STRUCTURAL CALCULATIONS

Dish Wireless LLC

Site Information
SESEA00351A
9752 SE 36th St
Mercer Island, WA 98040

April 27, 2023

Phillip J Nejman

Digitally signed by Phillip J Nejman
Date: 2023.04.27 17:09:24 -04'00'

STRUCTURAL CALCULATIONS

Dish Wireless LLC

Report Content
Site Design Criteria
Component Loads
Component Details
Equipment Platform Sketch
Equipment Platform Analysis
Antenna Sectors Single Line Sketch
Antenna Sector Platform Analysis
Anchorage Analysis
Existing Structure Checks

Governing Demand / Capacity Ratio Based on Original Design Loads
0.90 for Alpha Sector Down Vertical
Ratio Based on Member Capacity will be Lower

Governing Demand / Capacity Ratio Based on Member Capacity
.787 for Gamma Sector W8x24

Qualitative conclusions / important notes boxed red in SA body

Quantitative Demand / Capacity Ratios double boxed red in SA body

Site: **SESEA00351A** SM 4/20/2023

Design Criteria

IBC 2021 / ASCE 7-16 / CD & SA Globe Building 1978-79 Nielson Smith Architects & Planners

Building Risk Category:	II		ASCE 7-16 Table 1.5-1

WIND

Basic Wind Speed V_{ULT}:	98	*mph*	ASCE 7-16 Figure 26.5-1
Exposure Category:	C		ASCE 7-16 26.7
Roof AGL:	56	*ft*	

SEISMIC

Seismic Site Class:	D		ASCE 7-16 11.4.3 Default
Site Lat: 47.5772°	Site Long: -122.2088°		
S_{DS} from ASCE Hazard Tool and Site Lat / Long:	1.118		
Importance Factor I_p or I_e:	1.00		ASCE 7-16 13.1.3 or Table 1.5-2

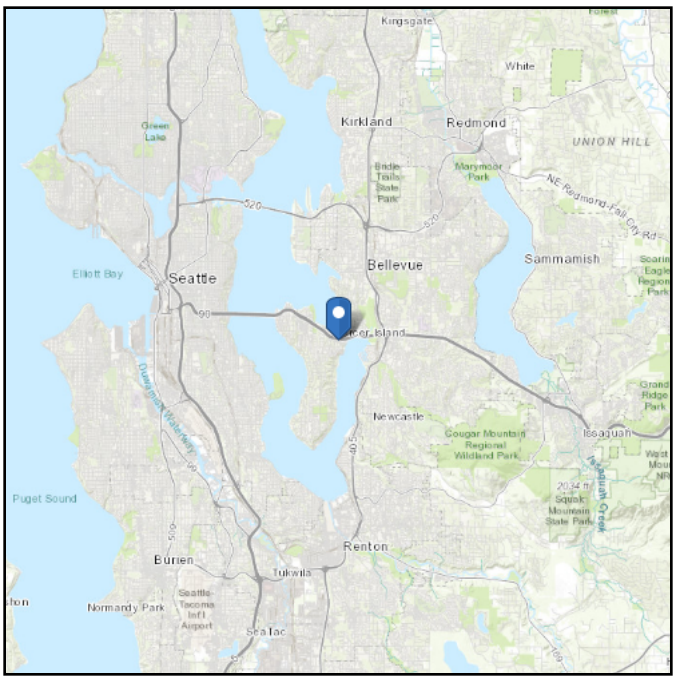
VERTICAL

Roof max Live Load L_r / Snow Load S:			25	*psf*
EPDM Roofing:	ref SV photos	0.5	*psf*	
1/2" ply:		2.3	*psf*	
Insulation:		2.4	*psf*	
TJ50 @ 48" OC:		1.5	*psf*	
T-Bar Ceiling:		1.8	*psf*	
Misc:		0.5	*psf*	
Roof Dead Load Total D:	except EPDM roofing ref July 1998 SA Beisans Engineering		**9**	*psf*
Roof Orignal Design Total Load:			45	*psf*
Roof Revised Design Total Load (D + S):			**34**	*psf*
Roof Excess Capacity:			**11**	*psf*

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-16	**Latitude:**	47.5772
Risk Category:	II	**Longitude:**	-122.2088
Soil Class:	D - Default (see Section 11.4.3)	**Elevation:**	100.90730644753764 ft (NAVD 88)



Wind

Results:

Wind Speed	98 Vmph
10-year MRI	67 Vmph
25-year MRI	74 Vmph
50-year MRI	78 Vmph
100-year MRI	83 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:	Thu Apr 20 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.

Seismic

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

Results:

S_S :	1.398	S_{D1} :	N/A
S_1 :	0.486	T_L :	6
F_a :	1.2	PGA :	0.598
F_v :	N/A	PGA_M :	0.718
S_{MS} :	1.677	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.118	C_v :	1.38

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

Data Accessed: Thu Apr 20 2023

Date Source: USGS Seismic Design Maps

Roof Framing

Dead Load

Roofing	1.1 2.2	6 psf
Plywood	2.3	2 psf
Insulation	2.4	3 psf
Joists	1.5	3 psf
Ceiling	1.8	3 psf
Misc		3 psf
Total D.L.		= 10.2 20 psf
Snow Load		= 25 psf

Dead + Snow = 45 psf

BEISANS ENGINEERING
STRUCTURAL CONSULTING INSPECTIONS
6501 FRANCIS AVENUE NORTH SEATTLE, WASHINGTON 98103 (206) 789-6617

PROJECT: Globe Building – SE-3408-A
9725 SE 36th Street
Mercer Island, WA 98040

PROJECT NUMBER: 98036
DATE: 7-1-98
PREPARED BY: JAB
SHEET 2

CALCULATION SHEETS

LOADING CRITERIA – ROOF AND/OR CEILING

☒ Main roof area
☐ Canopy or mansard roof
☐ Ceiling only
☐ Other

Reference Only

DEAD LOADS

Item	Material	Load – #/ft
Roofing & Fill	Asphalt Shingle Composition Roofing	2.2 psf
Sheathing Or Decking	1/2" Plywood Sheathing	2.3 psf
Insulation	Batt @ 0.3 psf/inch	2.4 psf
Ceiling	"T" Bar	1.8 psf
Fixtures – mech., elec., misc.	Miscellaneous	0.3 psf
Framing Subframing Purlins or Joists Girders	TJL @ 48" o.c.	1.5 psf
Total Dead Loads		11 psf

LIVE LOADS

☐ Normal load – 20 #/ft². Reducible by 0.08% per ft² for areas greater than 150 ft² to a maximum reduction of 40% or reducible to 16 #/ft² for areas greater than 600 ft².

☐ Normal load on roof with slope of 4:12 or more – 16 #/ft². Reducible by 0.06% per ft² for areas greater than 150 ft to a maximum reduction of 25% or reducible to 14 #/ft² for areas greater than 200 ft², 12 #/ft² over 600 ft².

☐ Normal load on roof with slope of 12:12 or more – 12 #/ft².

☒ Snow load – 25 #/ft² ☐ non-reducible ☒ reducible by (Load/40 – 0.5) #/ft² for each degree over 20°.

☐ Ceiling load only – 10 #/ft².

☐ Increase in Fb and Fv of 25% allowed for duration of load.

☒ Increase in Fb and Fv of 15% allowed for duration of load.

Site: **SESEA00351A**

RB 04/04/2023

Module 1

APPURTENANCE & EQUIPMENT CONFIGURATION

Dish Wireless Antenna Configuration

Sector	Existing/ Proposed	Centroid, AGL	Item	Qty	Weight per Quantity, lbs	Appurtenance Model	Mount Description
Alpha Sector	P	61' 9''	Antenna	1	75	JMA MX08FRO665-21	Pipe Mount; Inside FRP Screen
			Radio	2	200	Samsung-RF4450T-71A / Samsung-RF4451D-70A	
			OVP Device	1	25	RAYCAP RDIDC-4045-PF-48	
Beta Sector	P	61' 9''	Antenna	1	75	JMA MX08FRO665-21	Pipe Mount; Inside FRP Screen
			Radio	2	200	Samsung-RF4450T-71A / Samsung-RF4451D-70A	
			OVP Device	1	25	RAYCAP RDIDC-4045-PF-48	
Gamma Sector	P	61' 9''	Antenna	1	75	JMA MX08FRO665-21	Pipe Mount; Inside FRP Screen
			Radio	2	200	Samsung-RF4450T-71A / Samsung-RF4451D-70A	
			OVP Device	1	25	RAYCAP RDIDC-4045-PF-48	

Note: Refer to A&E Construction Drawings for additional information regarding final antenna and equipment locations and orientations. The data for weight above include additional weight for mounts.

FRP Analysis

9’ x 5’ x 10’

Site: SESEA00351A RB 04/04/2023

Module 1

Wind Load on Non-Structural Components

ASCE 7-16 Chapters 26 & 29

Risk Category:	II		*ASCE 7-16 Table 1.5-1*
Basic Wind Speed V_{ULT}:	98	*mph*	*ASCE 7-16 Figure 26.5-1A or B*
Exposure Category:	C		
Mean Roof Height:	56.0	*ft*	

ASCE 7-16 Table 26.11-1

Exposure	α	z_g:	z_{min}
B	7	1200	30
C	9.5	900	15
D	11.5	700	7

α:	9.5	
z_{min}:	15.0	*ft*
z_g:	900	*ft*

Exposure Coefficient $K_z = 2.01(z/z_g)^{2/\alpha}$:	1.12		*ASCE 7-16 Table 26-10-1*
Topographic Factor K_{zt}:	1.00		*ASCE 7-16 26.8*
Directionality Factor K_d:	0.85		*ASCE 7-16 Table 26.6-1: Equipment*
Ground Elevation Factor K_e:	1.00		*ASCE 7-16 Table 26.9-1:*
Velocity Pressure $q_z = .00256K_zK_{zt}K_dK_eV^2$:	23.4	*psf*	*ASCE 7-16 Equation 26.10-1* *ASCE 7-16 29.7*

Rooftop

Rooftop Equipment Factor (GC_r):	1.90		*ASCE 7-16 Formula 29.4.2*
Design Wind Pressure $q_z(GC_r)$:	44.5	*psf*	*ASCE 7-16 Formula 29.4.2*

Wind Component Load Strength Design

Item	Face	Projected Area A_f *ft²*	Lateral Wind F_h *#s*
6' Antenna F	F	10.0	445
OVP Box F	F	2.2	100
Dual MTI RRH S	S	2.2	99
8' 2.5'' STD Pipe	R	1.9	85

ASCE 7-16 Formula 29.4.2

Site: **SESEA00351A** RB 04/04/2023

Module 1

Seismic Load on Non-Structural Components:

ASCE 7-16 Chapter 13

Risk Category	**II**	ASCE 7-16 Table 1.5-1
Seismic Site Class:	**D**	ASCE 7-16 11.4.3 Default
Site Lat:	47.577188°	
Site Long:	-122.20879°	

S_{DS}:	**1.118**	
Item Importance I_p:	**1.00**	ASCE 7-16 13.1.3
Seismic Horizontal Force $F_{pmax} = 1.6I_pS_{DS}W_p$:		ASCE 7-16 Equation 13.3-2
Seismic Horizontal Force $F_p = .4I_pa_pS_{DS}W_p(1+2(z/h))/R_p$:		ASCE 7-16 Equation 13.3-1
Seismic Horizontal Force $F_{pmin} = 0.3I_pS_{DS}W_p$:		ASCE 7-16 Equation 13.3-3
Seismic Vertical Force $E_v = +/-.2S_{DS}W_p$:		ASCE 7-16 13.3.1.2
W_p:		Weight of Item *#s*
Amplification Factor a_p:	**2.5**	ASCE 7-16 Table 13.6-1
Response Modification Factor R_p:	**6**	ASCE 7-16 Table 13.6-1
z/h:		Elevation Ratio of Item / Roof:
		Ground = 0; Roof = 1; Ratio Between

Seismic Component Load Strength Design

Item	W_p, #s	z/h	Fp, #s	Ev, #s
9x5 FRP Screen F	**1100**	1	**615**	**246**
6' Antenna F	**75**	1	**42**	**17**
OVP Box F	**25**	1	**14**	**6**
Dual MTI RRH S	**200**	1	**112**	**45**
8' 2.5'' STD Pipe	**48**	1	**27**	**11**

Site: SESEA00351A RB 04/04/2023

Module 1

Wind Load on Flat Surfaces (page 1 of 2)

ASCE 7-16 Chapters 26 & 29

Risk Category:	II		ASCE 7-16 Table 1.5-1
Basic Wind Speed V_{ULT}:	98	*mph*	ASCE 7-16 Figure 26.5-1A or B
Exposure Category:	C		
Top of Component:	65	*ft*	

ASCE 7-16 Table 26.11-1

Exposure	α	z_g:	z_{min}
B	7	1200	30
C	9.5	900	15
D	12	700	7

α:	9.5	
z_{min}:	15.0	*ft*
z_g:	900	*ft*

Exposure Coefficient $K_z = 2.01(z/z_g)^{2/\alpha}$:	1.16		ASCE 7-16 Table 26-10-1
Topographic Factor K_{zt}:	1.00		ASCE 7-16 26.8
Directionality Factor K_d:	0.85		ASCE 7-16 Table 26.6-1:
Ground Elevation Factor K_e:	1.00		ASCE 7-16 Table 26.9-1:
Velocity Pressure $q_h = .00256K_zK_{zt}K_dK_eV^2$:	24.2	*psf*	ASCE 7-16 Equation 26.10-1
Gust Effect Factor G:	0.85		ASCE 7-16 26.11

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RB 04/04/2023

Module 1

Wind Load on Flat Surfaces (page 2 of 2)

Item	h *ft*	s *ft*	B *ft*	B/s	s/h	1.8-s/h for s/h > .8	C_f Case A & B	C_f Case C 0 to s	p psf
9x5 FRP Screen F	10.00	7.5	9.0	**1.20**	**0.75**	**1.0**	1.615	N/A	**33.2**
9x5 FRP Screen S	10.00	7.5	5.0	**0.67**	**0.75**	**1.0**	1.664	N/A	**34.2**

2-Post Case B

	F Case A #s	$_{SPOST}$ Case s (.7F Case A	CP in	M_{SPOST} Case B in-#s
9x5 FRP Screen S	1,281.16	**896.81**	**45.00**	**40,356.39**

Notes: ASCE 7-16 Figure 29.3-1

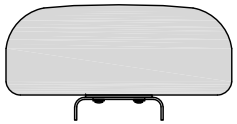
ASCE7-16 Equation 29.3-1

Case B ignored for other than 2-post items

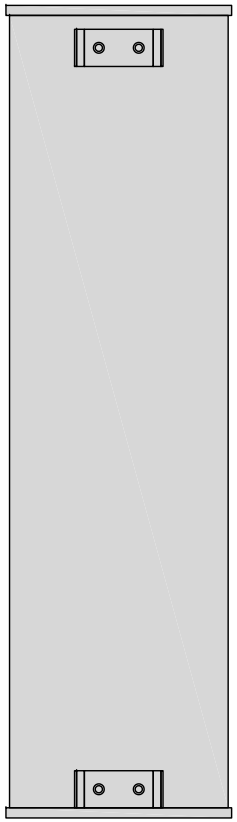
Case C ignored for B/s < 2

F acts at .55h above base for s/h = 1

JMA WIRELESS MX08FRO665-21 ANTENNA	
DIMENSIONS (HxWxD)	72.0"x20.0"x8.0"
TOTAL WEIGHT	64.5 LB
RF PORTS, CONNECTOR TYPE	8 x 4.3-10 FEMALE



PLAN



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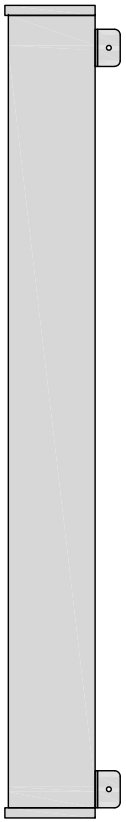

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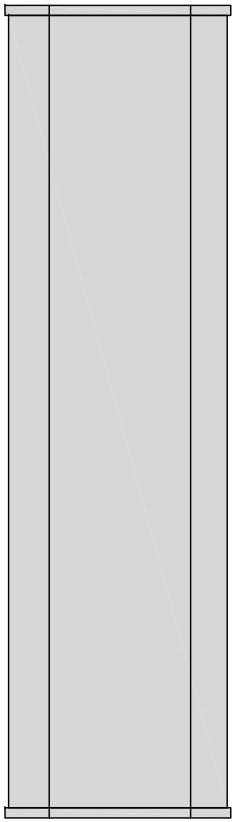
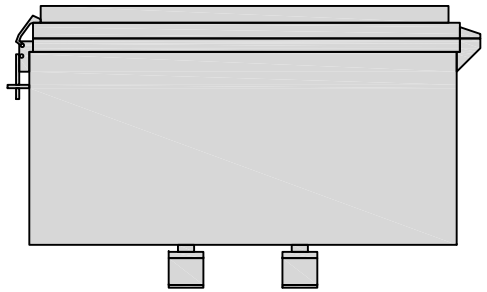


FRONT

ANTENNA DETAIL

RAYCAP RDIDC-3045-PF-48 SURGE PROTECTION DEVICE (OVP)	
DIMENSIONS (HxWxD)	19"x16.21"x9.64"
WEIGHT	21 lbs



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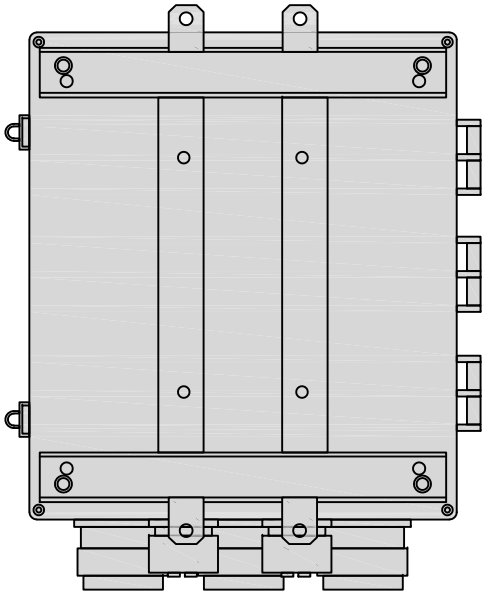

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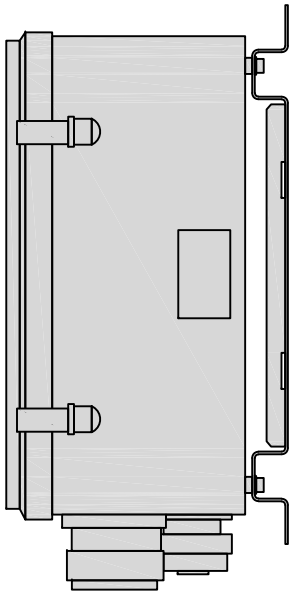

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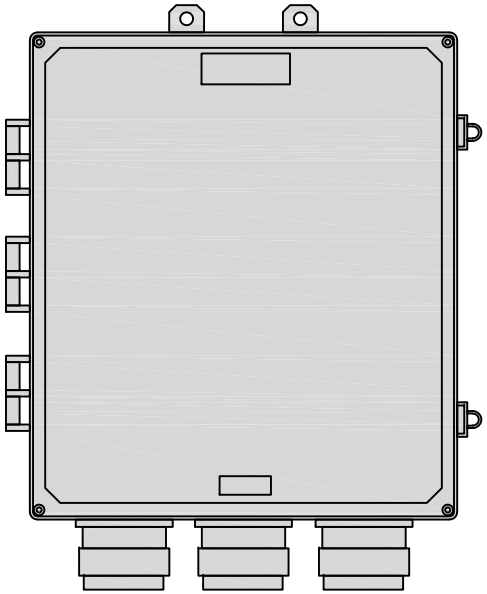


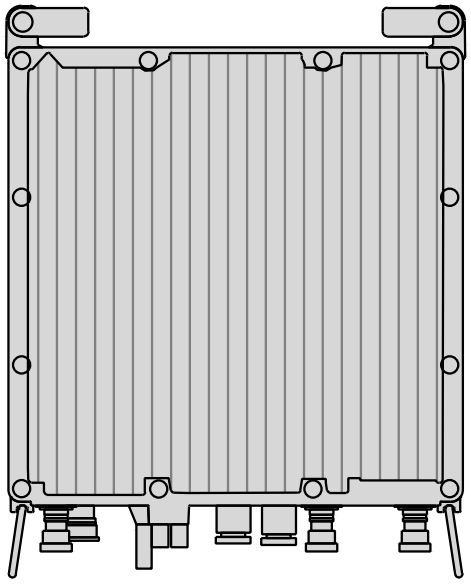
FRONT

SURGE PROTECTION DEVICE (OVP) DETAIL

SAMSUNG – MID BAND
RF4451D–70A

DIMENSIONS (HxWxD)	15"x15"x8.9"
WEIGHT	61.3 lbs
CONNECTOR TYPE	4.3–10 RF CONNECTOR
INPUT VOLTAGE	–48VDC (–36 to 58 VDC)

PLAN



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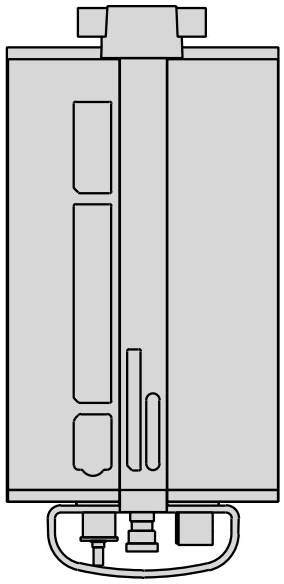

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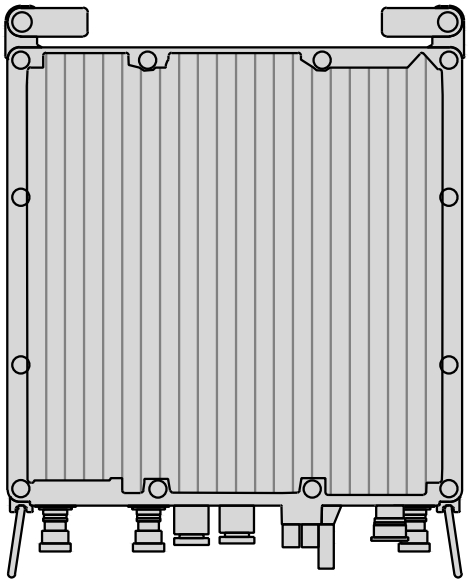
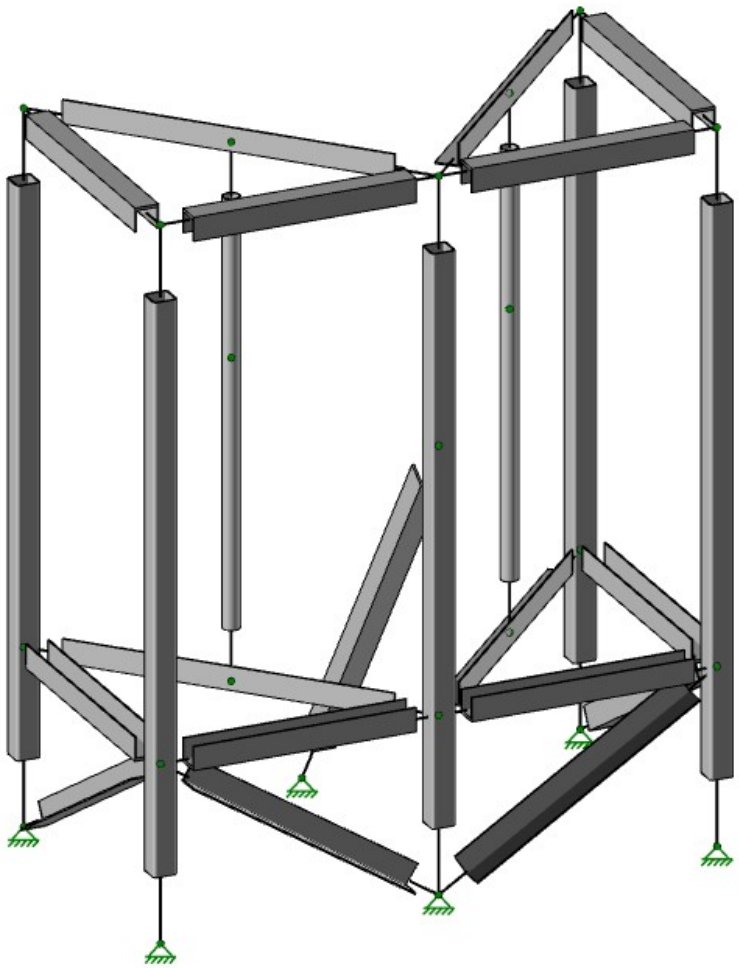


FRONT

240 Stockton Street, 3rd Floor
San Francisco, CA 94108
www.modusllc.com

STRUCTURAL ANALYSIS OF 9’ x 5’ x 10’ FRP SCREEN

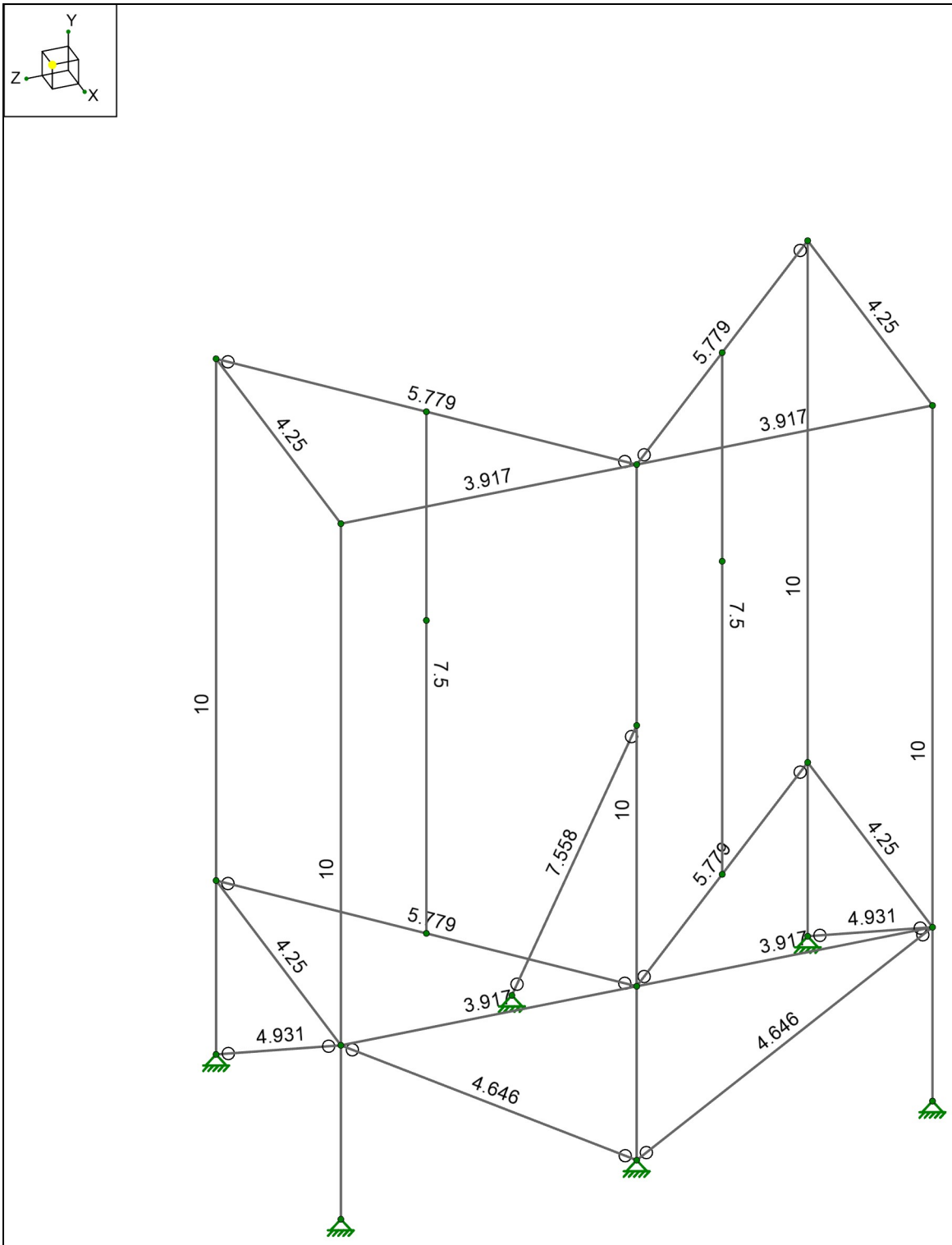


RESULT SUMMARY: SITE NUMBER SESEA00351A

Component	Bending Stress Ratio		Shear Stress Ratio	
FRP Members	56.7 %*	Pass	4 %**	Pass

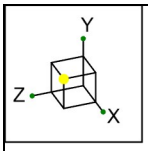
*Stress ratio calculated by considering factor of safety 2.5 as per Strongwell section 7 page 2.
** Stress ratio calculated by considering factor of safety 3 as per Strongwell section 7 page 2.

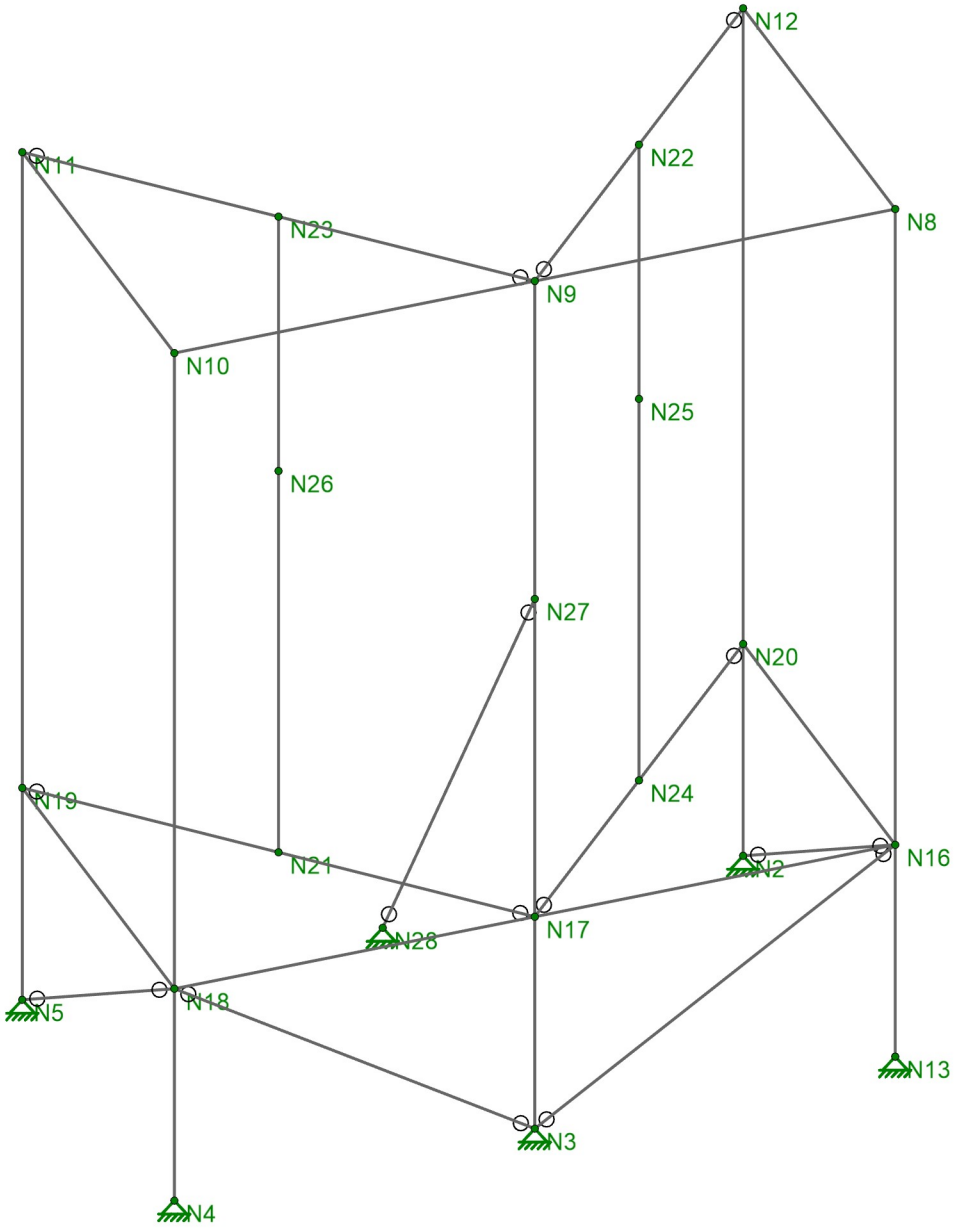
The FRP screen has sufficient capacity for the proposed applied load.



Member Length (ft) Displayed
Envelope Only Solution

Modulus LLC		SK-6
VM		Mar 24, 2023
		SESEA00351A - FRP Analysis.r3d





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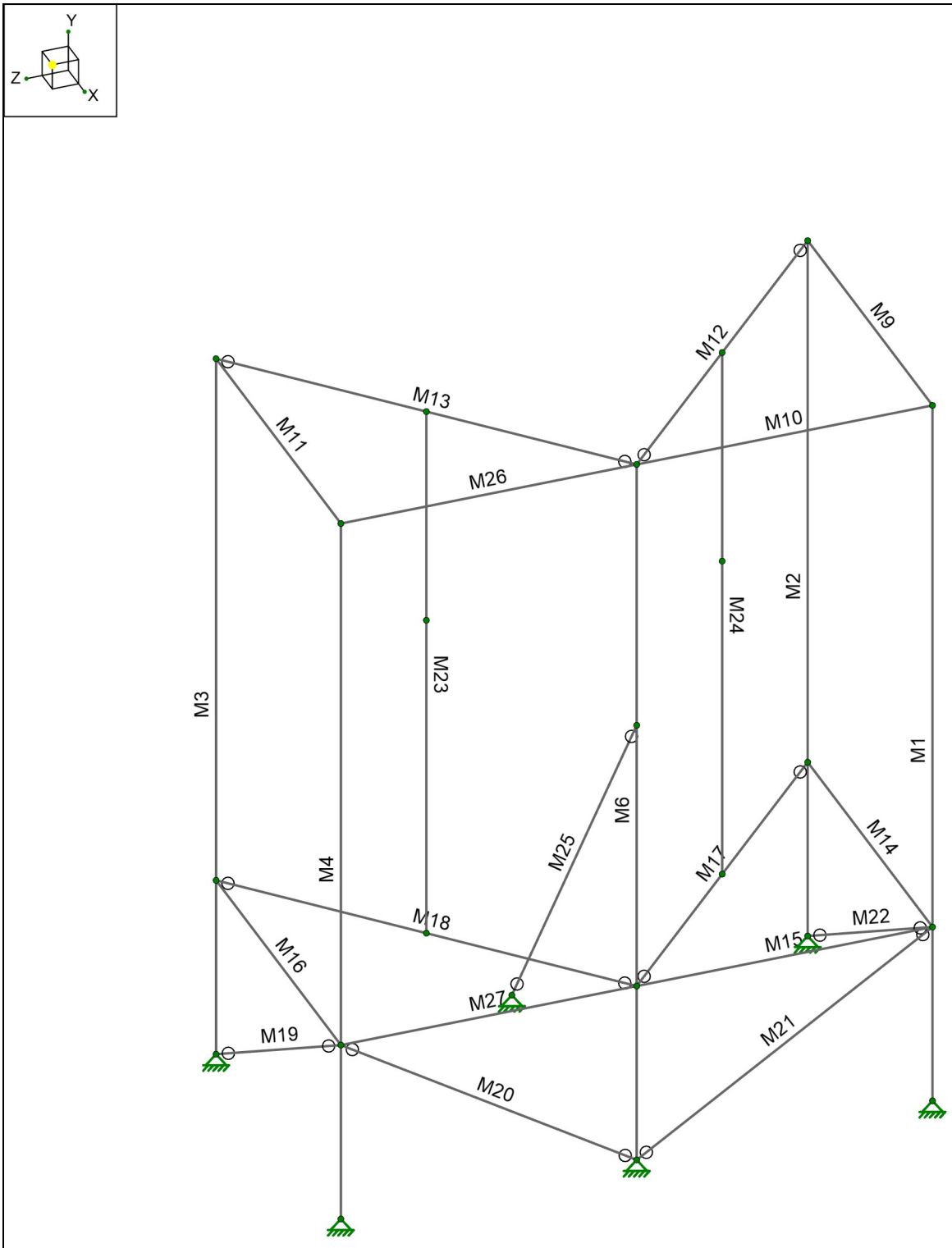

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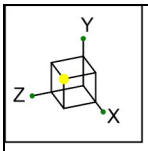

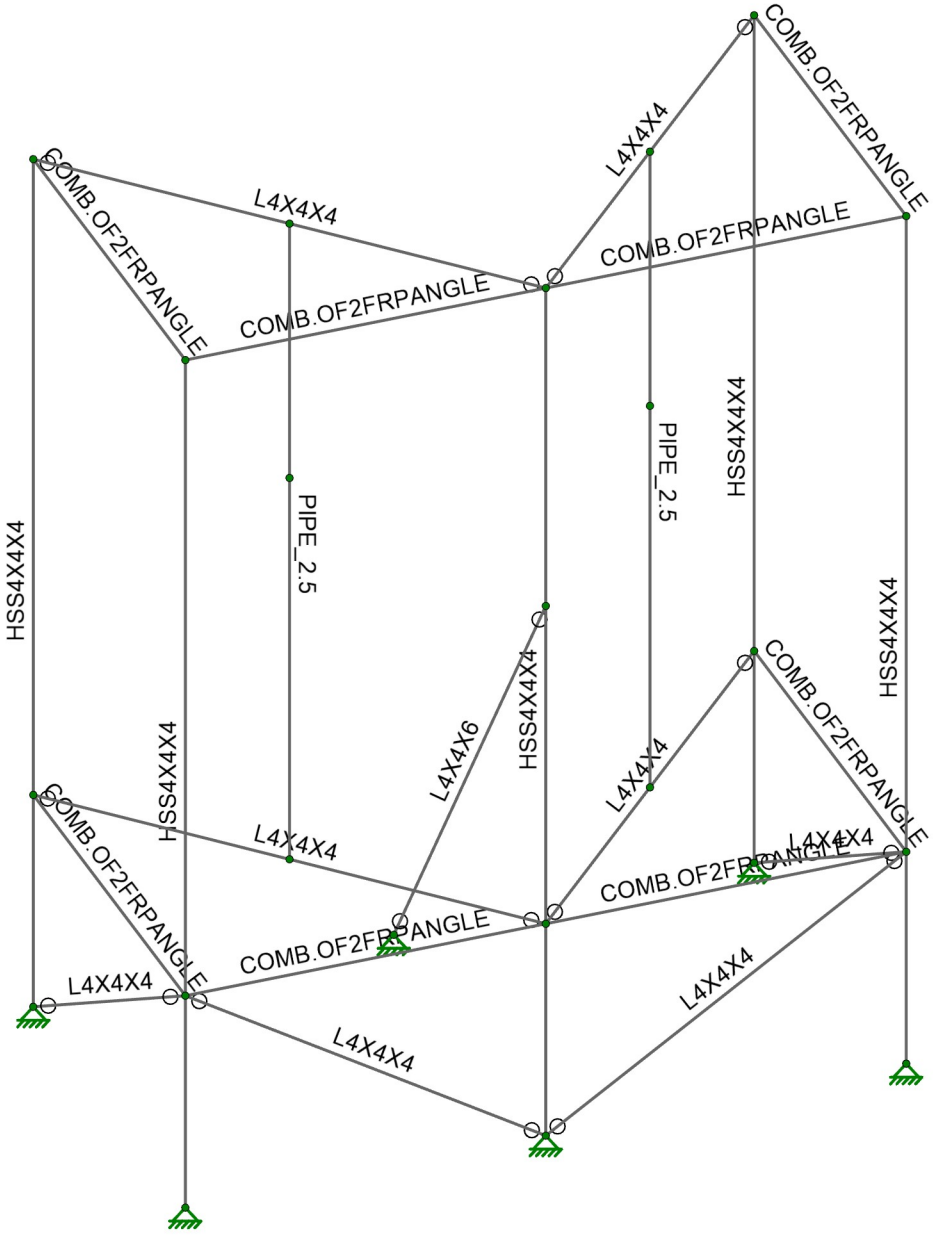

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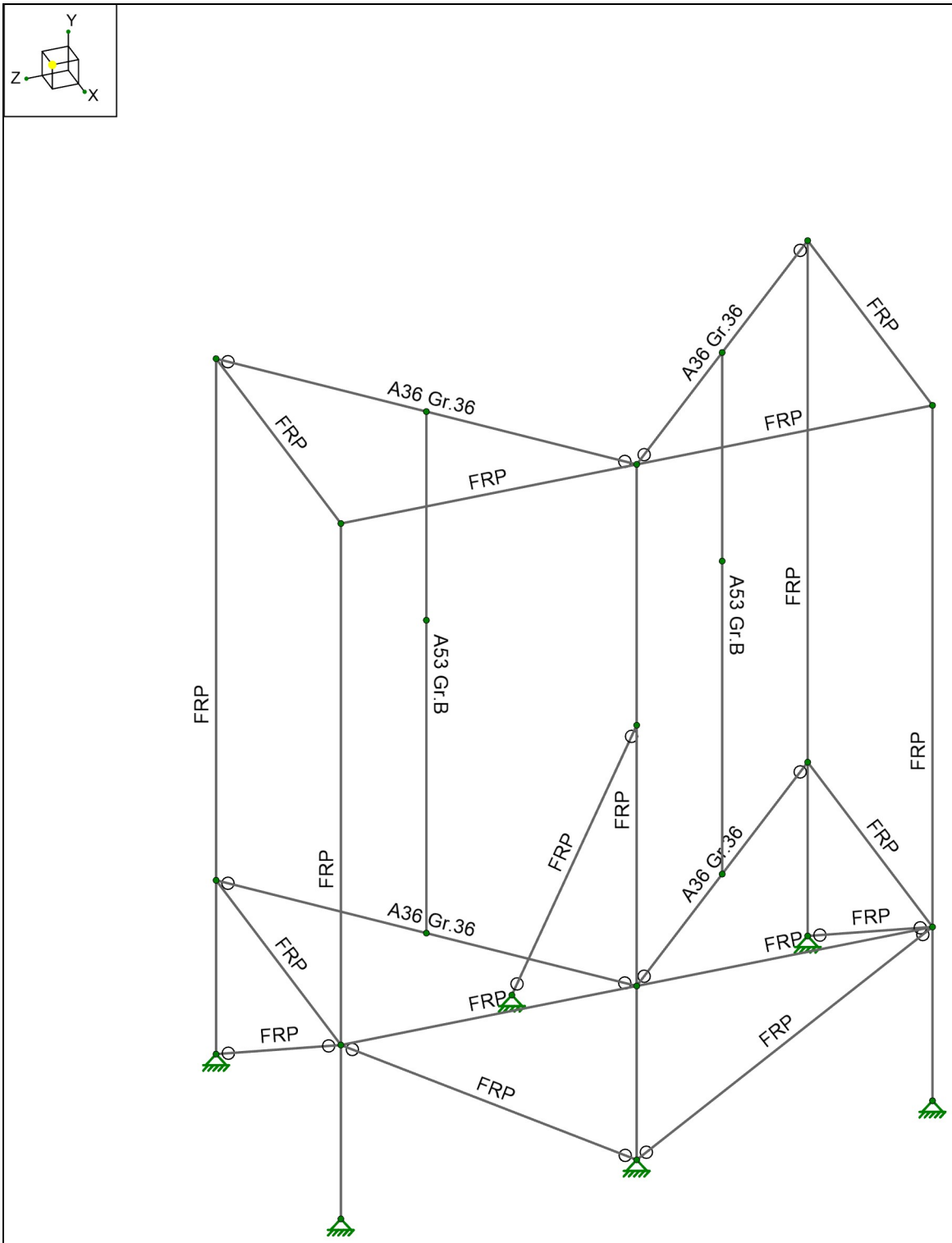

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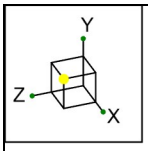

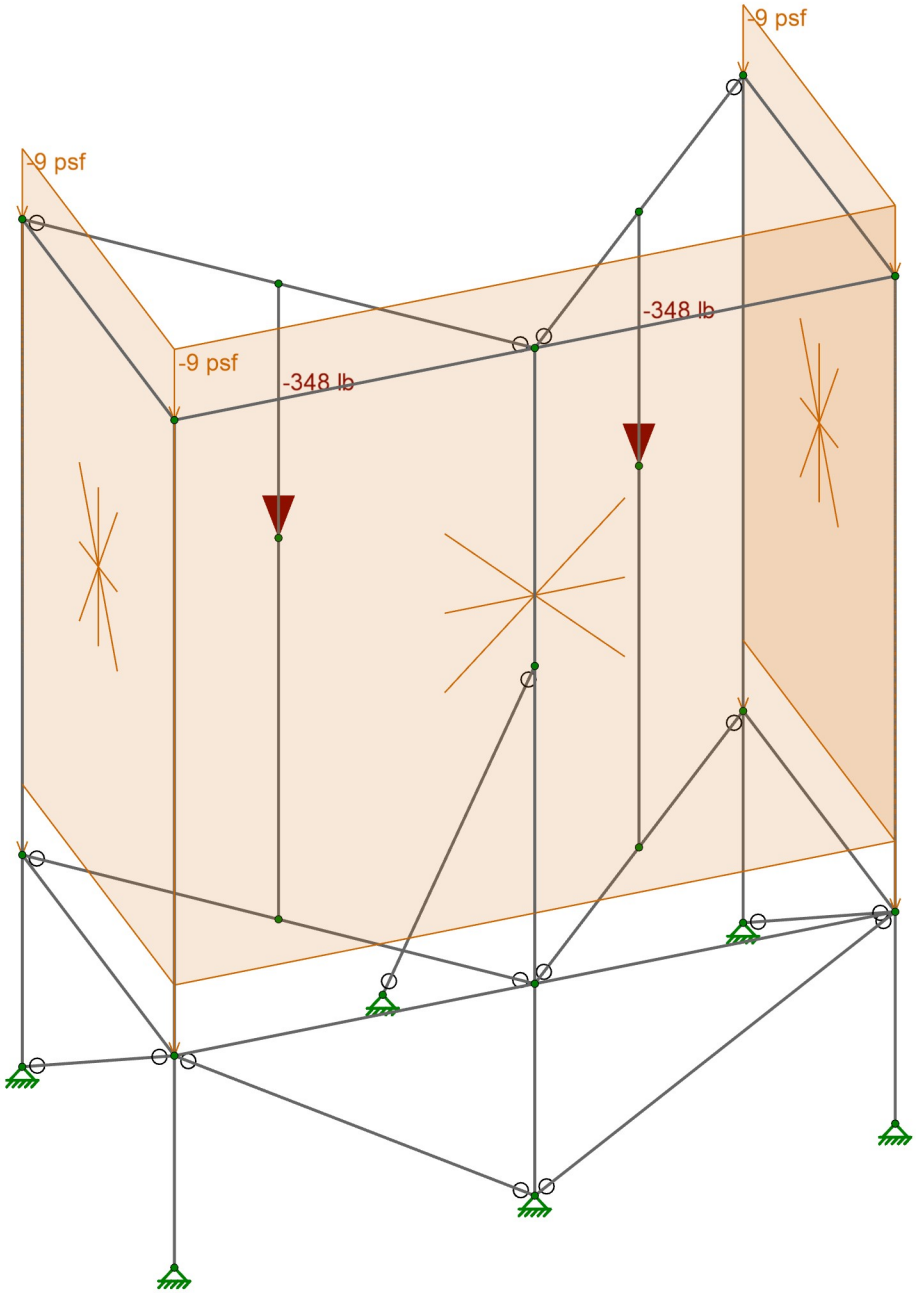

Loads: BLC 1, DL
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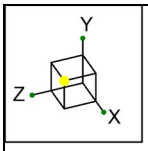
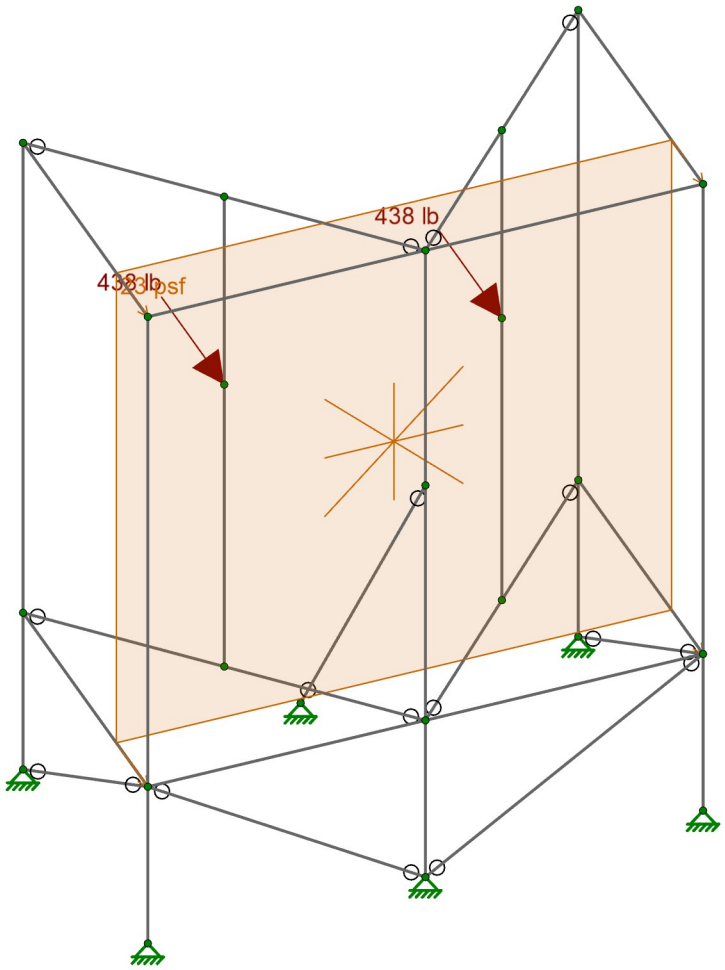
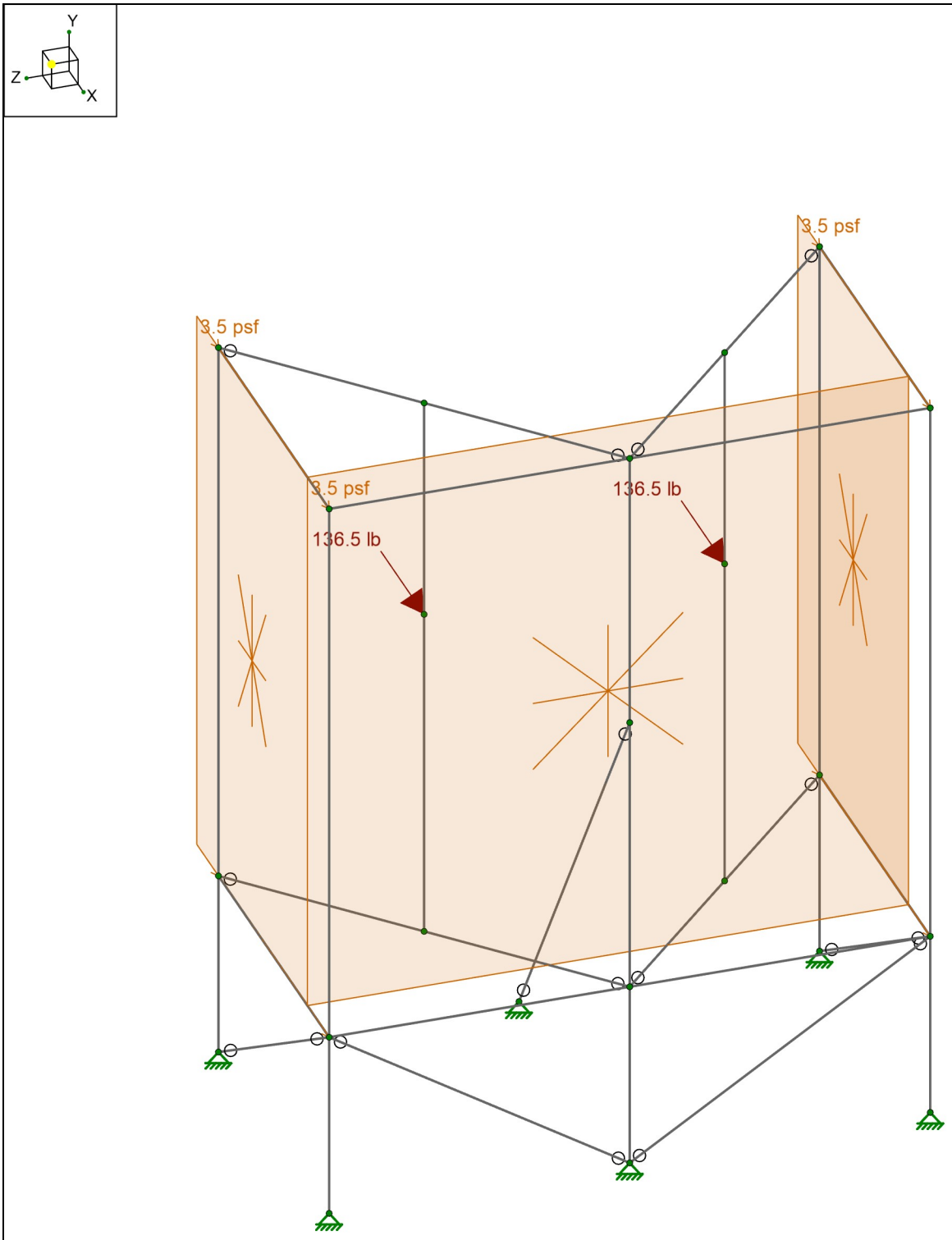




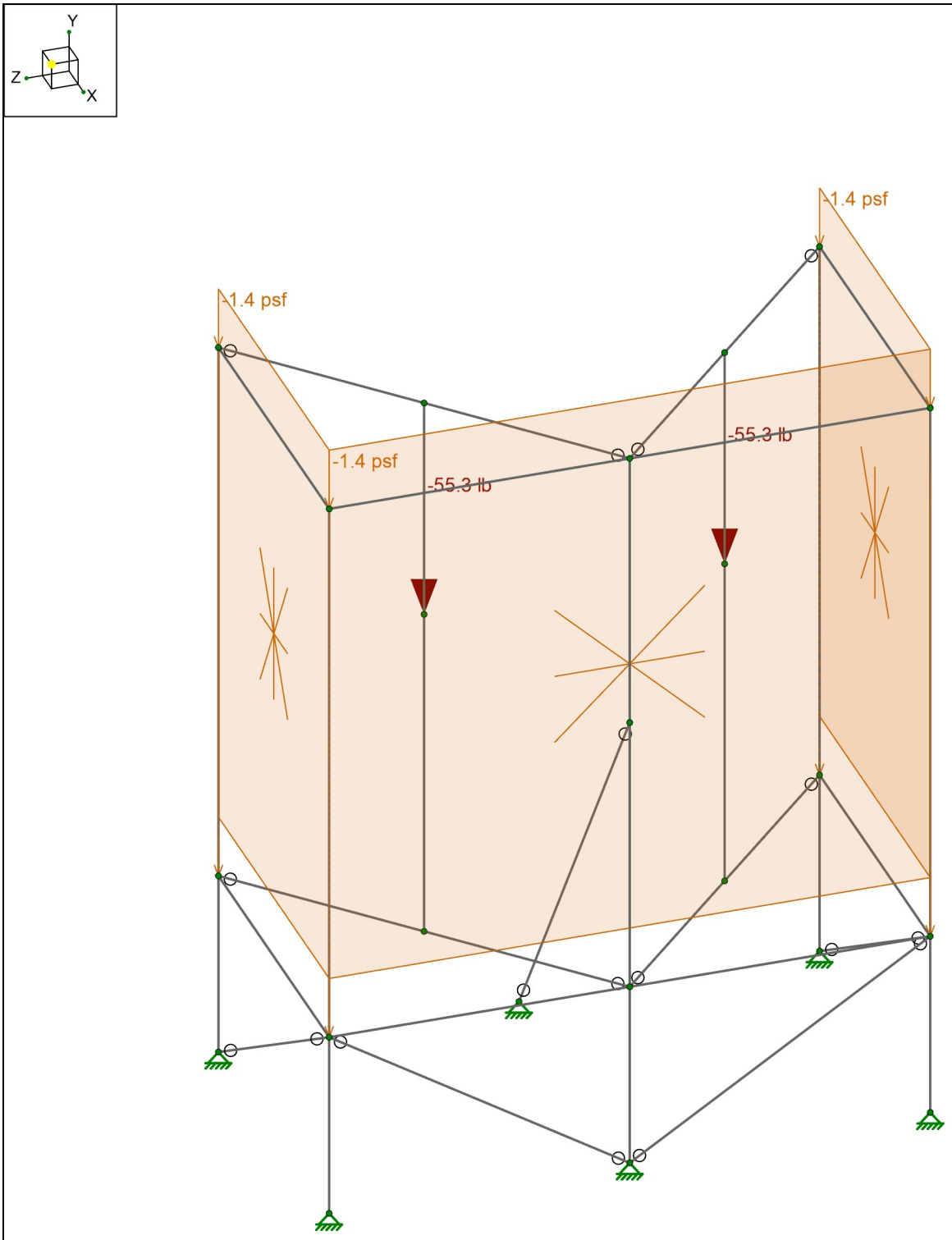
Loads: BLC 2, WL
Envelope Only Solution

Modulus LLC		SK-1
VM		Apr 07, 2023
		SESEA00351A - FRP Analysis.r3d



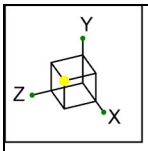
Loads: BLC 3, Ex
Envelope Only Solution

Modulus LLC		SK-11
VM		Mar 24, 2023
		SESEA00351A - FRP Analysis.r3d



Loads: BLC 4, Ey
Envelope Only Solution

Modulus LLC		SK-12
VM		Mar 24, 2023
		SESEA00351A - FRP Analysis.r3d



Code Check (Env)
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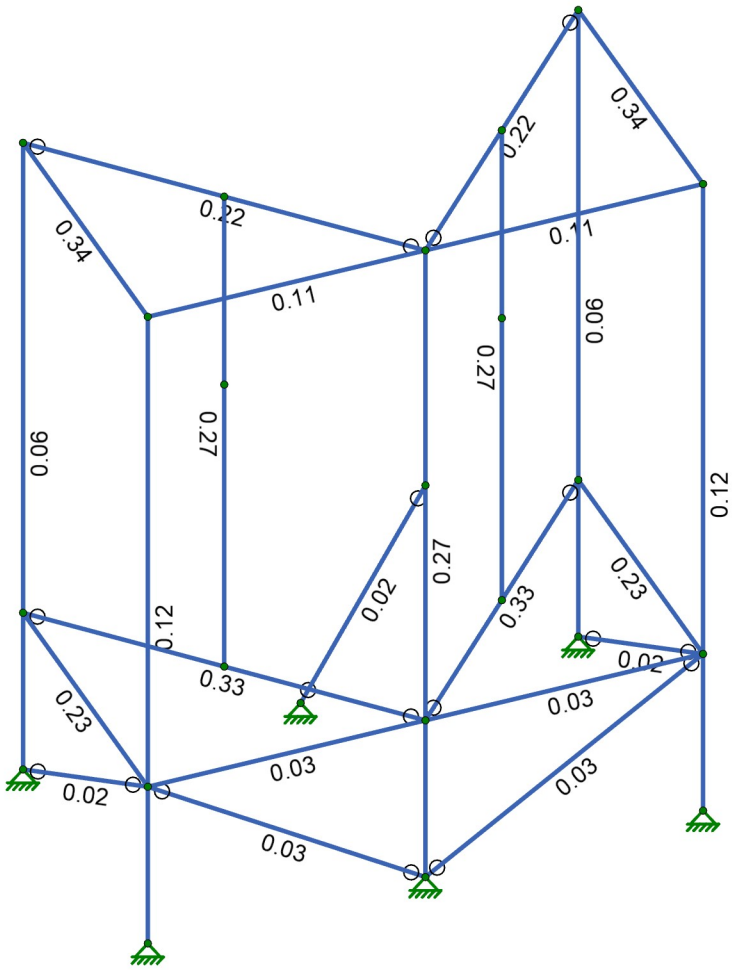
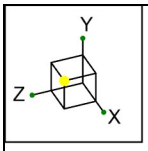
.90-1.0
.75-.90
.50-.75
0.-.50



Member Code Checks Displayed (Enveloped)
Envelope Only Solution

Modulus LLC		SK-2
VM		Apr 07, 2023
		SESEA00351A - FRP Analysis.r3d



Shear Check (Env)
No Calc
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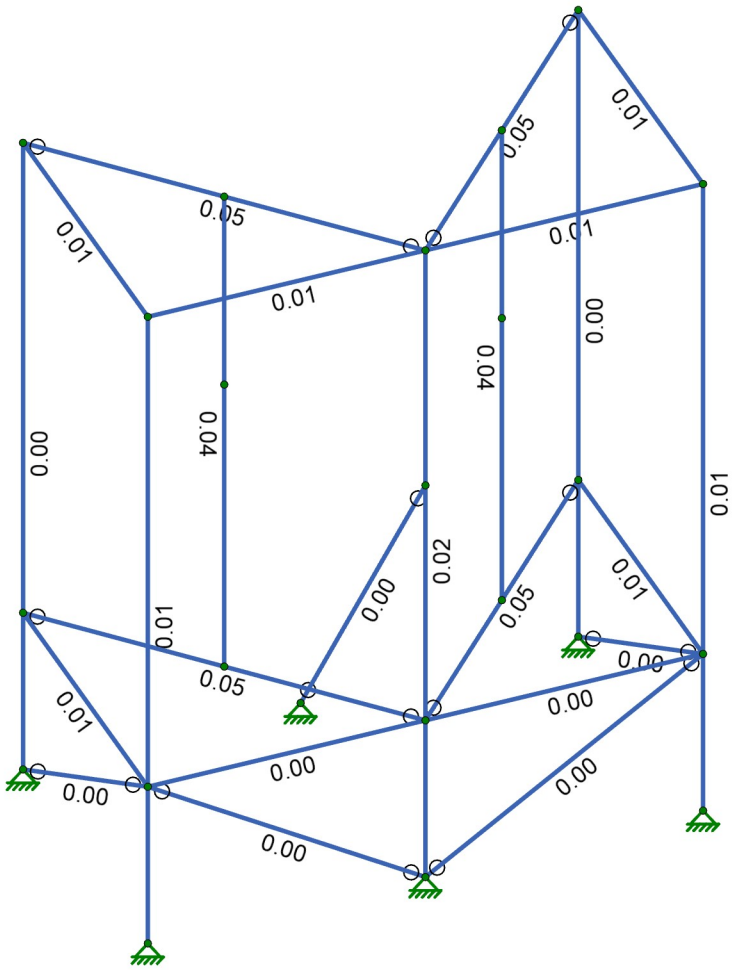

Member Shear Checks Displayed (Enveloped)
Envelope Only Solution

Modulus LLC		SK-3
VM		Apr 07, 2023
		SESEA00351A - FRP Analysis.r3d

Node Reactions

	LC	Node Label	X [lb]	Y [lb]	Z [lb]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	1	N13	-3.836	260.159	3.364	0	0	0
2	1	N4	-3.836	260.159	-3.364	0	0	0
3	1	N5	1.104	314.285	0.668	0	0	0
4	1	N2	1.104	314.285	-0.668	0	0	0
5	1	N3	1.289	643.466	0	0	0	0
6	1	N28	4.175	6.137	0	0	LOCKED	LOCKED
7	1	Totals:	0	1798.491	0			
8	1	COG (ft):	X: -1.5	Y: 6.54	Z: -3.917			
9	2	N13	80.144	724.238	4.31	0	0	0
10	2	N4	80.144	724.238	-4.31	0	0	0
11	2	N5	-447.233	-333.538	26.17	0	0	0
12	2	N2	-447.233	-333.538	-26.17	0	0	0
13	2	N3	-76.054	1789.378	0	0	0	0
14	2	N28	-526.104	-772.287	0	0	LOCKED	LOCKED
15	2	Totals:	-1336.336	1798.491	0			
16	2	COG (ft):	X: -1.5	Y: 6.54	Z: -3.917			
17	3	N13	28.267	484.228	3.978	0	0	0
18	3	N4	28.267	484.228	-3.978	0	0	0
19	3	N5	-189.497	78.377	8.152	0	0	0
20	3	N2	-189.497	78.377	-8.152	0	0	0
21	3	N3	-22.235	1086.062	0	0	0	0
22	3	N28	-146.528	-215.312	0	0	LOCKED	LOCKED
23	3	Totals:	-491.223	1995.96	0			
24	3	COG (ft):	X: -1.501	Y: 6.541	Z: -3.917			

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N13	0	0	-7.8332	
2	N2	-4.25	0	-7.8332	
3	N3	0	0	-3.9166	
4	N4	0	0	0	
5	N5	-4.25	0	0	
6	N8	0	10	-7.8332	
7	N9	0	10	-3.9166	
8	N10	0	10	0	
9	N11	-4.25	10	0	
10	N12	-4.25	10	-7.8332	
11	N16	0	2.5	-7.8332	
12	N17	0	2.5	-3.9166	
13	N18	0	2.5	0	
14	N19	-4.25	2.5	0	
15	N20	-4.25	2.5	-7.8332	
16	N21	-2.125	2.5	-1.9583	
17	N22	-2.125	10	-5.8749	
18	N23	-2.125	10	-1.9583	
19	N24	-2.125	2.5	-5.8749	
20	N25	-2.125	7	-5.8749	
21	N26	-2.125	7	-1.9583	
22	N27	0	6.25	-3.9166	
23	N28	-4.25	0	-3.9166	

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]
1	N13	Reaction	Reaction	Reaction
2	N4	Reaction	Reaction	Reaction
3	N5	Reaction	Reaction	Reaction
4	N2	Reaction	Reaction	Reaction
5	N3	Reaction	Reaction	Reaction
6	N28	Reaction	Reaction	Reaction

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e^{5}°F^{-1}]	Density [k/ft^{3}]	Yield [ksi]	Ry	Fu [ksi]	Rt
1	A992	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
2	A36 Gr.36	29000	11154	0.3	0.65	0.49	36	1.5	58	1.2
3	A572 Gr.50	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
4	A500 Gr.B RND	29000	11154	0.3	0.65	0.527	42	1.4	58	1.3
5	A500 Gr.B RECT	29000	11154	0.3	0.65	0.527	46	1.4	58	1.3
6	A500 Gr.C RND	29000	11154	0.3	0.65	0.527	46	1.4	62	1.3
7	A500 Gr.C RECT	29000	11154	0.3	0.65	0.527	50	1.4	62	1.3
8	A53 Gr.B	29000	11154	0.3	0.65	0.49	35	1.6	60	1.2
9	A1085	29000	11154	0.3	0.65	0.49	50	1.4	65	1.3
10	A913 Gr.65	29000	11154	0.3	0.65	0.49	65	1.1	80	1.1
11	FRP	2600	450	0.3	0.44	0.107	30	1.1	45	1.1
12	FRP,	2600	45000	0.3	0.44	0.107	30	1.1	45	1.1

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	FRP Column	HSS4X4X4	Column	Tube	FRP	Typical	3.37	7.8	7.8	12.8
2	FRP Angle	COMB.OF2FRPANGLE	Beam	Channel	FRP	Typical	3.75	5.561	8.828	0.173
3	FRP Brace	L4X4X4	Beam	Single Angle	FRP	Typical	1.93	3	3	0.044
4	FRP Diagonal Brace	L4X4X6	Beam	Single Angle	FRP	Typical	2.86	4.32	4.32	0.141
5	Steel Brace	L4X4X4	Beam	Single Angle	A36 Gr.36	Typical	1.93	3	3	0.044
6	Mount Pipe	PIPE_2.5	Column	HSS Pipe	A53 Gr.B	Typical	1.61	1.45	1.45	2.89

Member Primary Data

	Label	I Node	J Node	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N13	N8		FRP Column	Column	Tube	FRP	Typical
2	M2	N2	N12		FRP Column	Column	Tube	FRP	Typical
3	M3	N5	N11		FRP Column	Column	Tube	FRP	Typical
4	M4	N4	N10		FRP Column	Column	Tube	FRP	Typical
5	M6	N3	N9		FRP Column	Column	Tube	FRP	Typical
6	M9	N12	N8	90	FRP Angle	Beam	Channel	FRP	Typical
7	M10	N8	N9	90	FRP Angle	Beam	Channel	FRP	Typical
8	M11	N10	N11	90	FRP Angle	Beam	Channel	FRP	Typical
9	M14	N20	N16	270	FRP Angle	Beam	Channel	FRP	Typical
10	M15	N16	N17	270	FRP Angle	Beam	Channel	FRP	Typical
11	M16	N18	N19	270	FRP Angle	Beam	Channel	FRP	Typical
12	M12	N12	N9		Steel Brace	Beam	Single Angle	A36 Gr.36	Typical
13	M13	N9	N11		Steel Brace	Beam	Single Angle	A36 Gr.36	Typical
14	M17	N20	N17		Steel Brace	Beam	Single Angle	A36 Gr.36	Typical
15	M18	N17	N19		Steel Brace	Beam	Single Angle	A36 Gr.36	Typical
16	M19	N5	N18		FRP Brace	Beam	Single Angle	FRP	Typical
17	M20	N18	N3		FRP Brace	Beam	Single Angle	FRP	Typical
18	M21	N3	N16		FRP Brace	Beam	Single Angle	FRP	Typical
19	M22	N16	N2		FRP Brace	Beam	Single Angle	FRP	Typical
20	M23	N23	N21		Mount Pipe	Column	HSS Pipe	A53 Gr.B	Typical
21	M24	N22	N24		Mount Pipe	Column	HSS Pipe	A53 Gr.B	Typical
22	M26	N9	N10	90	FRP Angle	Beam	Channel	FRP	Typical
23	M27	N17	N18	270	FRP Angle	Beam	Channel	FRP	Typical
24	M25	N27	N28		FRP Diagonal Brace	Beam	Single Angle	FRP	Typical

Member Advanced Data

	Label	I Release	J Release	Physical	Deflection Ratio Options	Seismic DR
1	M1			Yes	** NA **	None
2	M2			Yes	** NA **	None
3	M3			Yes	** NA **	None
4	M4			Yes	** NA **	None
5	M6			Yes	** NA **	None
6	M9			Yes	Default	None
7	M10			Yes	Default	None
8	M11			Yes	Default	None
9	M14			Yes	Default	None
10	M15			Yes	Default	None
11	M16			Yes	Default	None
12	M12	BenPIN	BenPIN	Yes	Default	None
13	M13	BenPIN	BenPIN	Yes	Default	None
14	M17	BenPIN	BenPIN	Yes	Default	None
15	M18	BenPIN	BenPIN	Yes	Default	None
16	M19	BenPIN	BenPIN	Yes	Default	None

Member Advanced Data (Continued)

	Label	I Release	J Release	Physical	Deflection Ratio Options	Seismic DR
17	M20	BenPIN	BenPIN	Yes	Default	None
18	M21	BenPIN	BenPIN	Yes	Default	None
19	M22	BenPIN	BenPIN	Yes	Default	None
20	M23			Yes	** NA **	None
21	M24			Yes	** NA **	None
22	M26			Yes	Default	None
23	M27			Yes	Default	None
24	M25	BenPIN	BenPIN	Yes	Default	None

Design Size and Code Check Parameters

	Label	Max Axial/Bending Chk	Max Shear Chk
1	Typical	1	1
2	R2	0.4	0.33

Basic Load Cases

	BLC Description	Category	Nodal	Distributed	Area(Member)
1	DL	None	2		3
2	WL	None	2		1
3	Ex	None	2		3
4	Ey	None	2		3
5	BLC 1 Transient Area Loads	None		62	
6	BLC 2 Transient Area Loads	None		34	
7	BLC 3 Transient Area Loads	None		62	
8	BLC 4 Transient Area Loads	None		62	

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor
1	D	Yes	Y	1	1				
2	D+0.6Wx	Yes	Y	1	1	2	0.6		
3	D+0.7(Ex+Ey)	Yes	Y	1	1	3	0.7	4	0.7
4	Wx		Y	2	1				
5	Ex		Y	3	1				
6	Ey		Y	4	1				

Member Point Loads

No Data to Print...

Member Distributed Loads (BLC 5 : BLC 1 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M3	Y	-0.006	-0.015	3.438	4.375
2	M3	Y	-0.015	-0.02	4.375	5.312
3	M3	Y	-0.02	-0.02	5.312	6.25
4	M3	Y	-0.02	-0.02	6.25	7.188
5	M3	Y	-0.02	-0.015	7.188	8.125
6	M3	Y	-0.015	-0.006	8.125	9.062
7	M4	Y	-0.011	-0.029	3.438	4.375
8	M4	Y	-0.029	-0.038	4.375	5.312
9	M4	Y	-0.038	-0.038	5.312	6.25
10	M4	Y	-0.038	-0.038	6.25	7.188
11	M4	Y	-0.038	-0.029	7.188	8.125

Member Distributed Loads (BLC 5 : BLC 1 Transient Area Loads) (Continued)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
12	M4	Y	-0.029	-0.011	8.125	9.062
13	M11	Y	-0.005	-0.014	1.11e-16	1.062
14	M11	Y	-0.014	-0.018	1.062	2.125
15	M11	Y	-0.018	-0.014	2.125	3.188
16	M11	Y	-0.014	-0.005	3.188	4.25
17	M16	Y	-0.005	-0.014	3.331e-16	1.063
18	M16	Y	-0.014	-0.018	1.063	2.125
19	M16	Y	-0.018	-0.014	2.125	3.188
20	M16	Y	-0.014	-0.005	3.188	4.25
21	M1	Y	-0.011	-0.029	3.438	4.375
22	M1	Y	-0.029	-0.038	4.375	5.312
23	M1	Y	-0.038	-0.038	5.312	6.25
24	M1	Y	-0.038	-0.038	6.25	7.188
25	M1	Y	-0.038	-0.029	7.188	8.125
26	M1	Y	-0.029	-0.011	8.125	9.062
27	M2	Y	-0.006	-0.015	3.438	4.375
28	M2	Y	-0.015	-0.02	4.375	5.312
29	M2	Y	-0.02	-0.02	5.312	6.25
30	M2	Y	-0.02	-0.02	6.25	7.188
31	M2	Y	-0.02	-0.015	7.188	8.125
32	M2	Y	-0.015	-0.006	8.125	9.062
33	M9	Y	-0.005	-0.014	3.331e-16	1.063
34	M9	Y	-0.014	-0.018	1.063	2.125
35	M9	Y	-0.018	-0.014	2.125	3.188
36	M9	Y	-0.014	-0.005	3.188	4.25
37	M14	Y	-0.005	-0.014	1.11e-16	1.062
38	M14	Y	-0.014	-0.018	1.062	2.125
39	M14	Y	-0.018	-0.014	2.125	3.188
40	M14	Y	-0.014	-0.005	3.188	4.25
41	M6	Y	-0.01	-0.028	3.438	4.375
42	M6	Y	-0.028	-0.037	4.375	5.312
43	M6	Y	-0.037	-0.037	5.312	6.25
44	M6	Y	-0.037	-0.037	6.25	7.187
45	M6	Y	-0.037	-0.028	7.187	8.125
46	M6	Y	-0.028	-0.01	8.125	9.062
47	M10	Y	-0.005	-0.014	0	0.979
48	M10	Y	-0.014	-0.018	0.979	1.958
49	M10	Y	-0.018	-0.014	1.958	2.937
50	M10	Y	-0.014	-0.005	2.937	3.917
51	M15	Y	-0.005	-0.014	5.551e-17	0.979
52	M15	Y	-0.014	-0.018	0.979	1.958
53	M15	Y	-0.018	-0.014	1.958	2.937
54	M15	Y	-0.014	-0.005	2.937	3.917
55	M26	Y	-0.005	-0.014	5.551e-16	0.979
56	M26	Y	-0.014	-0.018	0.979	1.958
57	M26	Y	-0.018	-0.014	1.958	2.937
58	M26	Y	-0.014	-0.005	2.937	3.917
59	M27	Y	-0.005	-0.014	0	0.979
60	M27	Y	-0.014	-0.018	0.979	1.958
61	M27	Y	-0.018	-0.014	1.958	2.937
62	M27	Y	-0.014	-0.005	2.937	3.917

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

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	X	0.036	0.013	8.125	9.062
2	M4	X	0.013	0.036	3.438	4.375
3	M4	X	0.036	0.047	4.375	5.312
4	M4	X	0.047	0.047	5.312	6.25
5	M4	X	0.047	0.047	6.25	7.187
6	M4	X	0.047	0.036	7.187	8.125
7	M4	X	0.036	0.013	8.125	9.062
8	M6	X	0.026	0.071	3.438	4.375
9	M6	X	0.071	0.094	4.375	5.312
10	M6	X	0.094	0.094	5.312	6.25
11	M6	X	0.094	0.094	6.25	7.187
12	M6	X	0.094	0.071	7.187	8.125
13	M6	X	0.071	0.026	8.125	9.062
14	M10	X	0.013	0.035	0	0.979
15	M10	X	0.035	0.046	0.979	1.958
16	M10	X	0.046	0.035	1.958	2.937
17	M10	X	0.035	0.013	2.937	3.917
18	M15	X	0.013	0.035	5.551e-17	0.979
19	M15	X	0.035	0.046	0.979	1.958
20	M15	X	0.046	0.035	1.958	2.937
21	M15	X	0.035	0.013	2.937	3.917
22	M26	X	0.013	0.035	5.551e-16	0.979
23	M26	X	0.035	0.046	0.979	1.958
24	M26	X	0.046	0.035	1.958	2.937
25	M26	X	0.035	0.013	2.937	3.917
26	M27	X	0.013	0.035	0	0.979
27	M27	X	0.035	0.046	0.979	1.958
28	M27	X	0.046	0.035	1.958	2.937
29	M27	X	0.035	0.013	2.937	3.917
30	M1	X	0.013	0.036	3.438	4.375
31	M1	X	0.036	0.047	4.375	5.312
32	M1	X	0.047	0.047	5.312	6.25
33	M1	X	0.047	0.047	6.25	7.187
34	M1	X	0.047	0.036	7.187	8.125

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

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M14	X	0.007	0.005	2.125	3.188
2	M14	X	0.005	0.002	3.188	4.25
3	M6	X	0.004	0.011	3.438	4.375
4	M6	X	0.011	0.014	4.375	5.312
5	M6	X	0.014	0.014	5.312	6.25
6	M6	X	0.014	0.014	6.25	7.187
7	M6	X	0.014	0.011	7.187	8.125
8	M6	X	0.011	0.004	8.125	9.062
9	M10	X	0.002	0.005	0	0.979
10	M10	X	0.005	0.007	0.979	1.958
11	M10	X	0.007	0.005	1.958	2.937
12	M10	X	0.005	0.002	2.937	3.917
13	M15	X	0.002	0.005	5.551e-17	0.979
14	M15	X	0.005	0.007	0.979	1.958
15	M15	X	0.007	0.005	1.958	2.937
16	M15	X	0.005	0.002	2.937	3.917
17	M26	X	0.002	0.005	5.551e-16	0.979

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

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
18	M26	X	0.005	0.007	0.979	1.958
19	M26	X	0.007	0.005	1.958	2.937
20	M26	X	0.005	0.002	2.937	3.917
21	M27	X	0.002	0.005	0	0.979
22	M27	X	0.005	0.007	0.979	1.958
23	M27	X	0.007	0.005	1.958	2.937
24	M27	X	0.005	0.002	2.937	3.917
25	M3	X	0.002	0.006	3.438	4.375
26	M3	X	0.006	0.008	4.375	5.312
27	M3	X	0.008	0.008	5.312	6.25
28	M3	X	0.008	0.008	6.25	7.188
29	M3	X	0.008	0.006	7.188	8.125
30	M3	X	0.006	0.002	8.125	9.062
31	M4	X	0.004	0.011	3.438	4.375
32	M4	X	0.011	0.015	4.375	5.312
33	M4	X	0.015	0.015	5.312	6.25
34	M4	X	0.015	0.015	6.25	7.188
35	M4	X	0.015	0.011	7.188	8.125
36	M4	X	0.011	0.004	8.125	9.062
37	M11	X	0.002	0.005	1.11e-16	1.062
38	M11	X	0.005	0.007	1.062	2.125
39	M11	X	0.007	0.005	2.125	3.188
40	M11	X	0.005	0.002	3.188	4.25
41	M16	X	0.002	0.005	3.331e-16	1.063
42	M16	X	0.005	0.007	1.063	2.125
43	M16	X	0.007	0.005	2.125	3.188
44	M16	X	0.005	0.002	3.188	4.25
45	M1	X	0.004	0.011	3.438	4.375
46	M1	X	0.011	0.015	4.375	5.312
47	M1	X	0.015	0.015	5.312	6.25
48	M1	X	0.015	0.015	6.25	7.188
49	M1	X	0.015	0.011	7.188	8.125
50	M1	X	0.011	0.004	8.125	9.062
51	M2	X	0.002	0.006	3.438	4.375
52	M2	X	0.006	0.008	4.375	5.312
53	M2	X	0.008	0.008	5.312	6.25
54	M2	X	0.008	0.008	6.25	7.188
55	M2	X	0.008	0.006	7.188	8.125
56	M2	X	0.006	0.002	8.125	9.062
57	M9	X	0.002	0.005	3.331e-16	1.063
58	M9	X	0.005	0.007	1.063	2.125
59	M9	X	0.007	0.005	2.125	3.188
60	M9	X	0.005	0.002	3.188	4.25
61	M14	X	0.002	0.005	1.11e-16	1.062
62	M14	X	0.005	0.007	1.062	2.125

Member Distributed Loads (BLC 8 : BLC 4 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M3	Y	-0.0008677	-0.002	3.438	4.375
2	M3	Y	-0.002	-0.003	4.375	5.312
3	M3	Y	-0.003	-0.003	5.312	6.25
4	M3	Y	-0.003	-0.003	6.25	7.188
5	M3	Y	-0.003	-0.002	7.188	8.125
6	M3	Y	-0.002	-0.0008677	8.125	9.062
7	M4	Y	-0.002	-0.005	3.438	4.375

Member Distributed Loads (BLC 8 : BLC 4 Transient Area Loads) (Continued)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
8	M4	Y	-0.005	-0.006	4.375	5.312
9	M4	Y	-0.006	-0.006	5.312	6.25
10	M4	Y	-0.006	-0.006	6.25	7.188
11	M4	Y	-0.006	-0.005	7.188	8.125
12	M4	Y	-0.005	-0.002	8.125	9.062
13	M11	Y	-0.0008203	-0.002	1.11e-16	1.062
14	M11	Y	-0.002	-0.003	1.062	2.125
15	M11	Y	-0.003	-0.002	2.125	3.188
16	M11	Y	-0.002	-0.0008203	3.188	4.25
17	M16	Y	-0.0008203	-0.002	3.331e-16	1.063
18	M16	Y	-0.002	-0.003	1.063	2.125
19	M16	Y	-0.003	-0.002	2.125	3.188
20	M16	Y	-0.002	-0.0008203	3.188	4.25
21	M1	Y	-0.002	-0.005	3.438	4.375
22	M1	Y	-0.005	-0.006	4.375	5.312
23	M1	Y	-0.006	-0.006	5.312	6.25
24	M1	Y	-0.006	-0.006	6.25	7.188
25	M1	Y	-0.006	-0.005	7.188	8.125
26	M1	Y	-0.005	-0.002	8.125	9.062
27	M2	Y	-0.0008677	-0.002	3.438	4.375
28	M2	Y	-0.002	-0.003	4.375	5.312
29	M2	Y	-0.003	-0.003	5.312	6.25
30	M2	Y	-0.003	-0.003	6.25	7.188
31	M2	Y	-0.003	-0.002	7.188	8.125
32	M2	Y	-0.002	-0.0008677	8.125	9.062
33	M9	Y	-0.0008203	-0.002	3.331e-16	1.063
34	M9	Y	-0.002	-0.003	1.063	2.125
35	M9	Y	-0.003	-0.002	2.125	3.188
36	M9	Y	-0.002	-0.0008203	3.188	4.25
37	M14	Y	-0.0008203	-0.002	1.11e-16	1.062
38	M14	Y	-0.002	-0.003	1.062	2.125
39	M14	Y	-0.003	-0.002	2.125	3.188
40	M14	Y	-0.002	-0.0008203	3.188	4.25
41	M6	Y	-0.002	-0.004	3.438	4.375
42	M6	Y	-0.004	-0.006	4.375	5.312
43	M6	Y	-0.006	-0.006	5.312	6.25
44	M6	Y	-0.006	-0.006	6.25	7.187
45	M6	Y	-0.006	-0.004	7.187	8.125
46	M6	Y	-0.004	-0.002	8.125	9.062
47	M10	Y	-0.0008203	-0.002	0	0.979
48	M10	Y	-0.002	-0.003	0.979	1.958
49	M10	Y	-0.003	-0.002	1.958	2.937
50	M10	Y	-0.002	-0.0008203	2.937	3.917
51	M15	Y	-0.0008203	-0.002	5.551e-17	0.979
52	M15	Y	-0.002	-0.003	0.979	1.958
53	M15	Y	-0.003	-0.002	1.958	2.937
54	M15	Y	-0.002	-0.0008203	2.937	3.917
55	M26	Y	-0.0008203	-0.002	5.551e-16	0.979
56	M26	Y	-0.002	-0.003	0.979	1.958
57	M26	Y	-0.003	-0.002	1.958	2.937
58	M26	Y	-0.002	-0.0008203	2.937	3.917
59	M27	Y	-0.0008203	-0.002	0	0.979
60	M27	Y	-0.002	-0.003	0.979	1.958
61	M27	Y	-0.003	-0.002	1.958	2.937
62	M27	Y	-0.002	-0.0008203	2.937	3.917

Member Distributed Loads (BLC 8 : BLC 4 Transient Area Loads) (Continued)

Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N13	max	80.144	2	724.238	2	4.31	2	0	3	0	3	0	3
2		min	-3.836	1	260.159	1	3.364	1	0	1	0	1	0	1
3	N4	max	80.144	2	724.238	2	-3.364	1	0	3	0	3	0	3
4		min	-3.836	1	260.159	1	-4.31	2	0	1	0	1	0	1
5	N5	max	1.104	1	314.285	1	26.17	2	0	3	0	3	0	3
6		min	-447.233	2	-333.538	2	0.668	1	0	1	0	1	0	1
7	N2	max	1.104	1	314.285	1	-0.668	1	0	3	0	3	0	3
8		min	-447.233	2	-333.538	2	-26.17	2	0	1	0	1	0	1
9	N3	max	1.289	1	1789.378	2	0	2	0	3	0	3	0	3
10		min	-76.054	2	643.466	1	0	1	0	1	0	1	0	1
11	N28	max	4.175	1	6.137	1	0	2	0	3	LOCKED		LOCKED	
12		min	-526.104	2	-772.287	2	0	1	0	1	LOCKED		LOCKED	
13	Totals:	max	0	1	1995.96	3	0	2						
14		min	-1336.336	2	1798.491	1	0	1						

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 [lb]	Pnt/om [lb]	Mnyy/om [k-ft]	Mnzz/om [k-ft]	Cb	Eqn
1	M1	HSS4X4X4	0.124	2.5	2	0.01	3.438	y	2	7299.42	60538.922	5.663	5.663	1.741	H1-1b
2	M2	HSS4X4X4	0.062	2.5	2	0.005	10	y	2	7299.42	60538.922	5.663	5.663	1.618	H1-1b
3	M3	HSS4X4X4	0.062	2.5	2	0.005	10	y	2	7299.42	60538.922	5.663	5.663	1.618	H1-1b
4	M4	HSS4X4X4	0.124	2.5	2	0.01	3.438	y	2	7299.42	60538.922	5.663	5.663	1.741	H1-1b
5	M6	HSS4X4X4	0.265	2.5	2	0.018	6.25	y	2	7299.42	60538.922	5.663	5.663	1.796	H1-1a
6	M9	COMB.OF2FRPANGLE	0.336	4.25	2	0.011	3.63	z	2	22797.782	67365.269	0.69	7.906	1.978	H1-1b
7	M10	COMB.OF2FRPANGLE	0.113	0	2	0.014	1.673	z	2	25394.838	67365.269	0.69	7.906	2.048	H1-1b
8	M11	COMB.OF2FRPANGLE	0.336	0	2	0.011	0.62	z	2	22797.782	67365.269	0.69	7.906	1.978	H1-1b
9	M14	COMB.OF2FRPANGLE	0.229	0	2	0.009	3.94	z	2	22797.782	67365.269	0.69	7.906	1.539	H1-1b
10	M15	COMB.OF2FRPANGLE	0.027	2.162	2	0.004	3.917	z	2	25394.838	67365.269	0.69	7.601	1.279	H1-1b
11	M16	COMB.OF2FRPANGLE	0.229	4.25	2	0.009	0.31	z	2	22797.782	67365.269	0.69	7.906	1.539	H1-1b
12	M12	L4X4X4	0.216	2.89	2	0.046	5.779	y	2	27110.097	41604.79	2.088	4.132	1.457	H2-1
13	M13	L4X4X4	0.216	2.89	2	0.046	2.89	y	2	27110.097	41604.79	2.088	4.132	1.457	H2-1
14	M17	L4X4X4	0.327	2.89	2	0.046	5.779	y	2	27110.097	41604.79	2.088	4.148	1.484	H2-1
15	M18	L4X4X4	0.327	2.89	2	0.046	2.89	y	2	27110.097	41604.79	2.088	4.148	1.484	H2-1
16	M19	L4X4X4	0.017	4.931	2	0	4.931	y	2	3278.423	34670.659	1.74	0.799	1	H2-1
17	M20	L4X4X4	0.026	4.646	2	0	4.646	y	2	3424.797	34670.659	1.74	0.845	1	H2-1
18	M21	L4X4X4	0.026	4.646	2	0	4.646	y	2	3424.797	34670.659	1.74	0.845	1	H2-1
19	M22	L4X4X4	0.017	4.931	2	0	4.931	y	2	3278.423	34670.659	1.74	0.799	1	H2-1
20	M23	PIPE_2.5	0.269	7.5	2	0.036	7.5		2	21294.259	33742.515	2.393	2.393	1	H1-1b
21	M24	PIPE_2.5	0.269	7.5	2	0.036	7.5		2	21294.259	33742.515	2.393	2.393	1	H1-1b
22	M26	COMB.OF2FRPANGLE	0.113	3.917	2	0.014	2.244	z	2	25394.838	67365.269	0.69	7.906	2.048	H1-1b
23	M27	COMB.OF2FRPANGLE	0.027	1.754	2	0.004	0	z	2	25394.838	67365.269	0.69	7.601	1.279	H1-1b
24	M25	L4X4X6	0.018	7.558	2	0	7.558	y	3	2843.207	51377.246	2.439	1.153	1	H2-1

SAFETY FACTORS

Safety factors are defined as the ratio of the ultimate stress to the working or allowable stress.

$$\text{SAFETY FACTOR (S.F.)} = \frac{\text{ULTIMATE STRESS (U.S.)}}{\text{ALLOWABLE STRESS (A.S.)}}$$

$$\text{therefore, A.S.} = \frac{\text{U.S.}}{\text{S.F.}}$$

Safety factors compensate for:

- allowable tolerances of the part
- uncertainty of the anticipated loading (magnitude, type or placement)
- assumptions in methods of analysis
- fabrication tolerances (squareness of cuts, normal tolerances, etc.)

In Section 3 - **PROPERTIES OF EXTREN®**, Strongwell lists the **minimum** ultimate values for stresses obtained from coupon or full section testing. Typical property values are generally 20% -25% higher than those listed. Even though these are minimum ultimate stresses, these values **should not** be utilized for design purposes before dividing them by the appropriate safety factor.

The safety factors used in the various design tables were chosen to prevent first deformation of the part. First deformation is defined as the first visible deformation including local flange or web buckling, twisting, crushing, etc. The recommended safety factors used for design are:

	RECOMMENDED SAFETY FACTORS ①
Flexural members, beams	2.5 ②
Compression members, columns	3.0 ②
Shear	3.0
Connections	4.0
Modulus of Elasticity	1.0 ③
Shear Modulus	1.0 ③

NOTES:

① The safety factors given are for **static load conditions only**. Safety factors for impact loads and dynamic loads are typically **two times** the static load safety factor, see *Mechanics of Materials*, Reference 7. Long term service loads which result in creep deformations will require higher safety factors to insure satisfactory performance. For creep effects, see *Structural Plastics Design Manual,* Reference 2.

② Strongwell has developed empirical equations which calculate the allowable stresses for **EXTREN®** when used as compression members (columns) and as flexural members (beams). These equations, used to generate the allowable load tables found in this design manual, are the result of full section testing. This testing more accurately reflects the performance of the column or beam and should be used instead of coupon properties. The designer should use the allowable load found in the appropriate table, which includes a safety factor of 3.0 for columns and 2.5 for beams.

It must be noted that these equations are applicable only for **EXTREN®** and are a function of the proprietary resins and glass placement in the **EXTREN®** composite plus the size and shape of the part. The use of these empirical equations for pultruded products other than **EXTREN®** is not recommended and could result in a structural failure.

SERIES 500/525/600/625 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 600/625
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	D5379	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	0.60	0.60
Density	D792	lbs/in^3	0.062-0.070	0.062-0.070
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

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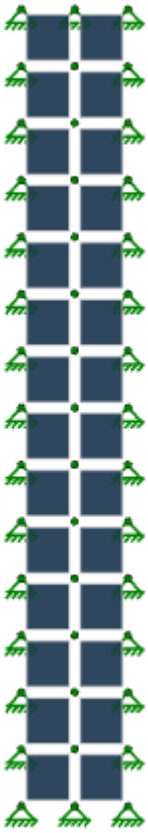
STRUCTURAL ANALYSIS OF 7.5’ x 1’ FRP PANEL



RESULT SUMMARY

Permissible deflection of FRP plate is 2 in.

Actual defection << Permissible deflection.

Therefore, The FRP panel has sufficient capacity for the proposed applied load.

Site Number: SESEA00351A
Site FRP Panel = 7.5’x1’ </=7.5’x1’: OK
Site Unit Wind Load = 21.5 psf </= 40 psf: OK

Envelope Node Displacements

	Node Label		X [in]	LC	Y [in]	LC	Z [in]	LC	X Rotation [rad]	LC	Y Rotation [rad]	LC	Z Rotation [rad]	LC
1	N1	max	0	1	0	3	0	3	0	3	2.44e-6	2	2.364e-6	2
2		min	0	2	0	1	0	1	0	1	0	1	0	1
3	N3	max	0	1	0	3	0	3	0	3	2.44e-6	2	0	1
4		min	0	2	0	1	0	1	0	1	0	1	-2.364e-6	2
5	N20	max	0	1	0	3	0	3	0	3	2.419e-3	2	0	2
6		min	0	2	0	1	0	1	0	1	0	1	0	1
7	N19	max	0	1	0	3	0	3	0	3	2.419e-3	2	0	1
8		min	0	2	0	1	0	1	0	1	0	1	0	2
9	N31	max	0	1	0	3	0	3	0	3	2.393e-3	2	1.023e-8	2
10		min	0	2	0	1	0	1	0	1	0	1	0	1
11	N32	max	0	1	0	3	0	3	0	3	2.419e-3	2	0	1
12		min	0	2	0	1	0	1	0	1	0	1	-1.24e-8	2
13	N47	max	0	1	0	3	0	3	0	3	2.393e-3	2	0	1
14		min	0	2	0	1	0	1	0	1	0	1	-1.023e-8	2
15	N48	max	0	1	0	3	0	3	0	3	2.419e-3	2	1.24e-8	2
16		min	0	2	0	1	0	1	0	1	0	1	0	1
17	N9	max	0	1	0	3	0	3	0	3	0	1	0	2
18		min	-0.007	2	0	1	0	1	0	1	0	2	0	1
19	N10	max	0	1	0	3	0	3	0	3	0	1	1.09e-3	2
20		min	0	2	0	1	0	1	0	1	0	2	0	1
21	N11	max	0	1	0	3	0	3	0	3	0	2	0	1
22		min	0	2	0	1	0	1	0	1	0	1	-1.09e-3	2
23	N12	max	0	1	0	3	0	3	0	3	0	1	0	1
24		min	-0.007	2	0	1	0	1	0	1	0	2	0	2
25	N13	max	0	1	0	3	0	3	0	3	0	1	1.472e-7	2
26		min	-0.007	2	0	1	0	1	0	1	0	2	0	1
27	N14	max	0	1	0	3	0	3	0	3	0	2	1.894e-5	2
28		min	-0.007	2	0	1	0	1	0	1	0	1	0	1
29	N15	max	0	1	0	3	0	3	0	3	0	2	0	1
30		min	-0.007	2	0	1	0	1	0	1	0	1	-1.472e-7	2
31	N16	max	0	1	0	3	0	3	0	3	0	1	0	1
32		min	-0.007	2	0	1	0	1	0	1	0	2	-1.894e-5	2
33	N17	max	0	1	0	3	0	3	0	3	0	1	0	1
34		min	0	2	0	1	0	1	0	1	-2.419e-3	2	0	2
35	N18	max	0	1	0	3	0	3	0	3	0	1	2.364e-6	2
36		min	0	2	0	1	0	1	0	1	-2.44e-6	2	0	1
37	N21	max	0	1	0	3	0	3	0	3	0	1	0	1
38		min	0	2	0	1	0	1	0	1	-2.44e-6	2	-2.364e-6	2
39	N22	max	0	1	0	3	0	3	0	3	0	1	0	2
40		min	0	2	0	1	0	1	0	1	-2.419e-3	2	0	1
41	N23	max	0	1	0	3	0	3	0	3	0	1	0	1
42		min	0	2	0	1	0	1	0	1	-2.419e-3	2	-1.24e-8	2
43	N24	max	0	1	0	3	0	3	0	3	0	1	1.023e-8	2
44		min	0	2	0	1	0	1	0	1	-2.393e-3	2	0	1
45	N25	max	0	1	0	3	0	3	0	3	0	1	1.24e-8	2
46		min	0	2	0	1	0	1	0	1	-2.419e-3	2	0	1
47	N26	max	0	1	0	3	0	3	0	3	0	1	0	1
48		min	0	2	0	1	0	1	0	1	-2.393e-3	2	-1.023e-8	2
49	N69	max	0	1	0	3	0	3	0	3	0	1	8.897e-7	2
50		min	0	2	0	1	0	1	0	1	-1.77e-3	2	0	1
51	N68	max	0	1	0	3	0	3	0	3	2.416e-3	2	2.103e-8	2
52		min	0	2	0	1	0	1	0	1	0	1	0	1
53	N67	max	0	1	0	3	0	3	0	3	1.77e-3	2	8.897e-7	2
54		min	0	2	0	1	0	1	0	1	0	1	0	1
55	N66	max	0	1	0	3	0	3	0	3	0	1	5.619e-4	2
56		min	-0.005	2	0	1	0	1	0	1	0	2	0	1
57	N65	max	0	1	0	3	0	3	0	3	0	1	0	2
58		min	0	2	0	1	0	1	0	1	-2.419e-3	2	0	1

Envelope Node Displacements (Continued)

	Node Label		X [in]	LC	Y [in]	LC	Z [in]	LC	X Rotation [rad]	LC	Y Rotation [rad]	LC	Z Rotation [rad]	LC
59	N64	max	0	1	0	3	0	3	0	3	2.419e-3	2	0	2
60		min	0	2	0	1	0	1	0	1	0	1	0	1
61	N63	max	0	1	0	3	0	3	0	3	0	1	2.103e-8	2
62		min	0	2	0	1	0	1	0	1	-2.416e-3	2	0	1
63	N62	max	0	1	0	3	0	3	0	3	0	1	2.562e-6	2
64		min	-0.007	2	0	1	0	1	0	1	0	2	0	1
65	N61	max	0	1	0	3	0	3	0	3	1.77e-3	2	0	1
66		min	0	2	0	1	0	1	0	1	0	1	-8.897e-7	2
67	N60	max	0	1	0	3	0	3	0	3	0	1	0	1
68		min	0	2	0	1	0	1	0	1	-2.416e-3	2	-2.103e-8	2
69	N59	max	0	1	0	3	0	3	0	3	0	1	0	1
70		min	0	2	0	1	0	1	0	1	-1.77e-3	2	-8.897e-7	2
71	N58	max	0	1	0	3	0	3	0	3	0	2	0	1
72		min	-0.005	2	0	1	0	1	0	1	0	1	-5.619e-4	2
73	N57	max	0	1	0	3	0	3	0	3	2.419e-3	2	0	1
74		min	0	2	0	1	0	1	0	1	0	1	0	2
75	N56	max	0	1	0	3	0	3	0	3	0	1	0	1
76		min	0	2	0	1	0	1	0	1	-2.419e-3	2	0	2
77	N55	max	0	1	0	3	0	3	0	3	0	2	0	2
78		min	-0.007	2	0	1	0	1	0	1	0	1	0	1
79	N54	max	0	1	0	3	0	3	0	3	2.416e-3	2	0	1
80		min	0	2	0	1	0	1	0	1	0	1	-2.103e-8	2
81	N53	max	0	1	0	3	0	3	0	3	0	1	0	1
82		min	-0.007	2	0	1	0	1	0	1	0	2	-2.562e-6	2
83	N52	max	0	1	0	3	0	3	0	3	2.419e-3	2	0	2
84		min	0	2	0	1	0	1	0	1	0	1	0	1
85	N51	max	0	1	0	3	0	3	0	3	0	1	0	2
86		min	-0.007	2	0	1	0	1	0	1	0	2	0	1
87	N50	max	0	1	0	3	0	3	0	3	0	1	0	1
88		min	0	2	0	1	0	1	0	1	-2.419e-3	2	0	2
89	N49	max	0	1	0	3	0	3	0	3	0	1	0	1
90		min	-0.007	2	0	1	0	1	0	1	0	2	0	2

Site: SESEA00351A SM 4/20/2023

Wind Load on Non-Structural Components

ASCE 7-16 Chapters 26, 29, & 30

Risk Category:	II		ASCE 7-16 Table 1.5-1
Basic Wind Speed V_{ULT}:	98	*mph*	ASCE 7-16 Figure 26.5-1A or B
Exposure Category:	C		

ASCE 7-16 Table 26.11-1

Exposure	α	z_g:	z_{min}
B	7	1200	30
C	9.5	900	15
D	11.5	700	7

α: **9.5** z_g: **900** *ft*

z_{min}: **15.0** *ft*

Topographic Factor K_{zt}:		1.00		ASCE 7-16 26.8
Directionality Factor K_d:	1.00 Round Radomes	0.85	All Else	ASCE 7-16 Table 26.6-1:
Ground Elevation Factor K_e:		1.00		ASCE 7-16 Table 26.9-1:

Rooftop Equipment or Wall Box (based on Solid Attached Signs)

Mean Roof Height q_h:	56	*ft*	
Exposure Coefficient $K_z = 2.01(z/z_g)^{2/\alpha}$:	1.12		ASCE 7-16 Table 26-10-1
Velocity Pressure $q_h = .00256K_zK_{zt}K_dK_eV^2$:	23.4	*psf*	ASCE 7-16 Equation 26.10-1
Rooftop Equipment Factor (GC_r):	1.90		ASCE 7-16 Formula 29.4-2
Design Wind Pressure $q_h(GC_r)$:	44.5	*psf*	ASCE 7-16 Formula 29.4-2

Wind Component Load Strength Design

Item	Face	Projected Area A_f ft^2	Lateral Wind F_h *#s*	
				ASCE 7-16 Formula 29.4-2
Charles PM639 F	F	16.3	725	
Charles PM639 S	S	23.3	1037	
5' H-Frame S	S	10.0	445	

Site: **SESEA00351A** SM 4/20/2023

Wind Load on Fence; FRP Screen; Wall; H-Frame

ASCE 7-16 Chapters 26 & 29

Risk Category:	II		ASCE 7-16 Table 1.5-1
Basic Wind Speed V_{ULT}:	98	*mph*	ASCE 7-16 Figure 26.5-1A or B
Exposure Category:	C		
Top of Wall / Screen / Height AGL h:	62	*ft*	Roof Height + H-Frame Height + 1'

ASCE 7-16 Table 26.11-1

Exposure	α	z_g:	z_{min}
B	7	1200	30
C	9.5	900	15
D	11.5	700	7

α: **9.5** z_g: **900** *ft*

z_{min}: **15.0** *ft*

Exposure Coefficient $K_z = 2.01(z/z_g)^{2/\alpha}$:	1.14		ASCE 7-16 Table 26-10-1
Topographic Factor K_{zt}:	1.00		ASCE 7-16 26.8
Directionality Factor K_d:	0.85		ASCE 7-16 Table 26.6-1: Walls; Fence; Screens
Ground Elevation Factor K_e:	1.00		ASCE 7-16 Table 26.9-1:
Velocity Pressure $q_i = .00256K_zK_{zt}K_dK_eV^2$:	23.9	*psf*	ASCE 7-16 Equation 26.10-1
Gust Effect Factor G:	0.85		ASCE 7-16 29.7 ASCE 7-16 26.11

Table Notes:
ASCE 7-16 Figure 29.3-1
ASCE7-16 Equation 29.3-1
Case B ignored for other than 2-post items
Case C ignored for B/s < 2
F acts at .55h above base for s/h = 1

Item	h *ft*	s *ft*	B *ft*	B/s	s/h	1.8-s/h for s/h > .8	C_f Case A & B	C_f Case C 0 to s	p psf
5' H-Frame F	5.0	5.00	5.0	1.0	1.00	0.8	1.35	N/A	27.4

2-Post Case B for H-Frame

	F Case A #s	F_{SPOST} Case B #s (.7F Case A)	CP in	M_{SPOST} Case B in-#s
5' H-Frame F	686	480	33.0	15849

Site: **SESEA00351A** SM 4/20/2023

Seismic Load on Non-Stuctural Components:

ASCE 7-16 Chapter 13

Risk Category			**II**	ASCE 7-16 Table 1.5-1
Seismic Site Class:			**D**	ASCE 7-16 11.4.3 Default
Site Lat:	47.5772°	Site Long:	-122.2088°	
S_{DS} from OSHPD Seismic Design Maps and Site Lat / Long:			**1.118**	
Item Importance I_p:			**1.00**	ASCE 7-16 13.1.3

Seismic Horizontal Force $F_{pmax} = 1.6I_pS_{DS}W_p$: ASCE 7-16 Equation 13.3-2

Seismic Horizontal Force $F_p = .4I_pa_pS_{DS}W_p(1+2(z/h))/R_p$: ASCE 7-16 Equation 13.3-1

Seismic Horizontal Force $F_{pmin} = 0.3I_pS_{DS}W_p$: ASCE 7-16 Equation 13.3-3

Seismic Vertical Force $E_v = +/-.2S_{DS}W_p$: ASCE 7-16 13.3.1.2

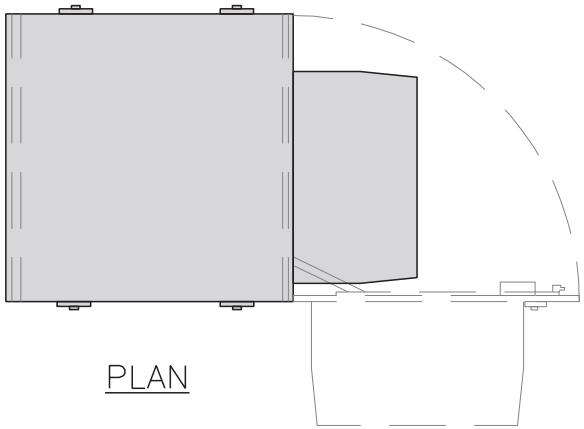
W_p:		Wieght of Item *#s*
Amplification Factor a_p:	**2.5**	ASCE 7-16 Table 13.6-1
Response Modification Factor R_p:	**6**	ASCE 7-16 Table 13.6-1
z/h:		Elevation Ratio of Item / Roof: Ground = 0; Roof = 1; Ratio Between

Seismic Component Load Strength Design

Item	W_p *#s*	z/h	Fp *#s*	Ev *#s*
Charles PM639 F	**1067**	1	**596**	**239**
5' H-Frame F	**340**	1	**190**	**76**

CHARLES INDUSTRY HEX CUBE–PM639155N4

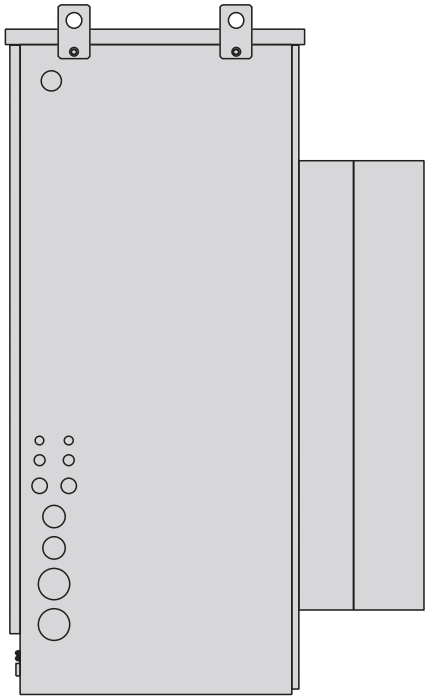
DIMENSIONS (HxWxD):	74"x32"x32"
POWER PLANT:	–48VDC ABB/600W
TOTAL WEIGHT (EMPTY)	408 LBS



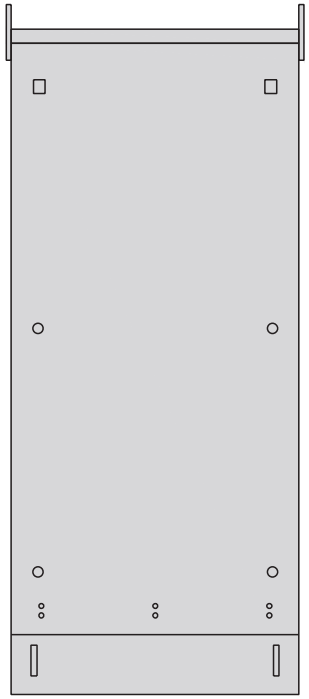
PLAN

FULLY LOADED 1067 LBS

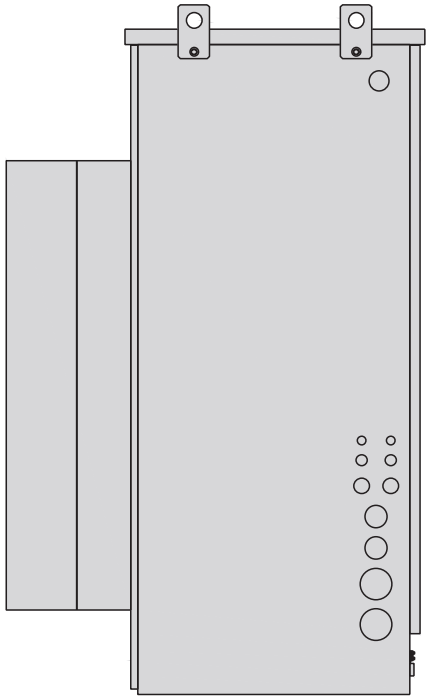
ANCHORAGE SPACING: 27.5" F TO B; 29" S TO S; (4) 5/8" DIA



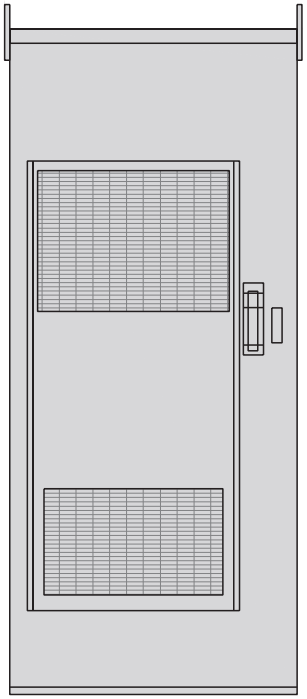
SIDE



BACK

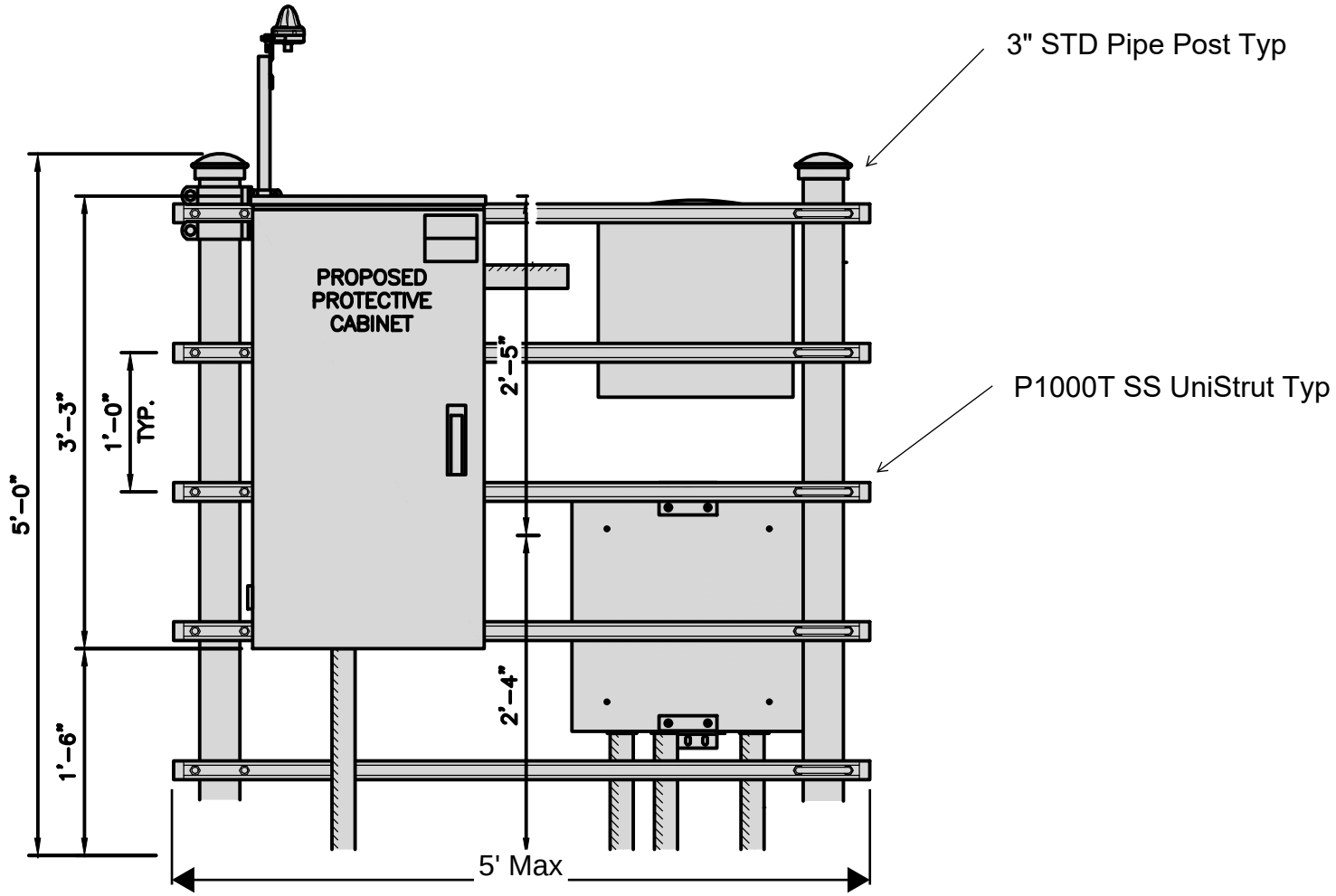


SIDE

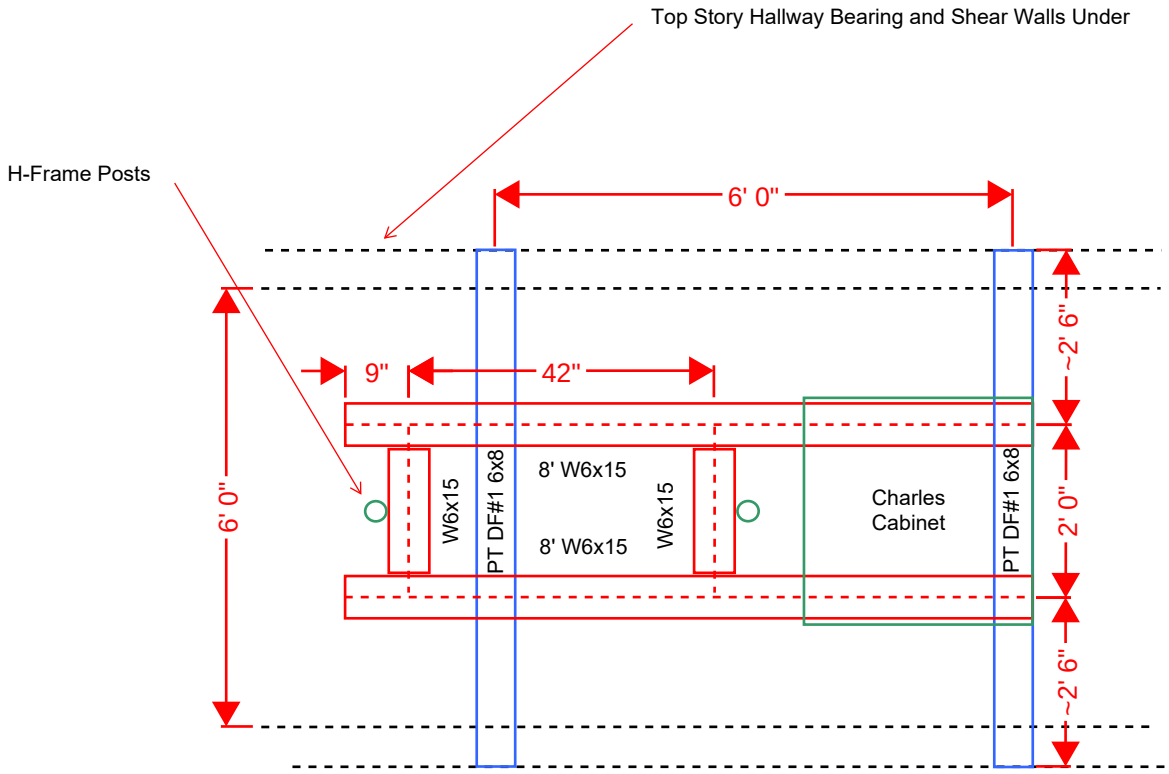


FRONT

TYP 5' X 5' H-FRAME



Calc Area: 25 sq ft; Equipment May Vary Up To Calc Maximum of 340#s; Bottom Connection Site Dependent



For connection detailing see drawing S-sheets

For connection analysis see specific SA pages

EQUIPMENT PLATFORM SKETCH

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

LIC# : KW-06018763, Build:20.23.2.14 Steve Marquis (c) ENERCALC INC 1983-2022

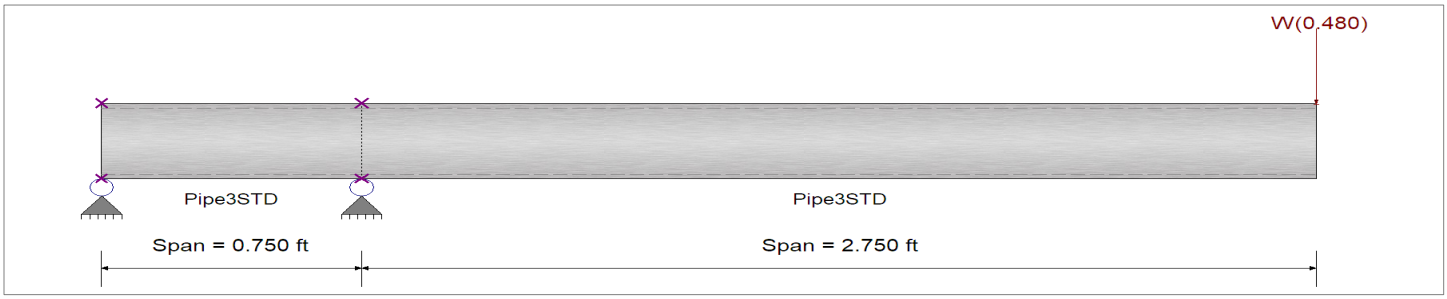
DESCRIPTION: 5' H-Frame Post

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	35.0 ksi
Beam Bracing :	Completely Unbraced	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
Load(s) for Span Number 2
Point Load : W = 0.480 k @ 2.750 ft, (Wind)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.230 : 1	Maximum Shear Stress Ratio =	0.090 : 1
Section used for this span	Pipe3STD	Section used for this span	Pipe3STD
Mu : Applied	1.320 k-ft	Vu : Applied	1.760 k
Mn * Phi : Allowable	5.749 k-ft	Vn * Phi : Allowable	19.562 k
Load Combination	W Only	Load Combination	W Only
		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	0.088 in	Ratio =	747	>=360	Span: 2 : W Only
Max Upward Transient Deflection	-0.001 in	Ratio =	8,990	>=360	Span: 2 : W Only
Max Downward Total Deflection	0.000 in	Ratio =	0	<180	
Max Upward Total Deflection	0.000 in	Ratio =	0	<180	

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Max Upward from all Load Conditions		2.240	
Max Upward from Load Cases		2.240	
Max Downward from all Load Conditions (Resi	-1.760		
Max Downward from Load Cases (Resisting Up	-1.760		
W Only	-1.760	2.240	

3120#s at 1/2" A307 Bolt Angle to WF due to shorter couple distance of 6"

H-FRAME POST TO W6X15 CONNECTION

1/2" A307 U-Bolt Shear Allowable at Supports 1 and 2 ((2) bolts effective; one for each leg of U-bolt; ASD value):

.5x4710x2 = 4710#s (A307 allowable = .5xA325 allowable)

Applied ASD Shear at Support 2 (U-Bolts) = .6x2240#s = 1344#s; Vs/Va = 1344/4710 = .285 < 1.000 OK

Applied ASD Shear at Support 2 (A307 Bolts) = .6x3120#s = 1872#s; Vs/Va = 1872/4710 = .397 < 1.000 OK

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

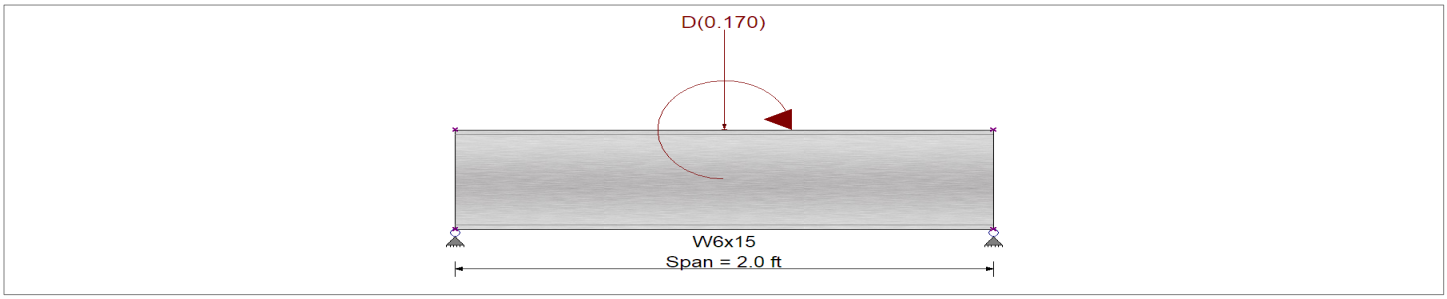
DESCRIPTION: H-Frame W6x15

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	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 calculated and added to loading
Load(s) for Span Number 1
Point Load : D = 0.170 k @ 1.0 ft, (D)

Moment : W = 1.320 k-ft, Loc = 1.0 ft in span, (W Post Moment)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.020 : 1	Maximum Shear Stress Ratio =	0.019 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	0.771 k-ft	Vu : Applied	0.780 k
Mn * Phi : Allowable	38.124 k-ft	Vn * Phi : Allowable	41.331 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		Location of maximum on span	2.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.000 in	Ratio =	231895	>=180	Span: 1 : +D+0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<180	

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.100	0.660
Max Upward from Load Cases	0.100	0.660
Max Downward from all Load Conditions (Resi	-0.660	
Max Downward from Load Cases (Resisting Up	-0.660	
D Only	0.100	0.100
W Only	-0.660	0.660

Represents 70% load on single post per ASCE 7-16 Figure / Equation 29.3-1

For 50% shared load between (2) posts reduces to .5 /.7 x 660 = 471#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

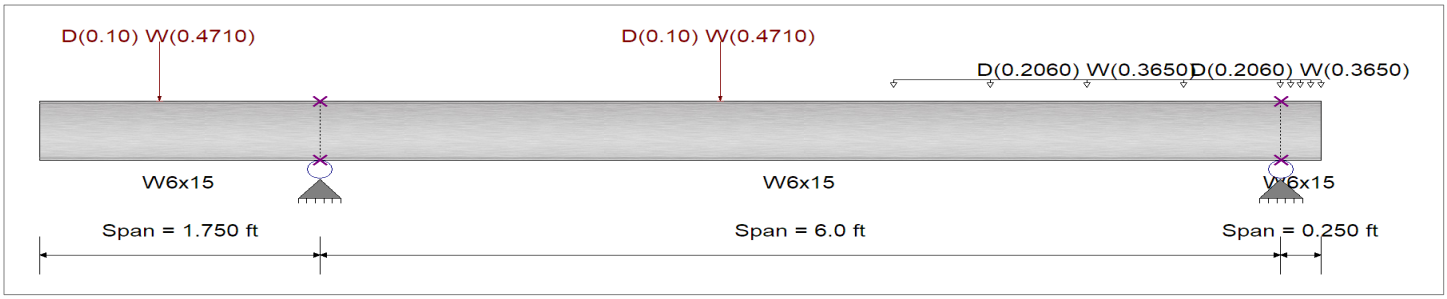
DESCRIPTION: Equipment W6x15 Dn X

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	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 calculated and added to loading
Load(s) for Span Number 1
Point Load : D = 0.10, W = 0.4710 k @ 0.750 ft, (H-Frame)

Load for Span Number 2
Uniform Load : D = 0.2060, W = 0.3650 k/ft, Extent = 3.583 -->> 6.0 ft, Tributary Width = 1.0 ft, (CC)

Point Load : D = 0.10, W = 0.4710 k @ 2.50 ft, (H-Frame)

Load for Span Number 3
Uniform Load : D = 0.2060, W = 0.3650 k/ft, Tributary Width = 1.0 ft, (CC)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.039 : 1	Maximum Shear Stress Ratio =	0.033 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	1.496 k-ft	Vu : Applied	1.382 k
Mn * Phi : Allowable	38.124 k-ft	Vn * Phi : Allowable	41.331 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		Location of maximum on span	6.000 ft
Span # where maximum occurs	Span # 2	Span # where maximum occurs	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.007 in	Ratio =	10019	>=180	Span: 3 : +D+0.60W
Max Upward Total Deflection	-0.001 in	Ratio =	5649	>=180	Span: 3 : +D+0.60W

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Max Upward from all Load Conditions		1.000	0.915	
Max Upward from Load Cases		1.000	0.915	
D Only		0.349	0.520	
W Only		1.000	0.915	

Max ASD Down = 520 + .6x915 = 1069#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

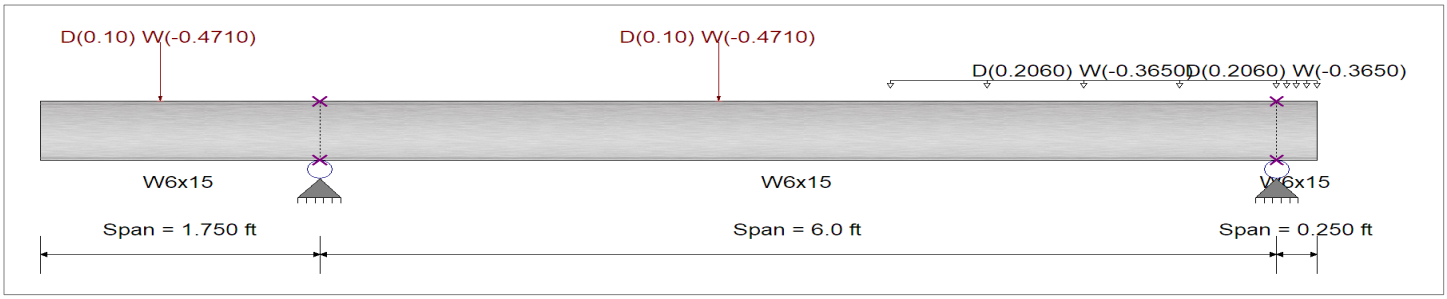
DESCRIPTION: Equipment W6x15 Up X

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	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 calculated and added to loading
Load(s) for Span Number 1
Point Load : D = 0.10, W = -0.4710 k @ 0.750 ft, (H-Frame)

Load for Span Number 2
Uniform Load : D = 0.2060, W = -0.3650 k/ft, Extent = 3.583 -->> 6.0 ft, Tributary Width = 1.0 ft, (CC)

Point Load : D = 0.10, W = -0.4710 k @ 2.50 ft, (H-Frame)

Load for Span Number 3
Uniform Load : D = 0.2060, W = -0.3650 k/ft, Tributary Width = 1.0 ft, (CC)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.010 : 1	Maximum Shear Stress Ratio =	0.008 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	0.386 k-ft	Vu : Applied	0.3374 k
Mn * Phi : Allowable	38.124 k-ft	Vn * Phi : Allowable	41.331 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		Location of maximum on span	0.758 ft
Span # where maximum occurs	Span # 2	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.000 in	Ratio =	89351	>=180	Span: 3 : +D+0.60W
Max Upward Total Deflection	-0.001 in	Ratio =	138379	>=180	Span: 3 : +D+0.60W

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Max Upward from all Load Conditions		0.349	0.520	
Max Upward from Load Cases		0.349	0.520	
Max Downward from all Load Conditions (Resis		-1.000	-0.915	
Max Downward from Load Cases (Resisting Up		-1.000	-0.915	
D Only		0.349	0.520	
W Only		-1.000	-0.915	

Max ASD Uplift (Lag Screw Tension) = .6x(1000-349) = 391#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

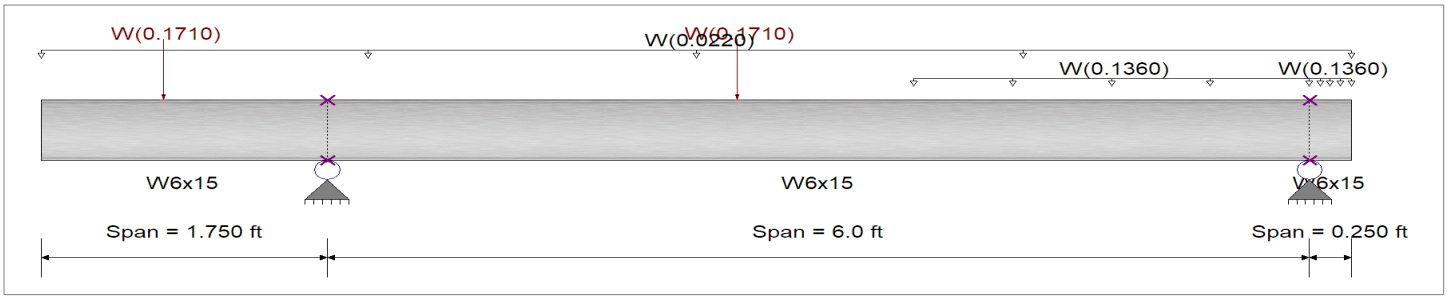
DESCRIPTION: Equipment W6x15 Y

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Minor Axis Bending		



Applied Loads

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

Beam self weight NOT internally calculated and added
Loads on all spans...
Uniform Load on ALL spans : W = 0.0220 k/ft

Load(s) for Span Number 1
Point Load : W = 0.1710 k @ 0.750 ft, (H-Frame)

Load for Span Number 2
Uniform Load : W = 0.1360 k/ft, Extent = 3.583 -->> 6.0 ft, Tributary Width = 1.0 ft, (CC)

Point Load : W = 0.1710 k @ 2.50 ft, (H-Frame)

Load for Span Number 3
Uniform Load : W = 0.1360 k/ft, Tributary Width = 1.0 ft, (CC)

Beam Combined Usage:

X + Y = .039 + .026 = .065 < 1.000 OK

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.026 : 1	Maximum Shear Stress Ratio =	0.004 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	0.420 k-ft	Vu : Applied	0.3665 k
Mn * Phi : Allowable	16.283 k-ft	Vn * Phi : Allowable	93.444 k
Load Combination	W Only	Load Combination	W Only
		Location of maximum on span	6.000 ft
Span # where maximum occurs	Span # 2	Span # where maximum occurs	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.006 in	Ratio =	12895	>=180	Span: 3 : +0.60W
Max Upward Total Deflection	-0.001 in	Ratio =	7421	>=180	Span: 3 : +0.60W

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Max Upward from all Load Conditions		0.475	0.406	
Max Upward from Load Cases		0.475	0.406	
W Only		0.475	0.406	

Max ASD (Lag Screw) Shear = .6x475 = 285#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Wood Beam

Project File: SESEA00351A.ec6

LIC# : KW-06018763, Build:20.23.2.14 Steve Marquis

DESCRIPTION: Equipment 6x8 Sleeper H-Frame End

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

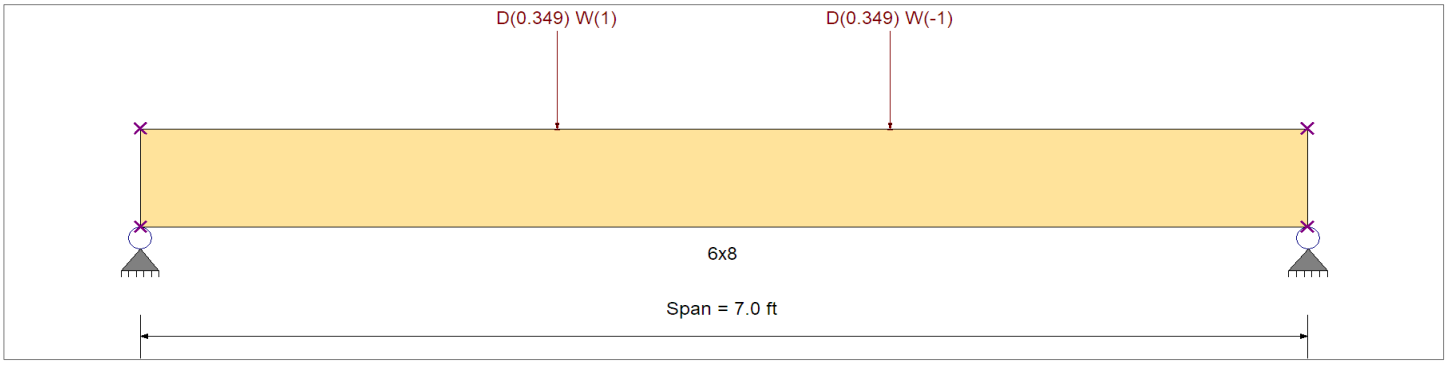
Wood Species : Douglas Fir-Larch
Wood Grade : No.1

Beam Bracing : Completely Unbraced

Fb +	1,200.0 psi
Fb -	1,200.0 psi
Fc - Prll	1,000.0 psi
Fc - Perp	625.0 psi
Fv	170.0 psi
Ft	825.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf



Applied Loads

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

Beam self weight calculated and added to loading
Point Load : D = 0.3490, W = 1.0 k @ 2.50 ft, (W6x15 Down)
Point Load : D = 0.3490, W = -1.0 k @ 4.50 ft, (W6x15 Up)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.205 : 1	Maximum Shear Stress Ratio	=	0.091 : 1
Section used for this span		6x8	Section used for this span		6x8
fb: Actual	=	314.14 psi	fv: Actual	=	19.86 psi
F'b	=	1,528.73 psi	F'v	=	217.60 psi
Load Combination		+D+0.60W	Load Combination		+D+0.60W
Location of maximum on span	=	2.504 ft	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 in	Ratio =	0 <360	n/a
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.028 in	Ratio =	2952 >=180	Span: 1 : +D+0.60W
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.60W														0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.205	0.091	1.60	1.00	1.00	1.00	1.000	1.00	0.80	1.00	1.35	314.1	1,528.7	0.55	19.9	217.6
+0.60D+0.60W					1.00	1.00	1.00	1.000	1.00	0.80	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.149	0.073	1.60	1.00	1.00	1.00	1.000	1.00	0.80	1.00	0.98	228.2	1,528.7	0.43	15.8	217.6

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.60W	1	0.0284	3.091		0.0000	0.000

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Wood Beam

Project File: SESEA00351A.ec6

DESCRIPTION: Equipment 6x8 Sleeper H-Frame End

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.380	0.380
Max Upward from Load Cases	0.380	0.380
Max Downward from all Load Conditio		-0.286
Max Downward from Load Cases (Resis		-0.286
D Only	0.380	0.380
W Only	0.286	-0.286

Max ASD Uplift = .6x(380-286) = 56#s **NO UPLIFT**

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Wood Beam

Project File: SESEA00351A.ec6

LIC# : KW-06018763, Build:20.23.2.14 Steve Marquis

DESCRIPTION: Equipment 6x8 Sleeper CC End

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

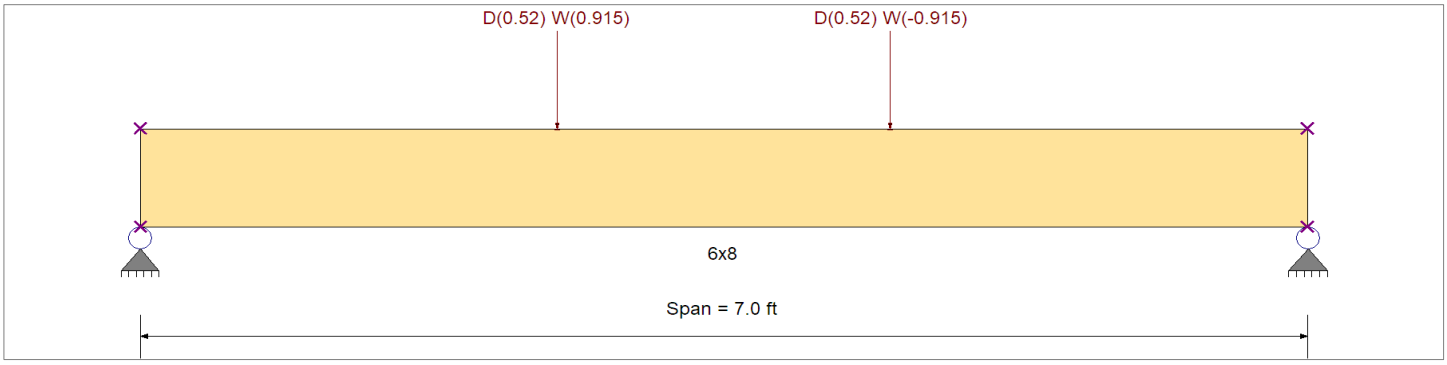
Wood Species : Douglas Fir-Larch
Wood Grade : No.1

Beam Bracing : Completely Unbraced

Fb +	1,200.0 psi
Fb -	1,200.0 psi
Fc - Prll	1,000.0 psi
Fc - Perp	625.0 psi
Fv	170.0 psi
Ft	825.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf



Applied Loads

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

Beam self weight calculated and added to loading
Point Load : D = 0.520, W = 0.9150 k @ 2.50 ft, (W6x15 Down)
Point Load : D = 0.520, W = -0.9150 k @ 4.50 ft, (W6x15 Up)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.265 : 1	Maximum Shear Stress Ratio	=	0.117 : 1
Section used for this span		6x8	Section used for this span		6x8
fb: Actual	=	405.19 psi	fv: Actual	=	25.55 psi
F'b	=	1,528.73 psi	F'v	=	217.60 psi
Load Combination		+D+0.60W	Load Combination		+D+0.60W
Location of maximum on span	=	2.504 ft	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 in	Ratio =	0 <360	n/a
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.041 in	Ratio =	2045 >=180	Span: 1 : +D+0.60W
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.60W														0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.265	0.117	1.60	1.00	1.00	1.00	1.000	1.00	0.80	1.00	1.74	405.2	1,528.7	0.70	25.6	217.6
+0.60D+0.60W					1.00	1.00	1.00	1.000	1.00	0.80	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.183	0.081	1.60	1.00	1.00	1.00	1.000	1.00	0.80	1.00	1.20	279.5	1,528.7	0.48	17.6	217.6

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.60W	1	0.0411	3.245		0.0000	0.000

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Wood Beam

Project File: SESEA00351A.ec6

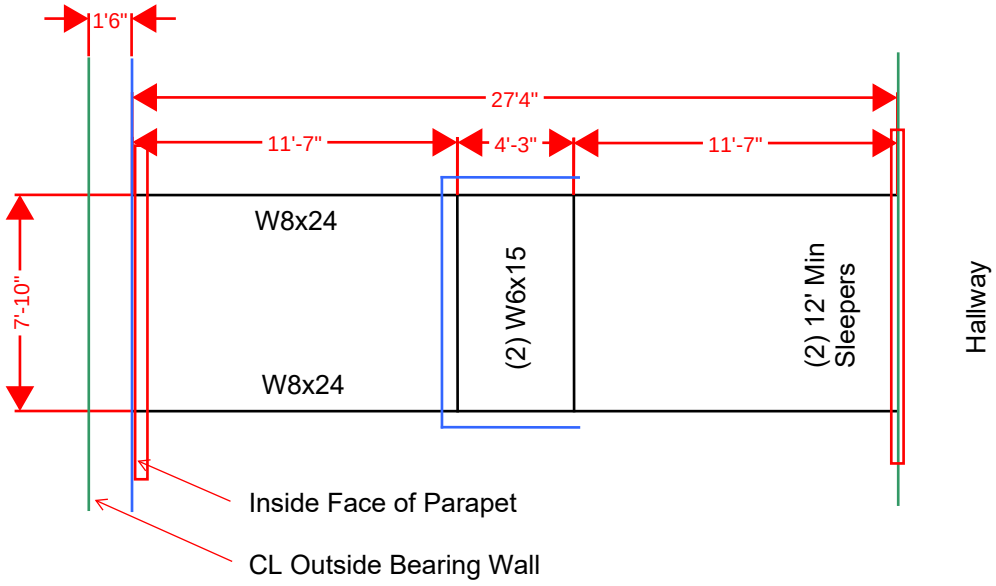
DESCRIPTION: Equipment 6x8 Sleeper CC End

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.551	0.551
Max Upward from Load Cases	0.551	0.551
Max Downward from all Load Conditio		-0.261
Max Downward from Load Cases (Resis		-0.261
D Only	0.551	0.551
W Only	0.261	-0.261

Max ASD Down = 551 + .6x261 = 708#s



Gamma Sector

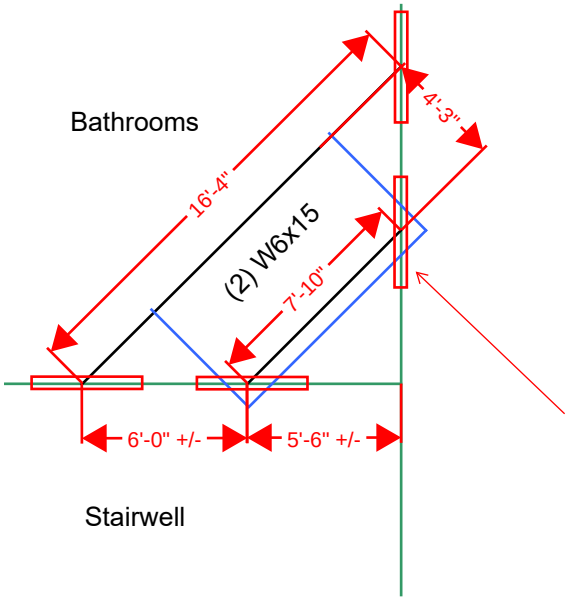
6x8 PT DF#1 Sleepers on Edge

CL WF Steel Beam

CL Supporting Wall

Outside Face of FRP Screen

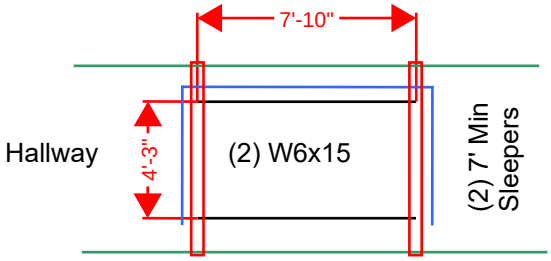
4'-3" / 7'-10" Beam Spacing / Lengths based on screen post spacing. All other dimensions to be field verified.



(4) 4' Min Sleepers

Sleepers may be combined

Beta Sector



Alpha Sector

SECTOR SCREEN SUPPORTING STRUCTURE

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

LIC# : KW-06018763, Build:20.23.2.14 Steve Marquis (c) ENERCALC INC 1983-2022

DESCRIPTION: Sector 7'10" W6x15 Max Dn X

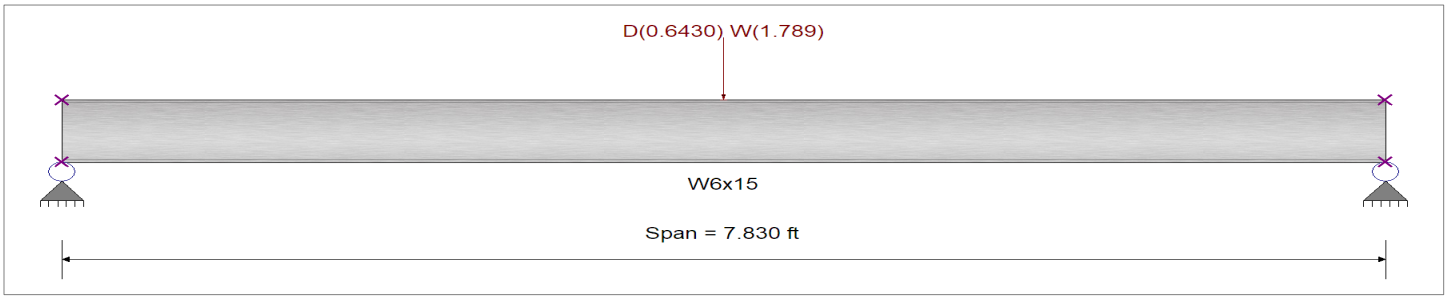
CODE REFERENCES

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

Material Properties

Analysis Method : Load Resistance Factor Design
Beam Bracing : Completely Unbraced
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

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

Beam self weight calculated and added to loading
Load(s) for Span Number 1
Point Load : D = 0.6430, W = 1.789 k @ 3.915 ft, (Node 3)

X + Y = .135 + .019 = .154 < 1.000 OK

(Screen Front Beam)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.135 : 1	Maximum Shear Stress Ratio =	0.033 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	5.150 k-ft	Vu : Applied	1.351 k
Mn * Phi : Allowable	38.124 k-ft	Vn * Phi : Allowable	41.331 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		Location of maximum on span	7.830 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.037 in	Ratio =	2553	>=180	Span: 1 : +D+0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<180	

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.895	0.895
Max Upward from Load Cases	0.895	0.895
D Only	0.380	0.380
W Only	0.895	0.895

ASD Dn = 380 + .6x895 = 917#s

ASD Up = .6x(895-380) = 309#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

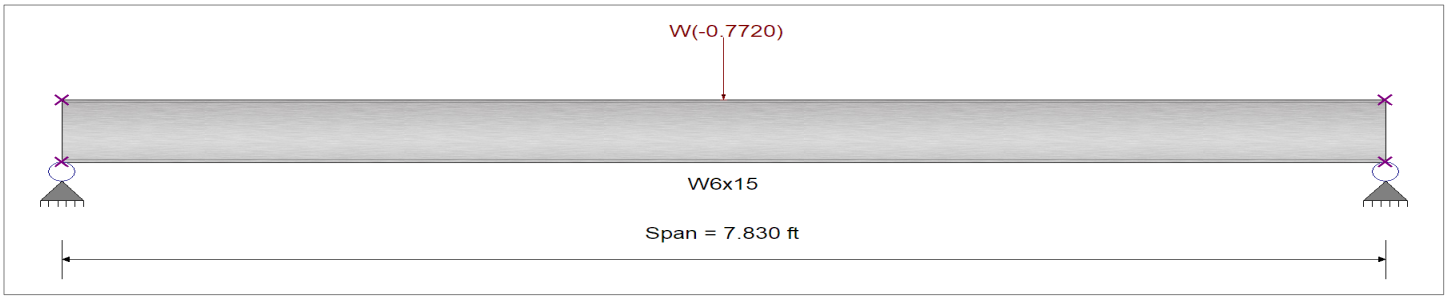
DESCRIPTION: Sector 7'10" W6x15 Max Up X

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	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 calculated and added to loading
Load(s) for Span Number 1
Point Load : W = -0.7720 k @ 3.915 ft, (Node 28)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.036 : 1	Maximum Shear Stress Ratio =	0.009 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	1.373 k-ft	Vu : Applied	0.3860 k
Mn * Phi : Allowable	38.124 k-ft	Vn * Phi : Allowable	41.331 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		Location of maximum on span	3.915 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.000 in	Ratio =	0	<180	
Max Upward Total Deflection	-0.008 in	Ratio =	11721	>=180	Span: 1 : +D+0.60W

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.059	0.059
Max Upward from Load Cases	0.059	0.059
Max Downward from all Load Conditions (Resis	-0.386	-0.386
Max Downward from Load Cases (Resisting Up	-0.386	-0.386
D Only	0.059	0.059
W Only	-0.386	-0.386

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

LIC# : KW-06018763, Build:20.23.2.14 Steve Marquis

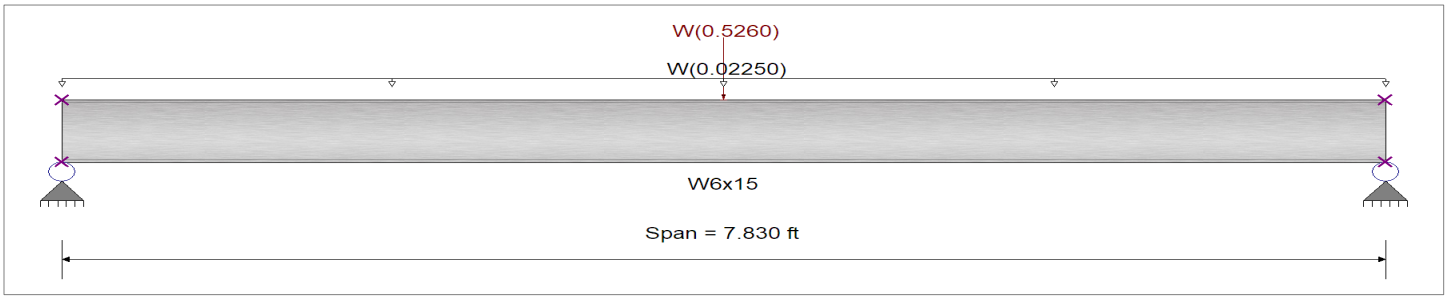
DESCRIPTION: Sector 7'10" W6x15 Y

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Minor Axis Bending		



Applied Loads

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

Beam self weight NOT internally calculated and added
Load(s) for Span Number 1
Point Load : W = 0.5260 k @ 3.915 ft, (Node 28)

Uniform Load : W = 0.02250 k/ft, Tributary Width = 1.0 ft, (Beam W)

X + Y = .036 + .074 = .110 < 1.000 OK

(Screen Rear Beam)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.074 : 1	Maximum Shear Stress Ratio =	0.004 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	1.202 k-ft	Vu : Applied	0.3511 k
Mn * Phi : Allowable	16.283 k-ft	Vn * Phi : Allowable	93.444 k
Load Combination	W Only	Load Combination	W Only
		Location of maximum on span	7.830 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360
Max Downward Total Deflection	0.025 in	Ratio =	3834	>=180 Span: 1 : +0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<180

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.351	0.351
Max Upward from Load Cases	0.351	0.351
W Only	0.351	0.351

ASD Max Shear for 7'10" Screen Beams = .6x351 = 211#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Wood Beam

Project File: SESEA00351A.ec6

LIC# : KW-06018763, Build:20.23.2.14 Steve Marquis

DESCRIPTION: Alpha Sector 6x8 Sleeper

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-16

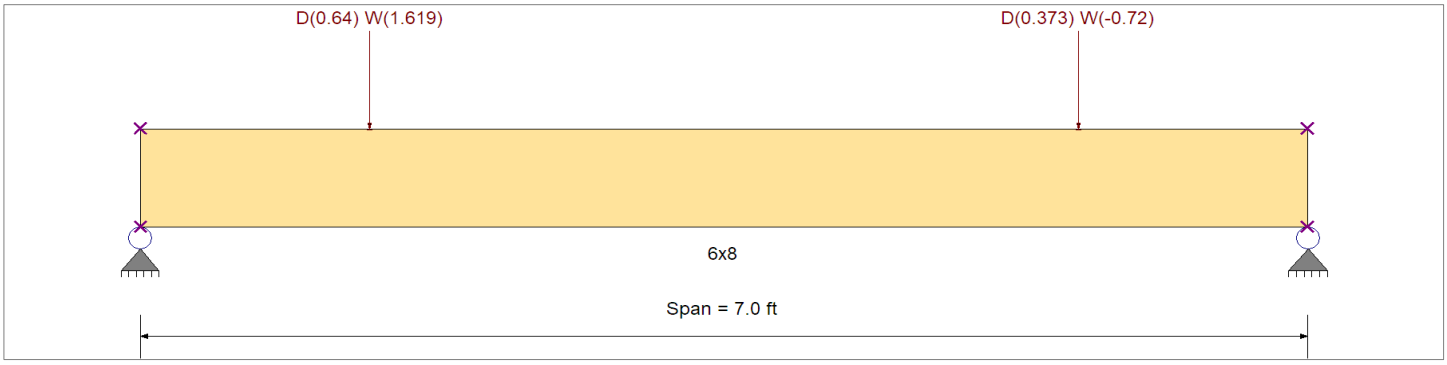
Wood Species : Douglas Fir-Larch
Wood Grade : No.1

Beam Bracing : Completely Unbraced

Fb +	1,200.0 psi
Fb -	1,200.0 psi
Fc - Prll	1,000.0 psi
Fc - Perp	625.0 psi
Fv	170.0 psi
Ft	825.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf



Applied Loads

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

Beam self weight calculated and added to loading
Point Load : D = 0.640, W = 1.619 k @ 1.375 ft, (W6x15 Dn + Node 4)
Point Load : D = 0.3730, W = -0.720 k @ 5.625 ft, (W6x15 Up + Node 5)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.274 : 1	Maximum Shear Stress Ratio	=	0.219 : 1
Section used for this span		6x8	Section used for this span		6x8
fb: Actual	=	418.37 psi	fv: Actual	=	47.60 psi
F'b	=	1,528.73 psi	F'v	=	217.60 psi
Load Combination		+D+0.60W	Load Combination		+D+0.60W
Location of maximum on span	=	1.380 ft	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 in	Ratio =	0 <360	n/a
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.039 in	Ratio =	2143 >=180	Span: 1 : +D+0.60W
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.60W														0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.274	0.219	1.60	1.00	1.00	1.00	1.000	1.00	0.80	1.00	1.80	418.4	1,528.7	1.31	47.6	217.6
+0.60D+0.60W					1.00	1.00	1.00	1.000	1.00	0.80	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.222	0.178	1.60	1.00	1.00	1.00	1.000	1.00	0.80	1.00	1.46	340.0	1,528.7	1.06	38.7	217.6

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.60W	1	0.0392	3.040		0.0000	0.000

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Wood Beam

Project File: SESEA00351A.ec6

DESCRIPTION: Alpha Sector 6x8 Sleeper

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.160	0.457
Max Upward from Load Cases	1.160	0.457
Max Downward from all Load Conditio		-0.261
Max Downward from Load Cases (Resis		-0.261
D Only	0.619	0.457
W Only	1.160	-0.261

ASD Max Down = 619 + .6x1160 = 1315#s

ASD Max Uplift = .6x(1160-619) = 325#s

ASD Max V = .6x(Node 2+3+4+5+13+28 X Direction Reaction)/4 = .6x(447+643-80+447-80+526)/4 = 200#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

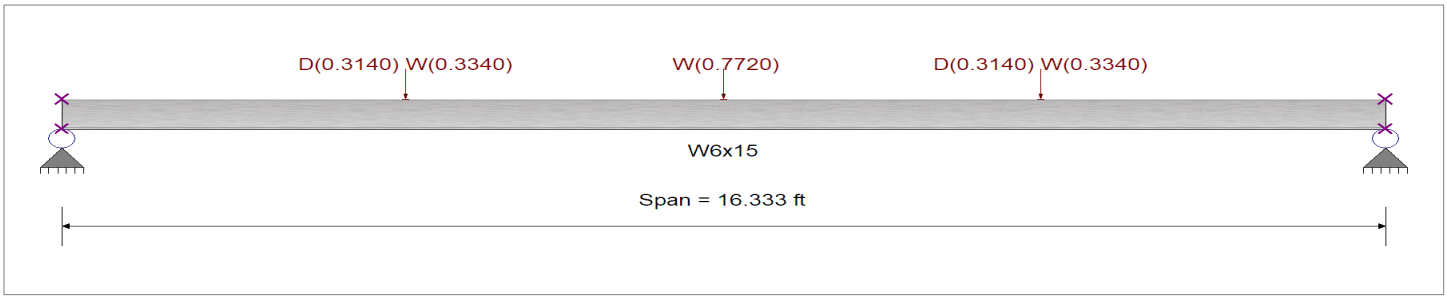
DESCRIPTION: Beta Sector 16'4" W6x15 X

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	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 calculated and added to loading
Load(s) for Span Number 1
Point Load : W = 0.7720 k @ 8.167 ft, (Node 28)

Point Load : D = 0.3140, W = 0.3340 k @ 4.250 ft, (Node 5)

Point Load : D = 0.3140, W = 0.3340 k @ 12.084 ft, (Node 2)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.229 : 1	Maximum Shear Stress Ratio =	0.030 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	6.773 k-ft	Vu : Applied	1.244 k
Mn * Phi : Allowable	29.529 k-ft	Vn * Phi : Allowable	41.331 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		Location of maximum on span	16.333 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.251 in	Ratio =	779	>=180	Span: 1 : +D+0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<180	

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.720	0.720
Max Upward from Load Cases	0.720	0.720
D Only	0.436	0.437
W Only	0.720	0.720

ASD Max Down = 436 + .6x720 = 868#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

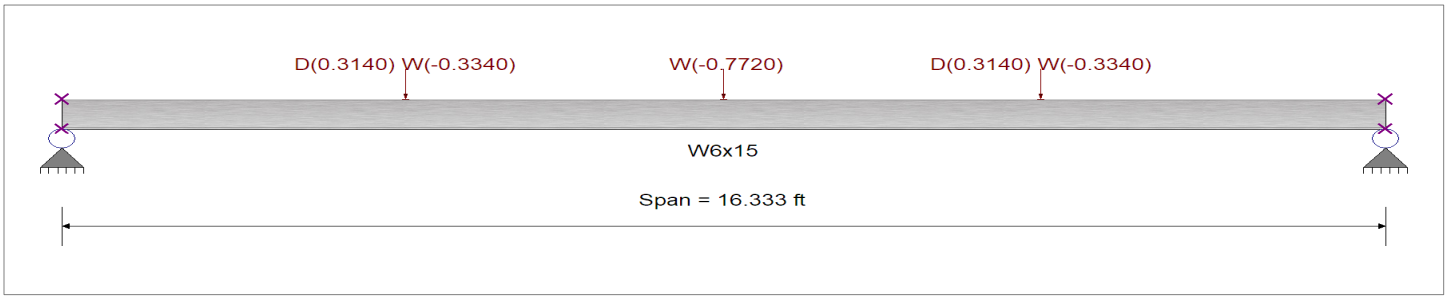
DESCRIPTION: Beta Sector 16'4" W6x15 X Up

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	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 calculated and added to loading
Load(s) for Span Number 1
Point Load : W = -0.7720 k @ 8.167 ft, (Node 28)

Point Load : D = 0.3140, W = -0.3340 k @ 4.250 ft, (Node 5)

Point Load : D = 0.3140, W = -0.3340 k @ 12.084 ft, (Node 2)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.066 : 1	Maximum Shear Stress Ratio =	0.009 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	2.370 k-ft	Vu : Applied	0.3860 k
Mn * Phi : Allowable	36.026 k-ft	Vn * Phi : Allowable	41.331 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		Location of maximum on span	8.167 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.000 in	Ratio =	0	<180	
Max Upward Total Deflection	-0.028 in	Ratio =	7064	>=180	Span: 1 : +D+0.60W

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.436	0.437
Max Upward from Load Cases	0.436	0.437
Max Downward from all Load Conditions (Resis	-0.720	-0.720
Max Downward from Load Cases (Resisting Up	-0.720	-0.720
D Only	0.436	0.437
W Only	-0.720	-0.720

ASD Max Uplift = .6x(720-436) = 170#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

DESCRIPTION: Beta Sector 16'4" W6x15 Y

CODE REFERENCES

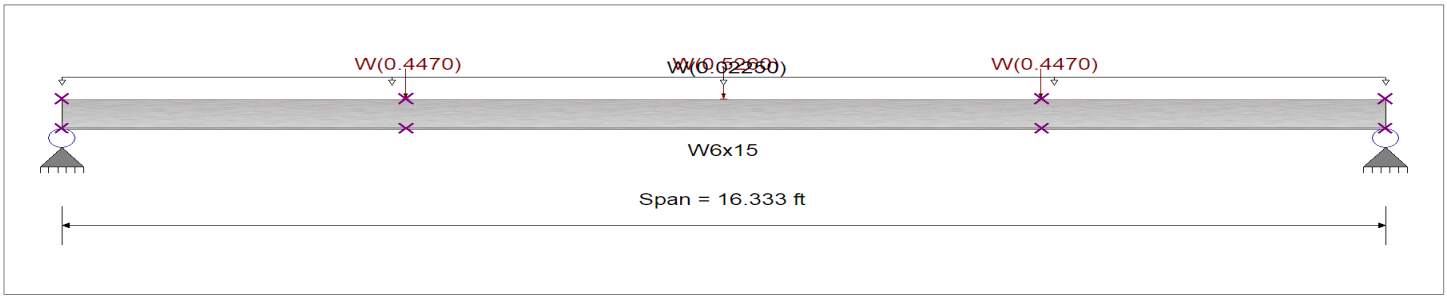
Calculations per AISC 360-16, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam bracing is defined Beam-by-Beam	E: Modulus :	29,000.0 ksi
Bending Axis :	Minor Axis Bending		

Unbraced Lengths

Span # 1, Defined Brace Locations, First Brace at 4.250 ft, Second Brace at 12.084 ft, Third Brace at ft



Applied Loads

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

Beam self weight NOT internally calculated and added
Load(s) for Span Number 1
Point Load : W = 0.5260 k @ 8.167 ft, (Node 28)
Point Load : W = 0.4470 k @ 4.250 ft, (Node 5)
Point Load : W = 0.4470 k @ 12.084 ft, (Node 2)
Uniform Load : W = 0.02250 k/ft, Tributary Width = 1.0 ft, (Beam W)

X + Y = .229 + .295 = .524 < 1.000 OK

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.295 : 1	Maximum Shear Stress Ratio =	0.010 : 1
Section used for this span	W6x15	Section used for this span	W6x15
Mu : Applied	4.798 k-ft	Vu : Applied	0.8938 k
Mn * Phi : Allowable	16.283 k-ft	Vn * Phi : Allowable	93.444 k
Load Combination	W Only	Load Combination	W Only
		Location of maximum on span	16.333 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	
Max Downward Total Deflection	0.486 in	Ratio =	403	>=180	Span: 1 : +0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<180	

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.894	0.894
Max Upward from Load Cases	0.894	0.894
W Only	0.894	0.894

ASD Max Shear = .6x894 = 536#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

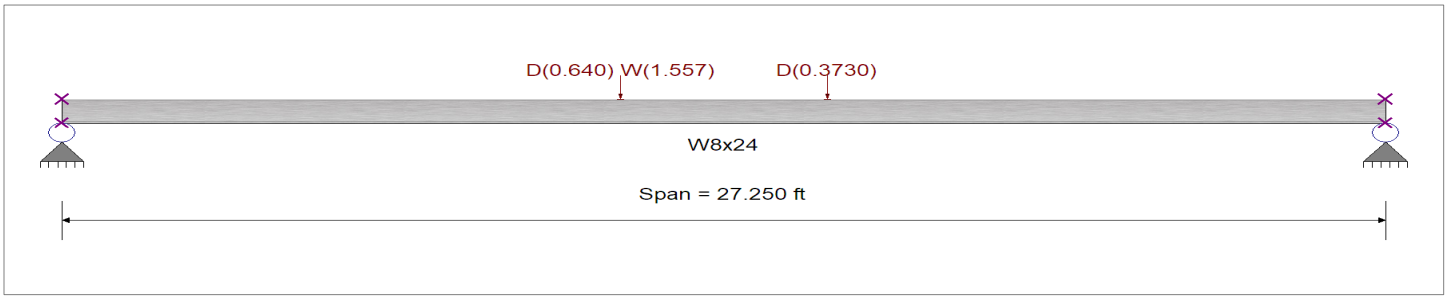
DESCRIPTION: Gamma Sector 27'3" W8x24 X

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	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 calculated and added to loading
Load(s) for Span Number 1
Point Load : D = 0.640, W = 1.557 k @ 11.50 ft, (W6x15 Node 4 D +Side W Dn)

Point Load : D = 0.3730 k @ 15.750 ft, (W6x15 + Node 5 D)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.437 : 1	Maximum Shear Stress Ratio =	0.033 : 1
Section used for this span	W8x24	Section used for this span	W8x24
Mu : Applied	20.218 k-ft	Vu : Applied	1.925 k
Mn * Phi : Allowable	46.219 k-ft	Vn * Phi : Allowable	58.286 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		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	0.000 in	Ratio =	0	<360
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360
Max Downward Total Deflection	0.699 in	Ratio =	468	>=180 Span: 1 : +D+0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<180

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.900	0.813
Max Upward from Load Cases	0.900	0.813
D Only	0.854	0.813
W Only	0.900	0.657

ASD Max Dn = 854 + .6x900 = 1394#s

ASD Max Dn for (2) D only = 2x854 = 1708#s

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

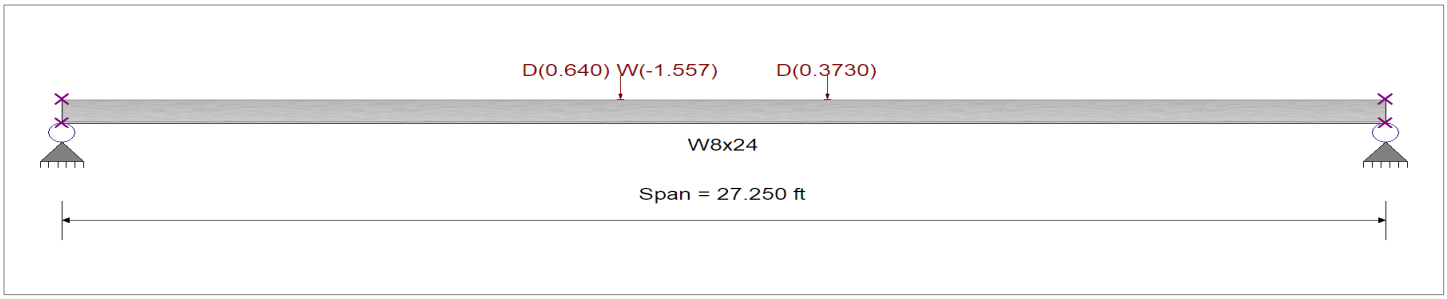
DESCRIPTION: Gamma Sector 27'3" W8x24 X Up

CODE REFERENCES

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

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	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 calculated and added to loading
Load(s) for Span Number 1
Point Load : D = 0.640, W = -1.557 k @ 11.50 ft, (W6x15 Node 4 D +Side W Dn)

Point Load : D = 0.3730 k @ 15.750 ft, (W6x15 + Node 5 D)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.028 : 1	Maximum Shear Stress Ratio =	0.010 : 1
Section used for this span	W8x24	Section used for this span	W8x24
Mu : Applied	1.757 k-ft	Vu : Applied	0.5824 k
Mn * Phi : Allowable	63.219 k-ft	Vn * Phi : Allowable	58.286 k
Load Combination	+1.20D+W	Load Combination	+1.20D+W
		Location of maximum on span	11.523 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0	<360
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360
Max Downward Total Deflection	0.149 in	Ratio =	2199	>=180 Span: 1 : +D+0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<180

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.854	0.813
Max Upward from Load Cases	0.854	0.813
Max Downward from all Load Conditions (Resi	-0.900	-0.657
Max Downward from Load Cases (Resisting Up	-0.900	-0.657
D Only	0.854	0.813
W Only	-0.900	-0.657

ASD Max Uplift = .6x(900-854) = Negligible

Project Title:
Engineer:
Project ID: SESEA00351A
Project Descr: Dish Rooftop

Steel Beam

Project File: SESEA00351A.ec6

LIC# : KW-06018763, Build:20.23.2.14 Steve Marquis

DESCRIPTION: Gamma Sector 27'3" W8x24 Y

CODE REFERENCES

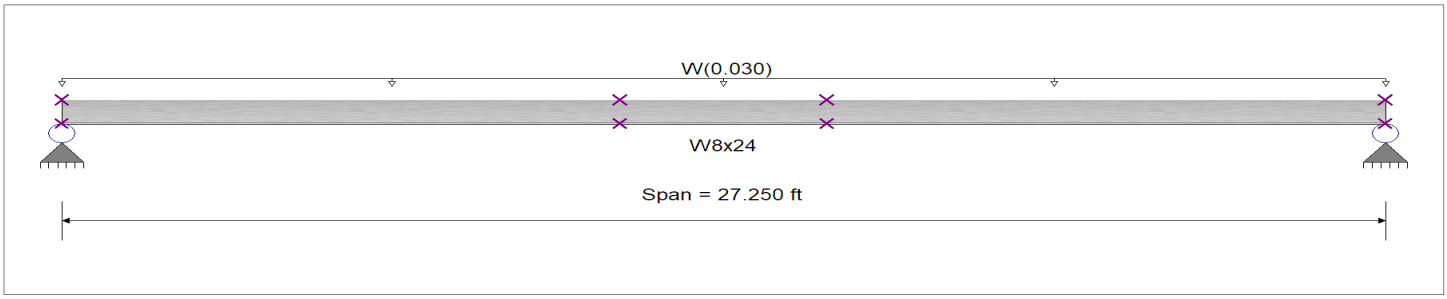
Calculations per AISC 360-16, IBC 2021, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam bracing is defined Beam-by-Beam	E: Modulus :	29,000.0 ksi
Bending Axis :	Minor Axis Bending		

Unbraced Lengths

Span # 1, Defined Brace Locations, First Brace at 11.50 ft, Second Brace at 15.750 ft, Third Brace at ft



Applied Loads

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

Beam self weight NOT internally calculated and added
Load(s) for Span Number 1
Point Load : W = 1.283 k @ 11.50 ft, (9x5 Screen Side W)

X + Y = .437 + .350 = .787 < 1.000 OK

Uniform Load : W = 0.030 k/ft, Tributary Width = 1.0 ft, (Beam W)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.350 : 1	Maximum Shear Stress Ratio =	0.007 : 1
Section used for this span	W8x24	Section used for this span	W8x24
Mu : Applied	11.234 k-ft	Vu : Applied	1.150 k
Mn * Phi : Allowable	32.138 k-ft	Vn * Phi : Allowable	156.0 k
Load Combination	W Only	Load Combination	W Only
		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	0.000 in	Ratio =	0	<360
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360
Max Downward Total Deflection	1.450 in	Ratio =	226	>=180 Span: 1 : +0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<180

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.150	0.950
Max Upward from Load Cases	1.150	0.950
W Only	1.150	0.950

ASD Max Shear = .6x1150 = 690#s

W based on 7.5'x5' Screen Side Panel and 34.2 psf ref FRP SA W

Site: **SESEA00351A** SM 4/20/2023

Component Anchorage Loads: ASD for Steel / Wood; Strength Design for Masonry / Concrete / Hilti Profis

ASCE 7-16 Chapter 13 & 29

Dead Load Reductions for Overturning Resistance:

D Adjusted	$.6W_p$-$.7E_v$	ASD Seismic
D Adjusted	$.6W_p$	ASD Wind
D Adjusted	$.9W_p$-E_v	SD Seismic
D Adjusted	$.9W_p$	SD Wind

Ω_0:	2.0	ASCE 7-16 Table 6-1
		Seismic Concrete or Masonry Anchorage

W must be > Ω_0E to govern for Concrete or Masonry Anchorage

Each item may have multiple lines for each connection type / spacing evaluated

Stress Ratio = $T_S/T_A + V_S/V_A$ and must be </= 1.00 to Pass

Support Service Loads are Item Shear and Moment
divided by # or spacing of Anchors / Posts as applicable

SFA = See Further Analysis for some items

ASD Bolt Allowables

Item	Length Min in	V_A #s	T_A #s
3/8" A325		2650	4970
1/2" A325		4710	8830
5/8" A325		7360	13800
3/4" A325		10600	19900
3/8" Lag	3	250	1240
1/2" Lag	4	450	2080
5/8" Lag	5	620	3100
3/4" Lag	6	720	4300

Lag penetration not including tip is 7D min

Lag Reference: NDS-2012 Sections 10 & 11 including C_D = 1.6

A325 Bolt Reference: AISC Steel Manual 13th Edition Tables 7-1 and 7-2

A307 Allowable = .5A325 AISC Steel Manual 13th Edition Tables 7-1 and 7-3
(U-bolts etc)

See following page for FRP Bearing allowables (ASD w/ SF) if applicable

Item	Anchor Base Mat'l	Analysis Method	Governing Lateral Load	V_S #s	T_S #s	M_S in-#s	D Adjusted #s	Support Type	# Supports / Anchors	Support Spacing in	V_S at Support #s	T_S at Support #s	Stress Ratio
Charles Cabinet to WF	Steel	ASD	W Side to Side	622	N/A	22963	640	A307 5/8 Bolt	4	29	156	236	0.08
Equipment WF to Sleeper	Wood	ASD	W	287	391	N/A	N/A	1/2" Lag Screw	2	N/A	144	196	0.41
Beta Sector 16' WF to Sleeper	Wood	ASD	W	170	536	N/A	N/A	1/2" Lag Screw	2	N/A	85	268	0.32
Gamma Sector 27' WF to Sleeper	Wood	ASD	W	690	0	N/A	N/A	5/8" Lag Screw	2	N/A	345	0	0.56
Beta 16' WF Sleeper to Roof	Wood	ASD	W	170	536	N/A	N/A	5/8" A307 Bolt	2	N/A	85	268	0.06
Beta 16' WF Sleeper to Roof	Wood	ASD	W	N/A	536	N/A	N/A	2-1/2" Dia Washer Bearing	2	N/A	N/A	268	0.10
2-1/2" Dia Plate Washer ASD Bearing Allowable = 625 psi x 4.5 sq in = 2813#s Ref NDS 2018													
Gamma 27' WF Sleeper to Roof	Wood	ASD	W	690	0	N/A	N/A	5/8" A307 Bolt	2	N/A	345	0	0.57
5/8" Bolt Allowable Sleeper to Double 2x6 Hem Fir Top Plate Perpendicular = 605#s Ref NDS 2018 Table 11A													
FRP Screen Bolt Bearing	FRP	ASD	W	1717	N/A	N/A	N/A	5/8" Bolt in Dbl Bearing	1	N/A	1717	0	0.55

BEARING ON FRP

Bolt Allowable for Given FRP Plate Thickness (1)

MATERIAL THICKNESS	BOLT DIAMETER				
	3/8"	1/2"	5/8"	3/4"	1"
1/8"	469	625	781	938	1250
1/4"	938	1250	1563	1875	2500
3/8"	1406	1875	2344	2813	3750
1/2"	1875	2500	3125	3750	5000
3/4"	2813	3750	4688	5625	7500
1"	3750	5000	6250	7500	10000

(1) BEARING on FRP plate or web controls (Factor of Safety = 3.0; Fp=10,000 psi)
The designer must confirm that no other component of connection controls.

BOLT SHEAR

Bolt Allowable for Given Bolt Diameter (2)

BOLT TYPE & APPLICATION	BOLT DIAMETER				
	3/8"	1/2"	5/8"	3/4"	1"
316SS- single shear (3)	1408	2503	3912	5633	10014
316SS- double shear	2816	5007	7823	11265	20027
FRP threaded rod (4) single shear	300	600	900	1000	2050
FRP threaded rod - double shear	600	1200	1800	2000	4100

(2) The designer must confirm that no other component of connection controls.
*(3) SHEAR of bolt controls. Fv=0.17*FU = 0.17*75,000 psi = 12,750 psi*
(4) SHEAR of FRP threaded rod controls (Factor of Safety = 4.0).
Ultimate values from Dynaform® Design Guide

RATIO OF EDGE DISTANCE TO FASTENER DIAMETER

	RANGE	RECOMMENDED
Edge Distance - cl* bolt to END	2.0-4.0	3.0
Edge Distance - cl* bolt to SIDE	1.5-3.5	2.5
Bolt Pitch - cl* to cl*	4.0-5.0	5.0

** - "cl" is centerline*

Site: **SESEA00351A** SM 4/20/2023

Existing Structure Vertical Load Checks

Allowable Roof Load from Excess Design Capacity:	11	*psf*	Ref Vertical Design Criteria
Allowable for Wood with ASD Wind Duration Factor:	**17.6**	*psf*	C_D = 1.6; Ref NDS 2018
Allowable Excess ASD Roof Truss Moment:	**1.238**	*kip ft per ft*	Relevant at Gamma Sector 30' Existing Truss Span only
Allowable Point Load at 3' from one end based on above:	**458**	*plf*	Wall allowable governs at 11*37/2 = 204 plf

Load / Usage Ratio = Applied / Allowable and must be </= 1.00 to Pass

Wind governs for all project applications

Bearing wall allowable = 17.6 psf x max span of supported roof / 2; 11 psf for Gamma Sector

Length Required can be satisfied with Wall length Occupied by Platform or Platform Supporting Sleeper

Item	Allowable *plf*	Applied *#s*		Length Required *ft*	Length Provided *ft*	Length / Usage Ratio
Equipment Platform	326	1260	708#s / 552#s	**4**	8	**0.48**
Alpha Sector	326	2630	1315#s / 1315#s	**8**	9	**0.90**
Beta Sector	326	917		**3**	4	**0.70**
Gamma Sector	204	1708	D only governs	**8**	12	**0.70**