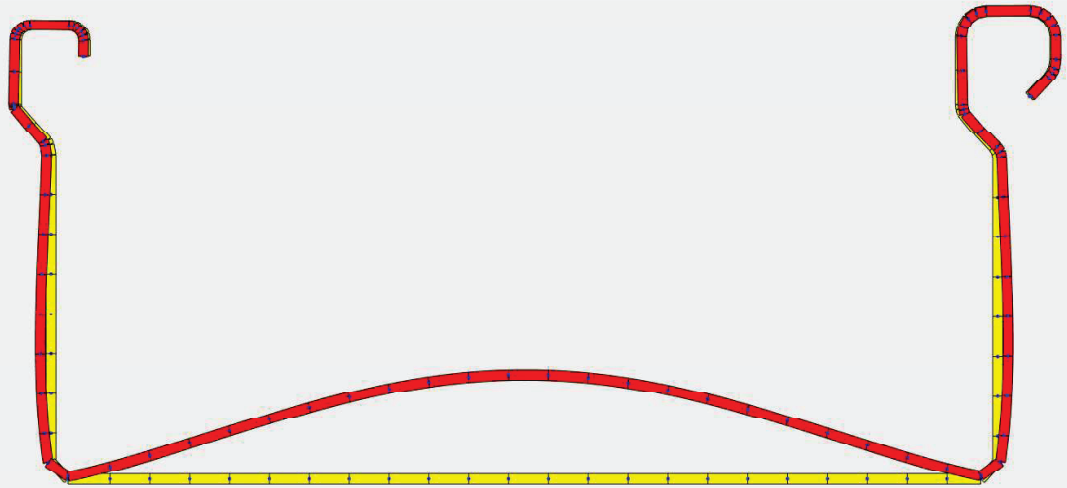


Buckled shape for CUFSM results

length = 60 load factor = 1.2039 mode = 1

cFSM classification results: vector norm C=0.0% D=99.8% L=0.1% O=0.0%

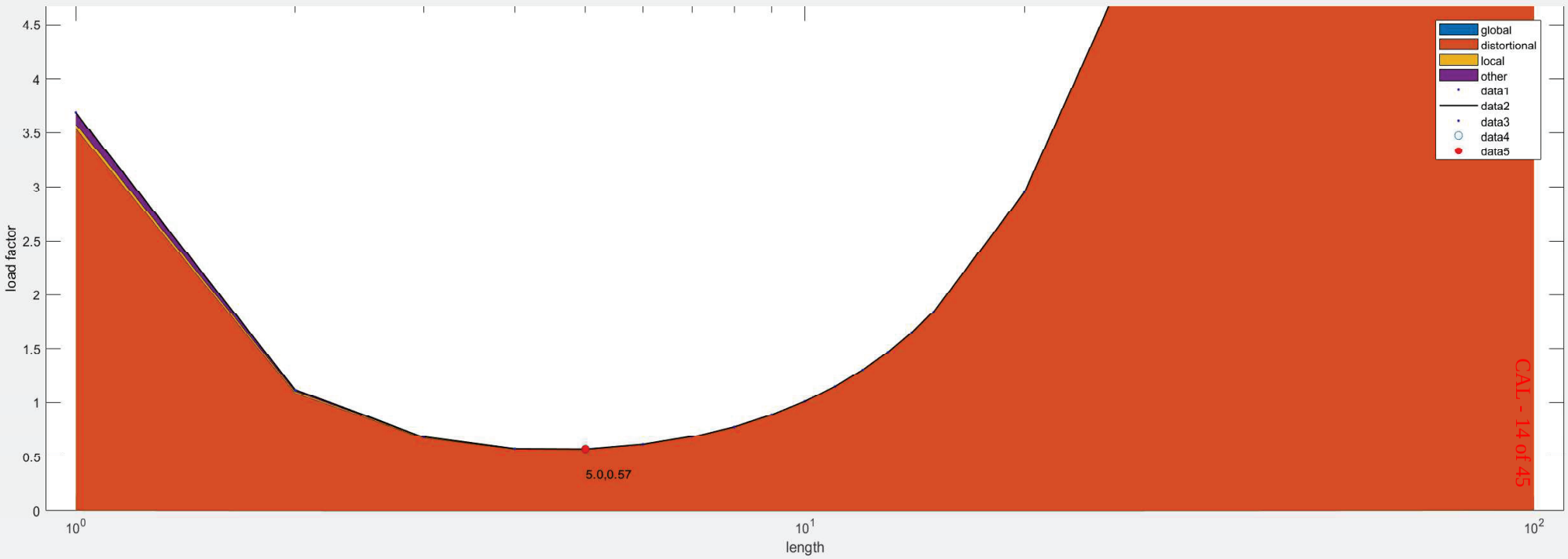




Buckled shape for CUFSM results

length = 5 load factor = 0.57114 mode = 1

cFSM classification results: vector norm G=0.0% D=99.7% L=0.2% O=0.1%



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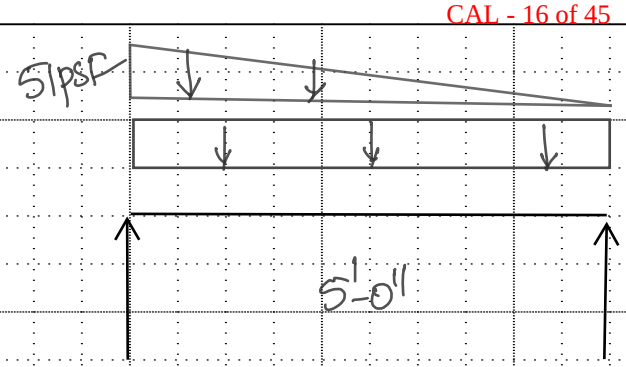
Aluminiun Material	**5052H-32**	Ftu = 31 ksi	Fty = 23 ksi	Fcy = 21 ksi	Fsy = 13.8 ksi	E = 10200 ksi		Section Modulus	
		31	23	21	13.8	10200		0.516	in^3
6x3x1/16 Section		b/t web (Both edges)	b/t Flange one Edge	k1	k2				
		32	92	0.5	2.04				
Table B.4.1									
Type of Stress & Member	Intersept	Slope	Intersection						
	ksi	Constant	Constant	Intersept	Slope	Intersection			
Axial Compression in Flat Elements	Bp = F cy (1+ (F cy / 440ḱ)^1/3)	Dp = Bp/20 (6Bp/E)^1/2	Cp = 2Bp/3Dp	28.617425	0.18564847	102.7656381			
				ksi	ksi	#			
Bending Compression in Flat Elements	Bbr = 1.3 Fcy (1 + (Fcy/340ḱ)^1/3)	Dbr = Bbr/20 (6Bbr/E)^1/2	Cbr = 2Bbr/3Dbr	38.091358	0.28509213	89.07379758			
				ksi	ksi	#			
Shear in Flat Elements	Bs = Fcy (1 + (Fsy/240ḱ)^1/3)	Ds = Bs/20 (6Bs/E)^1/2	Cs = 2Bs/3Ds	29.105415	0.19041723	101.9004967			
				ksi	ksi	#			
B5.4.1									
Flat Elements Supported on One Edge	Fc	b/t Flange	Slenderness Limit	S1	S2	Compare b/t with S1 & S2			
Yeilding	Fcy	b/t<=S1	S1 = (Bp-Fcy)/(5Dp)	8.2062888			0	0	ksi
Inelestic Buckling whose columns axis not in axis of symmetry	Bp-5.0Dp b/t	S<b/t<S2					0	0	ksi
Elastic Buckling in all other Columns	π^2E/(5 b/t)^2	b/t>=S2	S2 = Cp/5.0		20.5531276		1	0.475274	ksi
Post Buckling	k2(√BpE) / 5b/t	b/t>=S2	S 2 = k1Bp/(5Dp)		15.4148457		1	2.396005	ksi
B5.4.2									
Flat Elements Supported on Both Edges	Fc	b/t web	Slenderness Limit	S1	S2	Compare b/t with S1 & S2			
Yeilding	Fcy	b/t<=S1	S1 = (Bp-Fcy)/(1.6Dp)	25.644653			0	0	ksi
Inelestic Buckling	Bp-1.6Dp b/t	S<b/t<S2					1	19.11222	ksi
Post Buckling	k2(√BpE) / 1.6b/t	b/t>=S2	S 2 = k1Bp/(1.6Dp)		48.1713929		0	0	ksi
B.5.4.6 Flat Elements Alternate Method									
Fe for Members supported on both edges	∏^2E/(1.6 b/t)^2	38.36361694	λeq	S1	S2				
λeq	π√E/Fe	51.2							
Yeilding	Fcy	λeq<=S1	S1 = (Bp - Fcy)/(Dp)	41.031444			0	0	ksi
Inelestic Buckling	Bp-Dp λeq	S1<λeq<S2					1	21.49528	ksi
Post Buckling	k2(√BpE) / λeq	λeq>=S2	S2 = k1Bp/Dp		77.0742286		0	0	ksi
Local Buckling				S1	S2				
Mn	1.3FySc	b/t<S1	S1 = (Bbr - 1.3Fcy)/4Dbr	9.4630446			0		Kipin
	[Bbr - 4Dbr(b/t)]Sc	S1<b/t<S2					0		Kipin
	π^2ESc/(5 (b/t)^2)	b/t>=S2	S2 = Cbr/4		22.2684494		1	1.226206	Kipin

CUFSM Analysis Required for Open Shapes

Shear Capacity						
Members with Flat Webs Supported on Both Edges				S1	S2	
Yeilding	Fsy	b/t<S1	S1 = (Bs - Fsy) / (1.25Ds)	64.302648		1
Inelestic Buckling	Bs - 1.25Ds b/t	S1<b/t<S2				0
Elastic Buckling	π^2E/(1.25 b/t)^2	b/t>=S2	S2 = Cs/1.25		81.5203974	0



DECK

MAX. LOAD AT CANOPY

AT SOUTH ELEVATION.

DL CANOPY = 10psf

SL = 25psf

WL = −25psf

SNOWDRIFT = 51psf

DL+SL − GOVERNS DESIGN

TRIBUTARY ONTO

$$M = \underbrace{(10+25)}_{\text{DL SL PSF}} \times 0.5 \times \frac{5^2}{8} + 51\text{psf} \times 0.5 \times \frac{2 \times 5}{9\sqrt{3}}$$

$$= 54.7 \text{ lbft} + 16.4 \text{ lbft}$$

$$M_{LOAD} = 71.1 \text{ lbft}$$

$$M_{u\,LOAD} = 107.42 \text{ lbft} \quad (1.2DL + 1.6SL)$$

$$V = \underset{DL}{25} + \underset{SL}{31} + \underset{SL\ DRIFT}{43}$$

$$V_u = \underset{1.2DL}{30} + \underset{SL}{118 \text{ lbs}} \text{ lbs.}$$

$$V_u = 148 \text{ lbs}$$

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CAPACITY OF DECK BY CUFSM ANALYSIS

$$B_p = F_{cy}\left[1 + \frac{(F_{cy})^{1/3}}{11.4}\right]$$ COMPRESSION FLAT ELEMENTS

$$B_{br} = 1.3\,F_{cy}\left[1 + \frac{(F_{cy})^{1/3}}{7}\right]$$

$$B_s = \frac{F_{ty}}{\sqrt{3}}\left[1 + \frac{\left[F_{ty}/\sqrt{3}\right]^{1/3}}{9.3}\right]$$

ULT STRENGTH OF FLAT ELEMENTS IN COMPRESSION

$k_1 = 0.5$ $k_2 = 2.04$

SAFETY FACTORS

$n_u = 1.95$ $n_y = 1.65$ $n_a = 1.2$

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DECK SECTION PROPERTIES.

6x3x 1/16 SECTION.

$I_x = 1.024 \text{ in}^4$

$I_y = 5.232 \text{ in}^4$

$I_{xy} = 0.1913 \text{ in}^4$

$r_x = 1.107 \text{ in}$

$r_y = 2.502 \text{ in}$

$S_{x+} = 0.5172 \text{ in}^3$

$S_{x-} = 1.005 \text{ in}^3$

$S_{y+} = 1.621 \text{ in}^3$

$S_{y-} = 1.564 \text{ in}^3$

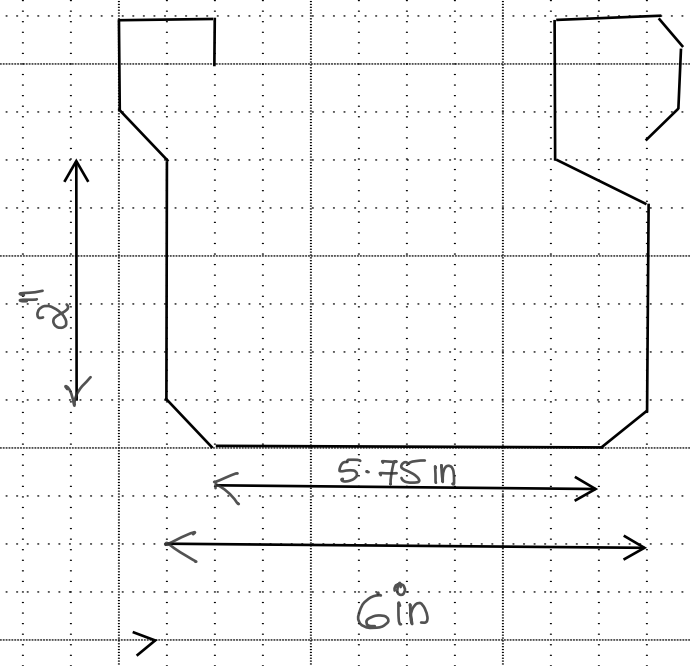
$X_c = 0.0584 \text{ in}$

$Y_c = -0.4808 \text{ in}$

$F_{cy} = 21 \text{ ksi}$

FLAT MEMBER,

H- SERIES TYPE



$b/t = \frac{2}{0.0625} = 32$

WEB

FOR BOTH EDGES

$b/t = \frac{5.75}{0.0625} = 92$

FLANGE

FOR SINGLE EDGE

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$$B_p = F_y\left[1+\left(\frac{F_{cy}}{440}\right)^{1/3}\right]$$

TABLE B.4.1

$B_p = 28.61$ ksi

$K_1 = 0.5$ $K_2 = 2.04$. (FLAT ELEMENTS) (TABLE B.4.3)

$$D_p = \frac{B_p}{20}\left(\frac{6B_p}{E}\right)^{1/2}$$

MOMENT CAPACITY = 62.44 ($\Omega = 1.65$)

PER B.5.4.2 FLAT ELEMENTS SUPPORTED ON BOTH EDGES. CUFSM ANALYSIS REQ'D.

PER CUFSM ANALYSIS

M_{xx} = 11 kip in = 916.6 kip ft, $P_{MAX} = 17^k$.

LOAD REDUCTION FACTOR = 0.29. COMPRESSION P_{MAX}

FLEXURE REDUCTION FACTOR = 0.57 FLEXURE

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CUFSM COMPRESSION BUCKLING STRESS = 0.29x21

= 6.09 ksi

CUFSM FLEXURAL BUCKLING STRESS = 0.57x21

= 11.97 ksi

MOMENT CAPACITY DUE TO COMPRESSION BUCKLING STRESS.

$F_c \times S_x$

$= 6.09 \times 0.516\ in^3$

(S_{xx+})

= 3.14 kip in

= 261.6 kip ft. (CUFSM ANALYSIS)

MOMENT CAPACITY DUE TO FLEXURAL BUCKLING STRESS =

$F_{e(CUFSM)} = 11.97$ ksi.

$\lambda_{eq} = \pi \sqrt{\frac{E}{F_e}} = 91.66$

$S_1 = 41.034$, $S_2 = 77.07$ (6-3-16)

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POST BUCKLING STRESS $= k_2 \sqrt{B_p E} / \lambda_{eq}$

$$= 2.04 \times \frac{\sqrt{28.67 \times 10{,}200}}{91.66}$$

$$= 12.02 \text{ ksi.}$$

MOMENT CAPACITY $= 12.02 \times 0.516 = 6.2$ kip-in

$= 6.2 \times 1000/12$

$= 516$ kip-ft.

MOMENT DUE TO COMPRESSION BUCKLING BUCKLING STRESS GOVERNS PER CUFSM ANALYSIS

DEFLECTION FOR CANOPY

$I_{xx} = 1.022 \text{ in}^4$.

$$\Delta = \frac{5}{384} \times \frac{(10+25) \times 0.5 \times 5^4 \times 12^4}{10{,}200 \times 10^3 \times 1.022 \text{ in}^4} \qquad 0.28$$

$$+ \qquad +$$

$$+ \; 0.1304 \times \frac{51 \times 0.5 \times 5^3 \times 12^3}{10{,}200 \times 10^3 \times 1.022} \qquad = 0.07$$

$$= 0.35 \text{ in}$$

$\frac{5 \times 12}{120} = 0.5$ in OK ✓

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DEFLECTION = 0.27 in

SNOW LOAD

$\frac{5 \times 12}{180}$ = 0.33 in OK ✓

SHEAR MAX = $(10+25)_{PSF} \times 0.5 \times \frac{5'}{2} + 51_{PSF} \times 0.5 \times 0.5 \times \frac{2}{3}$ = 53 lbs.

SHEAR CAPACITY = $F_{sy} A_w$

= 13.8 ksi x 0.83473

= 11.52 kips / 1.65 (Ω)

= 6.98 kips.

P_n ALLOWABLE FLEXURAL COMPRESSIVE STRESS FLAT ELEMENTS SUPPORTED ON ONE EDGE = 2.39 ksi x 0.834 = $\frac{1.9932 \text{ kips}}{1.2 (\Omega) (\text{AXIAL})}$ = 1660 lbs

$P_{CAPACITY} >> P_{DEMAND}$.

M_{DEMAND} = 107 lbft

$M_{CAPACITY}$ = 261.6 lbft

$\frac{P_u}{P_n} + \frac{M_u}{M_n} = \frac{148}{1660} + \frac{107}{261.6} \simeq 0.5 < 1$ OK ✓

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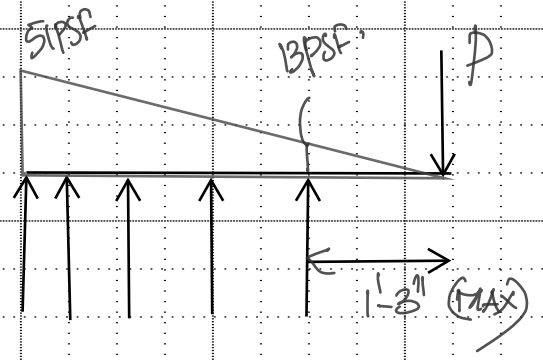
DECK ELEMENT

6x3x 1/16 — OK FOR GIVEN LOADS.

STIFFENER TUBE

RT 2x2x1/4 USED



P_{MAX} DUE TO GL SECTION LOAD

$$P = \underset{PSF}{(\overset{DL}{10}+\overset{SL}{25})} \times \frac{[3'-6''+3'-0'']}{2} \times 1.1$$

(CONTINUOUS MEMBER)

$$+ \; 13PSF \times \frac{1}{2} \times 1'-3''$$

$$P = \overset{1.2DL}{43} + \overset{SL}{157} \text{ lbs}$$

$$\left.\begin{aligned} P_u &= 200 \text{ lbs} \\ M_u &= 70 \text{ lb-ft} \end{aligned}\right\} \text{ LOADS MINIMUM.}$$

$$S_z = 0.911 \text{ in}^3$$

$$M_n = F_b S_z = F_{cy} S_z = 25 \times 0.911 \times \frac{1000}{12} \times \frac{1}{1.65} = 115 \text{ lb-ft}$$

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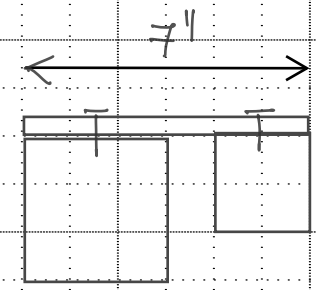
FOR DEFLECTION

$$\frac{PL^3}{3EI} = \frac{200 \times 1.25^3}{3 \times 10{,}200 \times 0.911} = 0.01 \text{ in}$$

L/1500 OK

USE MIN 2x2x1/4 ALUM. TUBE OK ✓

SHEAR



PL THICKNESS REQ'D

STIFFENER TUBE

$M_u = 70$ lb/ft

$$+ \quad W = (10+25) \times \frac{3'\text{-}6''}{2} \quad \text{(MAX)}$$

$$P = (\overset{1.2}{10} + \overset{1.6}{25}) \times \frac{3'\text{-}6''}{2} \times \frac{5'\text{-}0''}{2} = 230 \text{ lbs.}$$

$$M = (\overset{1.2}{10} + \overset{1.6}{25}) \times \frac{3'\text{-}6''}{2} \times \frac{5^2}{8}$$

$M = 284$ lb/ft (1.2DL+1.6SL)

$M = 284$ lb/ft $+ 70 = 354$ lb/ft.

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$T_{MAX} = \frac{354 \times 12}{5''} = 850 lbs.$

PL MIN THICKNESS DUE TO PRYING ACTION.

$t_{MIN} = \sqrt{\frac{4.44 \times 0.85 \times \boxed{3''}}{42 ksi}}$

$= 0.017$ PER PRYING ACTION.

USE 1/4" THICK PL.

M_{DUL} ON PL $= 840 \times 1 = 1680$ lb in

STRESS ON PL $= \frac{840}{0.0729} = 11.52$ ksi

STRESS ALLOWABLE $= \frac{35}{1.65} = 21.21$ ksi OK ✓

USE 1/4" T6 6061 PLATE.

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SCREWS AT HSS TO PL CONNECTION

#14 SCREW

SHEAR CAPACITY = 810 lbs (ALLOWABLE)

PULLOUT CAPACITY OVER 1/4" SHEET ALUMINUM = 997 lbs.

$$\sqrt{\left(\frac{230}{810}\right)^2 + \left(\frac{850}{997}\right)^2} < 1$$

$$= 0.93$$

USE MIN #14 - 14 - 2 TEK SCREWS.

#14 SCREWS TEK SCREWS @ 7" oc OK

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Calculated Section Properties (Fully Composite Always Assumed)

A = 1.8438

J = 0.0096029

xcg = 2.4407

zcg = 2.0699

Ixx = 7.4122

Izz = 5.2669

Ixz = 2.4823

θ = -33.3149

I11 = 9.0437

I22 = 3.6355

Open Section Properties

Xs = 3.5411

Zs = -1.7205

Cw = 16.2675

β1 = 6.0116

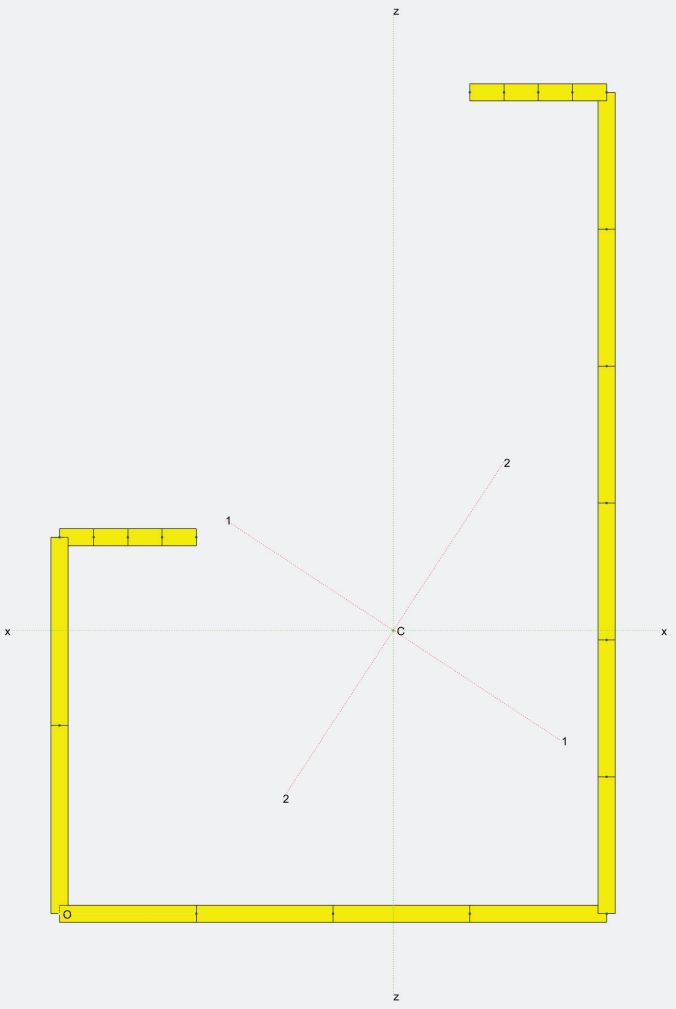
Basic Plot

ω

scale = 1

β2 = -7.2186

warping text out



Reference Applied Loads

for stress generation

P =	0	B =	0

○ principal or ◉ geometric ☑ restrained

M11 =	0	Mxx =	0
M22 =	0	Mzz =	0

Generate from Stress

First Yield Calculator

Fy = 21

Py =	38.7188	By =	36.74

principal: geometric:

M11y =	45.8663	Mxxy =	39.6064
M22y =	31.2896	Mzzy =	45.3177

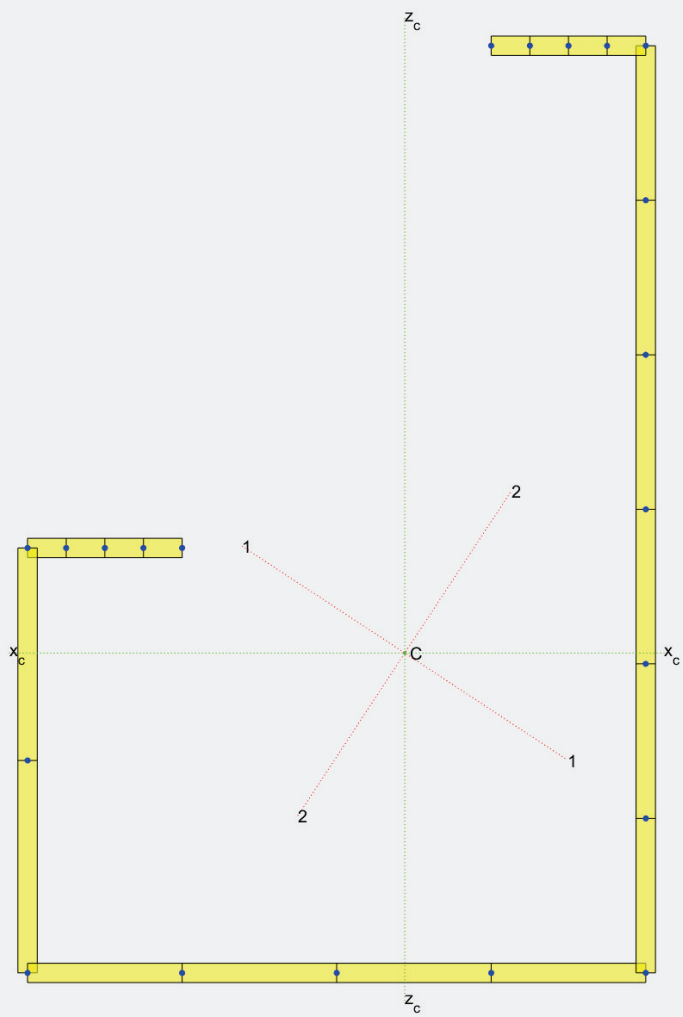
Push buttons to use first yield as demand

Submit Stress to input ? X

Reference Cross-section Stress

Plot Options:

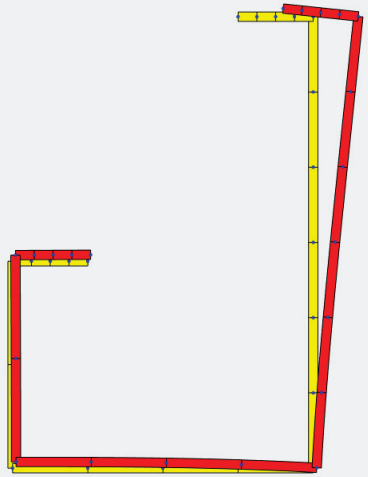
- ☐ node #
- ☐ element #
- ☐ material #
- ☐ stress mag.
- ☑ stress dist.
- ☐ coordinates
- ☐ constraints
- ☐ springs
- ☐ origin
- ☑ centroidal axes



Scale = 1

Max Comp.= 0

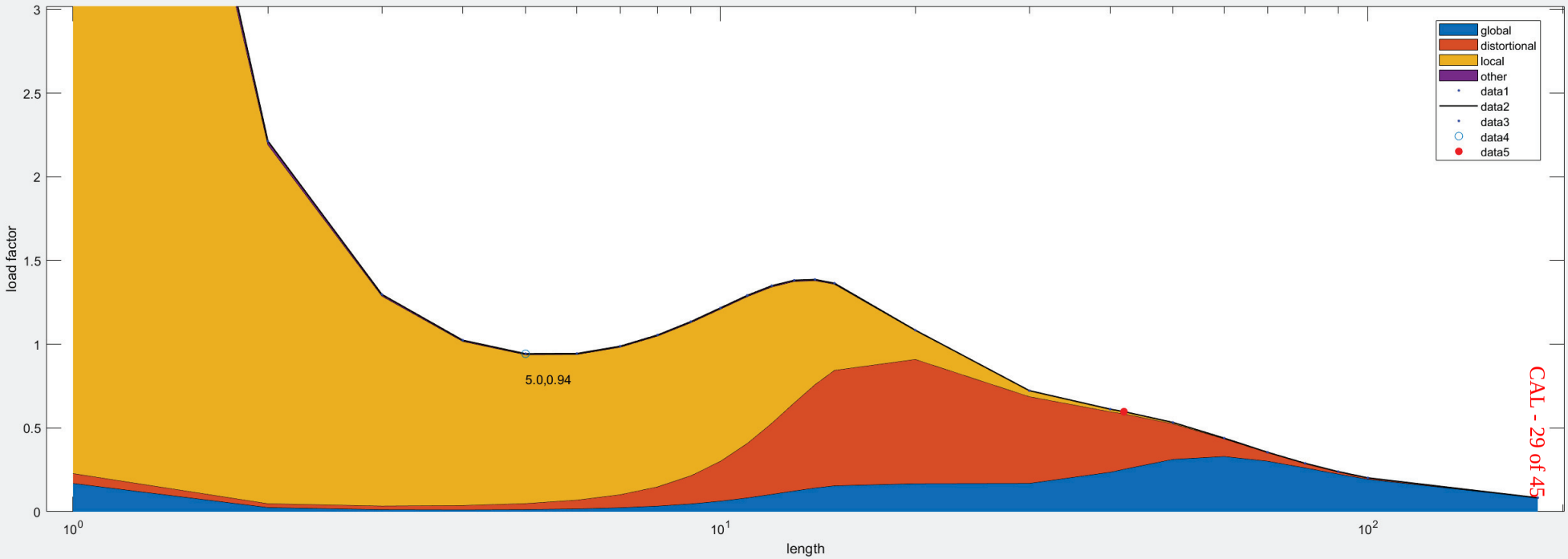
Min Tens.= 0

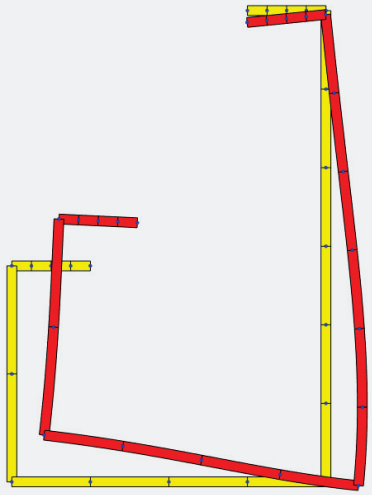


Buckled shape for CUFSM results

length = 42 load factor = 0.59807 mode = 1

cFSM classification results: off

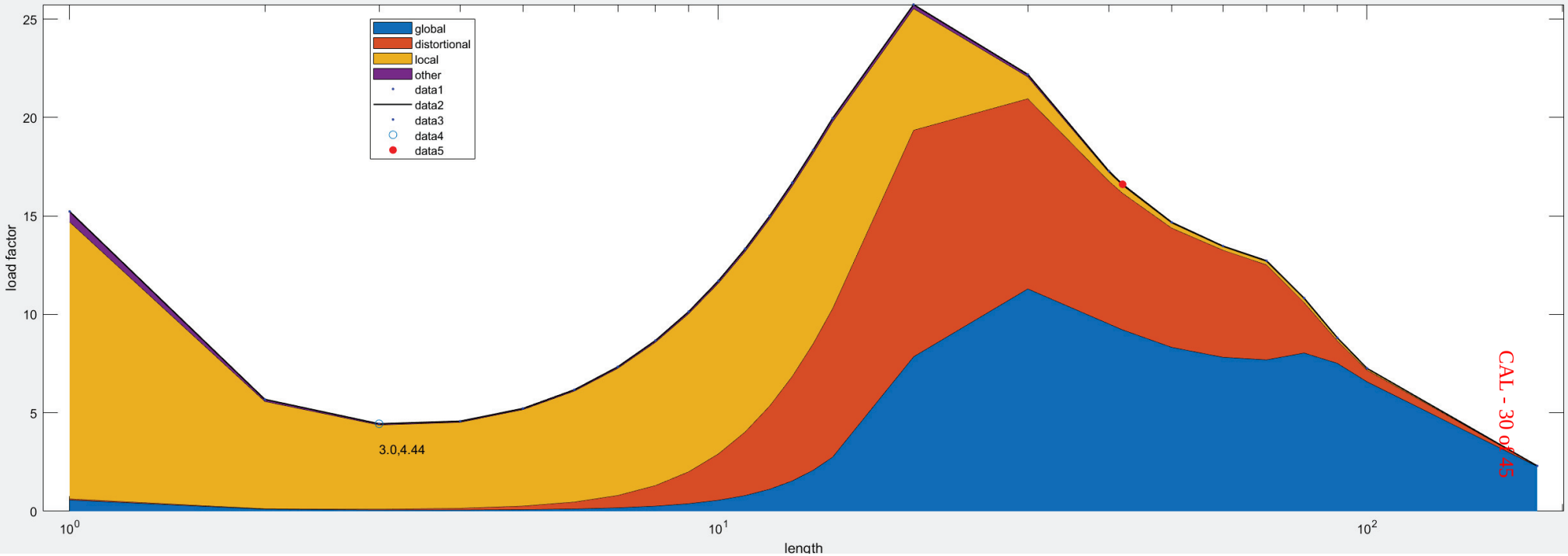


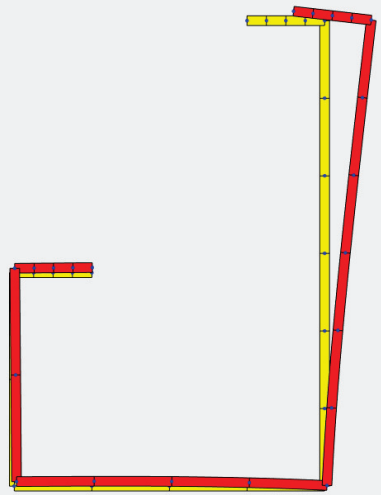


Buckled shape for CUFSM results

length = 42 load factor = 16.6064 mode = 1

cFSM classification results: vector norm G=55.5% D=41.8% L=2.4% O=0.3%

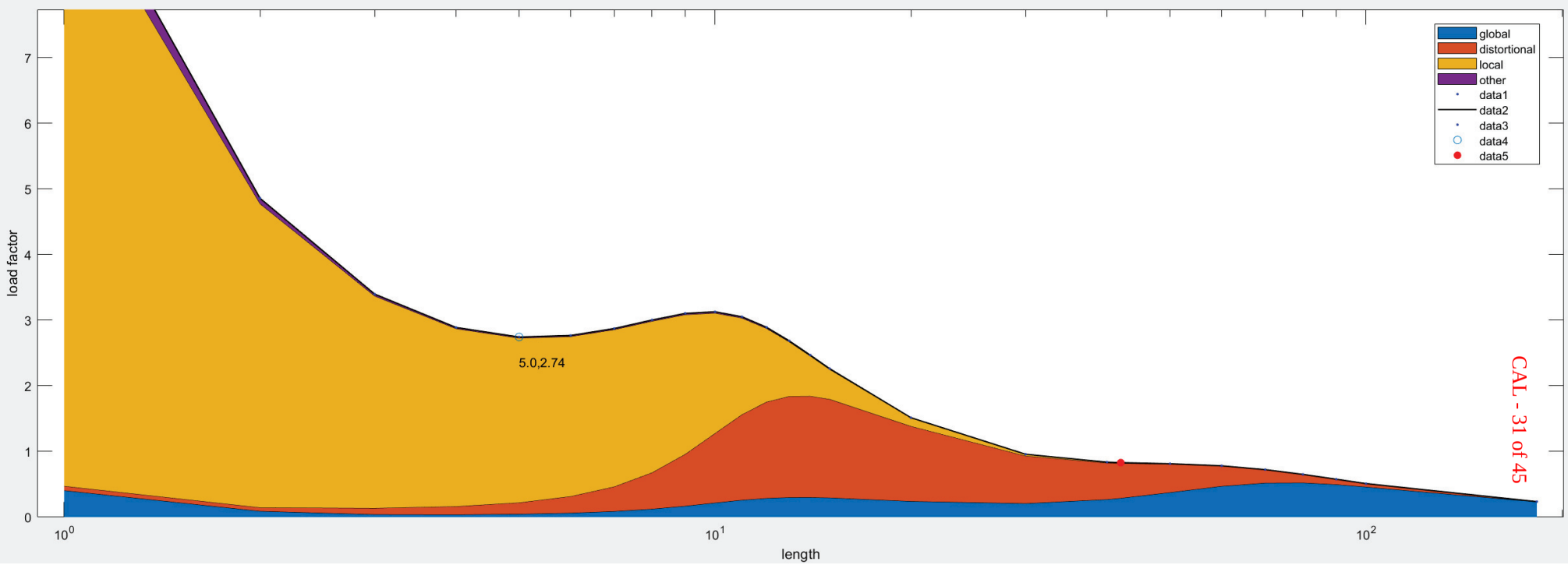




Buckled shape for CUFSM results

length = 42 load factor = 0.83056 mode = 1

cFSM classification results: vector norm G=34.9% D=63.9% L=1.1% O=0.1%



Aluminiun Material	**5052H-32**	Ftu = 31 ksi	Fty = 23 ksi	Fcy = 21 ksi	Fsy = 13.8 ksi	E = 10200 ksi		Section Modulus		
		31	23	21	13.8	10200		1.699	in^3	
G 6x4x1/8 Section		b/t web (Both edges)	b/t Flange one Edge	k1	k2					
		46	30	0.5	2.04					
Table B.4.1										
Type of Stress & Member	Intersept	Slope	Intersection							
	ksi	Constant	Constant	Intersept	Slope	Intersection				
Axial Compression in Flat Elements	Bp = F cy (1+ (F cy / 440ḱ)^1/3)	Dp = Bp/20 (6Bp/E)^1/2	Cp = 2Bp/3Dp	28.61742466	0.18564847	102.7656381				
				ksi	ksi	#				
Bending Compression in Flat Elements	Bbr = 1.3 Fcy (1 + (Fcy/340ḱ)^1/3)	Dbr = Bbr/20 (6Bbr/E)^1/2	Cbr = 2Bbr/3Dbr	38.09135815	0.28509213	89.07379758				
				ksi	ksi	#				
Shear in Flat Elements	Bs = Fcy (1 + (Fsy/240ḱ)^1/3)	Ds = Bs/20 (6Bs/E)^1/2	Cs = 2Bs/3Ds	29.10541476	0.19041723	101.9004967				
				ksi	ksi	#				
Compression in Columns & Beam Flanges	Bc = Fcy(1 + (Fcy/1000k)^0.5)	Dc= Bc/20(6 Bc/E)^0.5	Cc = 2Bc/3Dc	24.04318912	0.14296629	112.115888				
B5.4.1										
Flat Elements Supported on One Edge	Fc	b/t Flange	Slenderness Limit	S1	S2	Compare b/t with S1 & S2				
Yeilding	Fcy	b/t<=S1	S1 = (Bp-Fcy)/(5Dp)	8.206288809			0	0	ksi	
Inelestic Buckling whose columns axis not in axis of symmetry	Bp-5.0Dp b/t	S<b/t<S2					0	0	ksi	
Elastic Buckling in all other Columns	π^2E/(5 b/t)^2	b/t>=S2	S2 = Cp/5.0		20.5531276		1	4.469685	ksi	383.5351 Kipft
Post Buckling	k2(√BpE) / 5b/t	b/t>=S2	S 2 = k1Bp/(5Dp)		15.4148457		1	7.347748	ksi	630.4962 Kipft
B5.4.2										
Flat Elements Supported on Both Edges	Fc	b/t web	Slenderness Limit	S1	S2	Compare b/t with S1 & S2				
Yeilding	Fcy	b/t<=S1	S1 = (Bp-Fcy)/(1.6Dp)	25.64465253			0	0	ksi	
Inelestic Buckling	Bp-1.6Dp b/t	S<b/t<S2					1	14.9537	ksi	1283.148 lbft
Post Buckling	k2(√BpE) / 1.6b/t	b/t>=S2	S 2 = k1Bp/(1.6Dp)		48.1713929		0	0	ksi	
B.5.4.6 Flat Elements Alternate Method										
Fe for Members supported on both edges	∏^2E/(1.6 b/t)^2	18.56537984	λeq	S1	S2					
λeq	π√E/Fe	73.6								
Yeilding	Fcy	λeq<=S1	S1 = (Bp - Fcy)/(Dp)	41.03144405			0	0	ksi	
Inelestic Buckling	Bp-Dp λeq	S1<λeq<S2					1	25.17079	ksi	2159.857 lbft
Post Buckling	k2(√BpE) / λeq	λeq>=S2	S2 = k1Bp/Dp		77.0742286		0	0	ksi	
Local Buckling				S1	S2					
Mn	1.3FySc	b/t<S1	S1 = (Bbr - 1.3Fcy)/4Dbr	9.463044552			0		Kipin	
	[Bbr - 4Dbr(b/t)]Sc	S1<b/t<S2					0		Kipin	
	π^2ESc/(5 (b/t)^2)	b/t>=S2	S2 = Cbr/4		22.2684494		1	37.96998	Kipin	
	Length	42	Iy	5.27	J	0.007				
Lateral Torsional Buckling			2LbSc/(CbvIyJ)	S2						
Inelastic Buckling	Bc - 1.6Dcv(2LbSc/(Cb(vIyJ)))	23.3825142	8.341965106	S2 = (Cc/1.6)^2	4910.14545					2006.409 lbft
Elastic Buckling	π^2E/(2.56(2LbSc/(Cb(vIyJ)))									
CUFSM Analysis Required for Open Shapes										
Shear Capacity										
Members with Flat Webs Supported on Both Edges				S1	S2					
Yeilding	Fsy	b/t<S1	S1 = (Bs - Fsy) / (1.25Ds)	64.302648			1			
Inelestic Buckling	Bs - 1.25Ds b/t	S1<b/t<S2					0			
Elastic Buckling	π^2E/(1.25 b/t)^2	b/t>=S2	S2 = Cs/1.25		81.5203974		0			

G- SECTION

5052-H32 MEMBER

46G - 0.125 in THK

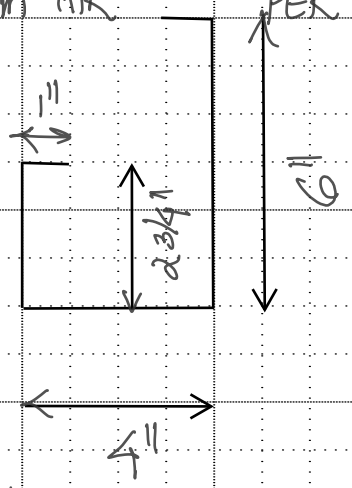
PER API

$F_y = 21$ ksi

$E_x = 10.2$ ksi

$\nu = 0.33$

$G = 3760$ ksi



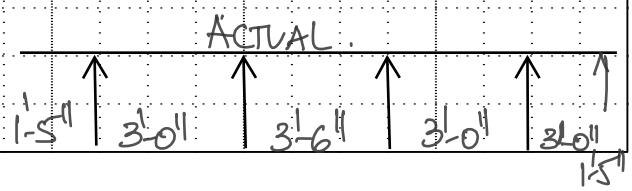
SECTION PER API MANUF. DWG.

LENGTH OF CANOPY. L = 184 in

15.25 in

MAX LENGTH OF G SECTION = 42 in

= 3'-6".



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$$W = (\overset{DL}{10} + \overset{SL}{25}) \times \frac{5'}{2}$$

PSF

$$+ \quad 51\text{PSF} \times \frac{5'-0''}{2} \times \frac{2}{3}$$

$$= 87.5 \text{ PLF} + 85 \text{ PLF}$$

SNOW DRIFT

$$M_{MAX} = (87.5 + 85) \times \frac{3.5^2}{8} = 265 \text{ lb/ft} \quad \text{(SERVICE)}$$

$$W_u = \underset{(1.2\,DL)}{25\text{PLF}} \quad \underset{1.6\,SL}{236\text{ PLF}}$$

$$M_u = 441 \text{ lb/ft} \cdot \text{(MAX)}$$

(CONSERVATIVE DESIGN. G. SECTION CONTINUOUS)

$$b/t = [4'' - 0.125 - 0.125] / 0.125 = 30$$

FLANGE (1 END)

$$b/t = [6 - 0.125 \times 2] / 0.125$$

WEB

$$= 46.$$

(2 ENDS)

By: _____

Associated Consultants, Inc. Structural Engineers 100 East 13th Street • Suite 10 • Vancouver, Washington 98660 Portland: (503) 384-0460 • Vancouver: (360) 699-0607	Project Halsey 'QSR' Remodel	Job No. 21-194
	Location 12035 NE Halsey St, Portland, OR 97220	Date
	Client TSA	Sheet No.

→ MOMENT CAPACITY OF G SECTION

FLAT ELEMENTS SUPPORTED ON ONE EDGE PER

M_n = 383 kip/ft, (SPREAD SHEET) $\Omega = 1.65$

ELASTIC BUCKLING STRESS = $4.47 \text{ ksi} \times S_{xx} \times \frac{1000}{12} \times \frac{1}{1.65}$

CUFSM ANALYSIS REQD FOR OPEN SHAPES.

PER CUFSM ANALYSIS.

BUCKLING STRESS IN COMPRESSION =

LOAD REDUCTION FACTOR =

FOR BENDING = 0.83

M BUCKLING STRESS IN FLEXURE = $\frac{39.6 \times 1000}{12} \times 0.83 = 2739 \text{ lb/ft}$

BUCKLING STRESS IN COMPRESSION = $21 \text{ ksi} \times 0.598 = 12.56 \text{ ksi}$

M_n BUCKLING STRENGTH DUE TO COMPRESSION = $12.56 \times S_x$ =

$12.56 \times 1.699 \times \frac{1000}{12}$

= 1778 lb/ft

By: _____

Associated Consultants, Inc. Structural Engineers
100 East 13th Street • Suite 10 • Vancouver, Washington 98660
Portland: (503) 384-0460 • Vancouver: (360) 699-0607

Project	Job No.
Halsey 'QSR' Remodel	21-194
Location	Date
12035 NE Halsey St, Portland, OR 97220	
Client	Sheet No.
TSA	

$P_n = 38.72 \times 0.598 = 23.15^k$

$P_n = 4.47 \text{ ksi} \times A_w =$

$4.47 \times 1.84 = 8.23^k$ (GOVERNS DESIGN)

(FC DUE TO FLAT ELEMENTS SUPPORTED ON ONE EDGE)

$\frac{P_u}{P_n} + \frac{M_u}{M_n} =$

$236 \text{ plf} \times \frac{(3+3'6")}{2} \times 1.1$

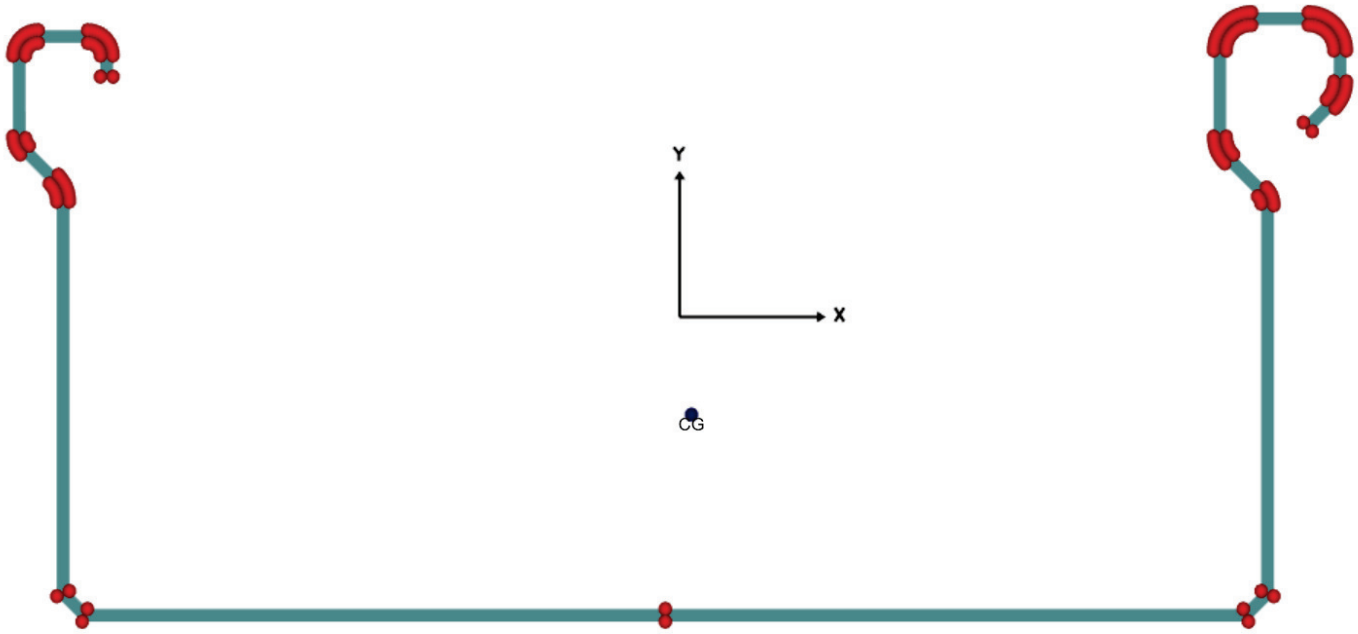
$\frac{935 \text{ lbs}}{8.23^k} + \frac{441 \text{ lbft}}{1778 \text{ lbft}} < 1$ OK ✓

G46 MEMBER — 1/8" THK OK FOR CURRENT LOADS

By: _____

Associated Consultants, Inc. Structural Engineers 100 East 13th Street • Suite 10 • Vancouver, Washington 98660 Portland: (503) 384-0460 • Vancouver: (360) 699-0607	Project Halsey 'QSR' Remodel	Job No. 21-194
	Location 12035 NE Halsey St, Portland, OR 97220	Date
	Client TSA	Sheet No.

APPENDIX



Overall

Depth	3 in
Width	6.574 in
Perimeter	26.85 in
Weight	0.001 K/ft

Geometric Properties

Area	0.8358 in^2
Ix	1.024 in^4
Iy	5.232 in^4
Ixy	0.1913 in^4
rx	1.107 in
ry	2.502 in
Sx+	0.5172 in^3
Sx-	1.005 in^3
Sy+	1.621 in^3
Sy-	1.564 in^3
Xc	0.0584 in
Yc	-0.4808 in

Principal Properties

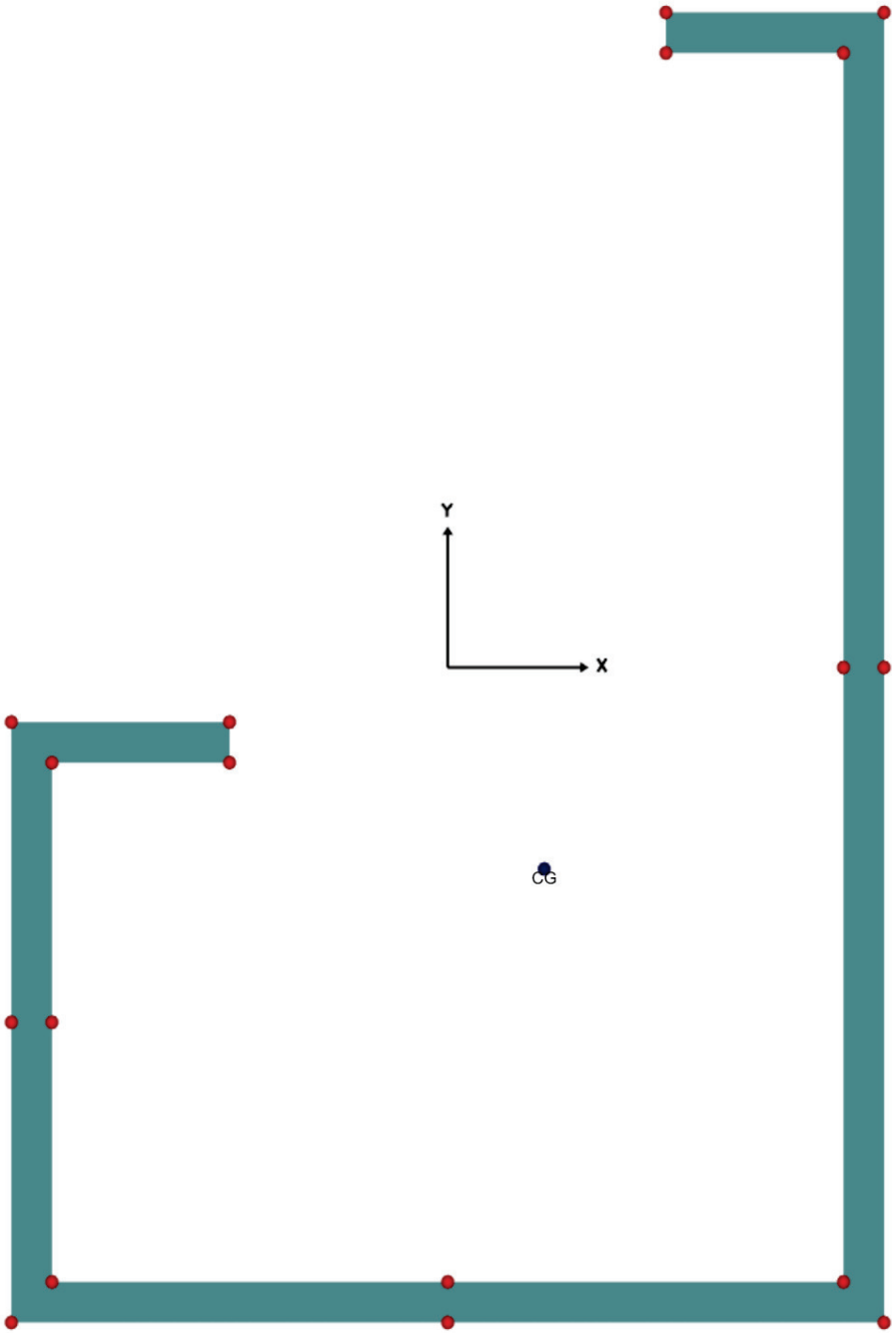
I1	5.241 in^4
I2	1.016 in^4
α	-87.4 deg
r1	2.504 in
r2	1.102 in
S1+	1.585 in^3
S1-	1.598 in^3
S2+	0.889 in^3
S2-	0.4987 in^3

Polar Properties

Ip	6.257 in^4
rp	2.736 in

Plastic Properties

Zx	0.8014 in^3
Zy	1.933 in^3
Xpna	0.2322 in
Ypna	-1.032 in



Overall

Depth	6 in
Width	4 in
Perimeter	28.38 in
Weight	0.0031 K/ft

Geometric Properties

Area	2.605 in^2
Ix	9.804 in^4
Iy	6.77 in^4
Ixy	3.341 in^4
rx	1.94 in
ry	1.612 in
Sx+	2.499 in^3
Sx-	4.72 in^3
Sy+	4.346 in^3
Sy-	2.772 in^3
Xc	0.4425 in
Yc	-0.9231 in

Principal Properties

I1	11.96 in^4
I2	4.617 in^4
α	-32.79 deg
r1	2.142 in
r2	1.331 in
S1+	2.887 in^3
S1-	3.896 in^3
S2+	1.897 in^3
S2-	1.91 in^3

Polar Properties

Ip	16.57 in^4
rp	2.522 in

Plastic Properties

Zx	4.226 in^3
Zy	3.687 in^3
Xpna	1.312 in
Ypna	-1.313 in

TABLE 2 – ALLOWABLE TENSILE PULL-OUT LOADS (P_{NOT}/Ω), pounds-force[1, 2, 3, 4]

Allowable Pullout Values (P/Ω) on Cold Formed Steel and Aluminum; Ω=3.0														
Screw Designation	Nominal Diameter (in.)	Steel Gauge/Thickness								Aluminum Thickness				
										6063-T52			6063-T6	
		18	16	14	12	1/8"	3/16"	1/4"	5/16"	1/8"	1/4"	3/8"	1/8"	1/4"
#10-16 HWH	0.190	140	182	211	388	404				250			377	
#12-14 HWH	0.216	138	186	230	481	496	809			278	680		434	864
#12-14 UPFH	0.216	140	218	252	473	507	837			274	642		418	812
1/4-14 HWH	0.250	170	224	274	431	582	971			283	732		403	997
1/4-20 HWH	0.250	157	231	282	427	571	1066	1422	1422	281	685	1118	396	949

1. For tension connections, the lower of the allowable pull-out, pullover, and fastener tension strength found in Table 2, 3, and 4, respectively must be used for design.
2. Nominal strengths are based on laboratory tests. Steel is compliance with AISI Manual of Cold-formed Steel Design, 2008 Edition, Part I: Dimension and Properties for Use with the 2007 North American Cold-Formed Steel Specification with minimum tensile strength 58 ksi. Aluminum is compliance with 2010 Aluminum Design Manual, Part I specification for Aluminum Structures; 6063-T52 with minimum tensile strength 22 ksi, or 6063-T6 with minimum tensile strength 30 ksi.
3. To calculate LRFD values, multiply values in table by the ASD safety factor of 3.0 and multiply again with the LRFD Φ factor of 0.5.
4. The base-metal thickness of 18 gauge steel is 0.048”; 16 gauge is 0.060”; 14 gauge is 0.075”; and 12 gauge is 0.105”;

TABLE 3 – ALLOWABLE TENSILE PULL-OVER LOADS (P_{NOT}/Ω), pounds-force[1, 2, 3, 4]

Allowable Pullover Values (P/Ω) on Cold Formed Steel and Aluminum; Ω=3.0												
Screw Designation	Nominal Diameter (in.)	Steel Gauge/Thickness						Aluminum Thickness				
								6063-T52			6063-T6	
		18	16	14	12	1/8"	3/16"	1/8"	1/4"	3/8"	1/8"	1/4"
#10-16 HWH	0.190	557	645	718	718	718		578			640	
#12-14 HWH	0.216	619	798	898	1092	1092	1092	586	827		783	885
#12-14 UPFH	0.216	489	624	716	716	716	716	561	818		750	818
1/4-14 HWH	0.250	661	958	1074	1514	1514	1514	722	1091		944	1183
1/4-20 HWH	0.250	667	916	1076	1568	1568	1568	688	1170	1190	922	1243

1. For tension connections, the lower of the allowable pull-out, pullover, and fastener tension strength found in Table 2, 3, and 4, respectively must be used for design.
2. Nominal strengths are based on laboratory tests. Steel is compliance with AISI Manual of Cold-formed Steel Design, 2008 Edition, Part I: Dimension and Properties for Use with the 2007 North American Cold-Formed Steel Specification with minimum tensile strength 58 ksi. Aluminum is compliance with 2010 Aluminum Design Manual, Part I specification for Aluminum Structures; 6063-T52 with minimum tensile strength 22 ksi, or 6063-T6 with minimum tensile strength 30 ksi.
3. To calculate LRFD values, multiply values in table by the ASD safety factor of 3.0 and multiply again with the LRFD Φ factor of 0.5.
4. The base-metal thickness of 18 gauge steel is 0.048”; 16 gauge is 0.060”; 14 gauge is 0.075”; and 12 gauge is 0.105”;

TABLE 4 – FASTENER STRENGTH OF SCREWS, pound-force[1, 2, 3, 4]

Fastener	Allowable Fastener Strength Ω=3		Nominal Fastener Strength (Tested)	
	Tensile, P_{ts}/Ω (lb)	Shear, P_{ss}/Ω (lb)	Tensile, P_{ts} (lb)	Shear, P_{ss} (lb)
#10-16 HWH	866	536	2598	1607
#12-14 HWH	1076	697	3227	2091
#12-14 UPFH	1039	645	3118	1935
#14-14 HWH	1455	909	4365	2727
#14-20 HWH	1561	908	4683	2725

1. For tension connections, the lower of the allowable pull-out, pullover, and fastener tension strength found in Table 2, 3, and 4, respectively must be used for design.
2. Nominal strengths are based on laboratory tests;
3. To calculate LRFD values, multiply values in table by the ASD safety factor of 3.0 and multiply again with the LRFD Φ factor of 0.5.
4. The base-metal thickness of 18 gauge steel is 0.048”; 16 gauge is 0.060”; 14 gauge is 0.075”; and 12 gauge is 0.105”;

TABLE 5 - ALLOWABLE SHEAR (BEARING) CAPACITY, pounds-force[1, 2, 3, 4]

Allowable Shear Values (S/Ω) on Cold Formed Steel and Aluminum; Ω=3.0												
Screw Designation	Nominal Diameter (in.)	Steel Gauges/(Thickness)							Aluminum Thickness			
									6063-T52		6063-T6	
		18-18	18-14	16-16	14-14	1/8"-3/16"	12-1/4"	3/16"-1/4"	1/8"-1/8"	1/8"-1/4"	1/8"-1/8"	1/8"-1/4"
# 10-16 HWH	0.190	331	583	475					402		454	
# 12-14 HWH	0.216	372	646	520	646				456	728	566	603
# 12-14 UPFH	0.216	375	662	542	636				520	580	639	542
1/4-14 HWH	0.250	376	622	536	785	838			519	806	731	810
1/4-20 HWH	0.250	356	687	520	760	854	860	860	529	819	692	921

1. The lower of the allowable shear (bearing) and the allowable fastener shear strength found in Table 4 and 5, respectively must be used for design.
2. Nominal strengths are based on laboratory tests. Steel is compliance with AISI Manual of Cold-formed Steel Design, 2008 Edition, Part I: Dimension and Properties for Use with the 2007 North American Cold-Formed Steel Specification with minimum tensile strength 58 ksi. Aluminum is compliance with 2010 Aluminum Design Manual, Part I specification for Aluminum Structures; 6063-T52 with minimum tensile strength 22 ksi, or 6063-T6 with minimum tensile strength 30 ksi.
3. To calculate LRFD values, multiply values in table by the ASD safety factor of 3.0 and multiply again with the LRFD Φ factor of 0.5.
4. The base-metal thickness of 18 gauge steel is 0.048”; 16 gauge is 0.060”; 14 gauge is 0.075”; and 12 gauge is 0.105”;

TABLE 6 - MINIMUM FASTENER SPACING AND EDGE DISTANCES

Screws Size	Screw Nominal Diameter (inch)	Fastened Material	Minimum Spacing (inch)	Minimum Edge Distance (inch)
No. 10	0.190	Steel	0.570	0.285
		Aluminum	0.760	0.380
No. 12	0.216	Steel	0.648	0.324
		Aluminum	0.864	0.432
1/4"	0.250	Steel	0.750	0.375
		Aluminum	1.000	0.500

SCREW FASTENERS

TAP-FLEX® Thread-Forming Structural Screws

GENERAL INFORMATION

TAP-FLEX®

Thread-Forming Structural Screws

PRODUCT DESCRIPTION

Tap-Flex® Thread-Forming Structural Screws are thread-forming, dual heat treated self-tapping fasteners that provide the strength, ductlity, and resistance to embrittlement failures required in critical curtain wall and dissimilar metal applications. Tap-Flex fasteners are designed to offer a replacement option for traditional nut and bolt assemblies. These fasteners provide an excellent solution for blind connections. The patented E-Form® segmented thread profile design improves installation and forms threads that provide increased thread engagement.

GENERAL APPLICATIONS AND USES

- Hollow Steel Sections (HSS)
- Window Walls/Glazing
- Curtain Wall/Cladding
- Angles and Brackets
- Metal Infill Panels
- Stairs and Risers

FEATURES AND BENEFITS

+ Eliminates thread-tapping operations and allows for blind installations (e.g. HSS)
+ High hardness lead threads for tapping into steel and aluminum
+ E-Form® thread profile overcomes friction build-up and reduces drive torque
+ Formed threads help resist loosening (e.g., vibration, thermal change)
+ Serrations on underside of hex washer head lock against the fixture
+ In the load-bearing area, a lower hardness heat treatment provides Grade 5 bolt mechanical properties, resulting in a fastener with increased ductility having no significant susceptibility to Hydrogen-Assisted Stress Corrosion Cracking (HASCC)
+ Stalgard® Plus Coating provides improved corrosion resistance as well as enhanced galvanic compatibility in dissimilar metal applications, including those involving aluminum, compared with fasteners with standard zinc plating
+ Fasteners coated with Stalgard PLUS typically show no red rust or other base metal corrosion on significant surfaces after 1500 hours of salt spray exposure in accordance with ASTM B117
+ Fasteners accept standard nuts and washers (if desired and/or required)

APPROVALS AND LISTINGS

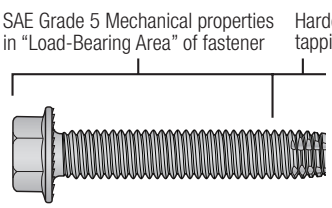
- Pull-out testing conducted in accordance with AISI S905 using the alternate tension test (with adjustments to allow for large fastener diameters)
- Shear testing conducted in accordance with AISI S905 using the standard lap joint shear test (with adjustments to allow for large fastener diameters)

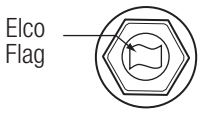
GUIDE SPECIFICATIONS

05 05 23 – Metal Fastenings, 09 22 16.23 – Fasteners. Fasteners shall be Tap-Flex as supplied by DEWALT, Towson, MD. Fasteners shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Fastener Component	Specification
Fastener Body	Medium carbon steel
Plating/Coating	Stalgard PLUS coating 1,500 hour rating in for ASTM B117 salt spray test





SECTION CONTENTS

General Information.....1
Material Specifications.....1
Installation Specifications.....2
Installation Instructions.....3
Performance Data.....4
Ordering Information.....6

TAP-FLEX

THREAD VERSION

- UNC threaded bolt

ANCHOR MATERIALS

- Carbon steel with Stalgard® PLUS coating

HEAD STYLES

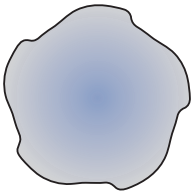
- Hex Washer Head

ANCHOR SIZE RANGE

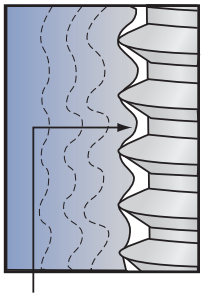
- 3/8" through 5/8" diameters

SUITABLE BASE MATERIALS

- Steel
- Aluminum



E-Form® Profile



TECHNICAL GUIDE – SCREW FASTENERS ©2023 DEWALT – REV. C

INSTALLATION SPECIFICATIONS

Installation Specifications and Supplemental Information for Tap-Flex

Dimension	Unit	Fastener Diameter		
		3/8"	1/2"	5/8"
Thread Size (UNC)	in.	3/8-16	1/2-13	5/8-11
Nominal drill bit diameter	-	8.5 mm or Q	29/64"	37/64"
Impact wrench socket size	in.	9/16	3/4	15/16
Head height[1]	in.	3/8	1/2	19/32
Washer diameter	in.	3/4	1	1-1/4
Maximum material thickness (Tapping)	in.	5/8	3/4	1
Effective tensile stress area (Threads)	in^2	0.078	0.142	0.226
Effective tensile stress area (Unthreaded Shank)	in^2	0.086	0.156	0.249
Minimum specified ultimate strength	ksi	120	120	120
Minimum specified yield strength	ksi	92	92	92

1. Head height includes the thickness of the integral washer.

Seating Torque of Tap-Flex Fasteners in Steel, ft-lbf[1,2,3,4]

Fastener Diameter	Steel Type and Thickness																	
	A653 Grade 33 / A500 Grade A (F_u = 45 ksi)						A36 / A500 Grade B (F_u = 58 ksi)						A572 Grade 50 (F_u = 65 ksi)					
	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"
3/8"	13	25	35	36	-	-	16	32	40	40	-	-	18	36	40	40	-	-
1/2"	13	26	33	56	95	-	17	34	43	72	95	-	19	38	48	80	95	-
5/8"	16	32	47	88	118	185	21	41	60	114	152	185	23	46	67	128	171	185

1. Tabulated seating torques are 75% of the tested ultimate failure torque in each material or 70% of the ultimate failure torque of the fastener, depending on the type of failure that occurred.
2. Tabulated seating torques are based on laboratory testing and are for reference only. If seating torques greater than snug tight are desired, it is suggested to determine the failure torque in the application and base material with a manual torque wrench. Maximum seating torque should not exceed 75% of this failure torque if a material failure occurs and 70% of this failure torque if a fastener failure occurs.
3. When using a washer under the head of the fastener, multiply tabulated seating torques by 0.75.
4. Seating torques for the 3/8" diameter Tap-Flex are based on testing using a 8.5mm drill bit.

Seating Torque of Tap-Flex Fasteners in Aluminum, ft-lbf[1,2,3,4]

Fastener Diameter	Aluminum Type and Thickness								
	6063-T5 (F_u = 22 ksi)			6063-T6 (F_u = 30 ksi)			6061-T6 (F_u = 38 ksi)		
	1/8"	3/16"	1/4"	1/8"	3/16"	1/4"	1/8"	3/16"	1/4"
3/8"	11	23	31	14	30	39	17	36	40
1/2"	11	22	32	15	27	44	18	32	56
5/8"	14	29	49	20	38	59	25	47	70

1. Tabulated seating torques are 75% of the tested ultimate failure torque in each material or 70% of the ultimate failure torque of the fastener, depending on the type of failure that occurred.
2. Tabulated seating torques are based on laboratory testing and are for reference only. If seating torques greater than snug tight are desired, it is suggested to determine the failure torque in the application and base material with a manual torque wrench. Maximum seating torque should not exceed 75% of this failure torque if a material failure occurs and 70% of this failure torque if a fastener failure occurs.
3. When using a washer under the head of the fastener, multiply tabulated seating torques by 0.75.
4. Seating torques for the 3/8" diameter Tap-Flex are based on testing using a 8.5mm drill bit.

Suggested Minimum Spacing and Edge Distance of Tap-Flex Fasteners[1]

Fastener Diameter d (in.)	Minimum Screw Spacing in Aluminum 2.5d (in.)	Minimum Screw Spacing in Steel 3d (in.)	Minimum Edge Distance in Aluminum and Steel 1.5d (in.)
3/8	15/16	1-1/8	9/16
1/2	1-1/4	1-1/2	3/4
5/8	1-9/16	1-7/8	15/16

1. Fastener spacing is measured center-to-center and fastener edge distance is measured center-to-edge.

PERFORMANCE DATA

Ultimate Tension Pull-Out Capacity of Tap-Flex in Steel, lbf[1,2]

Fastener Diameter	Material Type and Thickness																	
	A653 Grade 33 / A500 Grade A (F_u = 45 ksi)						A36 / A500 Grade B (F_u = 58 ksi)						A572 Grade 50 (F_u = 65 ksi)					
	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"
3/8"	1,565	3,350	5,030	7,915	9,705	9,705	2,020	4,320	6,485	9,705	9,705	9,705	2,260	4,840	7,270	9,705	9,705	9,705
1/2"	2,015	4,015	5,335	9,880	12,665	16,460	2,595	5,175	6,875	12,735	16,460	16,460	2,910	5,795	7,705	13,390	16,460	16,460
5/8"	2,655	4,800	7,495	12,405	16,285	21,220	3,420	6,190	9,660	15,985	20,990	26,795	3,830	6,935	10,825	16,815	20,990	26,795

1. Ultimate strengths are based on laboratory tests.
2. Ultimate load capacities must be reduced by a minimum safety factor of 3.0 or greater to determine allowable loads (ASD).

Allowable Tension Pull-Out Capacity of Tap-Flex in Steel, lbf[1,2]

Fastener Diameter	Material Type and Thickness																	
	A653 Grade 33 / A500 Grade A (F_u = 45 ksi)						A36 / A500 Grade B (F_u = 58 ksi)						A572 Grade 50 (F_u = 65 ksi)					
	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"	1/8"	3/16"	1/4"	3/8"	1/2"	5/8"
3/8"	520	1,115	1,675	2,640	3,235	3,235	675	1,440	2,160	3,235	3,235	3,235	755	1,615	2,425	3,235	3,235	3,235
1/2"	670	1,340	1,780	3,295	4,220	5,485	865	1,725	2,290	4,245	5,485	5,485	970	1,930	2,570	4,465	5,485	5,485
5/8"	885	1,600	2,500	4,135	5,430	7,075	1,140	2,065	3,220	5,330	6,995	8,930	1,275	2,310	3,610	5,605	6,995	8,930

1. Allowable (ASD) loads are based on a safety factor , $\Omega = 3.00$.
2. Allowable (ASD) capacities for other member thicknesses may be deterimined by interpolating within the table.

Ultimate Tension Pull-Out Capacity of Tap-Flex in Aluminum, lbf[1,2]

Fastener Diameter	Material Type and Thickness								
	6063-T5 (F_u = 22 ksi)			6063-T6 (F_u = 30 ksi)			6061-T6 (F_u = 38 ksi)		
	1/8"	3/16"	1/4"	1/8"	3/16"	1/4"	1/8"	3/16"	1/4"
3/8"	760	1,630	2,515	1,165	2,375	3,880	1,565	3,120	5,245
1/2"	955	1,820	3,000	1,440	2,895	4,465	1,925	3,965	5,935
5/8"	1,195	2,405	4,325	1,610	3,440	5,600	2,020	4,470	6,875

1. Ultimate strengths are based on laboratory tests.
2. Ultimate load capacities must be reduced by a minimum safety factor of 3.0 or greater to determine allowable loads (ASD).

Allowable Tension Pull-Out Capacity of Tap-Flex in Aluminum, lbf[1,2]

Fastener Diameter	Material Type and Thickness								
	6063-T5 (F_u = 22 ksi)			6063-T6 (F_u = 30 ksi)			6061-T6 (F_u = 38 ksi)		
	1/8"	3/16"	1/4"	1/8"	3/16"	1/4"	1/8"	3/16"	1/4"
3/8"	255	545	840	390	790	1,295	520	1,040	1,750
1/2"	320	605	1,000	480	965	1,490	640	1,320	1,980
5/8"	400	800	1,440	535	1,145	1,865	675	1,490	2,290

1. Allowable (ASD) loads are based on a safety factor , $\Omega = 3.00$.
2. Allowable (ASD) capacities for other member thicknesses may be deterimined by interpolating within the table.

Ultimate Shear Capacity of Tap-Flex in Aluminum-to-Aluminum Connections, lbf[1,2]

Fastener Diameter	Material Type and Thickness								
	6063-T5 (F_u = 22 ksi)			6063-T6 (F_u = 30 ksi)			6061-T6 (F_u = 38 ksi)		
	1/8"-1/8"	3/16"-3/16"	1/4"-1/4"	1/8"-1/8"	3/16"-3/16"	1/4"-1/4"	1/8"-1/8"	3/16"-3/16"	1/4"-1/4"
3/8"	1,875	3,060	4,660	2,460	3,820	5,200	3,040	4,580	5,575
1/2"	2,250	3,230	4,895	3,040	4,325	5,905	3,825	5,425	6,915
5/8"	2,180	3,320	5,105	2,890	4,640	6,240	3,600	5,955	7,370

1. Ultimate strengths are based on laboratory tests.
2. Ultimate load capacities must be reduced by a minimum safety factor of 3.0 or greater to determine allowable loads (ASD).

ORDERING INFORMATION

Tap-Flex

Cat. No.	Description (Diameter- TPI x Nominal Length)	Minimum Thread Length (in.)	Minimum Usable Thread Length[1] (in.)	Maximum Load-Bearing Length[2] (in.)	Minimum Protrusion Length[3] (in.)	Pack Qty.
3/8" Diameter, 9/16" Hex Washer Head with Serrations						
DFSESU310	3/8"-16 x 1-1/2"	1.500	1.000	1.000	0.500	500
DFSESU320	3/8"-16 x 2"	2.000	1.500	1.500	0.500	500
DFSESU330	3/8"-16 x 2-1/2"	2.500	2.000	2.000	0.500	400
DFSESU340	3/8"-16 x 3"	2.500	2.000	2.500	0.500	250
DFSESU350	3/8"-16 x 4"	2.500	2.000	3.500	0.500	250
DFSESU360	3/8"-16 x 5"	2.500	2.000	4.500	0.500	150
1/2" Diameter, 3/4" Hex Washer Head with Serrations						
DFSESU410	1/2"-13 x 1-1/2"	1.500	0.875	0.875	0.625	250
DFSESU420	1/2"-13 x 2"	2.000	1.375	1.375	0.625	250
DFSESU430	1/2"-13 x 2-1/2"	2.500	1.875	1.875	0.625	200
DFSESU440	1/2"-13 x 3"	2.500	1.875	2.375	0.625	150
DFSESU450	1/2"-13 x 4"	2.500	1.875	3.375	0.625	150
DFSESU460	1/2"-13 x 5"	2.500	1.875	4.375	0.625	100
5/8" Diameter, 15/16" Hex Washer Head with Serrations						
DFSESU510	5/8"-11 x 1-1/2"	1.500	0.625	0.625	0.875	200
DFSESU520	5/8"-11 x 2"	2.000	1.125	1.125	0.875	150
DFSESU530	5/8"-11 x 2-1/2"	2.500	1.625	1.625	0.875	150
DFSESU540	5/8"-11 x 3"	2.500	1.625	2.125	0.875	100
DFSESU550	5/8"-11 x 4"	2.500	1.625	3.125	0.875	100
DFSESU560	5/8"-11 x 5"	2.500	1.625	4.125	0.875	50

1. Minimum Usable Thread Length is the Minimum Thread Length minus the Minimum Protrusion Length (hardened point and lead tapping threads).
2. Maximum Load Bearing Length is the length of the lower hardness region below the head of the fastener, not including the hardened point and lead tapping threads.
3. The Minimum Protrusion Length is the portion of the fastener that must protrude past the back side of the supporting material.

Magnetic Drill Press

Impact Rated Socket	
Model #	**Description**
DWE1622K	2" 2-Speed Magnetic Drill Press

Impact Wrenches

Impact Rated Socket	
Model #	**Description**
DCF913	20V MAX* 3/8 in. Cordless Impact Wrench
DCF923	ATOMIC 20V MAX* 3/8 in. Cordless Impact Wrench
DCF911	20V MAX* 1/2 in. Cordless Impact Wrench
DCF921 DCF922	ATOMIC 20V MAX* 1/2 in. Cordless Impact Wrench
DCF891 DCF892	20V MAX* XR® 1/2 in. Mid-Range Impact Wrench

Impact Sockets

Fastener Size (in.)	Socket Size (in.)	Impact Rated Socket
		1/2" Square Drive
3/8	9/16	DWMT75122OSP
1/2	3/4	DWMT75113OSP
5/8	15/16	DWMT75104OSP

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