Structural Analysis
TNH Development

October 17, 2023

Project Name	8ft x 12ft x 12ft FRP Wall Enclosure
Site Location	1990 Olivera Rd. Concord, CA 94520 37.997685 N NAD83 122.048607 W NAD83
Structure Type	Rooftop
Structural Usage Ratio	**93%**
Overall Result	**Pass**

Upon reviewing the results of this analysis, it is our opinion that the structure does meet the specified IBC/ASCE/TIA code requirements. The proposed structure will be deemed adequate to support the proposed loading once the recommendations have been added as listed in this report.

Digitally signed by Michael B Leeper
Date: 2023.10.19 14:13:53-07'00'

1990 Olivera Rd., Concord, CA 94520
Office Phone: 800.916.1503 I *www.TNHDev.com*

Summary of Contents

Assumptions and Limitations

For the purposes of calculations, we assume an overall structure condition of "like new" and all members and connections to be free of corrosion and/or structural defects. The structure owner and/or contractor shall verify the structure's condition prior to installation of any proposed equipment. If actual conditions differ from those described in this report TNH should be notified immediately to complete a revised evaluation.

Our evaluation is completed using standard TIA, AISC, ACI, and ASCE methods and procedures. Our structural results are proprietary and should not be used by others as their own. TNH is not responsible for decisions made by others that are or are not based on our supplied assumptions and conclusions.

INTRODUCTION

TNH has performed a structural design for only the referenced 8'x12'x2' FRP enclosure. Connection to other structures is not part of this scope and is the responsibility of the customer to determine the size and frequency of anchors.

Supporting Documentation

Design Drawings	Shop Drawings by TNH, Dated: 10/17/2023

Analysis Code Requirements

Wind Speed	92 mph (Vult)
Wind Speed w/ ice	30 mph (3-Second Gust) w/ 0" ice
TIA Revision	ANSI/TIA-222-H
Adopted IBC	2021 IBC / 2022 CBC
Structure Class	II
Exposure Category	C
Topographic Category	1
Calculated Crest Height	0
Spectral Response	S_s: 1.625g S_1: 0.6g S_{DS}: 1.301g

CONCLUSION

Upon reviewing the results of this analysis, it is our opinion that the structure does meet the specified IBC/ASCE/TIA code requirements. The proposed structure will be deemed adequate to support the proposed loading once the recommendations have been added as listed in this report.

Recommendations:

- Refer to the latest structural drawings for details.
- Use ½" Ø FRP bolts with ASI MP55310 methacrylate adhesive. Applied to a minimum of 3"x3" area.
- Connection to other structures is beyond the scope of this analysis.

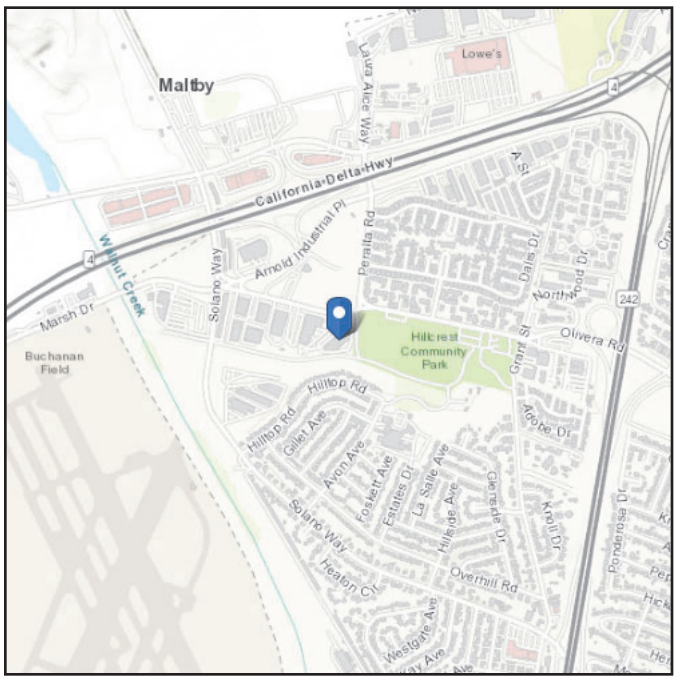
APPENDIX A
Design Tables & Resources

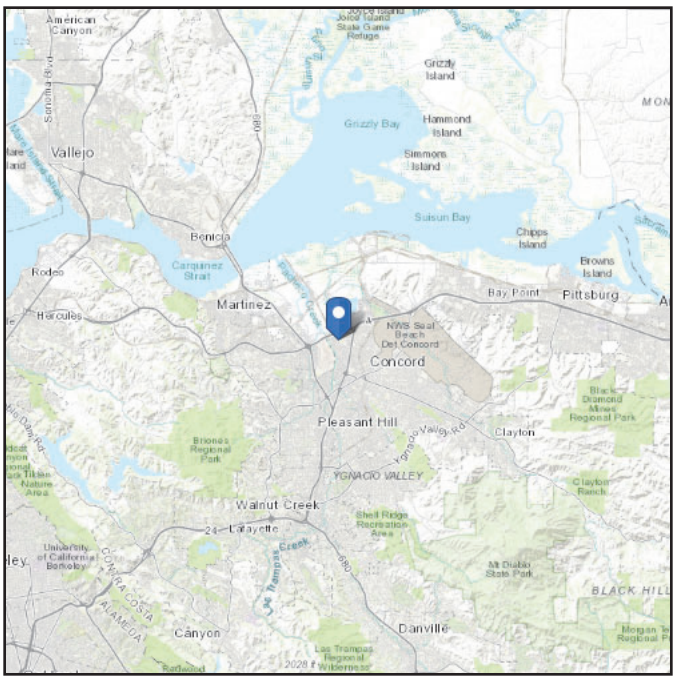
ASCE 7 Hazards Report

Address:
1990 Olivera Rd
Concord, California
94520

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Default (see Section 11.4.3)

Latitude: 37.997685
Longitude: -122.048607
Elevation: 24.768770375933958 ft (NAVD 88)





Wind

Results:

Wind Speed	92 Vmph
10-year MRI	64 Vmph
25-year MRI	70 Vmph
50-year MRI	75 Vmph
100-year MRI	79 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Sat Aug 12 2023

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	1.626	S_{D1} :	N/A
S_1 :	0.6	T_L :	8
F_a :	1.2	PGA :	0.659
F_v :	N/A	PGA_M :	0.791
S_{MS} :	1.951	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.301	C_v :	1.425

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Sat Aug 12 2023

Date Source: USGS Seismic Design Maps

Ice

Results:

Ice Thickness:	0 in.
Concurrent Temperature:	25 F
Gust Speed	30 mph
Data Source:	Standard ASCE/SEI 7-16, Figs. 10-2 through 10-8
Date Accessed:	Sat Aug 12 2023

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 500-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Snow

Results:

Ground Snow Load, p_g:	0 lb/ft^2
Mapped Elevation:	24.8 ft
Data Source:	ASCE/SEI 7-16, Table 7.2-8
Date Accessed:	Sat Aug 12 2023

Values provided are ground snow loads. In areas designated "case study required," extreme local variations in ground snow loads preclude mapping at this scale. Site-specific case studies are required to establish ground snow loads at elevations not covered.

Snow load values are mapped to a 0.5 mile resolution. This resolution can create a mismatch between the mapped elevation and the site-specific elevation in topographically complex areas. Engineers should consult the local authority having jurisdiction in locations where the reported ‘elevation’ and ‘mapped elevation’ differ significantly from each other.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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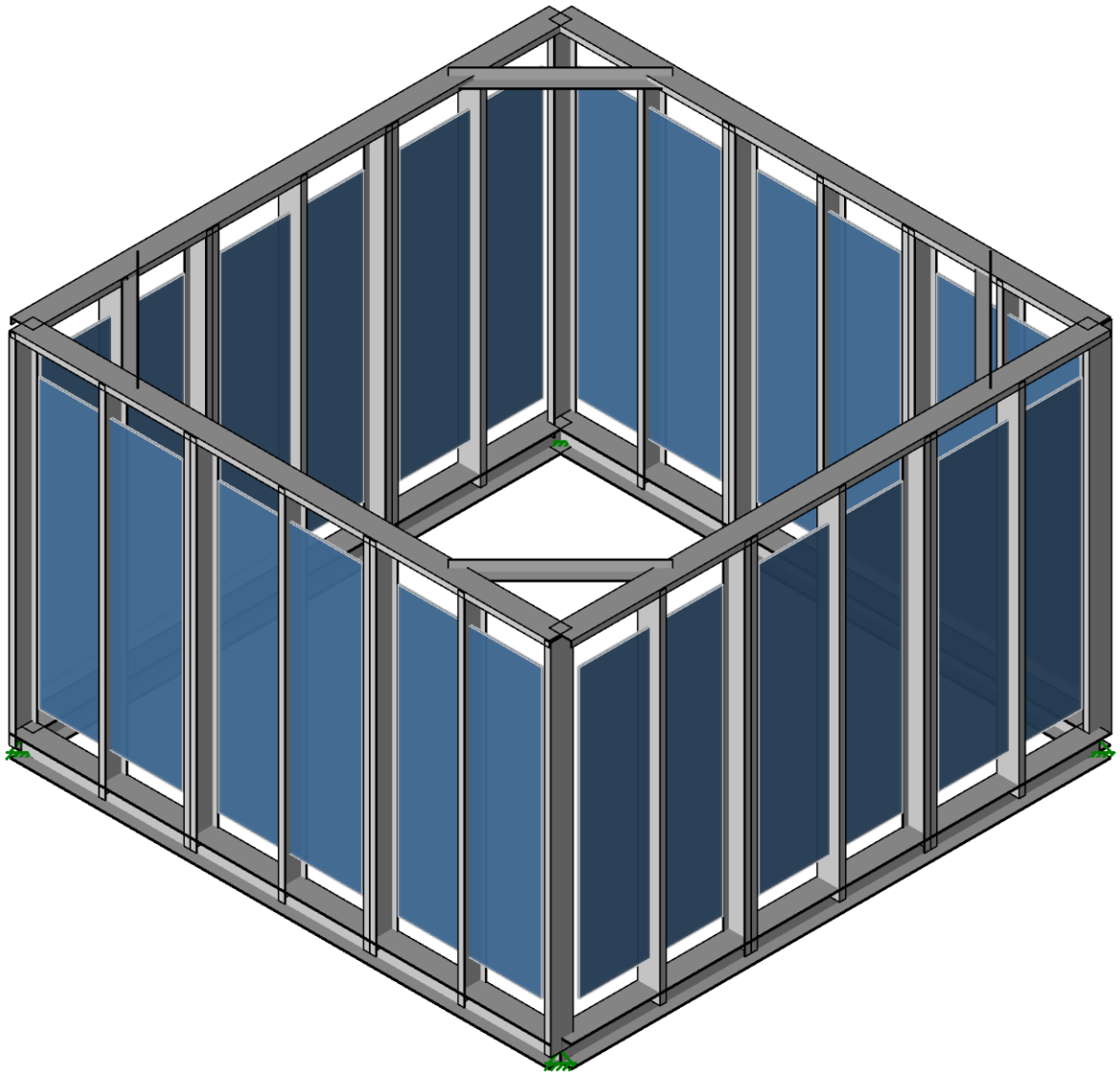
In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

Site Name:	8ftx12ftx12ft Wall Mount FRP Box	Design Wind Velocity:	92.0
		Wind Centerline:	28.0
Client:	TNH	Exposure Category:	C
Carrier:	TNH	Code	TIA-222-H
Date:	10/17/2023		

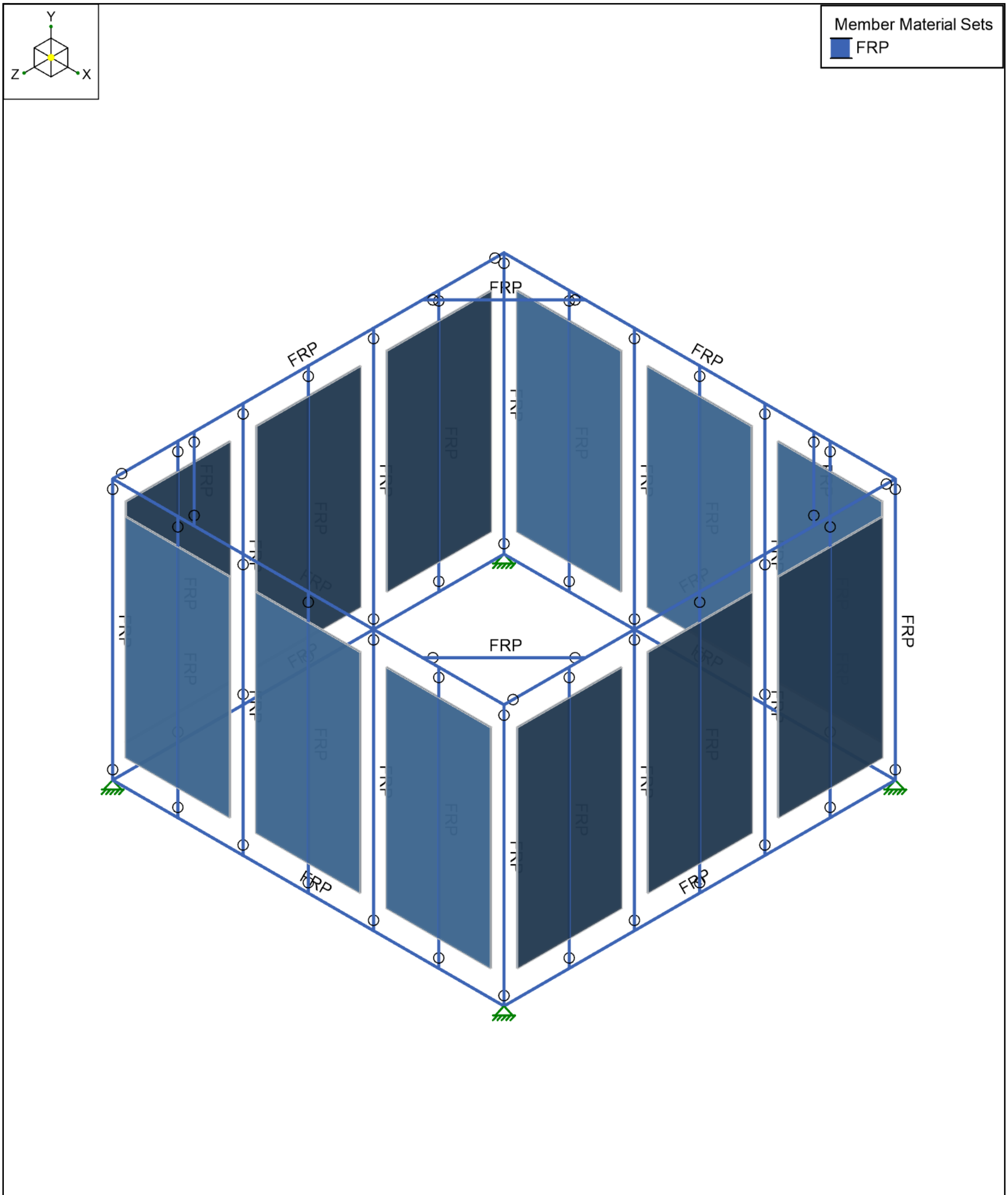
qz = 30.3 Fp = 0.78

Appurtenance Name	Quantity	Wind Force F-norm (lbs)	Wind Force F-perp (lbs)	Seismic Force F-norm (lbs)	Seismic Force F-perp (lbs)
8ftx12ftx12ft Roof Mount	1.0	1745.9	1745.9	2341.8	2341.8



Loads: BLC 1, Self Weight
Envelope Only Solution

TNH DEVELOPMENT	TNH	8ftx12ftx2ft FRP Wall Mount Box	SK-1
			Oct 17, 2023 at 11:28 PM
	2023-05-99		FRP Box 8Hx12Wx12D_10.1…



Loads: BLC 1, Self Weight
Envelope Only Solution

TNH DEVELOPMENT	TNH	8ftx12ftx2ft FRP Wall Mount Box	SK-2
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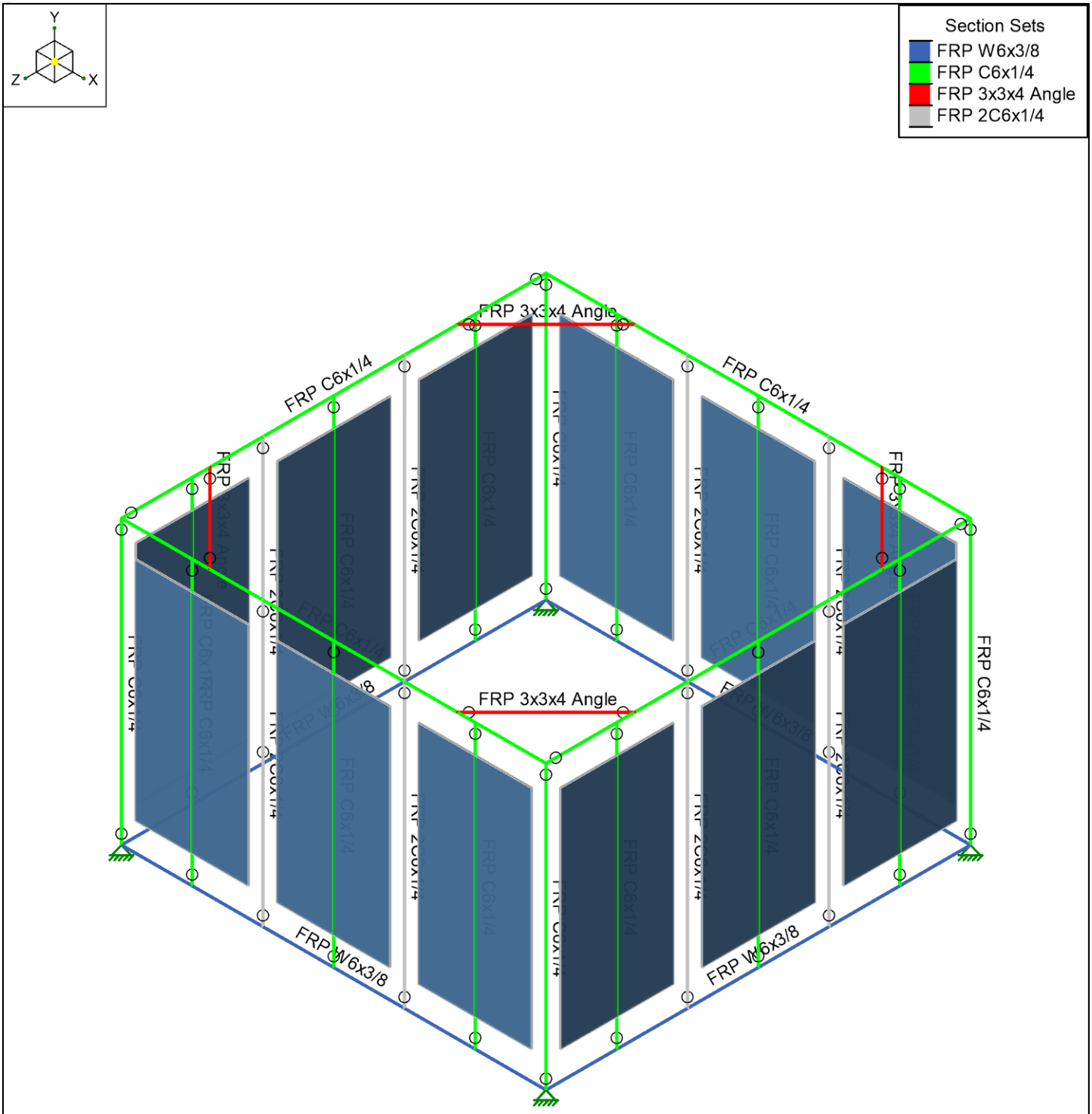

Loads: BLC 1, Self Weight
Envelope Only Solution

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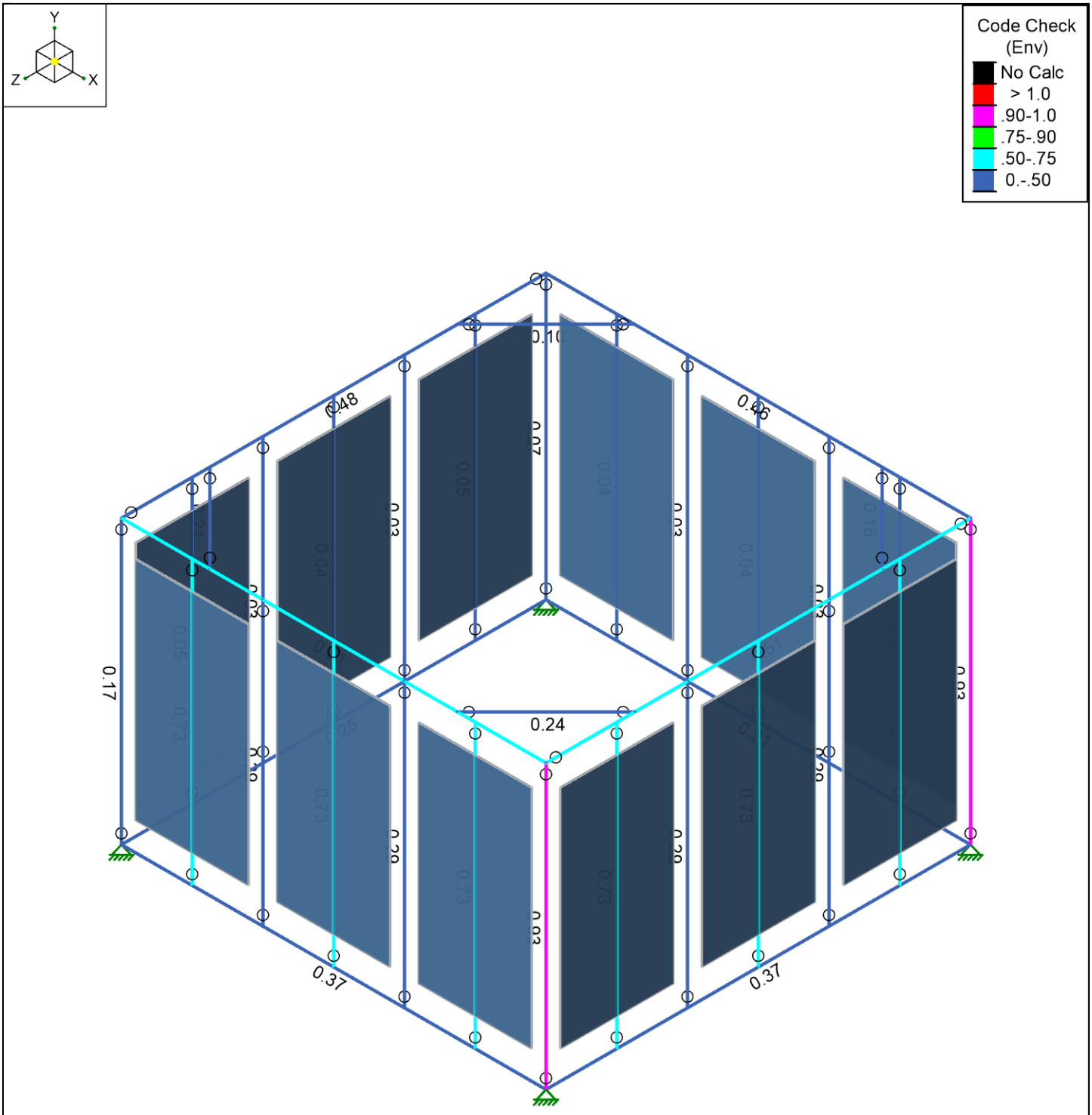
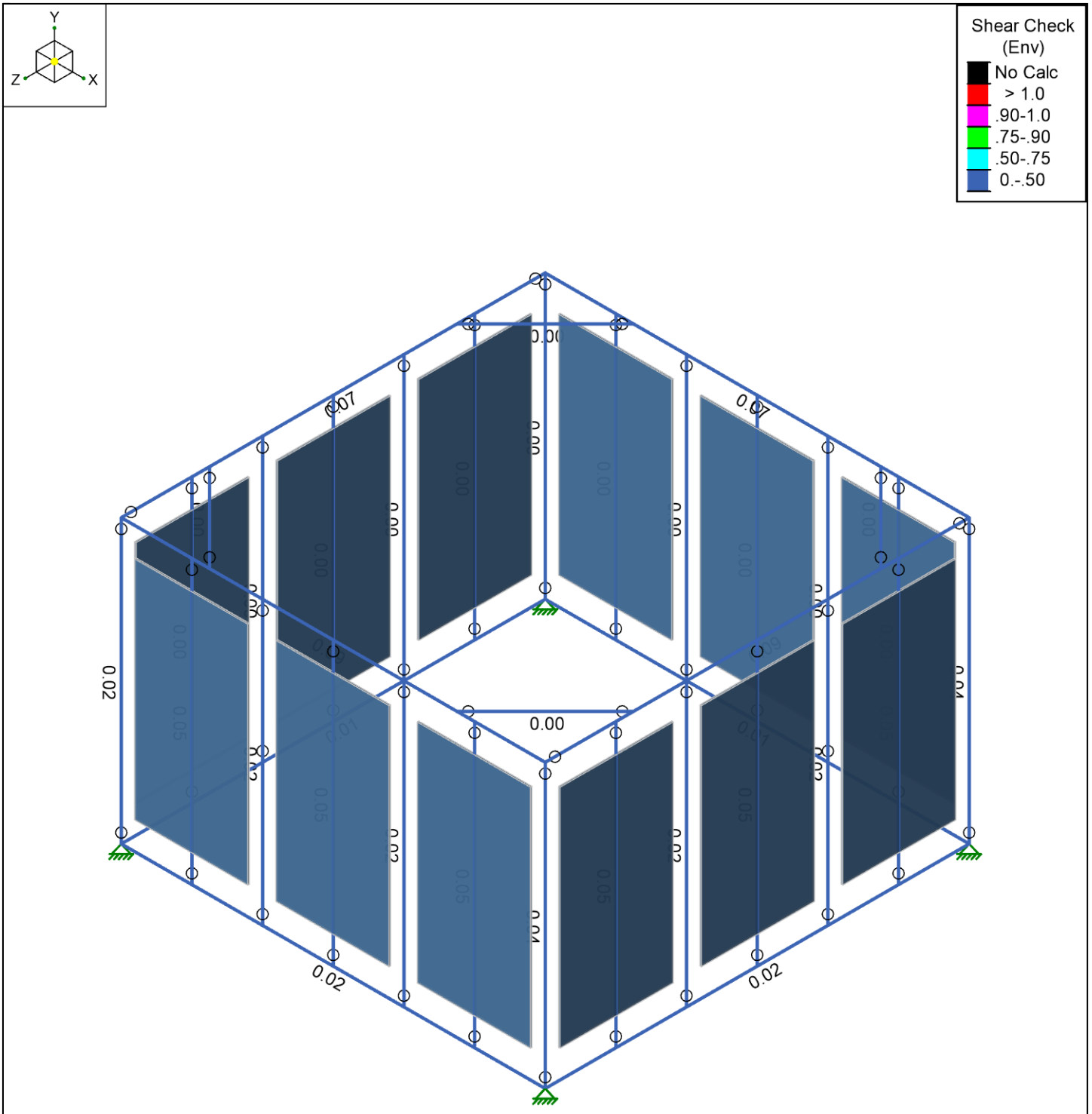


Member Code Checks Displayed (Enveloped)
Envelope Only Solution

TNH DEVELOPMENT	TNH	8ftx12ftx2ft FRP Wall Mount Box	SK-4
			Oct 17, 2023 at 11:30 PM
	2023-05-99		FRP Box 8Hx12Wx12D_10.1…



Member Shear Checks Displayed (Enveloped)
Envelope Only Solution

TNH DEVELOPMENT	TNH	8ftx12ftx2ft FRP Wall Mount Box	SK-5
			Oct 17, 2023 at 11:30 PM
	2023-05-99		FRP Box 8Hx12Wx12D_10.1…

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Distributed	Area(Member)
1	Self Weight	DL		-1.1			
2	Wind Load AZI 000	WLZ					1
3	Wind Load AZI 090	WLX					1
4	Seismic Load AZI 000	ELZ			-0.62		
5	Seismic Load AZI 090	ELX	-0.62				
6	BLC 2 Transient Area Loads	None				7	
7	BLC 3 Transient Area Loads	None				7	

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor
1	1.0D	Yes	Y	DL	1				
2	1D + 0.6W AZI 000	Yes	Y	DL	1	WLZ	0.6		
3	1D + 0.6W AZI 030	Yes	Y	DL	1	WLZ	0.52	WLX	0.3
4	1D + 0.6W AZI 060	Yes	Y	DL	1	WLZ	0.3	WLX	0.52
5	1D + 0.6W AZI 090	Yes	Y	DL	1			WLX	0.6
6	1D + 0.6W AZI 120	Yes	Y	DL	1	WLZ	-0.3	WLX	0.52
7	1D + 0.6W AZI 150	Yes	Y	DL	1	WLZ	-0.52	WLX	0.3
8	1D + 0.6W AZI 180	Yes	Y	DL	1	WLZ	-0.6		
9	1D + 0.6W AZI 210	Yes	Y	DL	1	WLZ	-0.52	WLX	-0.3
10	1D + 0.6W AZI 240	Yes	Y	DL	1	WLZ	-0.3	WLX	-0.52
11	1D + 0.6W AZI 270	Yes	Y	DL	1			WLX	-0.6
12	1D + 0.6W AZI 300	Yes	Y	DL	1	WLZ	0.3	WLX	-0.52
13	1D + 0.6W AZI 330	Yes	Y	DL	1	WLZ	0.52	WLX	-0.3
14	0.6D + 0.6W AZI 000	Yes	Y	DL	0.6	WLZ	0.6		
15	0.6D + 0.6W AZI 030	Yes	Y	DL	0.6	WLZ	0.52	WLX	0.3
16	0.6D + 0.6W AZI 060	Yes	Y	DL	0.6	WLZ	0.3	WLX	0.52
17	0.6D + 0.6W AZI 090	Yes	Y	DL	0.6			WLX	0.6
18	0.6D + 0.6W AZI 120	Yes	Y	DL	0.6	WLZ	-0.3	WLX	0.52
19	0.6D + 0.6W AZI 150	Yes	Y	DL	0.6	WLZ	-0.52	WLX	0.3
20	0.6D + 0.6W AZI 180	Yes	Y	DL	0.6	WLZ	-0.6		
21	0.6D + 0.6W AZI 210	Yes	Y	DL	0.6	WLZ	-0.52	WLX	-0.3
22	0.6D + 0.6W AZI 240	Yes	Y	DL	0.6	WLZ	-0.3	WLX	-0.52
23	0.6D + 0.6W AZI 270	Yes	Y	DL	0.6			WLX	-0.6
24	0.6D + 0.6W AZI 300	Yes	Y	DL	0.6	WLZ	0.3	WLX	-0.52
25	0.6D + 0.6W AZI 330	Yes	Y	DL	0.6	WLZ	0.52	WLX	-0.3
26	(1.0+0.14Sds)D + 0.7E AZI 000	Yes	Y	DL	1.182	ELZ	0.7		
27	(1.0+0.14Sds)D + 0.7E AZI 030	Yes	Y	DL	1.182	ELZ	0.606	ELX	0.35
28	(1.0+0.14Sds)D + 0.7E AZI 060	Yes	Y	DL	1.182	ELZ	0.35	ELX	0.606
29	(1.0+0.14Sds)D + 0.7E AZI 090	Yes	Y	DL	1.182			ELX	0.7
30	(1.0+0.14Sds)D + 0.7E AZI 120	Yes	Y	DL	1.182	ELZ	-0.35	ELX	0.606
31	(1.0+0.14Sds)D + 0.7E AZI 150	Yes	Y	DL	1.182	ELZ	-0.606	ELX	0.35
32	(1.0+0.14Sds)D + 0.7E AZI 180	Yes	Y	DL	1.182	ELZ	-0.7		
33	(1.0+0.14Sds)D + 0.7E AZI 210	Yes	Y	DL	1.182	ELZ	-0.606	ELX	-0.35
34	(1.0+0.14Sds)D + 0.7E AZI 240	Yes	Y	DL	1.182	ELZ	-0.35	ELX	-0.606
35	(1.0+0.14Sds)D + 0.7E AZI 270	Yes	Y	DL	1.182			ELX	-0.7
36	(1.0+0.14Sds)D + 0.7E AZI 300	Yes	Y	DL	1.182	ELZ	0.35	ELX	-0.606
37	(1.0+0.14Sds)D + 0.7E AZI 330	Yes	Y	DL	1.182	ELZ	0.606	ELX	-0.35
38	(0.6-0.2Sds)D + 0.7E AZI 000	Yes	Y	DL	0.418	ELZ	0.7		
39	(0.6-0.2Sds)D + 0.7E AZI 030	Yes	Y	DL	0.418	ELZ	0.606	ELX	0.35
40	(0.6-0.2Sds)D + 0.7E AZI 060	Yes	Y	DL	0.418	ELZ	0.35	ELX	0.606
41	(0.6-0.2Sds)D + 0.7E AZI 090	Yes	Y	DL	0.418			ELX	0.7
42	(0.6-0.2Sds)D + 0.7E AZI 120	Yes	Y	DL	0.418	ELZ	-0.35	ELX	0.606
43	(0.6-0.2Sds)D + 0.7E AZI 150	Yes	Y	DL	0.418	ELZ	-0.606	ELX	0.35
44	(0.6-0.2Sds)D + 0.7E AZI 180	Yes	Y	DL	0.418	ELZ	-0.7		

Load Combinations (Continued)

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor
45	(0.6-0.2Sds)D + 0.7E AZI 210	Yes	Y	DL	0.418	ELZ	-0.606	ELX	-0.35
46	(0.6-0.2Sds)D + 0.7E AZI 240	Yes	Y	DL	0.418	ELZ	-0.35	ELX	-0.606
47	(0.6-0.2Sds)D + 0.7E AZI 270	Yes	Y	DL	0.418			ELX	-0.7
48	(0.6-0.2Sds)D + 0.7E AZI 300	Yes	Y	DL	0.418	ELZ	0.35	ELX	-0.606
49	(0.6-0.2Sds)D + 0.7E AZI 330	Yes	Y	DL	0.418	ELZ	0.606	ELX	-0.35

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]
1	N1	Reaction	Reaction	Reaction
2	N26	Reaction	Reaction	Reaction
3	N38	Reaction	Reaction	Reaction
4	N13	Reaction	Reaction	Reaction

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	FRP W6x3/8	W6X3/8"WFFRP	Beam	Wide Flange	FRP	FRP	6.469	13.523	40.17	0.309
2	HSS3X3X3/16	HSS3X3X3/16	Beam	None	A500 Gr.B Rect	Typical	2.109	2.793	2.793	4.171
3	FRP C6x1/4	FRPC6X1/4	Beam	Channel	FRP	FRP	2.188	0.427	10.186	0.043
4	HSS4X4X4	HSS4X4X4	Beam	None	A500 Gr.B Rect	Typical	3.37	7.8	7.8	12.8
5	L3X3X4	L3X3X4	Beam	None	A36 Gr.36	Typical	1.44	1.23	1.23	0.031
6	FRP 3x3x4 Angle	L3X3X4	Beam	Single Angle	FRP	FRP	1.44	1.23	1.23	0.031
7	FRP 2C6x1/4	2C6X.25	Beam	Double Channel	FRP	FRP	4.375	1.488	20.372	0.102
8	PIPE_2.0	PIPE_2.0	Beam	None	A36 Gr.36	Typical	1.02	0.627	0.627	1.25

Nodal Loads and Enforced Displacements

No Data to Print...

Member Point Loads

No Data to Print...

Member Distributed Loads (BLC 6 : BLC 2 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, lb-ft/ft]	End Magnitude [k/ft, F, ksf, lb-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M7	Z	-0.036	-0.036	3.886e-16	8
2	M8	Z	-0.072	-0.072	3.886e-16	8
3	M9	Z	-0.072	-0.072	3.886e-16	8
4	M10	Z	-0.072	-0.072	3.886e-16	8
5	M11	Z	-0.072	-0.072	3.886e-16	8
6	M12	Z	-0.072	-0.072	3.886e-16	8
7	M13	Z	-0.036	-0.036	3.886e-16	8

Member Distributed Loads (BLC 7 : BLC 3 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, lb-ft/ft]	End Magnitude [k/ft, F, ksf, lb-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	X	-0.036	-0.036	3.886e-16	8
2	M2	X	-0.072	-0.072	3.886e-16	8
3	M3	X	-0.072	-0.072	3.886e-16	8
4	M4	X	-0.072	-0.072	3.886e-16	8
5	M5	X	-0.072	-0.072	3.886e-16	8
6	M6	X	-0.072	-0.072	3.886e-16	8
7	M7	X	-0.036	-0.036	3.886e-16	8

Member Area Loads (BLC 2 : Wind Load AZI 000)

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [ksf]
1	N25	N26	N13	N14	Z	Two Way	-0.036

Member Area Loads (BLC 3 : Wind Load AZI 090)

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [ksf]
1	N14	N13	N1	N2	X	Two Way	-0.036

Envelope AISC 15TH (360-16): ASD Member Steel Code Checks

	Member	Shape	Code Check	Loc[ft]	LC	Shear Check	Loc[ft]	Dir	LC	Pnc/om [k]	Pnt/om [k]	Mnyy/om [lb-ft]	Mnzz/om [lb-ft]	Cb	Eqn
0	M7	FRPC6X1/4	0.932	4	11	0.043	8	z	17	0.673	9.169	191.891	431.411	1.039	H1-1b
1	M1	FRPC6X1/4	0.932	4	11	0.043	8	z	17	0.673	9.169	191.891	431.411	1.039	H1-1b
2	M4	FRPC6X1/4	0.731	4	11	0.046	8	y	5	0.673	9.169	191.891	472.579	1.138	H1-1b
3	M10	FRPC6X1/4	0.731	4	8	0.046	8	y	2	0.673	9.169	191.891	472.589	1.138	H1-1b
4	M2	FRPC6X1/4	0.729	4	11	0.047	8	y	17	0.673	9.169	191.891	472.906	1.139	H1-1b
5	M6	FRPC6X1/4	0.729	4	11	0.047	8	y	17	0.673	9.169	191.891	472.906	1.139	H1-1b
6	M8	FRPC6X1/4	0.729	4	8	0.046	8	y	14	0.673	9.169	191.891	472.887	1.139	H1-1b
7	M12	FRPC6X1/4	0.729	4	8	0.046	8	y	14	0.673	9.169	191.891	472.887	1.139	H1-1b
8	M30	FRPC6X1/4	0.514	6	6	0.091	2.5	y	16	6.708	9.169	191.891	1336.781	1	H1-1b
9	M29	FRPC6X1/4	0.508	6	13	0.087	8	y	15	6.708	9.169	191.891	1336.781	1	H1-1b
10	M32	FRPC6X1/4	0.479	9.5	13	0.068	9.5	y	25	6.708	9.169	191.891	1336.781	1	H1-1b
11	M31	FRPC6X1/4	0.461	2.5	6	0.067	2.5	y	18	6.708	9.169	191.891	1336.781	1	H1-1b
12	M25	W6X3/8"WFFRP	0.37	6	7	0.024	10	z	14	9.464	27.115	2379.672	5257.325	1.6	H1-1b
13	M26	W6X3/8"WFFRP	0.369	6	6	0.025	10	z	11	9.464	27.115	2379.672	5257.325	3	H1-1b
14	M9	2C6X.25	0.293	4	8	0.023	0	y	8	1.184	18.338	511.637	1116.524	1.145	H1-1b
15	M11	2C6X.25	0.293	4	8	0.023	0	y	8	1.184	18.338	511.637	1116.524	1.145	H1-1b
16	M3	2C6X.25	0.293	4	11	0.023	0	y	11	1.184	18.338	511.637	1116.571	1.145	H1-1b
17	M5	2C6X.25	0.293	4	11	0.023	0	y	11	1.184	18.338	511.637	1116.571	1.145	H1-1b
18	M28	W6X3/8"WFFRP	0.247	12	8	0.014	8	y	2	9.464	27.115	2379.672	5257.325	3	H1-1b
19	M36	L3X3X4	0.243	1.768	3	0.004	3.536	y	7	3.431	6.036	215.669	392.86	1.136	H2-1
20	M27	W6X3/8"WFFRP	0.212	0	6	0.006	8	y	12	9.464	27.115	2379.672	5257.325	1.838	H1-1b
21	M33	L3X3X4	0.209	1.768	13	0.004	3.536	y	9	3.431	6.036	215.669	392.86	1.136	H2-1
22	M13	FRPC6X1/4	0.171	8	8	0.024	8	y	14	0.673	9.169	191.891	725.546	1.747	H1-1b
23	M35	L3X3X4	0.16	1.768	6	0.004	3.536	y	10	3.431	6.036	215.669	392.86	1.136	H2-1
24	M34	L3X3X4	0.099	1.768	10	0.002	3.536	y	13	3.431	6.036	215.669	392.86	1.136	H2-1
25	M19	FRPC6X1/4	0.071	8	3	0.002	8	y	25	0.673	9.169	191.891	418.754	1.008	H1-1b*
26	M24	FRPC6X1/4	0.045	4.417	33	0.002	8	y	13	0.673	9.169	191.891	471.881	1.136	H1-1b
27	M20	FRPC6X1/4	0.045	4.417	37	0.002	8	y	12	0.673	9.169	191.891	471.881	1.136	H1-1b
28	M18	FRPC6X1/4	0.044	4.417	34	0.002	8	y	25	0.673	9.169	191.891	471.298	1.135	H1-1b
29	M14	FRPC6X1/4	0.044	4.417	30	0.002	8	y	25	0.673	9.169	191.891	471.298	1.135	H1-1b
30	M22	FRPC6X1/4	0.042	4.417	27	0.002	8	z	26	0.673	9.169	191.891	471.523	1.135	H1-1b
31	M16	FRPC6X1/4	0.042	4.417	28	0.002	8	z	29	0.673	9.169	191.891	471.527	1.136	H1-1b
32	M15	2C6X.25	0.026	4	36	0.001	8	z	47	1.184	18.338	511.637	1105.285	1.134	H1-1b
33	M17	2C6X.25	0.026	4	28	0.001	8	z	47	1.184	18.338	511.637	1105.285	1.134	H1-1b
34	M21	2C6X.25	0.026	4	27	0.001	8	z	44	1.184	18.338	511.637	1106.234	1.135	H1-1b
35	M23	2C6X.25	0.026	4	31	0.001	8	z	44	1.184	18.338	511.637	1106.234	1.135	H1-1b

Adhesive Systems, Inc.
9411 Corsiar Road
Frankfort,IL 60423
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TECHNICAL DATA SHEET
TDS #: MP55310
METHACRYLATE ADHESIVE

MAXIMUM PERFORMANCE SERIES
MP55310 METHACRYLATE ADHESIVE

DESCRIPTION:

MP55310 is a high performance two part methacrylate adhesive engineered to bond a wide range of plastics, metals, and composite assemblies. It offers outstanding bond strength, is extremely durable, with excellent impact and weathering properties. *MP55310* greatly increases the reliability of finished assemblies with exceptional flexibility, it's ability to with stand extreme temperature fluctuation and thermal cycling, and resistance to a wide range of chemicals and environmental conditions.

PHYSICAL PROPERTIES (UNCURED):

VISCOSITY @ 25^{0}C (cps):	**RESIN**	**60,000**
	ACTIVATOR	**60,000**
COLOR:	**OFF WHITE**	**AMBER, GREY, OR BLACK**
MIXED DENSITY:	**8.20**	
MIX RATIO:	**VOLUME**	**1 TO 1**
	WEIGHT	**1 TO 1**
THIX INDEX:	**5**	
FLASH POINT:	**51^{0}F**	

PHYSICAL PROPERTIES (CURED):

STRENGTH (PSI):	**SHEAR**	**3000-3500**
	TENSILE	**3000-3500**
WORK TIME:	**10 MINUTES**	
HANDLING STRENGTH:	**30 MINUTES**	
GAP FILL:	**.125 INCHES**	
TEMPERATURE RANGE:	**-67^{0}F - +250^{0}F**	

WHAT THE MP SERIES BONDS:

METALS
- *ALUMINUM
- *STEEL
- *STAINLESS
- *COATED METALS

THERMO SETS
- *FIBERGLASS
- *PHENOLICS
- *GEL COATS
- *EPOXY
- *RIM URETHANE
- *POLYURETHANE
- *LIQUID MOLDING RESINS

THERMO PLASTICS
- *ACRYLICS
- *ABS
- *POLYCARBONATES
- *NYLONS
- *PPO's
- *VINYL'S
- *PVC's
- *STYRENE'S
- *PEEK's
- *PBT BLENDS
- *PET BLENDS

BENEFITS:

>NO SURFACE PREP
>EXCELLENT STRENGTH
>IMPACT RESISTANT
>100% REACTIVE
>ROOM TEMPERATURE CURE
>EASILY APPLIED

PACKAGING:

The MP 55310 Series is conveniently packaged in 50 mil, 400 mil, pail, and drum kits. Special packaging is available upon request.

EFFECTS OF TEMPERATURE:

The product is best used at temperatures between 65^0 F and 80^0 F. Temperatures below 65^0 F will slow the cure speed of the material and viscosities will be higher. Temperatures above 80^0 F will cause the material to cure faster and viscosities will be lower. For consistent dispensing maintain temperature in the above mentioned range.

STORAGE AND SHELF LIFE:

The shelf life of the MP55300 Series for most products is one year from date of shipment (check with ASI). Shelf life is based on the products being stored properly at temperatures between 55^0F and 75^0 F. Exposure to temperatures above 75^0 F will reduce the shelf life of these materials.

PRECAUTIONS:

ASI's MP55300 Series products are *flammable.* Keep away from heat, spark, and open flames.

KEEP OUT OF REACH OF CHILDREN. THE PRODUCT IS FOR INDUSTRIAL USE ONLY. Keep containers closed when not in use. Avoid contact with skin and eyes. Harmful if swallowed. Refer to Material Safety Data Sheet for complete safety information.

HANDLING AND CLEAN-UP:

For optimum bond strength and to insure maximum performance in the finished assembly mate parts together within the specified work time of the adhesive. Make sure the bond joint has uniform coverage and that a sufficient amount of adhesive is in the bond area. It is important to have the adhesive applied, parts aligned and positioned, within the established work times for the product. To ensure maximum performance in the finished assembly parts should remain undisturbed until the fixture time is reached.

Clean up is best before the adhesive has cured. Cleaners containing NMP (N-methyl pyrolidone) or Citrus terpene provide the best results. On cured adhesive repeat use may be required.

Revised 2/20/2014

NON WARRANTY:

Information contained herein is based on tests we believe to be reliable and accurate. It is offered in good faith for the benefit of the consumer. The Company shall not be liable for any injury, loss, or damage in the use of its chemical products since conditions or use are beyond our control. In every case we urge and recommend the user conduct tests to determine to their own satisfaction that the product is of acceptable quality and suitable for their particular purpose under their own operating conditions. Statements concerning the possible use of our products are not intended as recommendations to use our products in the infringement of any patent. These products are for industrial use only.

PROPERTIES OF EXTREN®

INTRODUCTION

The properties in this manual are for product as produced by Strongwell and the data sheets in this section present the **minimum** ultimate values from testing in conformance to ASTM procedures. These values are obtained from coupons machined from **EXTREN®** structural shapes and function as a proof test for the **EXTREN®** composite. Descriptions of the ASTM test procedures are found at the end of this section.

Strongwell verifies the full section bending Modulus of Elasticity using a simple beam concept at the start of each production run. The empirically determined **EXTREN®** structural design equations presented in later sections will be a function of the Modulus of Elasticity.

The designer must consider environmental factors in designing for the actual application. These factors include elevated temperature and corrosive chemicals.

TEMPERATURE EFFECTS

The approximate retention of mechanical properties at elevated temperatures are:

		EXTREN®	
		Series 500/525	**Series 625**
Ultimate Stress	100°F	85%	90%
	125°F	70%	85%
	150°F	50%	80%
	175°F	not recommended	75%
	200°F	not recommended	50%
	>200°F	not recommended	not recommended
Modulus of Elasticity	100°F	100%	100%
	125°F	90%	95%
	150°F	85%	90%
	175°F	not recommended	88%
	200°F	not recommended	85%
	>200°F	not recommended	not recommended

These recommendations are based on the normal **EXTREN®** proprietary resin system. Strongwell routinely processes other resin systems to achieve higher temperature ratings for specific applications. Independent test data confirms that EXTREN® structural shapes and plate maintain their mechanical and physical properties for temperatures down to at least -60°F.

CORROSION EFFECTS

As a general rule, the isophthalic polyester resin used in **EXTREN®** Series 500/525 is resistant to most acidic attacks while the vinyl ester resin in **EXTREN®** Series 625 is resistant to acids and bases. The effect of corrosive chemicals is temperature dependent with elevated temperature increasing the corrosion activity. A corrosion guide has been included in this manual and a Strongwell salesperson can respond to chemicals not listed in this guide.

Strongwell incorporates a synthetic veil on the surface of all **EXTREN®** structural shapes which causes a resin rich layer which enhances corrosion protection.

UV (ULTRAVIOLET RADIATION) EFFECTS

UV is a sunlight produced environmental attack on FRP composites. The synthetic surfacing veil also aids in protecting the composite from UV degradation, the effect of which is sometimes referred to as “fiber blooming”. **EXTREN®** also contains a UV inhibitor.

There is a large variation in the degree of fading from UV degradation based on the color selected. It should be noted that the surfacing veil, while not preventing color fading, serves to protect the composite from any mechanical property degradation potentially caused by UV. Coating with materials such as UV stabilized polyurethane based paints are very effective in maintaining the color and offer the optimum long-term protection from UV attack.

SERIES 500/525/625 STRUCTURAL SHAPES ULTIMATE COUPON PROPERTIES

Below are the test results for the **minimum** ultimate **coupon** properties of **EXTREN®** structural shapes as per the referenced ASTM procedures. The properties of plate as well as thermal cure rod and bar are found elsewhere in this section. Designers should refer to Section 8 — **FLEXURAL MEMBERS** and Section 9 — **COMPRESSION MEMBERS** for the recommended design equations for **EXTREN®**. The actual geometry and application of the structural shape will determine its ultimate usability. Additionally, WF / I-Beam ASTM properties may vary due to location in the part but the modulus of elasticity will not be affected.

PROPERTY	ASTM TEST	UNITS	SERIES 500/525	SERIES 625
MECHANICAL				
Tensile Stress, LW	D638	psi	30,000	30,000
Tensile Stress, CW	D638	psi	7,000	7,000
Tensile Modulus, LW	D638	10^6 psi	2.5	2.6
Tensile Modulus, CW	D638	10^6 psi	0.8	0.8
Compressive Stress, LW①	D695	psi	30,000	30,000
Compressive Stress, CW	D695	psi	15,000	16,000
Compressive Modulus, LW	D695	10^6 psi	2.5	2.6
Compressive Modulus CW	D695	10^6 psi	0.8	0.8
Flexural Stress, LW②	D790	psi	30,000	30,000
Flexural Stress, CW	D790	psi	10,000	10,000
Flexural Modulus, LW②	D790	10^6 psi	1.6	1.6
Flexural Modulus, CW	D790	10^6 psi	0.8	0.8
Modulus of Elasticity ③	full section	10^6 psi	2.6	2.8
Modulus of Elasticity (W and I Shapes > 4") ③	full section	10^6 psi	2.5	2.5
Shear Modulus, LW ④⑧	—	10^6 psi	0.425	0.425
Short Beam Shear, LW ⑦⑧	D2344	psi	4,500	4,500
Ultimate Bearing Stress, LW	D953	psi	30,000	30,000
Poisson's Ratio, LW⑧	D3039	in/in	0.33	0.33
Notched Izod Impact, LW	D256	ft-lbs/in	25	25
Notched Izod Impact, CW	D256	ft-lbs/in	4	4
PHYSICAL				
Barcol Hardness⑤	D2583	—	45	45
24 hr. Water Absorption⑥	D570	% Max	0.6	0.6
Density	D792	lbs/in^3	.062-.070	.062-.070
Coefficient of Thermal Expansion, LW ⑧	D696	10^{-6} in/in/°F	7	7
Coefficient of Thermal Expansion, CW ⑧	D696	10^{-6} in/in/°F	16	16
Thermal Conductivity ⑧	C177	BTU-in/ft^2/hr/°F	4	4
ELECTRICAL				
Arc Resistance, LW ⑧	D495	seconds	120	120
Dielectric Strength, LW ⑧	D149	KV/in	35	35
Dielectric Strength, PF ⑨	D149	volts/mil	200	200

PROPERTY	TEST	VALUE
FLAMMABILITY (Only Series 525 and 625)		
Flammability Classification (1/8")	UL 94	VO
Tunnel Test	ASTM E84	25 Max
NBS Smoke Chamber	ASTM E662	650-700 (Typical)
Flammability	ASTM D635	Self Extinguishing
UL Thermal Index	Generic	266°F
British Fire Test	BS 476-7	Class 1

LW — lengthwise
CW — crosswise
PF — perpendicular to laminate face

NOTES:

① Refer to Section 9 — **COMPRESSION MEMBERS** for the recommended allowable stresses for **EXTREN®** columns.

② Refer to Section 8 — **FLEXURAL MEMBERS** for the recommended allowable stresses for **EXTREN®** beams. LW results are for the flange only.

③ This value is determined from full section simple beam bending of **EXTREN®** structural shapes and will be used in Sections 8 and 9 for design.

④ The Shear Modulus value has been determined from tests with full sections of **EXTREN®** structural shapes. Less precise values are occasionally estimated for pultrusion by using an equation for isotropic materials, $G=E/[2(1+\nu)]$. For example, if **EXTREN®** pultrusions are assumed to be isotropic with a Poisson's Ratio (ν) of 0.33 and a Modulus of Elasticity of 2.6×10^6 psi, then G = 977,000 psi, which exceeds the listed tested value. **EXTREN®** shapes are mat/roving composites and anisotropic.

⑤ Strongwell incorporates a synthetic surfacing veil routinely on the surface of all **EXTREN®** structural shapes. This has the effect of lowering the measured Barcol Hardness and does not reflect an absence of cure. Other additives incorporated into the composite for corrosion protection and surface improvements may also reduce Barcol Hardness to a typical value of 45. A surface unprotected by a surfacing veil without additives would have a minimum value of 50.

⑥ Measured as a percentage maximum by weight.

⑦ Span to depth ratio of 3:1; **EXTREN®** angles will have a minimum value of 4000 psi and the I/W shapes are tested in the web.

⑧ Typical values.

⑨ This is a typical value which varies with composite thickness.

THERMAL CURE ROD AND BAR ULTIMATE COUPON PROPERTIES

Below are the test results for the **minimum** ultimate **coupon** properties of thermal cure rod and bar as per the referenced ASTM procedures. Rod and bar stock contain longitudinal reinforcements only – no mat. Coupon testing provides a proof test for the composite, but the actual geometry and application of the structural shape will determine its ultimate usability.

PROPERTY	ASTM TEST	UNITS	THERMAL CURE CLEAR
MECHANICAL			
Tensile Stress, LW	D3916	psi	100,000
Tensile Modulus, LW	D3916	10^6 psi	6.0
Compressive Stress, Axial, LW	D695	psi	60,000
Flexural Stress, LW	D790	psi	100,000
Flexural Modulus, LW	D790	10^6 psi	6.0
Notched Izod Impact, LW	D256	ft-lbs/in	40
Short Beam Shear, LW	D4475	psi	5,500
PHYSICAL			
Barcol Hardness	D2583	—	50
24 hr. Water Absorption ①	D570	% Max	0.25
Density	D792	lbs/in^3	.072-0.76
Coefficient of Thermal Expansion ②	D696	10^{-6} in/in/°F	5
ELECTRICAL			
Dielectric Strength, LW ②	D149	KV/in	35

LW — lengthwise or parallel to the roving

NOTE: All thermal cure rod and bar are not normally produced with a fire retardant resin. Thermal cure rod and bar were not designed to be machined. Machining may cause splintering or other issues due to the lack of off-axis reinforcements.

① Measured as a percentage maximum by weight.
② Typical values.

SERIES 500/525 PLATE ULTIMATE COUPON PROPERTIES

Below are the test results for the minimum ultimate coupon properties of **EXTREN®** Series 500/525 plate as per the referenced ASTM procedures. Designers should refer to Section 10 — **PLATE** for the recommended design equations for **EXTREN®**. The actual geometry and application of the plate will determine its ultimate usability.

PROPERTY	ASTM TEST	UNITS	THICKNESS 1/8"	3/16"-3/8"	1/2"-1"
MECHANICAL					
Tensile Stress, LW	D638	psi	20,000	20,000	20,000
Tensile Stress, CW	D638	psi	7,500	10,000	10,000
Tensile Modulus, LW	D638	10^6 psi	1.8	1.8	1.8
Tensile Modulus, CW	D638	10^6 psi	0.7	0.9	1.0
Compressive Stress, Edgewise, LW	D695	psi	24,000	24,000	24,000
Compressive Stress, Edgewise, CW	D695	psi	15,500	16,500	20,000
Compressive Modulus, Edgewise, LW	D695	10^6 psi	1.8	1.8	1.8
Compressive Modulus, Edgewise, CW	D695	10^6 psi	0.7	0.9	1.0
Flexural Stress, Flatwise, LW	D790	psi	24,000	24,000	24,000
Flexural Stress, Flatwise, CW	D790	psi	10,000	13,000	17,000
Flexural Modulus, Flatwise, LW	D790	10^6 psi	1.1	1.1	1.4
Flexural Modulus, Flatwise, CW	D790	10^6 psi	0.8	0.8	1.3
Ultimate Bearing Stress, LW	D953	psi	32,000	32,000	32,000
Poisson's Ratio, LW ②	D3039	in/in	0.31	0.31	0.31
Poisson's Ratio, CW ②	D3039	in/in	0.29	0.29	0.29
Notched Izod Impact, LW	D256	ft-lbs/in	15	10	10
Notched Izod Impact, CW	D256	ft-lbs/in	5	5	5
PHYSICAL					
Barcol Hardness	D2583	—	40	40	40
24 hr. Water Absorption ①	D570	% Max	0.6	0.6	0.6
Density	D792	lbs/in^3	.060-0.68	.060-0.68	.060-0.68
Coefficient of Thermal Expansion ②	D696	10^{-6} in/in/°F	8	8	8
ELECTRICAL					
Dielectric Strength, LW ②	D149	KV/in	35	35	35
Dielectric Strength, PF ②	D149	volts/mil	200	N.T.	N.T.

LW — lengthwise
CW — crosswise
PF — perpendicular to the laminate face
N.T. — not tested

NOTES:
① Measured as a percentage maximum by weight.
② This is a typical value which varies with composite thickness.

SERIES 625 PLATE ULTIMATE COUPON PROPERTIES

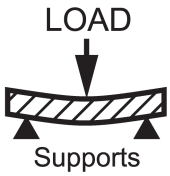
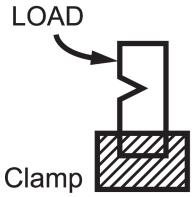
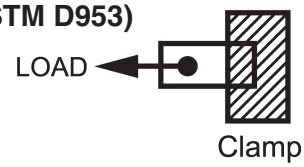
Below are the test results for the minimum ultimate coupon properties of **EXTREN®** Series 625 plate as per the referenced ASTM procedures. Designers should refer to Section 10 — **PLATE** for the recommended design equations for **EXTREN®**. The actual geometry and application of the plate will determine its ultimate usability.

PROPERTY	ASTM TEST	UNITS	THICKNESS 1/8"	3/16"-1/4"	3/8"-1"
MECHANICAL					
Tensile Stress, LW	D638	psi	20,000	20,000	20,000
Tensile Stress, CW	D638	psi	7,500	10,000	10,000
Tensile Modulus, LW	D638	10^6 psi	1.8	1.8	1.8
Tensile Modulus, CW	D638	10^6 psi	1.0	1.0	1.0
Compressive Stress, Edgewise, LW	D695	psi	24,000	24,000	24,000
Compressive Stress, Edgewise, CW	D695	psi	16,500	17,500	17,500
Compressive Modulus, Edgewise, LW	D695	10^6 psi	1.8	1.8	1.8
Compressive Modulus, Edgewise, CW	D695	10^6 psi	1.0	1.0	1.0
Flexural Stress, Flatwise, LW	D790	psi	24,000	24,000	24,000
Flexural Stress, Flatwise, CW	D790	psi	10,000	13,000	17,000
Flexural Modulus, Flatwise, LW	D790	10^6 psi	1.1	1.1	1.4
Flexural Modulus, Flatwise, CW	D790	10^6 psi	0.8	0.9	1.3
Ultimate Bearing Stress, LW	D953	psi	32,000	32,000	32,000
Poisson's Ratio, LW ②	D3039	in/in	0.32	0.32	0.32
Poisson's Ratio, CW ②	D3039	in/in	0.24	0.24	0.24
Notched Izod Impact, LW	D256	ft-lbs/in	15	10	10
Notched Izod Impact, CW	D256	ft-lbs/in	5	5	5
PHYSICAL					
Barcol Hardness	D2583	—	40	40	40
24 hr. Water Absorption ①	D570	% Max	0.6	0.6	0.6
Density	D792	lbs/in^3	.060-0.68	.060-0.68	.060-0.68
Coefficient of Thermal Expansion ②	D696	10^{-6} in/in/°F	8	8	8
ELECTRICAL					
Dielectric Strength, LW ②	D149	KV/in	35	35	35
Dielectric Strength, PF ②	D149	volts/mil	250	N.T.	N.T.

LW — lengthwise
CW — crosswise
PF — perpendicular to the laminate face
N.T. — not tested

NOTES:
① Measured as a percentage maximum by weight.
② This is a typical value which varies with composite thickness.

DESCRIPTION OF TESTS FOR EXTREN®

TEST	DESCRIPTION
TENSILE STRENGTH (ASTM D638) 	The tensile strength is determined by pulling ends of a test specimen until failure. The tensile modulus can be calculated by measuring the ratio of stress and strain. When the tensile strength is measured in the longitudinal direction, as a first approximation, it is an indication of relative roving content. For example, an all roving thermal cure rod has a higher tensile strength than the **EXTREN®** structural shapes which are a combination of roving and continuous strand mat.
FLEXURAL PROPERTIES (ASTM D790) 	The flexural strength is determined by placing a test specimen between two supports and applying a load to the center. ASTM D790 specifies required span to depth ratios for the test specimen. Flexural tests on coupon samples are often used to determine the effects of environmental conditions such as temperature and corrosive agents.
COMPRESSIVE STRENGTH (ASTM D695) 	The ultimate compressive strength of a composite is a force required to rupture the composite when a load is applied such that the specimen is crushed. The compressive test is an excellent indication of the resin matrix to reinforcement bond and has been adopted by the ANSI A14.5 specification for fiberglass rail as the primary physical property audit.
IZOD IMPACT (ASTM D256) 	The Izod impact is determined by subjecting a specimen to a pendulum-type collision; the specimen can be notched or unnotched. The energy required to rupture the specimen due to the collision caused by the swinging pendulum is used to calculate the Izod impact strength.
BEARING STRESS (ASTM D953) 	This test specimen consists of a flat strip with a hole machined in one end as specified by the ASTM procedure. The testing consists of clamping the end without the hole and attempting to tear or rupture the hole in the specimen. The load required to rupture the hole is used to determine the bearing stress.
MODULUS OF ELASTICITY	This parameter is determined by loading a prescribed length of the full shape (not a coupon) with a support at each end and applying a center load. From the measured deflection and the known load and span, the bending modulus of elasticity can be determined once the shear deflection effects are identified. This is a more reliable estimate of the field performance in beam bending situation than the coupon properties.

DESCRIPTION OF TESTS FOR EXTREN®

BARCOL HARDNESS (ASTM D2583)

The barcol hardness is a measure of the resistance of the surface of a test specimen to penetration by a needle probe which is spring driven. The barcol hardness value is generally an average of multiple measurements on the same part and is an approximate measure of the composite's completeness of cure.

WATER ABSORPTION (ASTM D570)

In this test, the specimens are immersed in water for a period of 24 hours and the change in weight is measured. This test has utility in electrical and corrosive applications.

DENSITY (ASTM D792)

The density is the ratio of the mass (weight) of a specimen to the volume of the specimen. This parameter is important in determining the ultimate weight of the finished product.

SPECIFIC GRAVITY (ASTM D792)

The ratio of the density of a composite to the density of water.

ARC RESISTANCE (ASTM D495)

This test is performed by placing two probes on a test specimen at a distance of 1/4". A high voltage, low current, arc is passed between the probes with a specified on/off cycle for this arc. The time taken for the arc to completely burn a path through the composite is measured.

DIELECTRIC STRENGTH (ASTM D149)

In this electrical test, the sample is placed between electrodes with the electrodes and the sample immersed in non-conducting oil to prevent a false failure signal. Failure occurs when the voltage is sufficient to cause the current to discharge through the composite. This test is occasionally performed after conditioning the test specimen with water at elevated temperatures.

WEATHERING QUV WEATHEROMETER (ASTM G53)

The QUV Weatherometer applies alternating cycles of water, high temperature, humidity and ultraviolet exposure to measure the weatherability of a given composite and/or additive. This test is primarily comparative in nature between composites and/or formulations. The geographic location of the composite will determine its actual weatherability.

UL 94

EXTREN® Series 525 and Series 625 conform to UL 94 testing with a VO Rating. In the UL 94 test, a vertically clamped sample is subjected to a flame from a Bunsen burner.

TUNNEL TEST (ASTM E84)

In the 25 foot tunnel test, a smoke generation value and the rate of flame spread are determined. This test has been the standard for years in measuring flammability and smoke generation.

NBS SMOKE CHAMBER (ASTM E662)

This test requires a much smaller test specimen and essentially places this specimen in the bottom of a chamber and measures the smoke that is generated to an optical detector at the top of the chamber.

FLAMMABILITY (ASTM D635)

This is a less severe flammability test in which the specimen is held horizontally with one end subjected to a flame for 30 seconds.

SPECIFICATION FOR EXTREN® FIBERGLASS REINFORCED POLYMER (FRP)

SCOPE

This specification covers **EXTREN®** fiberglass reinforced polymer (FRP) wide flange shapes, I-shapes, channels, angles, tubing, rod, bar, flat sheet and special shapes produced by Strongwell, Bristol, Virginia, and its locations.

PRODUCT DESCRIPTION

All structural shapes shall be **EXTREN®** FRP Series (select one: 500, 525 or 625) produced using the pultrusion process.

All rod and bar shall be Strongwell FRP thermal cure rod and bar produced using the pultrusion process.

DESIGN

Selection of structural shapes for use under compressive or flexural load to be in accordance with load tables provided in the Strongwell *Design Manual*.

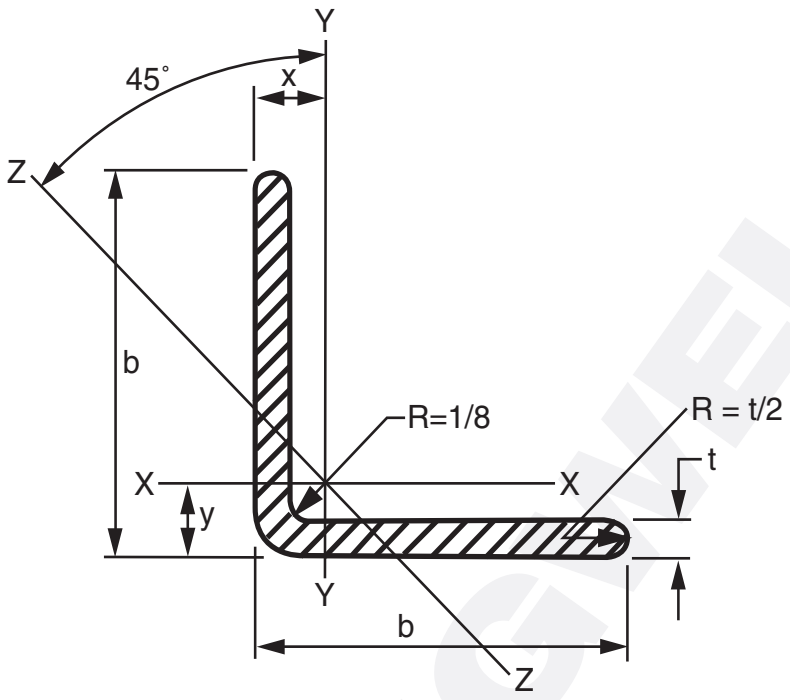
TOLERANCES

The tolerance for a structural shape supplied to this specification shall be within the limits given in Section 5 - **TOLERANCES** of the Strongwell *Design Manual*.

FABRICATION AND HANDLING

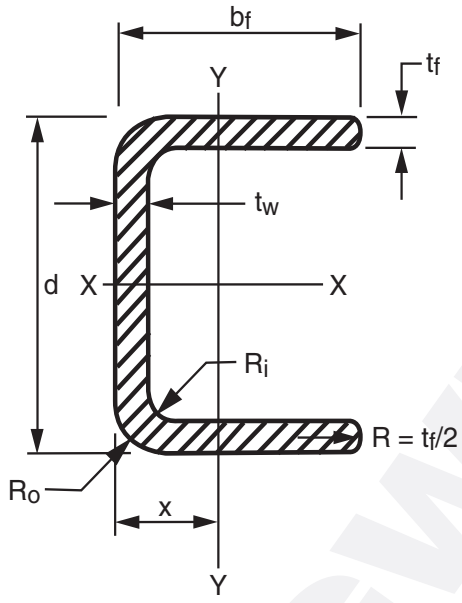
1) Cut edges and holes can be sealed with a resin compatible with the resin matrix used in the structural shape if there is concern about the environment in which the shape will be used.
2) The fabricator and contractor shall exercise precautions necessary to protect the fiberglass pultruded structural shapes from abuse to prevent breakage, nicks, gouges, etc. during fabrication, handling and installation.
3) Structural shapes shall be fabricated and assembled as indicated on the design drawings and in accordance with Strongwell's **EXTREN®** *Fabrication & Repair Manual*.

NOTE:
See Section 20 — **Specifications for Fiberglass Reinforced Polymer Products and Fabrications**.



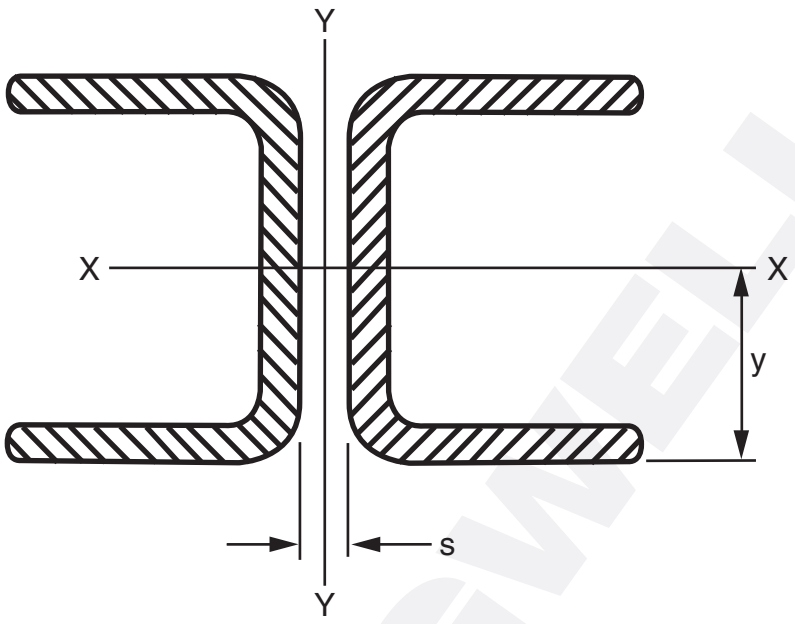
EXTREN® EQUAL LEG ANGLES

PHYSICAL PROPERTIES				SECTION PROPERTIES						DESIGN PROPERTIES	
SIZE		A	NOM. Wt/ft	AXIS X—X OR Y—Y				AXIS Z—Z		b — t	J
b	t			I	S	r	x or y	I	r		
in	in	in^2	lbs	in^4	in^3	in	in	in^4	in		in^4
1	1/8	0.22	0.18	0.02	0.03	0.30	0.29	0.01	0.19	8.00	0.001
1-1/4	1/8	0.29	0.24	0.04	0.05	0.37	0.35	0.02	0.24	10.00	0.002
1-1/4	3/16	0.42	0.35	0.06	0.07	0.37	0.37	0.03	0.24	6.67	0.005
1-1/2	1/8	0.35	0.29	0.07	0.07	0.45	0.41	0.03	0.29	12.00	0.002
1-1/2	3/16	0.51	0.43	0.11	0.10	0.45	0.44	0.04	0.29	8.00	0.006
1-1/2	1/4	0.67	0.56	0.13	0.13	0.44	0.46	0.06	0.29	6.00	0.007
2	1/8	0.48	0.40	0.19	0.13	0.63	0.55	0.08	0.46	16.00	0.002
2	3/16	0.70	0.59	0.27	0.19	0.61	0.56	0.11	0.39	10.67	0.008
2	1/4	0.92	0.77	0.34	0.24	0.60	0.58	0.14	0.39	8.00	0.020
3	1/4	1.42	1.19	1.18	0.54	0.91	0.82	0.49	0.58	12.00	0.030
3	3/8	2.09	1.76	1.70	0.80	0.90	0.87	0.70	0.58	8.00	0.090
4	1/4	1.92	1.61	2.94	1.00	1.23	1.07	1.21	0.79	16.00	0.040
4	3/8	2.84	2.39	4.26	1.48	1.22	1.12	1.75	0.78	10.67	0.134
4	1/2	3.75	3.15	5.56	1.97	1.22	1.18	2.29	0.78	8.00	0.312
5	1/2	4.71	3.96	11.34	3.35	1.55	1.61	4.87	1.02	10.00	0.390
6	1/4	2.94	2.47	10.70	2.43	1.91	1.59	4.36	1.22	24.00	0.061
6	3/8	4.34	3.65	14.85	3.38	1.85	1.60	6.07	1.18	16.00	0.204
6	1/2	5.72	4.80	19.38	4.46	1.84	1.66	7.92	1.17	12.00	0.480



EXTREN® CHANNELS

PHYSICAL PROPERTIES								SECTION PROPERTIES							DESIGN PROPERTIES		
SIZE				A	NOM. Wt/ft	R_i	R_o	AXIS X—X			AXIS Y—Y				$\frac{b_f}{t_f}$	A_w	J
d	b_f	t_w	t_f					I	S	r	I	S	r	x			
in	in	in	in	in^2	lbs	in	in	in^4	in^3	in	in^4	in^3	in	in		in^2	in^4
1-1/2	1	3/16	3/16	0.59	0.50	1/8	5/16	0.18	0.24	0.56	0.04	0.06	0.26	0.35	5.33	0.21	0.010
1-1/2	1-1/2	1/4	1/4	1.00	0.84	1/8	3/8	0.32	0.42	0.56	0.22	0.24	0.38	0.59	6.00	0.25	0.020
2	9/16	1/8	1/8	0.34	0.29	1/16	3/16	0.18	0.18	0.71	0.01	0.02	0.15	0.15	4.50	0.22	0.001
2	7/8	1/4	1/4	0.80	0.67	1/8	1/8	0.40	0.40	0.70	0.03	0.13	0.21	0.26	3.50	0.38	0.016
2-5/8	1-1/4	1/8	3/16	0.75	0.63	1/8	3/16	0.82	0.62	1.04	0.12	0.14	0.40	0.42	6.67	0.28	0.007
3	7/8	1/4	1/4	1.00	0.84	1/8	3/8	1.15	0.77	1.04	0.06	0.09	0.23	0.25	3.50	0.62	0.020
3	1	3/16	3/16	0.87	0.73	1/8	5/16	1.03	0.68	1.09	0.07	0.09	0.28	0.27	5.33	0.49	0.010
3	1-1/2	1/4	1/4	1.31	1.10	1/8	3/8	1.81	1.21	1.18	0.25	0.53	0.44	0.47	6.00	0.63	0.027
3-1/2	1-1/2	3/16	3/16	1.11	0.93	1/8	5/16	1.91	1.09	1.31	0.19	0.18	0.41	0.42	8.00	0.59	0.013
4	1-1/16	1/8	1/8	0.71	0.60	1/8	1/4	1.55	0.78	1.45	0.06	0.08	0.29	0.23	8.50	0.47	0.004
4	1-1/8	1/4	1/4	1.38	1.16	1/8	3/8	2.87	1.43	1.41	0.13	0.15	0.30	0.30	4.50	0.88	0.030
4	1-3/8	3/16	3/16	1.16	0.97	1/8	5/16	2.62	1.31	1.48	0.19	0.18	0.40	0.35	7.33	0.68	0.014
5	1-3/8	1/4	1/4	1.76	1.48	1/8	3/8	5.78	2.31	1.79	0.25	0.24	0.37	0.34	5.50	1.12	0.040
5-1/2	1-1/2	3/16	3/16	1.49	1.25	1/8	5/16	5.80	2.11	1.98	0.22	0.19	0.38	0.34	8.00	0.96	0.018
5-1/2	1-1/2	1/4	1/4	2.00	1.68	1/8	5/16	7.78	2.83	1.97	0.33	0.29	0.41	0.36	6.00	1.25	0.042
6	1-5/8	1/4	1/4	2.13	1.79	1/8	3/8	10.22	3.41	2.16	0.43	0.35	0.44	0.38	6.50	1.38	0.050
6	1-11/16	3/8	3/8	3.23	2.71	3/16	9/16	14.55	4.85	2.12	0.54	0.44	0.41	0.44	4.50	1.97	0.150
8	2-3/16	1/4	1/4	2.97	2.49	1/8	3/8	25.22	6.31	2.91	1.10	0.65	0.61	0.49	8.75	1.88	0.060
8	2-3/16	3/8	3/8	4.36	3.66	3/16	9/16	35.75	8.94	2.87	1.42	0.86	0.57	0.53	5.83	2.72	0.200
10	2-3/4	1/2	1/2	7.25	6.09	3/8	3/4	92.46	18.49	3.57	3.99	1.93	0.74	0.68	5.50	4.50	0.600
12	3	1/2	1/2	8.17	6.86	3/8	7/8	142.8	23.8	4.18	5.07	2.20	0.79	0.70	6.00	5.50	0.750
14	3-1/2	3/4	3/4	14.62	12.28	3/8	1-1/8	352.74	50.39	4.91	12.16	4.62	0.91	0.87	4.67	9.38	2.742
18	2-3/16	3/16	3/8	4.14	3.48	1/16	1/4	151.02	16.78	6.04	1.00	0.55	0.53	0.29	11.67	3.31	0.049
24	3	1/4	1/4	7.60	6.38	3/8	1/8	484.33	40.36	7.98	3.56	1.34	0.68	0.35	11.54	6.10	0.173



DOUBLE EXTREN® CHANNELS

PHYSICAL PROPERTIES						SECTION PROPERTIES						
SIZE				A 2 chan	NOM. Wt/ft 2 chan	AXIS X—X				RADII OF GYRATION AXIS Y—Y		
d	b_f	t_w	t_f			I	S	r	y	s, BACK TO BACK OF CHANNELS - IN.		
in	in	in	in	in^2	lbs	in^4	in^3	in	in	0	1/4	1/2
1-1/2	1-1/2	1/4	1/4	2.00	1.68	0.64	0.85	0.56	0.75	0.70	0.81	0.92
3	1	3/16	3/16	1.74	1.46	2.06	1.37	1.09	1.50	0.39	0.48	0.59
3	7/8	1/4	1/4	2.01	1.69	2.31	1.54	1.04	1.50	0.35	0.46	0.56
4	1-3/8	3/16	3/16	2.32	1.95	5.25	2.62	1.43	2.00	0.53	0.62	0.72
4	1-1/8	1/4	1/4	2.76	2.32	5.74	2.87	1.48	2.00	0.42	0.52	0.63
5	1-3/8	1/4	1/4	3.52	2.96	11.56	4.62	1.79	2.50	0.50	0.59	0.70
6	1-5/8	1/4	1/4	4.26	3.58	20.44	6.82	2.16	3.00	0.59	0.68	0.79
6	1-11/16	3/8	3/8	6.47	5.43	29.10	9.70	2.12	3.00	0.63	0.73	0.83
8	2-3/16	1/4	1/4	5.94	4.99	50.44	12.62	2.91	4.00	0.80	0.87	0.96
8	2-3/16	3/8	3/8	8.72	7.32	71.50	17.88	2.87	4.00	0.78	0.87	0.97
10	2-3/4	1/2	1/2	14.50	12.18	184.92	36.99	3.57	5.00	1.00	1.09	1.19
14	3-1/2	3/4	3/4	29.25	24.57	705.48	100.78	4.91	7.00	1.26	1.35	1.44
18	2-3/16	3/16	3/16	8.27	6.95	302.03	33.56	6.04	9.00	0.58	0.65	0.74