ECLIPSE ENGINEERING
A CUSHING TERRELL COMPANY

May 15, 2025

Geoff Luczycki
Fortress Building Products
1720 N 1st Street
Garland, TX 75040

Project Number: 24-01-074

Re: 2x2 Tube Capacity

Geoff,

Per your request, Eclipse Engineering, P.C. (EEPC) has completed the structural calculations to determine the maximum span of the 2x2 tubes used for the Fortress stair assemblies. These calculations were done in accordance with the 2021 IBC and the ASCE 7-16.

The 2x2 tubes are approximately 0.052 inches thick. Based on the attached calculations, the tubes may be used for stair steps provided they are used in groups of (4) tubes per step and have a maximum span of 4'-0". The tubes may be fastened into a minimum 16g cold formed stringer and supported with Fortress F10 brackets or Fortress F50 brackets with a minimum (2) #8 self-tapping screws into the stringer.

For landings, the tubes can span various distances based on the total load applied. Please see the attached span table for the maximum span for any given total load.

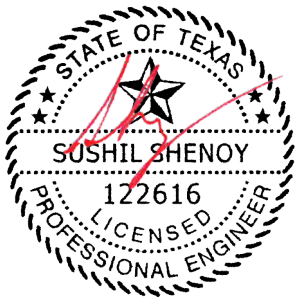
EEPC determined the maximum span for the above noted component only. We do not take responsibility for any other element of the stair system nor for the stair assembly as a whole.

Please contact us with any questions.

Sincerely,

Eclipse Engineering, P.C.

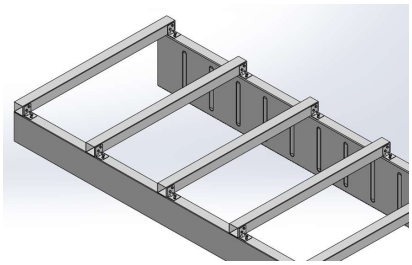
Sean Smith, E.I.T.
Staff Engineer
seansmith@cushingterrell.com



Firm Number: F-2217
EXP 12/31/2025

Span Table for 2x2 Tubes @ 16 o.c.

Load (psf)	Span Length
50	5'-3"
60	5'-0"
70	4' 9"
80	4' 6"
90	4' 3"
100	4' 0"
110	4' 0"
120	4' 0"
130	3' 9"
140	3' 9"
150	3' 6"
160	3' 6"
170	3' 6"
180	3' 6"
190	3' 3"
200	3' 3"



Span Table for 2x2 Tubes @ 12 o.c.

Load (psf)	Span Length
50	5'-9"
60	5'-6"
70	5' 3"
80	5' 0"
90	4' 9"
100	4' 6"
110	4' 6"
120	4' 3"
130	4' 3"
140	4' 0"
150	4' 0"
160	4' 0"
170	3' 9"
180	3' 9"
190	3' 9"
200	3' 6"

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Fortress 2x2 Tube Capacity Check

Point Load Check

Tube Length - $l := 48\ in$

Point Load - $P := 100\ lbf$

Moment - $M := \frac{P \cdot l}{4} = 100\ lbf \cdot ft$

$E := 29000\ ksi$

$I := 0.2448\ in^4$

$S := 0.2485\ in^3$

Deflection - $\Delta := \frac{P \cdot l^3}{48\ E \cdot I} = 0.032\ in$

Stress - $\sigma := \frac{M}{S} = 4.829\ ksi$ Much less than yield of the steel. OK

Uniform Load Check

Tube Length - $l := 57\ in$

Uniform Load - $w := 70\ psf \cdot 1.33\ ft = 93.1\ plf$

Moment - $M := \frac{w \cdot l^2}{8} = 262.571\ lbf \cdot ft$

$E := 29000\ ksi$

$I := 0.2448\ in^4$

$S := 0.2485\ in^3$

Deflection - $\Delta := \frac{5 \cdot w \cdot l^4}{384 \cdot E \cdot I} = 0.15\ in$

$\frac{l}{\Delta} = 379$ Greater than L/360, OK

Stress - $\sigma := \frac{M}{S} = 12.679\ ksi$ Less than Yield Strength of 34 ksi (Q325 Steel), OK

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Clip Capacities

$F := 34\ ksi$ Yield Strength of Q235

$\Omega_b := 1.67$ Bending Safety Factor

$\Omega_v := 2$ Shear Safety Factor

Allowable Bending Strength

$$f_b := \frac{F}{\Omega_b} = 20.359\ ksi$$

Allowable Shear Strength

$$f_v := \frac{F}{\Omega_v} = 17\ ksi$$

Clip Bearing Checks

$P := 0.3\ kip$ Live Load on Stair

$l_{10} := 1.79\ in$ Length of F10 Clip

$S_{10} := 0.1378\ in^3$ Section Modulus of F10 Clip

$M_{10} := P \cdot l_{10} = 0.537\ kip \cdot in$ Moment Demand

$$F_b := \frac{M_{10}}{S_{10}} = 3.897\ ksi$$

<20.36 ksi, Okay

$t := 0.064\ in$ Clip Thickness

$w := 1.5\ in$ F10 Width

$A := t \cdot w = 0.096\ in^2$ Shear Area

$$F_v := \frac{P}{A} = 3.125\ ksi$$

<17 ksi, Okay

F50 Clip has larger Section Modulus and Shear Area, Okay by Inspection

Fastener Check

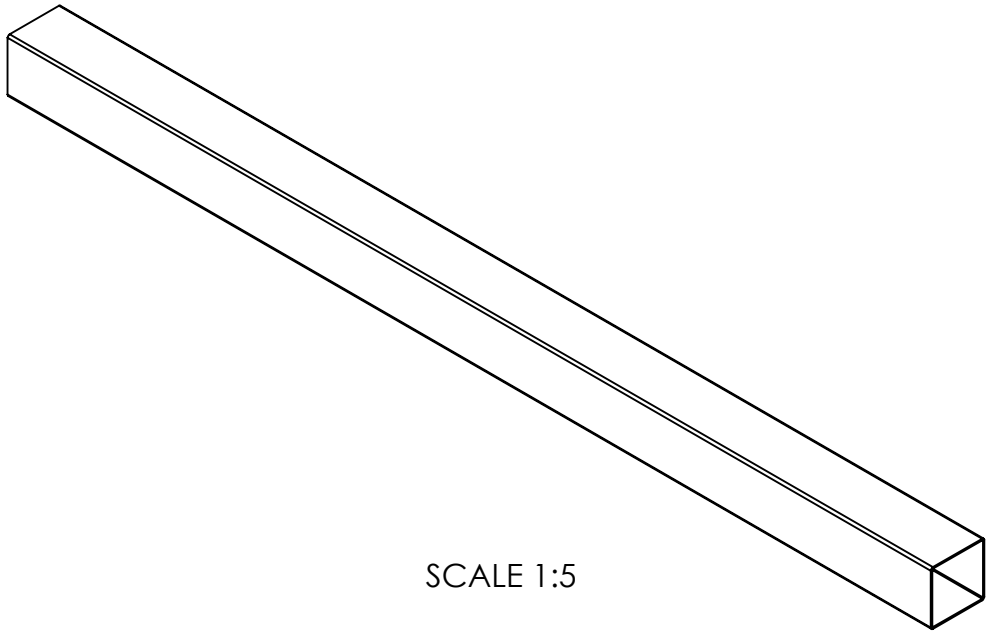
Each Clip has a minimum of (2) screws into Stringer

$n := 2$ Minimum Number of Fasteners

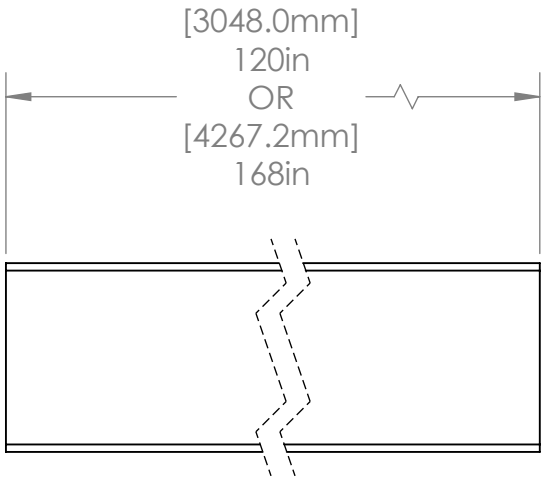
$V := 344\ lbf$ Shear Capacity of #8 Screw in 16g Cold Formed Material

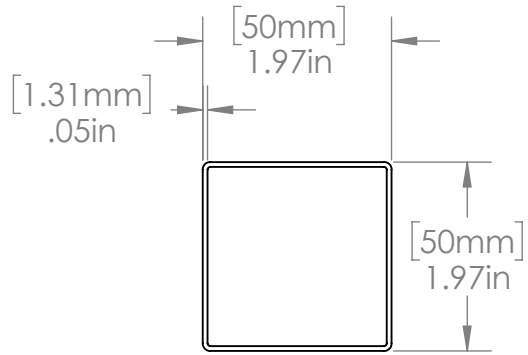
$$v := \frac{P}{n} = 150\ lbf$$

Shear Demand for Single Fastener
< 300 lbf, Okay



SCALE 1:5





REV	DATE	BY	DESCRIPTION
7	12/9/24	GL	Initial Drawing

FORTRESS BUILDING PRODUCTS

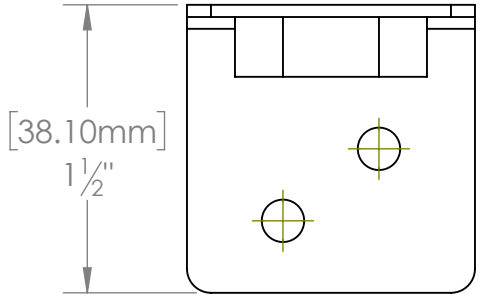
Fortress Iron, LP
1720 N 1st Street
Garland, Tx 75040

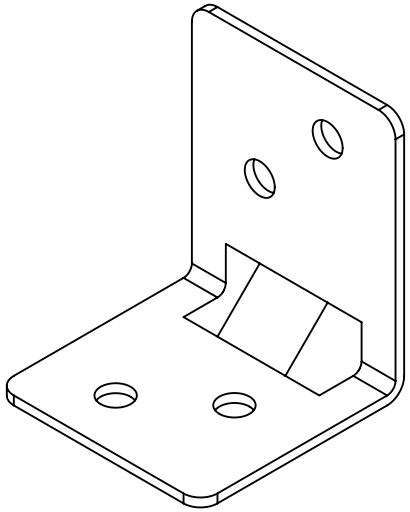
DESCRIPTION: FF-EVOLUTION-2"x2" LAT BRACE/PURLIN-18GA-PC

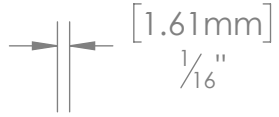
DRAWN BY: KevinF | SCALE: 1:5

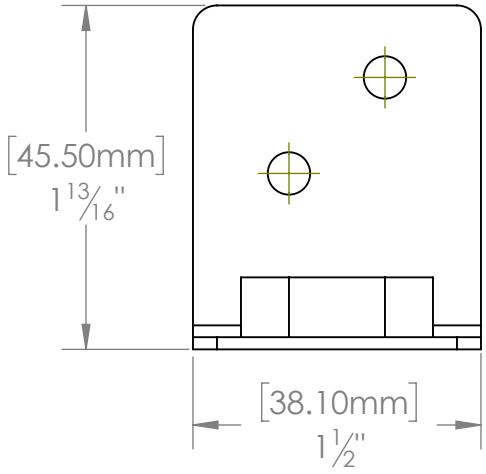
DATE: 12/9/2024 | DIVISION: FRAMING

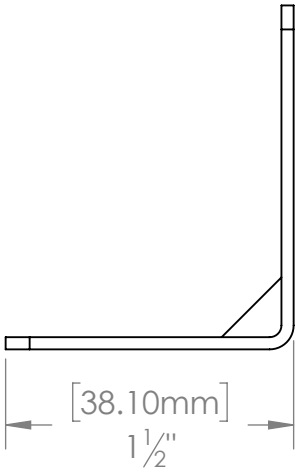
Sheet: 1 OF 1 | ITEM #: 282011401, 282011001 | FILE NAME/PART #: L7580-11691A | REV: 7











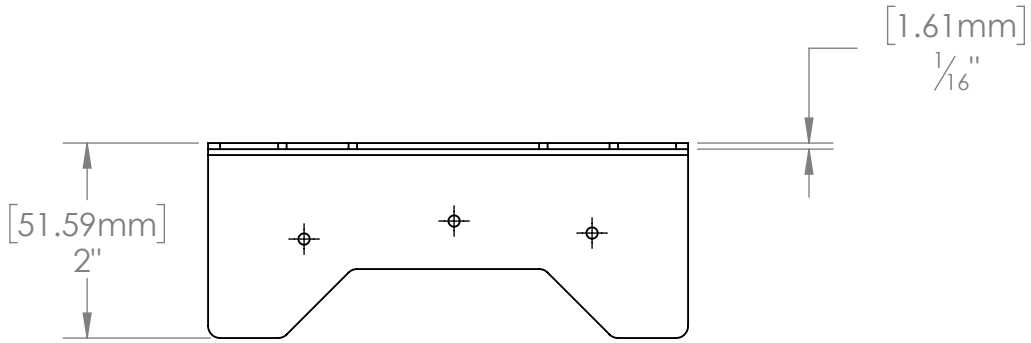
REV	DATE	BY	DESCRIPTION
A1	12/9/24	GL	Update Sheet Format

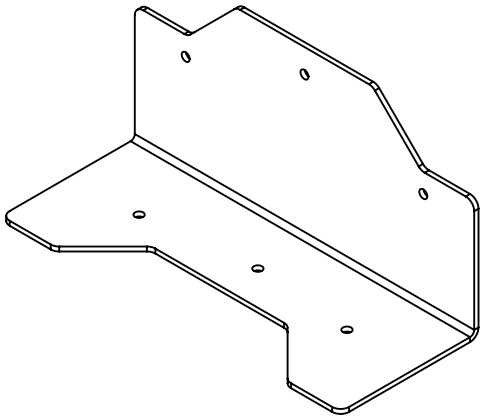
FORTRESS BUILDING PRODUCTS

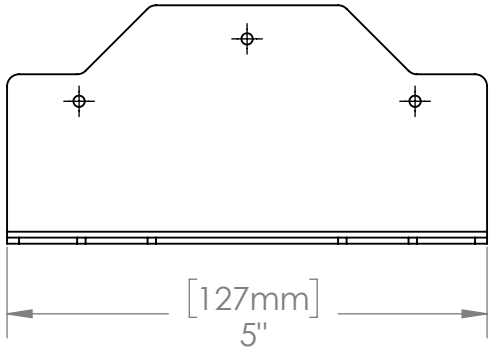
Fortress Iron, LP
1720 N 1st Street
Garland, Tx 75040

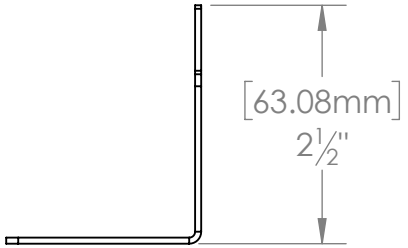
DESCRIPTION: FF-EVOLUTION-F10 BRACKET
DRAWN BY: chrisw
DATE: 03/27/2018
DIVISION: Framing
SCALE: 1:2

Sheet: 1 OF 1
ITEM #: 183041601
FILE NAME/PART #: L7577-06781A
REV: A









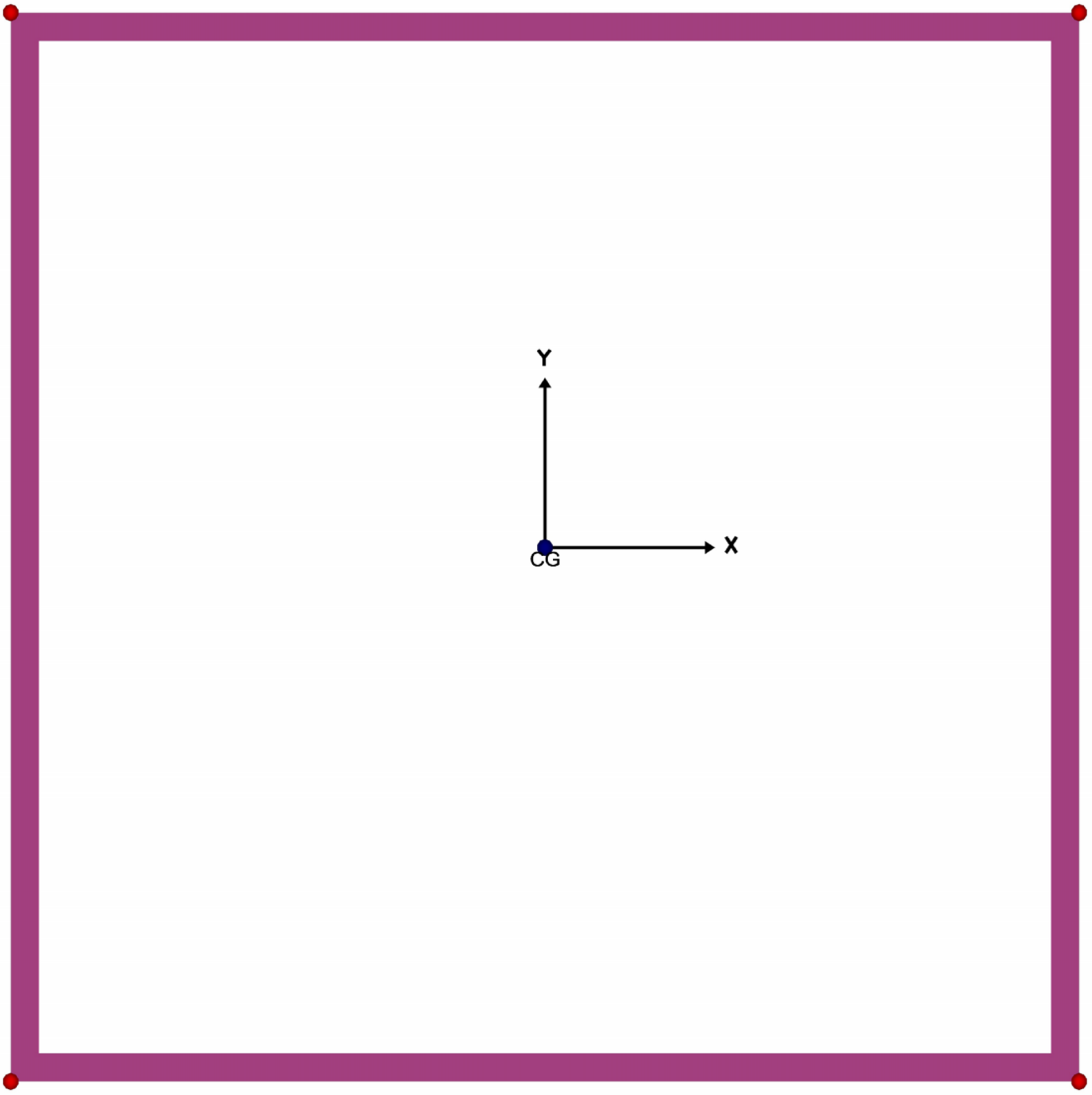
REV	DATE	BY	DESCRIPTION
A	12/9/24	GL	Update Sheet Format

FORTRESS BUILDING PRODUCTS

Fortress Iron, LP
1720 N 1st Street
Garland, Tx 75040

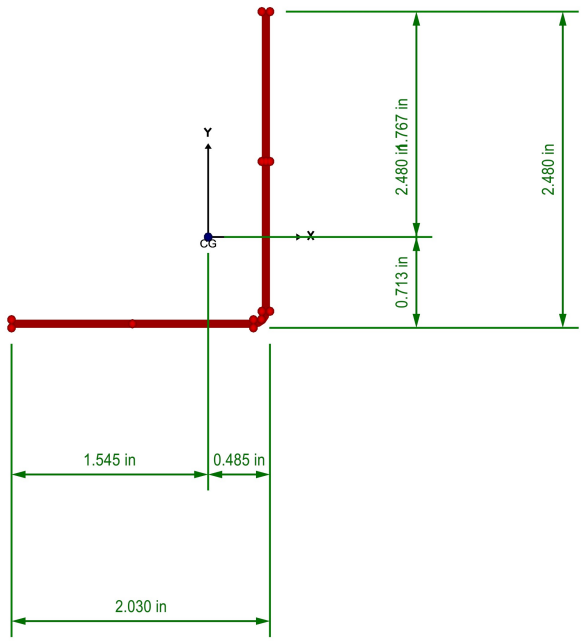
DESCRIPTION: FF-EVOLUTION-F50 BRACKET
DRAWN BY: chrisw
DATE: 03/27/2018
DIVISION: Framing
SCALE: 1:2

Sheet: 1 OF 1
ITEM #: 183021601
FILE NAME/PART #: L7577-06784A
REV: A


Y
X
CG

Geometric Properties

Area	0.399	in^2
Ix	0.245	in^4
Ixy	0.000	in^4
Iy	0.245	in^4
Sx+	0.249	in^3
Sx-	0.249	in^3
Sy+	0.249	in^3
Sy-	0.249	in^3
Xc	0.000	in
Yc	0.000	in
rx	0.783	in
ry	0.783	in



Geometric Properties

Area	0.282	in^2
Ix	0.182	in^4
Ixy	0.087	in^4
Iy	0.112	in^4
Sx+	0.103	in^3
Sx-	0.256	in^3
Sy+	0.231	in^3
Sy-	0.073	in^3
Xc	0.000	in
Yc	0.000	in
rx	0.805	in
ry	0.631	in

Principal Properties

I1	0.241	in^4
I2	0.054	in^4
S1+	0.139	in^3
S1-	0.166	in^3
S2+	0.072	in^3
S2-	0.058	in^3
r1	0.925	in
r2	0.436	in
α	-34.008	deg

Torsion Properties

Cw	0.000	in^6
H	0.612	
J	0.000	in^4
Xsc	0.452	in
Ysc	-0.678	in
ro	1.307	in
B1	0.758	in

Overall Properties

Depth	2.480	in
Perimeter	8.932	in
Weight	0.001	K/ft
Width	2.030	in

Polar Properties

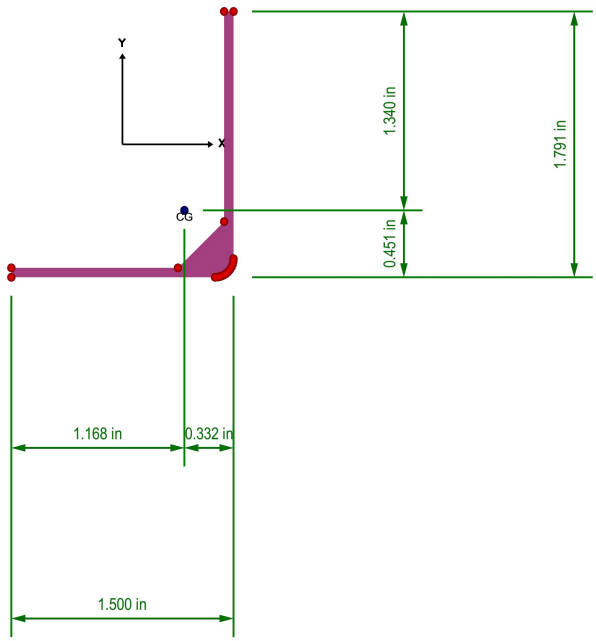
Ip	0.295	in^4
rp	1.023	in

Plastic Properties

Xpna	0.427	in
Ypna	-0.434	in
Zx	0.188	in^3
Zy	0.129	in^3

Shear Flow

Name	Qx in^3	Qy in^3	f(Vx) K/ft	f(Vy) K/ft
Pipe Sector 1	0.006	0.004	0.000	0.000
Rectangle 1	0.083	0.072	0.000	0.000
Rectangle 2	0.089	0.068	0.000	0.000



Geometric Properties

Area	0.250	in^2
Ix	0.073	in^4
Ixy	0.031	in^4
Iy	0.046	in^4
Sx+	0.054	in^3
Sx-	0.161	in^3
Sy+	0.138	in^3
Sy-	0.039	in^3
Xc	0.418	in
Yc	-0.445	in
rx	0.539	in
ry	0.427	in

Principal Properties

I1	0.093	in^4
I2	0.026	in^4
S1+	0.071	in^3
S1-	0.091	in^3
S2+	0.054	in^3
S2-	0.033	in^3
r1	0.609	in
r2	0.320	in
α	-33.191	deg

Plastic Properties

Xpna	0.645	in
Ypna	-0.730	in
Zx	0.100	in^3
Zy	0.073	in^3

Torsion Properties

Cw	0.000	in^6
H	0.681	
J	0.001	in^4
Xsc	0.692	in
Ysc	-0.827	in
ro	0.833	in
B1	0.535	in

Overall Properties

Depth	1.791	in
Perimeter	6.346	in
Weight	0.001	K/ft
Width	1.500	in

Polar Properties

Ip	0.118	in^4
rp	0.688	in