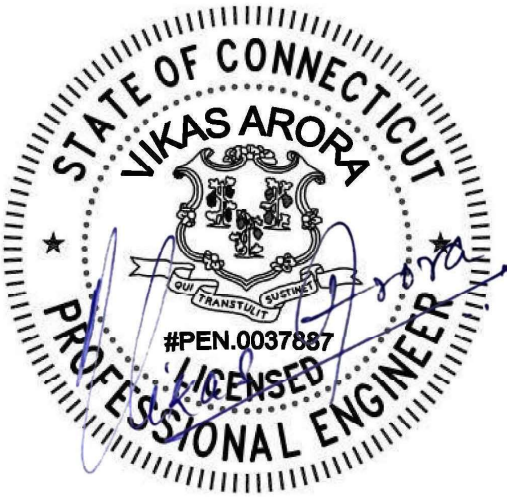
POLAR RACKING SOL-X SOLAR TRACKER

STRUCTURAL CALCULATION REPORT

(EDITION 1; JAN 29, 2025)



Greenskies Clean Energy - 15866 Winchester, CT (7140)
Spencer Hill Rd., Winchester, CT 06098

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STRUCTURAL NARRATIVE

The Polar Racking Axsus Solar Tracker System is bi-facial solar panel system intended for application in large-scale, commercial solar arrays. Each table in the array is self supporting via piles driven into the soil. At each pile there is a spherical joint, actuator, and pivot arm with drive the system and allow it to tilt from a range of 0° to 60° in each direction. The Sol X20 system has two posts per table and a maximum of 12 modules per table. The Sol X25 has three posts per table and allows for a maximum of 24 modules per table. The X20 system is intended to be used at interior or exterior applications and the X25 system is designed for interior applications only. See the Array Layout provided for a site-specific graphic.

The design of the structural elements including the purlin, pivot arm, pivot bracket, pile attachment, and all connections are contained within this report. This calculation package includes the pile design above ground. (Underground pile calculation and design are provided by others.)

The tracker is designed to resist wind, snow, ice, seismic loading, and its self-weight in accordance with ASCE 7-16. Allowable stress design is used to evaluate the structural components as the structural system is composed of Cold-Formed Steel sections. Analysis of Cold-Formed Steel members conforms to the 2016 edition of AISI S100.

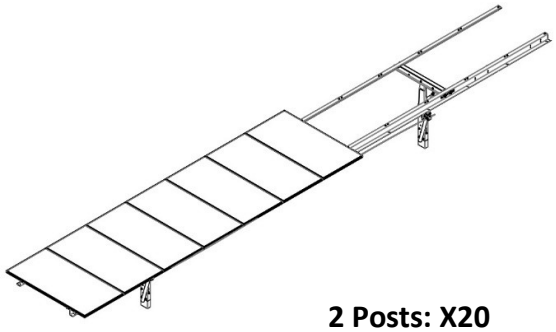
The system has been tested at a reduced scale to understand the effects of dynamic and static wind loading. The wind tunnel tests are used to determine the pressure coefficients to be used in conjunction with ASCE 7-16. For more information about calculation of these coefficients and how they are applied to determine pressures and forces, see the Wind Load Summary sheet. Also, there are several adjustment factors provided in the Array Properties and Geometry section to ensure that testing values are applicable to a range of system geometries, not just the baseline model which was tested.

Additionally, testing has been performed on a full-scale system to determine the natural frequency and inherent damping for several vibration modes. The results of this dynamic testing have been incorporated in Array Properties and Geometry in order to make full use of the dynamic results from the wind tunnel testing.

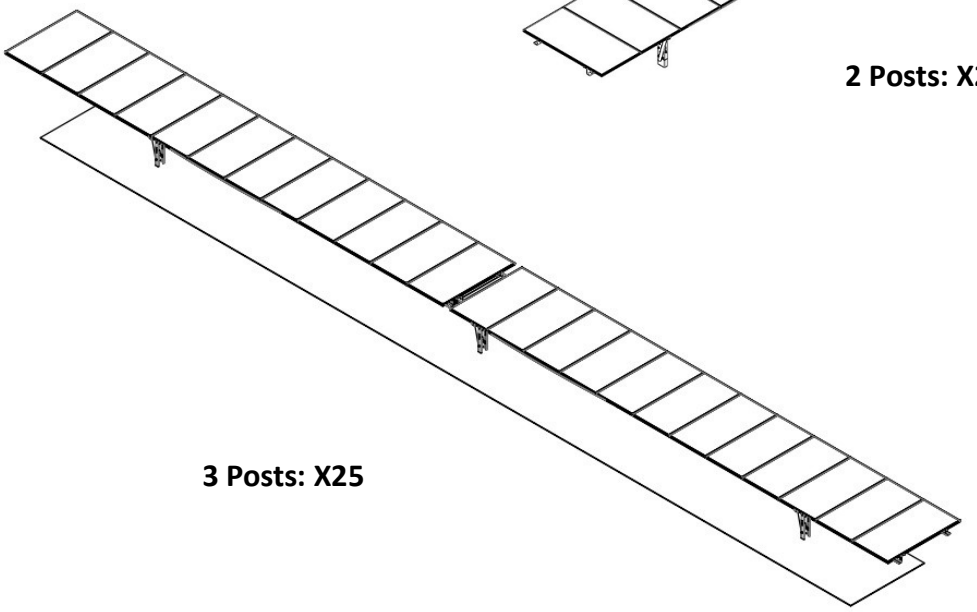
BASIC LOAD PATH

- Modules are supported by Omega beams in middle and C-shape joists at ends.
- Omega beams and C-shape joists sit on Z-shape purlins.
- Z-shape purlins carry loads to the Pivot Arms.
- Pivot Arms are supported by Pivot Brackets in the center and are braced by Actuator.
- Actuators transfer axial force to Drive Bracket.
- Pivot Brackets and Drive Brackets are fixed at top of the Piles.
- Piles transfer Axial, Shear and Bending to the ground.

Note: there are ties/braces under the purlins in middle spans and at the ends



2 Posts: X20



3 Posts: X25

LOADING CRITERIA

The structure of both the X20 and X25 systems is designed based on the following load type and criteria.

• Dead load:

Self-weight of the structure and panels

• Ice load:

Ice loading is only evaluated at the flat panel condition (stow position). The array will not operate during an ice event.

• Snow load:

The operating system has a snow depth sensor that limits accumulated snow to 3 inches. When snow reaches 3 inches on the ground, the tracker rotates to 60 degrees to shed snow. Therefore, the maximum snow load is based on 3 inches of snow depth with density in accordance with ASCE 7 Equation 7.7-1.

• Seismic load:

Earthquake loading is based on building code.

• Wind load:

The operating system limits tracking operations to windspeeds below 30 mph. When the windspeed on site exceeds 30 mph, the system stows the panels at 0 degrees. Therefore, the structure is designed for the full design windspeed at 0 degrees (checked full design windspeed in [-3°~0~ +3°] range), 30 mph for 5 to 45 degrees and 20 mph for 60 degrees. Wind pressure is determined from static and dynamic coefficients from Wind Tunnel Testing Report by RWDI dated November 29, 2018. Different wind coefficients are provided based on location in the array, central and perimeter.

PROJECT :		MODULE :	Module: Heliene		
No. :	7140	SPECIFICATION :	144HC M10 SL Bifacial		
Name :	Greenskies Clean Energy	Module Length	L_{mod} =	2279	mm
State :	CT, US	Module Width	W_{mod} =	1134	mm
Address :	Spencer Hill Rd., Winchester, CT 0	Module Thickness	Th_{mod} =	35	mm
Date :	29-01-2025 Rev. 2	Module Weight	M_{mod} =	29.2	kg

TABLE SPECIFICATION		Perimeter Class			Central Class		
Number of Modules	N.Mod.=	1P	12	Bi-facial	1P	24	Bi-facial
Module Gap	G_{mod} =		16	mm		16	mm
Table Length	L_{Table} =		13.784	m		27.76	m
Table Width	W_{Table} =		2.28	m		2.28	m
swing_Length Table Height	H_{Table} =	-80	1976	mm	-80	1976	mm
Span , Number of Posts , contilever		8.34	2	N/A	10.23	3	N/A
Span between posts	Span =	By Length	8.34	m	By Length	10.23	m
Leading Edge (at 60)	L.E. =		914.4	mm		914.4	mm
FREQUENCY & DAMPING		**Torque**	**Normal**	**Rock**	**Torque**	**Normal**	**Rock**
Frequency	HZ	2.3	2.8	1.4	1.7	1.9	1.4
Damping (tilt)	%	3.50%	2.00%	4.00%	5.00%	2.50%	4.00%
Damping (stow)	%	3.50%	2.00%	4.00%	5.00%	2.50%	4.00%
Drift y-y (Frequency, Damping tilt, & Stow)		1.6	2.00%	2.00%	1.5	3.00%	3.00%

GENERAL SITE SPECIFICATION & CLIMATE DATA

(BUILDING CODE : ASCE 7-2016)

Row Spacing	R.S.(m) =	4.6
Ground Coverage Ratio	GCR (%) =	49.54%
Wind Load :		
Exposure Coefficient	K_z =	0.85
Topographic Factor	K_{zt} =	1
Wind Directionality factor	K_d =	0.85
Wind Speed (tilt)	V_{tilt} (mph)=	30
Wind Speed (tilt 60)	$V_{t.60}$ (mph)=	20
Wind Speed (stow)	V (mph) =	105
Importance Factor (wind)	I_w =	1
Ice Load :		
Importance Factor (ice)	I_i =	0.8
Nominal Mapped Ice Thickness	t (inch) =	1
$Wind_{Ice}$ Speed (mph)	V_i =	50
Ice Density	ρ_i (pcf) =	56.2

Snow Load :		
Exposure Factor	C_e =	1
Thermal Factor	C_t =	1.2
Importance Factor(snow)	I_s =	1
Ground Snow Loads	p_g (PSF) =	40
Dump Depth	d (inch) =	3
Snow Density	ρ_s (lb/ft^3)=	19.20
Earthquake Load : (Coordinate : ... , ...)		
Maped Short Period Acc. (g)	S_S =	0.167
Maped 1 sec. Period Acc. (g)	S_1 =	0.054
site classification	Site Class :	D
Risk Category	R.C. :	I
Seismic Design Category	S.D.C. :	B
Long Transition Period (s)	T_L =	6
Importance Factor (Seismic)	I_e =	1

MODULE SPECIFICATION

Module Length	L_{mod} =	89.7	inch	≈	2279	mm	
Module Width	W_{mod} =	44.6	inch	≈	1134	mm	
Module Weight	M_{mod} =	64.4	lb	≈	29.20	kg	
Module Gap	G_{mod} =	0.63	inch	≈	16	mm	
TABLE HEIGHT :	H =	77.80	inch	≈	1976	mm	

TABLE CLASSES :			**Perimeter Class Table**			**Central Class Table**		
			Number	Single	Total	Number	Single	Total
			# / Unit #	kg	kg	#	kg	kg
Superimposed			T_{per}			T_{cen}		
Module :			12	29.2	350.4	24	29.2	700.8
Structural Parts								
	Unit L (m)	**Unit W (kg/m)**						
Post :	1.6762359	5.31	2	8.9	17.8	3	8.9	26.7
Pivet Bracket :	0.3		2	2.3	4.6	3	2.3	6.9
Pivet Arm :	1.177		2	6.9	13.8	3	6.9	20.7
C.C. Purlin:		3.95				2	109.7	219.3
P.C. Purlin :		5.31	2	73.2	146.4			
Omega Rail :	1.44		13	2.61504	34.0	26	2.61504	68.0
Mounting :	*Omega Rail*							
SUM					216.6			341.6
Mechanical Parts								
Actuator :			2	7.163	14.3	3	7.163	21.5
Drive Shaft :	1	0.74	13.784	0.7	10.2	27.764	0.7	20.5
Others :								
SUM					24.5			42.0
			kips	kN	kg	kips	kN	kg
TOT. SUM			1.30	5.8	591.5	2.39	10.6	1084.5

SUMMARY :	**Perimeter Class Table**			**Central Class Table**		
	kips	kN	kg	kips	kN	kg
Column Base Sum :	0.08	0.4	36.2	0.12	0.5	54.3
Distributed Base Sum :	1.22	5.4	555.3	2.27	10.1	1030.2

Snow Load							U.S Base Project (ASCE 7)	Page | 6
FLAT ROOF SNOW LOADS, p_f						$p_f = 0.7C_eC_tI_sp_g$		(7.3-1)
Exposure Factor	C_e =	1.00			: see table 7.3-1 -(113-58)			
Thermal Factor	C_t =	1.20			: see table 7.3-2			
Importance Factor	I_s =	1.00			: see table 1.5-2			
Ground Snow Loads	p_g =	40.00	PSF		: see table .... -(106-51)			
Flat Roof Snow Load	p_f =	33.6	PSF	≈	1.61	kPa		
Minimum Snow Load for Low-Slope Roofs, p_m						$p_m = I_sp_g$		(7.3.4)
MSL for LSF	p_m =	20	PSF	≈	0.96	kPa		
SLOPED ROOF SNOW LOADS, p_s						$p_s = C_sp_f$		(7.4-1)
DUMPED SNOW								
Minimum RSL (LowSlope)	p_{g_Actual} =	33.6	PSF	≈	1.61	kPa	: Low Slope < 15	
Dump Depth	d =	3	inch	≈	76.20	mm	***eq.fresh =***	***26.9 in***
Snow Density	ρ_s =	19.2	lb/ft^3	≈	307.6	kg/m^3	***eq.acc. =***	***21 in***
	p_{df} =	4.8	PSF	≈	0.23	kPa	***Assume :***	**33.6**
MAXIMIZE SNOW AT 60 DEGREE TILT w/o DUMPING :								
Max Pressure for 60 deg. Tilt	p_{max_60} =	4.39	PSF	≈	0.21	kPa	Baseline:	4.3872
Consider 3 inch fresh snow (low density) stick to the chord (ignore slope factor) for 60 deg. tilt :								Yes
Apply 3 inch dump :	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Static Position Snow Load								
Module Length	L_{mod} =	89.7	inch	≈	2279	mm		
Module Width	W_{mod} =	44.6	inch	≈	1134	mm		
Module Gap	G_{mod} =	0.63	inch	≈	16	mm		
Perimeter Class Table	T_{per} =	12	#					
Central Class Table	T_{cen} =	24	#					
Perimeter Class Table Area	A_{per} =	338	sq.ft	≈	31.41	sq.m		
Central Class Table Area	A_{cen} =	681	sq.ft	≈	63.27	sq.m		

Description	Tilt	0	3	10	20	30	45	60
	C_s	1.00	1.00	1.00	0.91	0.73	0.45	0.18
	SL (PSF)	4.80	4.80	4.80	4.36	3.49	2.18	0.87
P.C. Table :	SL (kips)	1.62	1.62	1.60	1.39	1.02	0.52	0.15
C.C. Table :	SL (kips)	3.27	3.26	3.22	2.79	2.06	1.05	0.30
	SL (kPa)	0.23	0.23	0.23	0.21	0.17	0.10	0.04
P.C. Table :	SL (kN)	7.2	7.2	7.1	6.2	4.5	2.3	0.7
C.C. Table :	SL (kN)	14.5	14.5	14.3	12.4	9.2	4.7	1.3

ICE LOADS CAUSED BY FREEZING RAIN

Nominal Mapped Ice Thickness	t =	1.00	inch	Equivalent Nominal Thickness :		0.20	inch
Importance Factor (ice)	I_i =	0.8					
Importance Factor (wind)	I_w =	1.0					
Height Above Ground	z =	6.48	ft				
Height Factor	f_z =	0.85	$f_z = \left(\frac{z}{33}\right)^{0.1}$	$for\ 0 < z < 900ft$	f_z = 1.4	for $z > 900ft$	(10.4-4)
Topographic Factor	K_{zt} =	1					
Ice Density	ρ_i =	56.20	pcf				

ICE LOAD ON MODULES

Module Length	L_{mod} =	89.7	inch ≈	2279	mm		
Module Width	W_{mod} =	44.6	inch ≈	1134	mm		
Module Thickness	Th_{mod} =	1.4	inch ≈	35	mm		
Design Ice Thickness	t_d =	0.68	inch	coef. (t_d) =	1	ASCE 7-16	(10-4-5)
Diameter of the CC	D_c =	89.73	inch	: diameter of the cylinder circumscribing an object			
Cross Section Area Of Ice	A_i =	193.10	sq.inch				(10.4-1)
Plate Reduction Factor	$P.R.D$ =	0.6					
C.C. Purlin Length	$L_{C.C.purlin}$ =	1093.0709	inch				
P.C. Purlin Length	$L_{P.C.purlin}$ =	542.67717	inch				
C.C. Table Module Ice Load	$D_{i\_CCModule}$ =	4.12	kips	≈	6.1691542	PSF for SAP	
P.C. Table Module Ice Load	$D_{i\_PCModule}$ =	2.04	kips	≈	6.125603	PSF for SAP	

ICE LOAD ON PURLINS

Diameter of the CC	D_c =	6.95	inch	: diameter of the cylinder circumscribing an object	
Cross Section Area Of Ice	A_i =	16.29	sq.inch		
Reduction Factor	$R.D$ =	1			
C.C. Purlin Total Length	$TL_{C.C.pur}$ =	2186.1417	inch		
P.C. Purlin Total Length	$TL_{P.C.pur}$ =	1085.3543	inch		
C.C. Table Purlin Ice Load	$D_{i\_CCPurlin}$ =	0.00	kips	**Ice around purlin consideration :**	No
P.C. Table Purlin Ice Load	$D_{i\_CPPurlin}$ =	0.00	kips	**Ice around purlin consideration :**	No

ICE LOAD ON POSTS

Diameter of the CC	D_c =	6.95	inch	: diameter of the cylinder circumscribing an object	
Cross Section Area Of Ice	A_i =	16.29	sq.inch		
Reduction Factor	$R.D$ =	1			
C.C. Post Length	$L_{C.C.post}$ =	77.80	inch		
P.C. Post Length	$TL_{P.C.post}$ =	77.80	inch		
C.C. Table Post Ice Load	D_{i_CCPost} =	0.00	kips	**Ice around post consideration :**	No
P.C. Table Post Ice Load	D_{i_PCPost} =	0.00	kips	**Ice around post consideration :**	No

Wind Load	(Static Full Chord)				U.S Base Project (ASCE 7)		Page | 8
VELOCITY PRESSURE, q_z				$q_z = 0.00256 K_z K_{zt} K_d V^2$			(26.10-1)
Exposure Coefficient	K_z =	0.85		: see table 26.10 -(323-268)			
Topographic Factor	K_{zt} =	1.00		: see table 26.10 -(323-268)			
Wind Directionality factor	K_d =	0.85		: see table 26.10 -(323-268)			
Ground Elevation Factor	K_e =	1.00		-------			
Wind Speed (mph)	V =	105.00	V_{tilt} =	30	$V_{t.60}$ =	20	: 3s@33ft
Velocity Pressure (PSF)	q_z =	20.4	q_{z_tilt} =	1.7	$q_{z\_t.60}$ =	0.7	: operating
STATIC WIND LOAD PRUSSURE (Max), p_{static}				$p_{static} = \beta q_z R G C_{p\_static}$			RWDI(3.2.3)
STATIC WIND LOAD MOMENT (Max), M_{static}				$M_{static} = \beta q_z R G C_{m\_static} A L$			RWDI(3.2.3)
Module Length	L_{mod} =	89.7	inch ≈	2279	mm	***C.C.R.T.L.E=***	8.77
Module Width	W_{mod} =	44.6	inch ≈	1134	mm	***P.C.R.T.L =***	6.89
Module Gap	G_{mod} =	0.63	inch ≈	16	mm	***C.C.R.T.L =***	10.23
Perimeter Class Table	T_{per} (#) =	12	**Perimeter Equivalent Len. (m) [default = actual] :**				6.89
Central Class Table	T_{cen} (#) =	24	**Central Equivalent Len. (m) [default = actual] :**				8.77
Perimeter Class Table Area	A_{per} =	342	sq.ft ≈	31.81	sq.m	A_{per} + =	***4.32***
Central Class Table Area	A_{cen} =	699	sq.ft ≈	64.91	sq.m	A_{cen} + =	***9.03***
Allowable Stress Load Factor	β =	1.02	: RWDI		***Consider Purlin Flange (P.C) :***		No
Ground Coverage Ration	GCR =	0.50	GCR is in the range		***Consider Purlin Flange (C.C) :***		No
Chord Length	L =	89.7	inch ≈	2279.0	mm	***F. over L (mm)***	60
Table Height	H =	77.8	inch ≈	2.0	m	H/L is in the range	

>>> Full Chord Perimeter Class Table :

tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	GC_{m_Torque}	$GC_{m\_OverTurning}$	$p_{Downforce}$	p_{Uplift}	M_{Torque}	$M_{overturning}$
				(R applied)	(PSF)	(PSF)	(kips.ft)	(kips.ft)
0	0.2383512	-0.375058	0.1054903	0.1315507	5.0	-7.8	5.6	7.0
3	0.4552147	-0.539991	0.1119616	0.1559316	9.5	-11.2	6.0	8.3
10	0.6227514	-0.65162	0.1159708	0.212275	1.1	-1.1	0.5	0.9
20	0.8141906	-0.673069	0.1131906	0.2888082	1.4	-1.1	0.5	1.3
30	1.0145459	-0.796352	0.1235291	0.4532589	1.7	-1.4	0.5	2.0
45	1.1232397	-0.901091	0.1238685	0.6402165	1.9	-1.5	0.5	2.8
60	1.1244154	-1.014033	0.0955372	0.8311581	0.8	-0.8	0.2	1.6

>>> Full Chord Central Class Table :

tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	GC_{m_Torque}	$GC_{m\_OverTurning}$	$p_{Downforce}$	p_{Uplift}	M_{Torque}	$M_{overturning}$
				(R applied)	(PSF)	(PSF)	(kips.ft)	(kips.ft)
0	0.1392151	-0.196836	0.0451612	0.0556811	2.9	-4.1	4.9	6.0
3	0.2279833	-0.307398	0.0625205	0.0920303	4.7	-6.4	6.8	10.0
10	0.2866527	-0.422711	0.0777748	0.1446422	0.5	-0.7	0.7	1.3
20	0.318625	-0.436182	0.0767904	0.191684	0.5	-0.7	0.7	1.7
30	0.3050952	-0.457571	0.0699602	0.2533924	0.5	-0.8	0.6	2.2
45	0.3156423	-0.385337	0.0486821	0.2650682	0.5	-0.7	0.4	2.4
60	0.2843515	-0.293068	0.0550985	0.2750795	0.2	-0.2	0.2	1.1

DYNAMIC WIND LOAD THRESHOLD

Wind Speed (ft/s)	V =	154	V_{tilt} =	44	$V_{t.60}$ =	29	: 3s@33ft
Critical Friquency (HZ)	F_{Cr} =	5.85	F_{Cr_tilt} =	1.67	$F_{Cr\_t.60}$ =	1.11	: Fig 3 (RWDI)

		Perimeter Class Table			***Central Class Table***		
		stow	tilt	tilt-60	stow	tilt	tilt-60
Natural Frequency (Torque)	n_T (HZ) =	**2.3**	*2.3*	2.3	**1.7**	*1.7*	1.7
Dynamic Torque Frequency Applicability		1	0	0	1	0	0
Natural Frequency (Normal)	n_N (HZ) =	**2.8**	2.8	2.8	**1.9**	1.9	1.9
Dynamic Normal Frequency Applicability		1	0	0	1	0	0
Natural Frequency (Roll)	n_R (HZ) =	**1.4**	1.4	1.4	**1.4**	1.4	1.4
Dynamic Roll Frequency Applicability		1	1	0	1	1	0

DYNAMIC WIND LOAD PRUSSURE (Max), $p_{dynamic}$ $p_{dynamic} = \beta q_z G C_{p\_dynamic}$ RWDI(3.2.3)

DYNAMIC WIND LOAD MOMENT (Max), $M_{dynamic}$ $M_{dynamic} = \beta q_z G C_{m\_dynamic} AL$ RWDI(3.2.3)

		stow	tilt	tilt-60	stow	tilt	tilt-60
Reduced Frequency (Torque)	$n_T L/V$ =	0.1117	0.3908	0.5863	0.0825	0.2889	0.4333
Torque Damping	D_T =	**3.50%**	**3.50%**	3.50%	**5.00%**	**5.00%**	5.00%
Reduced Frequency (Normal)	$n_N L/V$ =	0.1359	0.4758	0.7137	0.0922	0.3229	0.4843
Normal Damping	D_N =	**2.00%**	**2.00%**	2.00%	**2.50%**	**2.50%**	2.50%
Reduced Frequency (Roll)	$n_R L/V$ =	0.0680	0.2379	0.3569	0.0680	0.2379	0.3569
Roll Damping	D_R =	**4.00%**	**4.00%**	4.00%	**4.00%**	**4.00%**	4.00%

>>> Full Chord Perimeter Class Table :

tilt	$GC_{p\_Dynamic}$	$-GC_{p\_Dynamic}$	GC_{m_Torque}	$GC_{m\_Overturning}$	$p_{Dyn\_Downforce}$ (PSF)	p_{Dyn_Uplift} (PSF)	M_{dyn_Torque} (kips.ft)	$M_{dyn\_Overturning}$ (kips.ft)
0	0.5130117	-0.513012	0.0944563	0.0947403	10.67	-10.67	5.0	5.0
3	0.5130117	-0.513012	0.0944563	0.0947403	10.67	-10.67	5.0	5.0
10	0	0	0	0.092774	0.0	0.0	0.0	0.4
20	0	0	0	0.0992979	0.0	0.0	0.0	0.4
30	0	0	0	0.0992979	0.0	0.0	0.0	0.4
45	0	0	0	0.0569725	0.0	0.0	0.0	0.2
60	0	0	0	0	0.0	0.0	0.0	0.0

>>> Full Chord Central Class Table :

tilt	$GC_{p\_Dynamic}$	$-GC_{p\_Dynamic}$	GC_{m_Torque}	$GC_{m\_Overturning}$	$p_{Dyn\_Downforce}$ (PSF)	p_{Dyn_Uplift} (PSF)	M_{dyn_Torque} (kips.ft)	$M_{dyn\_Overturning}$ (kips.ft)
0	0.2494881	-0.249488	0.0388818	0.0443202	5.19	-5.19	4.2	4.8
3	0.2494881	-0.249488	0.0388818	0.0443202	5.19	-5.19	4.2	4.8
10	0.3657753	-0.365775	0.0651235	0.090287	0.0	0.0	0.0	0.8
20	0.2141698	-0.21417	0.036416	0.0591727	0.0	0.0	0.0	0.5
30	0.2141698	-0.21417	0.036416	0.0591727	0.0	0.0	0.0	0.5
45	0.2783829	-0.278383	0.0195039	0.0285393	0.0	0.0	0.0	0.3
60	0	-0.278383	0	0	0.0	0.0	0.0	0.0

Support Reaction for Wind Load			**(Class:** both **| Tilt:** all **| Support:** total **)**					Page | 10
TABLE HEIGHT :		*H =*	6.48	ft				
1. Overturning $_{(St+Dyn)}$			2. Normal-$P_{(St+Dyn)}$ + $Torque_{(St+0.6Dyn)}$			3. Normal-$P_{(St+0.6Dyn)}$ + $Torque_{(St+Dyn)}$		
>>> Perimeter Class Table :								
tilt	Vx (kips) $_1$	Vx (kips) $_2$	Vx (kips) $_3$	Vx (kips)	M_{yy} (kips.ft)$_1$	M_{yy} (kips.ft)$_2$	M_{yy} (kips.ft)$_3$	M_{yy} (kips.ft)
0	0	0.00	0.00	0.00	12.1	8.64	10.65	12.05
3	0	0.39	0.32	0.39	13.4	11.53	13.04	13.35
10	0	0.07	0.07	0.07	1.3	0.93	0.93	1.33
20	0	0.16	0.16	0.16	1.7	1.54	1.54	1.69
30	0	0.29	0.29	0.29	2.4	2.45	2.45	2.45
45	0	0.46	0.46	0.46	3.0	3.53	3.53	3.53
60	0	0.25	0.25	0.25	1.6	1.82	1.82	1.82
>>> Central Class Table :								
tilt	Vx (kips) $_1$	Vx (kips) $_2$	Vx (kips) $_3$	Vx (kips)	M_{yy} (kips.ft)$_1$	M_{yy} (kips.ft)$_2$	M_{yy} (kips.ft)$_3$	M_{yy} (kips.ft)
0	0	0.00	0.00	0.00	10.9	7.44	9.13	10.87
3	0	0.42	0.35	0.42	14.8	12.07	13.27	14.81
10	0	0.09	0.09	0.09	2.1	1.25	1.25	2.08
20	0	0.18	0.18	0.18	2.2	1.83	1.83	2.22
30	0	0.27	0.27	0.27	2.8	2.38	2.38	2.77
45	0	0.32	0.32	0.32	2.6	2.53	2.53	2.60
60	0	0.13	0.13	0.13	1.1	1.08	1.08	1.08
>>> Perimeter Class Table :								
tilt	P (kips) $_1$	P (kips) $_2$	P (kips) $_3$	P (kips)	T (kips) $_1$	T (kips) $_2$	T (kips) $_3$	T (kips)
0	0	5.35	3.89	5.35	0	-6.33	-4.86	-6.33
3	0	6.89	5.43	6.89	0	-7.49	6.04	-7.49
10	0	0.36	0.36	0.36	0	-0.37	-0.38	-0.38
20	0	0.44	0.44	0.44	0	-0.37	-0.39	-0.39
30	0	0.51	0.51	0.51	0	-0.40	-0.46	-0.46
45	0	0.46	0.46	0.46	0	-0.37	0.52	-0.52
60	0	0.15	0.15	0.15	0	-0.13	-0.26	-0.26
>>> Central Class Table :								
tilt	P (kips) $_1$	P (kips) $_2$	P (kips) $_3$	P (kips)	T (kips) $_1$	T (kips) $_2$	T (kips) $_3$	T (kips)
0	0	5.65	4.20	5.65	0	-6.49	-5.04	-6.49
3	0	6.93	5.48	6.93	0	-8.08	-6.63	-8.08
10	0	0.33	0.33	0.33	0	-0.49	-0.49	-0.49
20	0	0.36	0.36	0.36	0	-0.49	-0.49	-0.49
30	0	0.31	0.31	0.31	0	-0.47	-0.47	-0.47
45	0	0.26	0.26	0.26	0	-0.32	-0.32	-0.32
60	0	0.07	0.07	0.07	0	-0.08	-0.08	-0.08

Wind on Ice Load	**(Static Full Chord)**			U.S Base Project (ASCE 7)			Page | 11
VELOCITY PRESSURE, q_z				$q_z = 0.00256 K_z K_{zt} K_d V^2$			(26.10-1)
Exposure Coefficient	K_z =	0.85		Equivalent Wind$_{ice}$ Speed :		40.00	mph
Topographic Factor	K_{zt} =	1.00					
Wind Directionality factor	K_d =	0.85					
Ground Elevation Factor	K_e =	1.00		*Apply Wind on Ice for Tilt Position ?*		NO	
Wind$_{ice}$ Speed (mph)	V_i =	50.00	V_{i_tilt} =	0	$V_{i\_t.60}$ =	0	: 3s@33ft
Velocity Pressure (PSF)	q_z =	4.6	q_{z_tilt} =	0.0	$q_{z\_t.60}$ =	0.0	: operating
STATIC WIND LOAD PRUSSURE (Max), p_{static}				$p_{static} = \beta q_z R G C_{p\_static}$			RWDI(3.2.3)
STATIC WIND LOAD MOMENT (Max), M_{static}				$M_{static} = \beta q_z R G C_{m\_static} A L$			RWDI(3.2.3)
Module Length	L_{mod} =	89.7	inch ≈	2279	mm		
Module Width	W_{mod} =	44.6	inch ≈	1134	mm		
Module Gap	G_{mod} =	0.63	inch ≈	16	mm		
Perimeter Class Table	T_{per} =	12	#				
Central Class Table	T_{cen} =	24	#				
Perimeter Class Table Area	A_{per} =	342	sq.ft ≈	31.81	sq.m	A_{per} + =	4.32
Central Class Table Area	A_{cen} =	699	sq.ft ≈	64.91	sq.m	A_{cen} + =	9.03
Alloable Stress Load Factor	β =	1.02		: RWDI -2 M			
Ground Coverage Ration	GCR =	0.50		GCR is in the acceptable range			
Chord Length	L =	89.7	inch ≈	2279.0	m		
Table Height	H =	77.8	inch ≈	2.0	m	H/L is in the range	

>>> Full Chord Perimeter Class Table :				(R applied)	(PSF)	(PSF)	(kips.ft)	(kips.ft)
tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	GC_{m_Torque}	$GC_{m\_OverTurning}$	$p_{Downforce}$	p_{Uplift}	M_{Torque}	$M_{overturning}$
0	0.2383512	-0.375058	0.1054903	0.1315507	1.1	-1.8	1.1	1.4
3	0.4552147	-0.539991	0.1119616	0.1559316	2.1	-2.5	1.2	1.6
10	0.6227514	-0.65162	0.1159708	0.212275	0.0	0.0	0.0	0.0
20	0.8141906	-0.673069	0.1131906	0.2888082	0.0	0.0	0.0	0.0
30	1.0145459	-0.796352	0.1235291	0.4532589	0.0	0.0	0.0	0.0
45	1.1232397	-0.901091	0.1238685	0.6402165	0.0	0.0	0.0	0.0
60	1.1244154	-1.014033	0.0955372	0.8311581	0.0	0.0	0.0	0.0

>>> Full Chord Central Class Table :				(R applied)	(PSF)	(PSF)	(kips.ft)	(kips.ft)
tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	GC_{m_Torque}	$GC_{m\_OverTurning}$	$p_{Downforce}$	p_{Uplift}	M_{Torque}	$M_{overturning}$
0	0.1392151	-0.196836	0.0451612	0.0556811	0.7	-0.9	1.0	1.2
3	0.2279833	-0.307398	0.0625205	0.0920303	1.1	-1.4	1.3	2.0
10	0.2866527	-0.422711	0.0777748	0.1446422	0.0	0.0	0.0	0.0
20	0.318625	-0.436182	0.0767904	0.191684	0.0	0.0	0.0	0.0
30	0.3050952	-0.457571	0.0699602	0.2533924	0.0	0.0	0.0	0.0
45	0.3156423	-0.385337	0.0486821	0.2650682	0.0	0.0	0.0	0.0
60	0.2843515	-0.293068	0.0550985	0.2750795	0.0	0.0	0.0	0.0

DYNAMIC WIND LOAD THRESHOLD

Wind Speed (ft/s)	V_i =	73.33	V_{i_tilt} =	0.01	$V_{i\_t.60}$ =	0.01	: 3s@33ft
Critical Friquency (HZ)	F_{Cr} =	2.78	F_{Cr_tilt} =	-0.01	$F_{Cr\_t.60}$ =	-0.01	: Fig 3 (RWDI)

Coef. n_T	Coef. n_N	Coef. n_R	Perimeter Class Table			Central Class Table		
1.00	1.00	1.00	stow	tilt	tilt-60	stow	tilt	tilt-60
Natural Frequency (Torque)		n_T (HZ) =	**2.30**	*2.30*	2.30	**1.70**	*1.70*	1.70
Dynamic Torque Frequency Applicability			1	0	0	1	0	0
Natural Frequency (Normal)		n_N (HZ) =	**2.80**	*2.80*	2.80	**1.90**	*1.90*	1.90
Dynamic Normal Frequency Applicability			0	0	0	1	0	0
Natural Frequency (Roll)		n_R (HZ) =	**1.40**	*1.40*	1.40	**1.40**	*1.40*	1.40
Dynamic Roll Frequency Applicability			1	0	0	1	0	0

DYNAMIC WIND LOAD PRUSSURE (Max), $p_{dynamic}$ $p_{dynamic} = \beta q_z G C_{p\_dynamic}$ RWDI(3.2.3)

DYNAMIC WIND LOAD MOMENT (Max), $M_{dynamic}$ $M_{dynamic} = \beta q_z G C_{m\_dynamic} A L$ RWDI(3.2.3)

Coef.for Damping w/ Ice =	1	stow	tilt	tilt-60	stow	tilt	tilt-60
Reduced Frequency (Torque)	$n_T L / V$ =	0.23	1172.53	1172.53	0.17	866.66	866.66
Torque Damping	D_T =	**3.50%**	**3.50%**	3.50%	**5.00%**	**5.00%**	5.00%
Reduced Frequency (Normal)	$n_N L / V$ =	0.29	1427.43	1427.43	0.19	968.62	968.62
Normal Damping	D_N =	**2.00%**	**2.00%**	2.00%	**2.50%**	**2.50%**	2.50%
Reduced Frequency (Roll)	$n_R L / V$ =	0.14	713.72	713.72	0.14	713.72	713.72
Roll Damping	D_R =	**4.00%**	**4.00%**	4.00%	**4.00%**	**4.00%**	4.00%

>>> Full Chord Perimeter Class Table :

tilt	$GC_{p\_Dynamic}$	$-GC_{p\_Dynamic}$	GC_{m_Torque}	$GC_{m\_Overturning}$	$p_{Dyn\_Downforce}$ (PSF)	p_{Dyn_Uplift} (PSF)	M_{dyn_Torque} (kips.ft)	$M_{dyn\_Overturning}$ (kips.ft)
0	0.372968	-0.372968	0.0756045	0.0739213	0.0	0.0	0.9	0.9
3	0.372968	-0.372968	0.0756045	0.0739213	0.0	0.0	0.9	0.9
10	0	0	0	0	0.0	0.0	0.0	0.0
20	0	0	0	0	0.0	0.0	0.0	0.0
30	0	0	0	0	0.0	0.0	0.0	0.0
45	0	0	0	0	0.0	0.0	0.0	0.0
60	0	0	0	0	0.0	0.0	0.0	0.0

>>> Full Chord Central Class Table :

tilt	$GC_{p\_Dynamic}$	$-GC_{p\_Dynamic}$	GC_{m_Torque}	$GC_{m\_Overturning}$	$p_{Dyn\_Downforce}$ (PSF)	p_{Dyn_Uplift} (PSF)	M_{dyn_Torque} (kips.ft)	$M_{dyn\_Overturning}$ (kips.ft)
0	0.233189	-0.233189	0.0524863	0.0532175	1.1	-1.1	1.3	1.3
3	0.233189	-0.233189	0.0524863	0.0532175	1.1	-1.1	1.3	1.3
10	0	0	0	0	0.0	0.0	0.0	0.0
20	0	0	0	0	0.0	0.0	0.0	0.0
30	0	0	0	0	0.0	0.0	0.0	0.0
45	0	0	0	0	0.0	0.0	0.0	0.0
60	0	0	0	0	0.0	0.0	0.0	0.0

Support Reaction for W on Ice Load			**(Class:** both **| Tilt:** all **| Support:** total **)**					Page | 13
TABLE HEIGHT :		*H =*	6.48	ft				
1. Overturning $_{(St+Dyn)}$			2. Normal-P$_{(St+Dyn)}$ + Torque$_{(St+0.6Dyn)}$			3. Normal-P$_{(St+0.6Dyn)}$ + Torque$_{(St+Dyn)}$		
>>> Perimeter Class Table :								
tilt	Vx (kips) $_1$	Vx (kips) $_2$	Vx (kips) $_3$	Vx (kips)	M_{yy} (kips.ft)$_1$	M_{yy} (kips.ft)$_2$	M_{yy} (kips.ft)$_3$	M_{yy} (kips.ft)
0	0	0.00	0.00	0.00	2.3	1.65	2.02	2.27
3	0	0.05	0.05	0.05	2.5	2.02	2.38	2.53
10	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
20	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
30	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
45	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
60	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
>>> Central Class Table :								
tilt	Vx (kips) $_1$	Vx (kips) $_2$	Vx (kips) $_3$	Vx (kips)	M_{yy} (kips.ft)$_1$	M_{yy} (kips.ft)$_2$	M_{yy} (kips.ft)$_3$	M_{yy} (kips.ft)
0	0	0.00	0.00	0.00	2.5	1.74	2.26	2.50
3	0	0.09	0.08	0.09	3.3	2.72	3.13	3.28
10	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
20	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
30	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
45	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
60	0	0.00	0.00	0.00	0.0	0.00	0.00	0.00
>>> Perimeter Class Table :								
tilt	P (kips) $_1$	P (kips) $_2$	P (kips) $_3$	P (kips)	T (kips) $_1$	T (kips) $_2$	T (kips) $_3$	T (kips)
0	0	0.38	0.38	0.38	0	-0.61	-0.61	-0.61
3	0	0.73	0.73	0.73	0	-0.87	0.87	-0.87
10	0	0.00	0.00	0.00	0	0.00	0.00	0.00
20	0	0.00	0.00	0.00	0	0.00	0.00	0.00
30	0	0.00	0.00	0.00	0	0.00	0.00	0.00
45	0	0.00	0.00	0.00	0	0.00	0.00	0.00
60	0	0.00	0.00	0.00	0	0.00	0.00	0.00
>>> Central Class Table :								
tilt	P (kips) $_1$	P (kips) $_2$	P (kips) $_3$	P (kips)	T (kips) $_1$	T (kips) $_2$	T (kips) $_3$	T (kips)
0	0	1.23	0.92	1.23	0	-1.42	-1.11	-1.42
3	0	1.52	1.21	1.52	0	-1.78	-1.47	-1.78
10	0	0.00	0.00	0.00	0	0.00	0.00	0.00
20	0	0.00	0.00	0.00	0	0.00	0.00	0.00
30	0	0.00	0.00	0.00	0	0.00	0.00	0.00
45	0	0.00	0.00	0.00	0	0.00	0.00	0.00
60	0	0.00	0.00	0.00	0	0.00	0.00	0.00

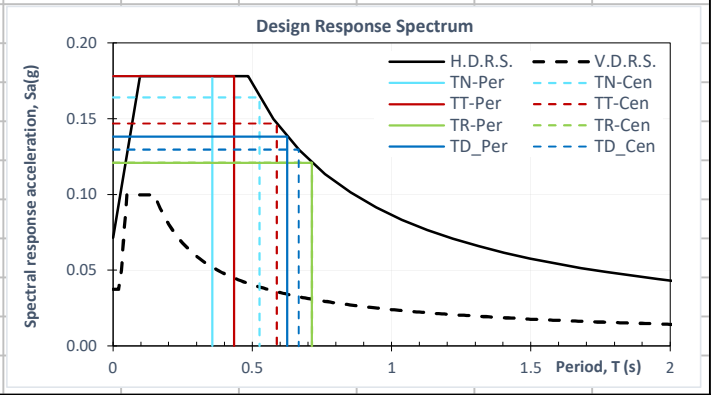
SEISMIC GROUND MOTION VALUES

ASCE 7-16 (11.4)

S_S =	**0.167**	g	Mapped Short Period Spectral Response Acceleration Parameter (Figs 22-N)
S_1 =	**0.054**	g	Mapped 1 Second Spectral Response Acceleration Parameter (Figs 22-N)
Site Class :	**D**		Seismic Design Category (Chapter 20)
F_a =	1.600		Short-Period Site Coefficient (at 0.2 s-period) - (Table 11.4-1)
F_v =	2.400		Long-Period Site Coefficient (at 1.0 s-period) - (Table 11.4-2)
S_{MS} =	0.267	g	Spectral Response Acceleration at Short Periods
S_{M1} =	0.130	g	Spectral Response Acceleration at a Period of 1s
S_{DS} =	0.178	g	Spectral Response Acceleration Parameter at Short Periods
S_{D1} =	0.086	g	Spectral Response Acceleration Parameter at a Period of 1s
I_e =	**1**		Seismic Importance Factor

DESIGN RESPONSE SPECTRUM

T_0 =	0.097	s	The Fundamental Period of The Structure					
T_S =	0.485	s	Short-Period Transition Period					
T_L =	**6**	s	Long-Period Transition Period (Fig 22-14 ~17)					
S_a =	Formula.1	g	11.4-5	Formula.1	$0 < T < T_0$	11.4-6	Formula.2	$T_S < T < T_L$
S_a =	0.178	g	S_{DS}	*0.178*	$T_0 < T < T_S$	11.4-7	Formula.3	$T_L < T < T_\infty$
S_a =	Formula.2	g						
S_a =	Formula.3	g						
$T_{T.Per}$ =	**0.435**	s						
$T_{R.Per}$ =	**0.714**	s						
$T_{N.Per}$ =	**0.357**	s						
$T_{T.Cen}$ =	**0.588**	s						
$T_{R.Cen}$ =	**0.714**	s						
$T_{N.Cen}$ =	**0.526**	s						
T_{D_Cen} =	0.667	s						
T_{D_Per} =	0.625	s						



STRUCTURAL DESIGN BASIS & EQUIVALENT LATERAL FORCE

			Perimeter Class Table			*Central Class Table*		
			R	Ω_0	C_d	*R*	Ω_0	C_d
Table (15.4-1)	East-West	X-dir	1.25	1.25	1.25	1.25	1.25	1.25
Table (15.4-1)	North-South	Y-dir	1.25	1.25	1.25	1.25	1.25	1.25
(11.9.3)	Vertical	Z-dir	***Sav, shall be taken as two-thirds of the value of SaMv(11.9.2)***					
			C_S	*W(kip)*	*V(kip)*	C_S	*W(kip)*	*V(kip)*
(15.4)	East-West	X-dir	0.10	1.96	0.19	0.10	2.95	0.29
(15.4)	North-South	Y-dir	0.11	1.96	0.22	0.10	2.95	0.31
	X & Y	***MINIMUM***	0.01	1.96	0.02	0.01	2.95	0.03
(12.4.3)	Vertical	Z-dir	0.04	1.96	0.07	0.04	2.95	0.11

Support Load Summary **(Class:** Perimeter **| Tilt:** 0/45/60 **| Support:** all **)**

SUPPORT TRIBUTARY RATIO :

Total Length	L_{Total} =	**13.78**	m
Number of Supports	$N_{Supports}$ =	**2**	#
Span	L_{Span} =	**8.34**	m
Cantilever Length	$L_{Cantilever}$ =	2.72	m
End Support Ratio	$Ratio_{End}$ =	0.50	
Mid. Support Ratio	$Ratio_{Mid}$ =	N/A	

Support	Tilt	Reaction	Dead	Snow	Ice	Wind	Seismic	Wind on Ice
End Support	0	P (kips)	0.65	0.81	1.02	2.68	0.03	0.19
		T (kips)	n/a	n/a	n/a	-3.16	-0.03	-0.30
		V_x (kips)	n/a	n/a	n/a	0.00	0.09	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	6.03	0.61	1.14
	45	P (kips)	0.65	0.26	n/a	0.23	0.03	0.00
		T (kips)	n/a	n/a	n/a	-0.26	-0.03	0.00
		V_x (kips)	n/a	n/a	n/a	0.23	0.09	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	1.77	0.61	0.00
	60	P (kips)	0.65	0.07	n/a	0.07	0.03	0.00
		T (kips)	n/a	n/a	n/a	-0.13	-0.03	0.00
		V_x (kips)	n/a	n/a	n/a	0.13	0.09	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	0.91	0.61	0.00

Support	Tilt	Reaction	Dead	Snow	Ice	Wind	Seismic	Wind W/ Ice
Middle Support	0	P (kips)	N/A	N/A	N/A	N/A	n/a	N/A
		T (kips)	n/a	n/a	n/a	N/A	n/a	N/A
		V_x (kips)	n/a	n/a	n/a	N/A	n/a	N/A
		M_{yy} (kips.ft)	n/a	n/a	n/a	N/A	n/a	N/A
	45	P (kips)	N/A	N/A	n/a	N/A	n/a	N/A
		T (kips)	n/a	n/a	n/a	N/A	n/a	N/A
		V_x (kips)	n/a	n/a	n/a	N/A	n/a	N/A
		M_{yy} (kips.ft)	n/a	n/a	n/a	N/A	n/a	N/A
	60	P (kips)	N/A	N/A	n/a	N/A	n/a	N/A
		T (kips)	n/a	n/a	n/a	N/A	n/a	N/A
		V_x (kips)	n/a	n/a	n/a	N/A	n/a	N/A
		M_{yy} (kips.ft)	n/a	n/a	n/a	N/A	n/a	N/A

SUPPORT TRIBUTARY RATIO :

Total Length	L_{Total} =	27.76	m
Number of Supports	$N_{Supports}$ =	3	#
Span	L_{Span} =	10.23	m
Cantilever Length	$L_{Cantilever}$ =	3.65	m
End Support Ratio	$Ratio_{End}$ =	0.32	
Mid. Support Ratio	$Ratio_{Mid}$ =	0.37	

Support	Tilt	Reaction	Dead	Snow	Ice	Wind	Seismic	Wind on Ice
End Support	0	P (kips)	0.76	1.03	1.30	1.78	0.03	0.39
		T (kips)	n/a	n/a	n/a	-2.05	-0.03	-0.45
		V_x (kips)	n/a	n/a	n/a	0.00	0.09	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	3.43	0.58	0.79
	45	P (kips)	0.76	0.33	n/a	0.08	0.03	0.00
		T (kips)	n/a	n/a	n/a	-0.10	-0.03	0.00
		V_x (kips)	n/a	n/a	n/a	0.10	0.09	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	0.82	0.58	0.00
	60	P (kips)	0.76	0.09	n/a	0.02	0.03	0.00
		T (kips)	n/a	n/a	n/a	-0.02	-0.03	0.00
		V_x (kips)	n/a	n/a	n/a	0.04	0.09	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	0.34	0.58	0.00

Support	Tilt	Reaction	Dead	Snow	Ice	Wind	Seismic	Wind W/ Ice
Middle Support	0	P (kips)	0.88	1.20	1.52	2.08	0.04	0.45
		T (kips)	n/a	n/a	n/a	-2.39	-0.04	-0.52
		V_x (kips)	n/a	n/a	n/a	0.00	0.11	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	4.00	0.68	0.92
	45	P (kips)	0.88	0.39	n/a	0.10	0.04	0.00
		T (kips)	n/a	n/a	n/a	-0.12	-0.04	0.00
		V_x (kips)	n/a	n/a	n/a	0.12	0.11	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	0.96	0.68	0.00
	60	P (kips)	0.88	0.11	n/a	0.03	0.04	0.00
		T (kips)	n/a	n/a	n/a	-0.03	-0.04	0.00
		V_x (kips)	n/a	n/a	n/a	0.05	0.11	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	0.40	0.68	0.00

Support Load Summary **(Class:** both **| Tilt:** 0/60 **| Support:** worse case **)**

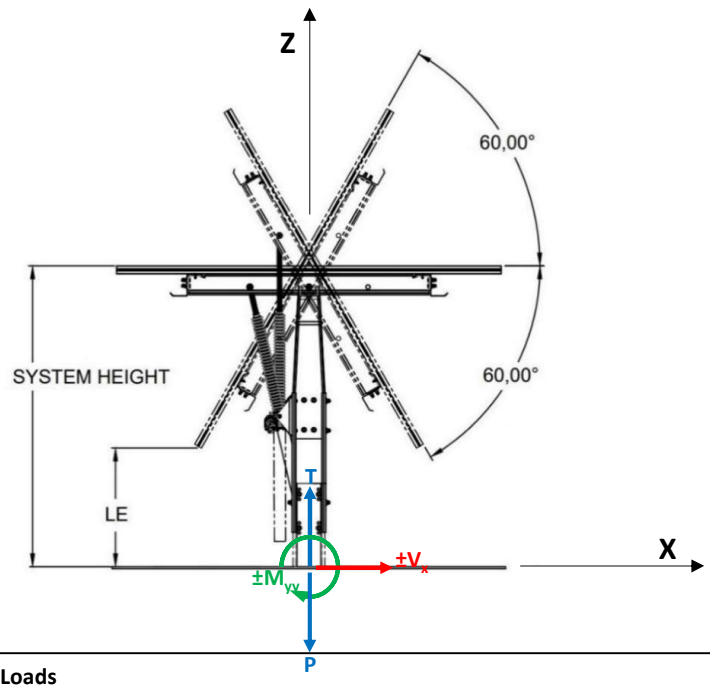
Unfactored Reaction Loads at : 3.00 ° tilt

Table	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
Perimeter Class	P (kips)	0.65	0.81	0.00	3.44	0.03	0.37	1.62
	T (kips)	n/a	n/a	n/a	-3.75	-0.03	-0.44	-1.92
	V_x (kips)	n/a	n/a	n/a	0.20	0.09	0.02	0.10
	M_{yy} (kips.ft)	n/a	n/a	n/a	6.68	0.61	1.26	4.15
Central Class	P (kips)	0.88	1.20	0.00	2.55	0.04	0.56	1.22
	T (kips)	n/a	n/a	n/a	-2.98	-0.04	-0.66	-1.64
	V_x (kips)	n/a	n/a	n/a	0.16	0.11	0.03	0.09
	M_{yy} (kips.ft)	n/a	n/a	n/a	5.46	0.68	1.21	3.68

Note : P = Downforce, T = Uplift Force, V = Base Shear Force, M = Overturning Moment

Table	*Support* / *Tilt*	*Reaction*	Dead	Snow	Ice	Wind	Seismic	Wind on Ice
Perimeter Class	End Support 0	P (kips)	0.65	0.81	1.02	2.68	0.03	0.19
		T (kips)	n/a	n/a	n/a	-3.16	-0.03	-0.30
		V_x (kips)	n/a	n/a	n/a	0.00	0.09	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	6.03	0.61	1.14
Central Class	Middle Support 0	P (kips)	0.88	1.20	1.52	2.08	0.04	0.45
		T (kips)	n/a	n/a	n/a	-2.39	-0.04	-0.52
		V_x (kips)	n/a	n/a	n/a	0.00	0.11	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	4.00	0.68	0.92

Table	*Support* / *Tilt*	*Reaction*	Dead	Snow	Ice	Wind	Seismic	Wind on Ice
Perimeter Class	End Support 45	P (kips)	0.65	0.26	n/a	0.23	0.03	0.00
		T (kips)	n/a	n/a	n/a	-0.26	-0.03	0.00
		V_x (kips)	n/a	n/a	n/a	0.23	0.09	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	1.77	0.61	0.00
Central Class	Middle Support 45	P (kips)	0.88	0.39	n/a	0.10	0.04	0.00
		T (kips)	n/a	n/a	n/a	-0.12	-0.04	0.00
		V_x (kips)	n/a	n/a	n/a	0.12	0.11	0.00
		M_{yy} (kips.ft)	n/a	n/a	n/a	0.96	0.68	0.00



Unfactored Reaction Loads

Table	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
Perimeter Class	P (kips)	0.65	0.81	1.02	3.44	0.03	0.37	1.62
	T (kips)	n/a	n/a	n/a	-3.75	-0.03	-0.44	-1.92
	V_x (kips)	n/a	n/a	n/a	0.23	0.09	0.02	0.23
	M_{yy} (kips.ft)	n/a	n/a	n/a	6.68	0.61	1.26	4.15
Central Class	P (kips)	0.88	1.20	1.52	2.55	0.04	0.56	1.22
	T (kips)	n/a	n/a	n/a	-2.98	-0.04	-0.66	-1.64
	V_x (kips)	n/a	n/a	n/a	0.16	0.11	0.03	0.12
	M_{yy} (kips.ft)	n/a	n/a	n/a	5.46	0.68	1.21	3.68

Note : P = Downforce, T = Uplift Force, V = Base Shear Force, M = Overturning Moment

Maximum Panel Pressure

(ASD Factored)				(Strength Design Factored)		
DIRECTION (UNIT)	FULL STRIP	HALF STRIP	*NOTE : Self weight is not considered*	DIRECTION (UNIT)	FULL STRIP	HALF STRIP
Upward (PSF)	14.1	18.1		Upward (PSF)	26.0	32.5
Downward (PSF)	-14.7	-20.2		Downward (PSF)	-24.5	-33.6
Upward (Pa)	677	865		Upward (Pa)	1244	1556
Downward (Pa)	-705	-966		Downward (Pa)	-1175	-1610

ASD Factored Combination Loads **(Table Class:** Perimeter/Central **| Support:** The Worse Case **)**

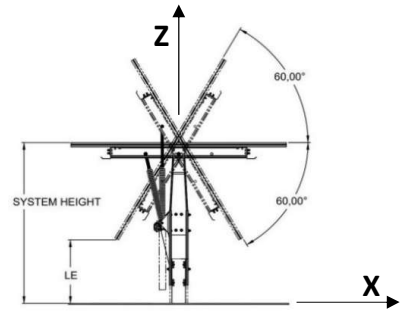
Notes:

(1) - *Replace V_y & M_{xx} with V_x & M_{yy} respectively for lateral load combination at Y direction*

(2) - *Uplift force combination load case*

(3) - *Tortion over Z axis is negligible*

(4) - *Shear Forces & Bending Moments are appleid in both +/- direction*



Perimeter Class Table	Reaction	P	T	V_x	M_{yy}	V_y (1)	M_{xx} (1)
Comb.No.	***Load Combination***	*kips*	*kips*	*kips*	*kips.ft*	*kips*	*kips.ft*
1	*D*	0.65					
2	*D + S*	1.46					
3	*D + 0.6W*	2.72		0.14	4.01	0.02	0.60
4	*D + 0.75S + 0.45W*	1.99		0.10	1.87	0.02	0.28
5	*0.6D + 0.6W* (2)		1.86	0.14	4.01	0.02	0.60
6	*D + 0.7D $_i$*	1.37					
7	*D + 0.7D $_i$ + 0.7W $_i$*	1.62		0.02	0.88	0.00	0.13
8	*0.6D + 0.7D $_i$ + 0.7W $_i$* (2)	0.80		0.02	0.88	0.00	0.13
9	*D + 0.7E $_v$ + 0.7E $_h$*	0.68		0.07	0.43	0.07	0.43
10	*D+0.75S+0.525E $_v$ +0.525E $_h$*	1.28		0.05	0.32	0.05	0.32
11	*0.6D + 0.525E $_v$ + 0.525E $_h$* (2)	0.37		0.07	0.43	0.07	0.43

Central Class Table	Reaction	P	T	V_x	M_{yy}	V_y (1)	M_{xx} (1)
Comb.No.	***Load Combination***	*kips*	*kips*	*kips*	*kips.ft*	*kips*	*kips.ft*
1	*D*	0.88					
2	*D + S*	2.08					
3	*D + 0.6W*	2.41		0.09	3.28	0.01	0.33
4	*D + 0.75S + 0.45W*	2.33		0.05	1.66	0.01	0.17
5	*0.6D + 0.6W* (2)		1.26	0.09	3.28	0.01	0.33
6	*D + 0.7D $_i$*	1.94					
7	*D + 0.7D $_i$ + 0.7W $_i$*	2.33		0.02	0.85	0.00	0.08
8	*0.6D + 0.7D $_i$ + 0.7W $_i$* (2)	1.13		0.02	0.85	0.00	0.08
9	*D + 0.7E $_v$ + 0.7E $_h$*	0.90		0.07	0.48	0.07	0.48
10	*D+0.75S+0.525E $_v$ +0.525E $_h$*	1.80		0.06	0.36	0.06	0.36
11	*0.6D + 0.525E $_v$ + 0.525E $_h$* (2)	0.50		0.07	0.48	0.07	0.48

P = Downforce, V_x = Base Shear Force in X direction , M_{yy} = Overturning Moment over Y axis

T = Uplift Force , V_y = Base Shear Force in Y direction , M_{xx} = Overturning Moment over X axis

Strength Design Factored Combination Loads **(Table Class:** Perimeter/Central **| Support:** The Worse Case **)**

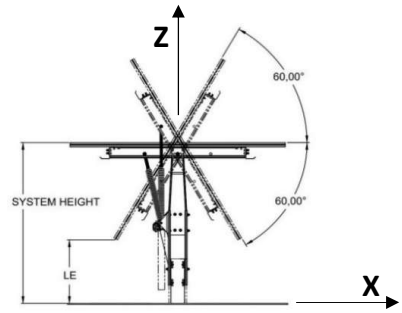
Notes:

(1) - *Replace V_y & M_{xx} with V_x & M_{yy} respectively for lateral load combination at Y direction*

(2) - *Uplift force combination load case*

(3) - *Tortion over Z axis is negligible*

(4) - *Shear Forces & Bending Moments are appleid in both +/- direction*



Perimeter Class Table	Reaction	P	T	V_x	M_{yy}	V_y (1)	M_{xx} (1)
Comb.No.	***Load Combination***	*kips*	*kips*	*kips*	*kips.ft*	*kips*	*kips.ft*
1	***1.4D***	0.91					
2	***1.2D + 1.6S***	2.08					
3	***1.2D + 1.6S + 0.5W***	2.89		0.12	2.08	0.02	0.31
4	***1.2D + 0.5S + 1.0W***	4.63		0.23	6.68	0.03	1.00
5	***0.9D + 1.0W*** (2)		3.16	0.23	6.68	0.03	1.00
6	***1.2D + 0.5S + 0.2D $_i$***	1.39					
7	***1.2D + 1.0D $_i$ + 1.0W $_i$***	2.17		0.02	1.26	0.00	0.19
8	***0.9D + 1.0D $_i$ + 1.0W $_i$*** (2)	1.17		0.02	1.26	0.00	0.19
9	***1.2D + 1.0D $_i$***	1.81					
10	***1.2D + 0.2S + 1E $_v$ + 1E $_{hx}$***	0.98		0.09	0.61	0.09	0.61
11	***0.9D + (-1)E $_v$ + 1E $_{hx}$*** (2)	0.55		0.09	0.61	0.09	0.61

Central Class Table	Reaction	P	T	V_x	M_{yy}	V_y (1)	M_{xx} (1)
Comb.No.	***Load Combination***	*kips*	*kips*	*kips*	*kips.ft*	*kips*	*kips.ft*
1	***1.4D***	1.23					
2	***1.2D + 1.6S***	2.98					
3	***1.2D + 1.6S + 0.5W***	3.59		0.06	1.84	0.01	0.18
4	***1.2D + 0.5S + 1.0W***	4.21		0.16	5.46	0.02	0.55
5	***0.9D + 1.0W*** (2)		2.19	0.16	5.46	0.02	0.55
6	***1.2D + 0.5S + 0.2D $_i$***	1.96					
7	***1.2D + 1.0D $_i$ + 1.0W $_i$***	3.13		0.03	1.21	0.00	0.12
8	***0.9D + 1.0D $_i$ + 1.0W $_i$*** (2)	1.65		0.03	1.21	0.00	0.12
9	***1.2D + 1.0D $_i$***	2.57					
10	***1.2D + 0.2S + 1E $_v$ + 1E $_{hx}$***	1.33		0.11	0.68	0.11	0.68
11	***0.9D + (-1)E $_v$ + 1E $_{hx}$*** (2)	0.75		0.11	0.68	0.11	0.68

P = Downforce, V_x = Base Shear Force in X direction , M_{yy} = Overturning Moment over Y axis

T = Uplift Force , V_y = Base Shear Force in Y direction , M_{xx} = Overturning Moment over X axis

Single Solar Panel Pressure **(Loads:** Wind/Snow/Ice$_{Dead}$ **| Tilt:** 0 ~ 60 **)**

Class	**STATIC WIND PRESSURE (PSF)**				**DYNAMIC WIND PRESSURE (PSF)**			
Perimeter	***Full Strip***		***Half Strip***		***Full Strip***		***Half Strip***	
tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	$GC_{p\_Downforce}$	GC_{p_Uplift}	$GC_{p\_Dynamic}$	$-GC_{p\_Dynamic}$	$GC_{p\_Dynamic}$	$-GC_{p\_Dynamic}$
0	8.26	-9.34	12.19	-17.38	10.67	-10.67	10.67	-10.67
3	12.91	-13.88	19.43	-22.96	10.67	-10.67	10.67	-10.67
10	1.41	-1.49	1.98	-2.18	0.00	0.00	0.00	0.00
20	2.13	-1.60	2.70	-2.19	0.00	0.00	0.00	0.00
30	2.76	-2.16	3.42	-2.82	0.00	0.00	0.00	0.00
45	3.28	-2.51	3.94	-3.21	0.00	0.00	0.00	0.00
60	1.43	-1.15	1.75	-1.29	0.00	0.00	0.00	0.00
Central	***Full Strip***		***Half Strip***		***Full Strip***		***Half Strip***	
tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	$GC_{p\_Downforce}$	GC_{p_Uplift}	$GC_{p\_Dynamic}$	$-GC_{p\_Dynamic}$	$GC_{p\_Dynamic}$	$-GC_{p\_Dynamic}$
0	5.68	-5.97	8.33	-10.65	5.19	-5.19	5.19	-5.19
3	7.51	-9.01	10.95	-14.96	5.19	-5.19	5.19	-5.19
10	0.68	-0.97	1.00	-1.60	0.00	0.00	0.00	0.00
20	0.88	-1.12	1.24	-1.74	0.00	0.00	0.00	0.00
30	0.87	-1.15	1.08	-1.77	0.00	0.00	0.00	0.00
45	0.94	-1.04	1.05	-1.39	0.00	0.00	0.00	0.00
60	0.37	-0.34	0.51	-0.45	0.00	0.00	0.00	0.00
Class	**TOTAL WIND PRESSURE (PSF)**				**SNOW (PSF)**		**ICE (PSF)**	
Perimeter	***Full Strip***		***Half Strip***		***Normal Direction***		***Normal Direction***	
tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	$GC_{p\_Downforce}$	GC_{p_Uplift}	$p_{Downforce}$	GC_{p_Uplift}	$p_{Downforce}$	$p_{Downforce}$-Sap
0	18.93	-20.01	22.86	-28.05	4.80	0.00	6.37	6.17
3	23.58	-24.55	30.10	-33.63	4.79	0.00	6.36	5.65
10	1.41	-1.49	1.98	-2.18	4.73	0.00	6.26	5.65
20	2.13	-1.60	2.70	-2.19	4.10	0.00	5.89	5.65
30	2.76	-2.16	3.42	-2.82	3.02	0.00	5.10	5.64
45	3.28	-2.51	3.94	-3.21	1.54	0.00	3.60	5.63
60	1.43	-1.15	1.75	-1.29	0.44	0.00	1.80	5.63
Central	***Full Strip***		***Half Strip***		***Normal Direction***		***Normal Direction***	
tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	$GC_{p\_Downforce}$	GC_{p_Uplift}	$p_{Downforce}$	GC_{p_Uplift}	$p_{Downforce}$	$p_{Downforce}$-Sap
0	10.87	-11.16	13.52	-15.84	4.80	0.00	6.37	6.17
3	12.70	-14.20	16.14	-20.15	4.79	0.00	6.36	5.65
10	0.68	-0.97	1.00	-1.60	4.73	0.00	6.26	5.65
20	0.88	-1.12	1.24	-1.74	4.10	0.00	5.89	5.65
30	0.87	-1.15	1.08	-1.77	3.02	0.00	5.10	5.64
45	0.94	-1.04	1.05	-1.39	1.54	0.00	3.60	5.63
60	0.37	-0.34	0.51	-0.45	0.44	0.00	1.80	5.63

Single Solar Panel Pressure **(Class:** Perimeter **| Load:** all **| Tilt:** 0 **| Method:** ASD/Strength Design **)**

	Dead	Snow	Ice	Wind	Wind on Ice	EQ. ver.	EQ. hor.	
	D	S	D_i	W	W_i	E_v	E_h	
Comb. No.	**LOAD COMBINATIONS FOR ALLOWABLE STRESS DESIGN**							*Sum(PSF)*
1		***4.80***	***6.37***	***23.58***	***1.87***	***0.08***	0	*0.00*
2		4.80	6.37	23.58	1.87	0.08	0	*4.80*
3		4.80	6.37	23.58	1.87	0.08	0	*14.15*
4		4.80	6.37	***12.91***	***1.87***	0.08	0	*9.41*
5	***0.00***	4.80	6.37	***-24.55***	***-2.12***	0.08	0	*-14.73*
6		4.80	6.37	23.58	1.87	0.08	0	*4.46*
7		4.80	6.37	23.58	1.87	0.08	0	*5.77*
8		4.80	6.37	23.58	1.87	0.08	0	*5.77*
9		4.80	6.37	23.58	1.87	0.08	0	*4.46*
10		4.80	6.37	23.58	1.87	0.08	0	*0.06*
11		4.80	6.37	23.58	1.87	0.08	0	*3.64*
12	0.00	4.80	6.37	-24.55	-2.12	0.08	0	*-0.06*
Maximum Single Panel Downforce Pressure (FACTORED for ASD in PSF) =								14.15
Maximum Single Panel uplift Pressure (FACTORED for ASD in PSF) =								-14.73

	Dead	Snow	Ice	Wind	Wind on Ice	EQ. ver.	EQ. hor.	
	D	S	D_i	W	W_i	E_v	E_h	
Comb. No.	**LOAD COMBINATIONS FOR STRENGTH DESIGN**							*Sum(PSF)*
1		4.80	6.37	23.58	1.87	0.08	0.00	*0.00*
2		4.80	6.37	23.58	1.87	0.08	0.00	*7.68*
3		4.80	6.37	12.91	1.87	0.08	0.00	*14.13*
4		4.80	6.37	23.58	1.87	0.08	0.00	*25.98*
5	0.00	4.80	6.37	-24.55	-2.12	0.08	0.00	*-24.55*
6		4.80	6.37	23.58	1.87	0.08	0.00	*3.67*
7		4.80	6.37	23.58	1.87	0.08	0.00	*8.24*
8		4.80	6.37	23.58	1.87	0.08	0.00	*8.24*
9		4.80	6.37	23.58	1.87	0.08	0.00	*6.37*
10		4.80	6.37	23.58	1.87	0.08	0.00	*1.04*
11	0.00	4.80	6.37	-24.55	-2.12	0.08	0.00	*-0.08*
Maximum Single Panel Downforce Pressure (FACTORED for Strength Design in PSF) =								25.98
Maximum Single Panel Uplift Pressure (FACTORED for Strength Design in PSF) =								-24.55

Consider Self Weight For Uplift Combinations : No

Half Single Solar Panel Pressure **(Class:** Perimeter **| Load:** all **| Tilt:** 0 **| Method:** ASD/Strength Design **)**

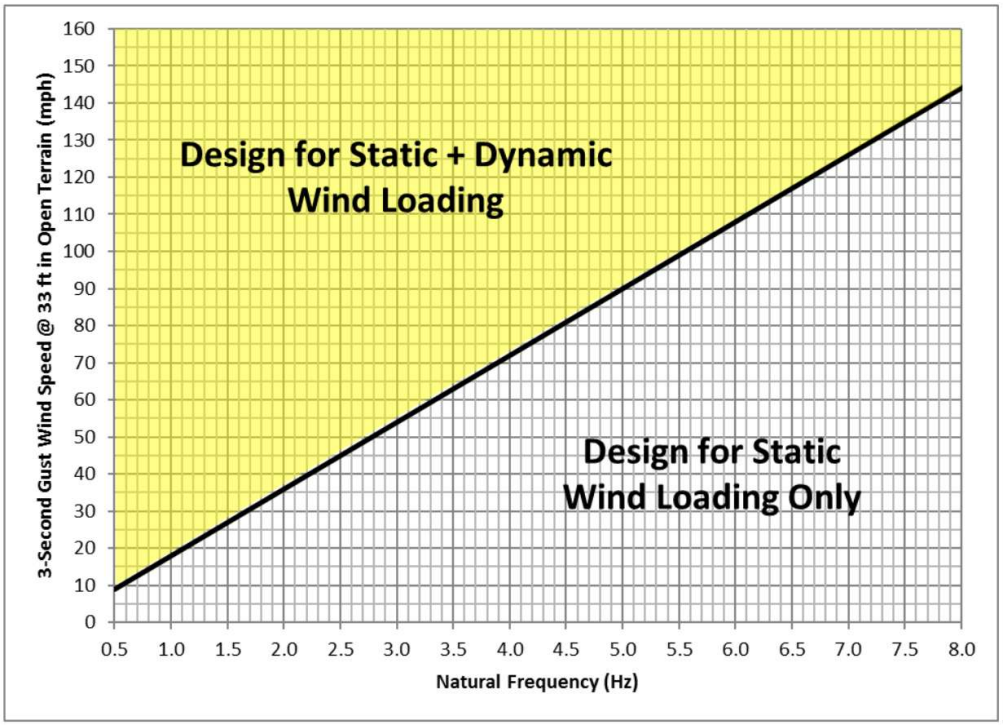
	Dead	Snow	Ice	Wind	Wind on Ice	EQ. ver.	EQ. hor.	
	D	S	D_i	W	W_i	E_v	E_h	
Comb. No.	**LOAD COMBINATIONS FOR ALLOWABLE STRESS DESIGN**							*Sum(PSF)*
1		***4.80***	***6.37***	***30.10***	***2.76***	***0.08***	0	*0.00*
2		4.80	6.37	30.10	1.87	0.08	0	*4.80*
3		4.80	6.37	30.10	2.76	0.08	0	*18.06*
4		4.80	6.37	***19.43***	***2.76***	0.08	0	*12.34*
5	***0.00***	4.80	6.37	***-33.63***	***-3.94***	0.08	0	*-20.18*
6		4.80	6.37	30.10	1.87	0.08	0	*4.46*
7		4.80	6.37	30.10	1.87	0.08	0	*5.77*
8		4.80	6.37	30.10	1.87	0.08	0	*5.77*
9		4.80	6.37	30.10	1.87	0.08	0	*4.46*
10		4.80	6.37	30.10	1.87	0.08	0	*0.06*
11		4.80	6.37	30.10	1.87	0.08	0	*3.64*
12	0.00	4.80	6.37	-33.63	-3.94	0.08	0	*-0.06*
Maximum Single Panel Downforce Pressure (FACTORED for ASD in PSF) =								18.06
Maximum Single Panel uplift Pressure (FACTORED for ASD in PSF) =								-20.18

	Dead	Snow	Ice	Wind	Wind on Ice	EQ. ver.	EQ. hor.	
	D	S	D_i	W	W_i	E_v	E_h	
Comb. No.	**LOAD COMBINATIONS FOR STRENGTH DESIGN**							*Sum(PSF)*
1		4.80	6.37	30.10	2.76	0.08	0.00	*0.00*
2		4.80	6.37	30.10	2.76	0.08	0.00	*7.68*
3		4.80	6.37	19.43	2.76	0.08	0.00	*17.40*
4		4.80	6.37	30.10	2.76	0.08	0.00	*32.50*
5	0.00	4.80	6.37	-33.63	-3.94	0.08	0.00	*-33.63*
6		4.80	6.37	30.10	2.76	0.08	0.00	*3.67*
7		4.80	6.37	30.10	2.76	0.08	0.00	*9.13*
8		4.80	6.37	30.10	2.76	0.08	0.00	*9.13*
9		4.80	6.37	30.10	2.76	0.08	0.00	*6.37*
10		4.80	6.37	30.10	2.76	0.08	0.00	*1.04*
11	0.00	4.80	6.37	-33.63	-3.94	0.08	0.00	*-0.08*
Maximum Single Panel Downforce Pressure (FACTORED for Strength Design in PSF) =								32.50
Maximum Single Panel Uplift Pressure (FACTORED for Strength Design in PSF) =								-33.63

Consider Self Weight For Uplift Combinations :	No

Wind & Wind on Ice Load			(Static/Dynamic/Total Half Chord)					Page | 24
WIND	Chord Length (ft)		L =	7.5	Alloable Stress Load Factor		β =	1.02
Velocity Pressure (PSF)		q_z =	20.4	q_{z_tilt} =	1.7	$q_{z\_t.60}$ =	0.7	: operating
Perimeter	Static Coef. (R applied)		**Static (PSF)**		**Dynamic (PSF)**		**Total (PSF)**	
tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	$GC_{p\_Downforce}$	GC_{p_Uplift}	$p_{Downforce}$	p_{Uplift}	$p_{Downforce}$	p_{Uplift}
0	0.2717391	-0.590547	5.7	-12.3	10.7	-10.7	16.3	-23.0
3	0.5585385	-0.713359	11.6	-14.8	10.7	-10.7	22.3	-25.5
10	0.7890017	-0.796972	1.3	-1.4	0.0	0.0	1.3	-1.4
20	0.9298679	-0.757773	1.6	-1.3	0.0	0.0	1.6	-1.3
30	0.8967648	-0.759077	1.5	-1.3	0.0	0.0	1.5	-1.3
45	0.8959022	-0.839647	1.5	-1.4	0.0	0.0	1.5	-1.4
60	0.9940137	-0.859681	0.8	-0.6	0.0	0.0	0.8	-0.6
Central	Static Coef. (R applied)		**Static (PSF)**		**Dynamic (PSF)**		**Total (PSF)**	
tilt	$GC_{p\_Downforce}$	GC_{p_Uplift}	$GC_{p\_Downforce}$	GC_{p_Uplift}	$p_{Downforce}$	p_{Uplift}	M_{Torque}	$M_{overturning}$
0	0.189324	-0.308333	3.9	-6.4	5.2	-5.2	9.1	-11.6
3	0.3643963	-0.454142	7.6	-9.4	5.2	-5.2	12.8	-14.6
10	0.5017626	-0.573121	0.9	-1.0	0.0	0.0	0.9	-1.0
20	0.6248752	-0.554391	1.1	-0.9	0.0	0.0	1.1	-0.9
30	0.6158416	-0.533053	1.0	-0.9	0.0	0.0	1.0	-0.9
45	0.5544731	-0.390207	0.9	-0.7	0.0	0.0	0.9	-0.7
60	0.4935359	-0.288734	0.4	-0.2	0.0	0.0	0.4	-0.2
WIND on ICE					Alloable Stress Load Factor		β =	1.02
Velocity Pressure (PSF)		q_z =	4.6	q_{z_tilt} =	0.0	$q_{z\_t.60}$ =	0.0	: operating
Same static coeficient applied		tilt	**Static (PSF)**		**Dynamic (PSF)**		**Total (PSF)**	
			$GC_{p\_Downforce}$	GC_{p_Uplift}	$p_{Downforce}$	p_{Uplift}	$p_{Downforce}$	p_{Uplift}
Equivalent Length (m) ***default : actual***	***Perimeter Class***	0	1.3	-2.8	0.0	0.0	1.3	-2.8
		3	2.6	-3.4	0.0	0.0	2.6	-3.4
		10	0.0	0.0	0.0	0.0	0.0	0.0
		20	0.0	0.0	0.0	0.0	0.0	0.0
		30	0.0	0.0	0.0	0.0	0.0	0.0
12		45	0.0	0.0	0.0	0.0	0.0	0.0
		60	0.0	0.0	0.0	0.0	0.0	0.0
Equivalent Length (m) ***default : actual***	***Central Class***	0	0.9	-1.5	1.1	-1.1	2.0	-2.6
		3	1.7	-2.1	1.1	-1.1	2.8	-3.2
		10	0.0	0.0	0.0	0.0	0.0	0.0
		20	0.0	0.0	0.0	0.0	0.0	0.0
		30	0.0	0.0	0.0	0.0	0.0	0.0
12		45	0.0	0.0	0.0	0.0	0.0	0.0
		60	0.0	0.0	0.0	0.0	0.0	0.0

Design Threshold for Including Dynamic Wind Loading	Figure: 3
Magna Structural Systems Inc. Project #1701209	Date: March 2, 2018

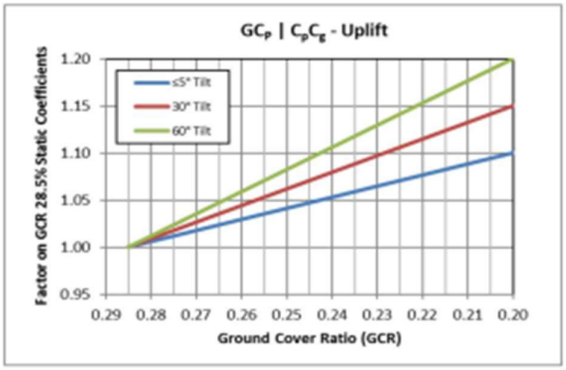


		Ref.1	Ref.0	tilt	stow	tilt-60
Critical Frequency	HZ	0.55	7.8	1.665385	5.848077	1.107692
Wind Speed (tilt)	mph	10	140	30	105	20

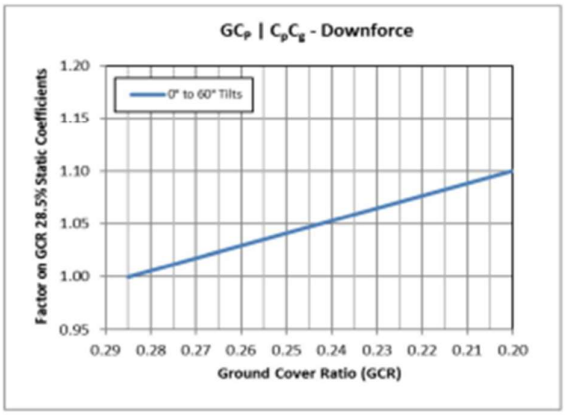
Influence of Row Spacing (GCR)
Factors Apply to GCR 28.5% Static Wind Load Coefficients

Figure: 6

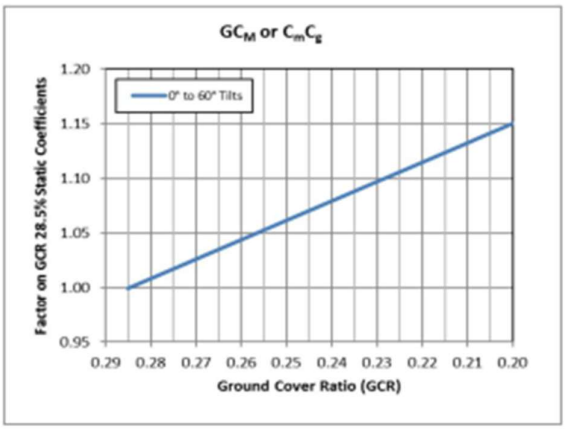
Magna Structural Systems Inc. Project #1701208 Date: March 2, 2018



Tilt	$GCR_{Ref.1}$	$R'_{Uplift.1}$	$GCR_{Ref.0}$	$R'_{Uplift.0}$	GCR_{Design}	R'_{Uplift}
0	28.50%	1	20%	1.1	29%	1
5	28.50%	1	20%	1.1	29%	1
10	28.50%	1	20%	1.11	29%	1
20	28.50%	1	20%	1.13	29%	1
30	28.50%	1	20%	1.15	29%	1
45	28.50%	1	20%	1.175	29%	1
60	28.50%	1	20%	1.2	29%	1



Tilt	$GCR_{Ref.1}$	$R'_{Downforce.1}$	$GCR_{Ref.0}$	$R'_{Downforce.0}$	GCR_{Design}	$R'_{Downforce}$
0	28.50%	1	20%	1.1	29%	1
5	28.50%	1	20%	1.1	29%	1
10	28.50%	1	20%	1.1	29%	1
20	28.50%	1	20%	1.1	29%	1
30	28.50%	1	20%	1.1	29%	1
45	28.50%	1	20%	1.1	29%	1
60	28.50%	1	20%	1.1	29%	1



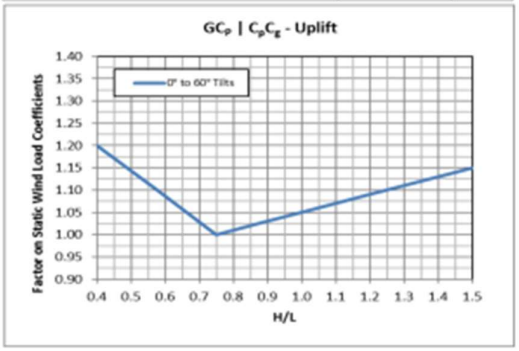
Tilt	$GCR_{Ref.1}$	$R'_{GCm.1}$	$GCR_{Ref.0}$	$R'_{GCm.0}$	GCR_{Design}	R'_{GCm}
0	28.50%	1	20%	1.15	29%	1
5	28.50%	1	20%	1.15	29%	1
10	28.50%	1	20%	1.15	29%	1
20	28.50%	1	20%	1.15	29%	1
30	28.50%	1	20%	1.15	29%	1
45	28.50%	1	20%	1.15	29%	1
60	28.50%	1	20%	1.15	29%	1

Tilt	$R'_{Downforce}$	R'_{Uplift}	R'_{GCm}	R'_{GCm}
0	1	1	1	1
5	1	1	1	1
10	1	1	1	1
20	1	1	1	1
30	1	1	1	1
45	1	1	1	1
60	1	1	1	1

Influence of Array Height (H)
Factors Apply to Static Wind Load Coefficients

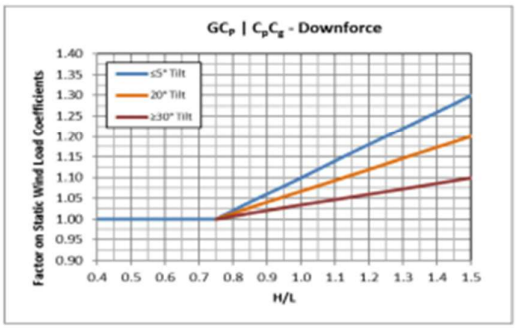
Figure: 7

Magna Structural Systems Inc. Project #1761208 Date: March 2, 2010

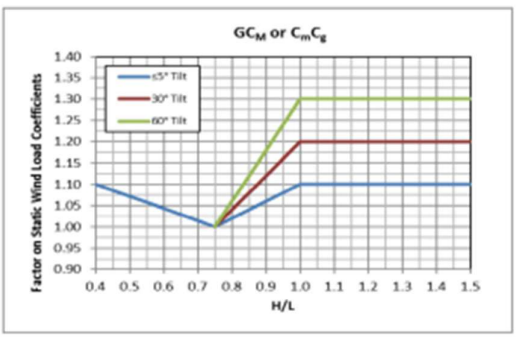


H/L_{design}	0.86715

Tilt	$H/L_{Ref.1}$	$R''_{Uplift.1}$	$H/L_{Ref.0}$	$R''_{Uplift.0}$	$H/L_{Ref.2}$	$R''_{Uplift.2}$	H/L_{design}	R''_{Uplift}
0	0.40	1.2	0.75	1	1.50	1.15	0.86715	1.02343
5	0.40	1.2	0.75	1	1.50	1.15	0.86715	1.02343
10	0.40	1.2	0.75	1	1.50	1.15	0.86715	1.02343
20	0.40	1.2	0.75	1	1.50	1.15	0.86715	1.02343
30	0.40	1.2	0.75	1	1.50	1.15	0.86715	1.02343
45	0.40	1.2	0.75	1	1.50	1.15	0.86715	1.02343
60	0.40	1.2	0.75	1	1.50	1.15	0.86715	1.02343



Tilt	$H/L_{Ref.1}$	$R''_{Downforce.1}$	$H/L_{Ref.0}$	$R''_{Downforce.0}$	$H/L_{Ref.2}$	$R''_{Downforce.2}$	H/L_{design}	$R''_{Downforce}$
0	0.40	1	0.75	1	1.50	1.3	0.86715	1.04686
5	0.40	1	0.75	1	1.50	1.3	0.86715	1.04686
10	0.40	1	0.75	1	1.50	1.26666	0.86715	1.041652
20	0.40	1	0.75	1	1.50	1.2	0.86715	1.03124
30	0.40	1	0.75	1	1.50	1.1	0.86715	1.01562
45	0.40	1	0.75	1	1.50	1.1	0.86715	1.01562
60	0.40	1	0.75	1	1.50	1.1	0.86715	1.01562



Tilt	$H/L_{Ref.1}$	$R''_{GCm.1}$	$H/L_{Ref.0}$	$R''_{GCm.0}$	$H/L_{Ref.2}$	$R''_{GCm.2}$	H/L_{design}	R''_{GCm}
0	0.40	1.1	0.75	1	1.00	1.1	0.86715	1.04686
5	0.40	1.1	0.75	1	1.00	1.1	0.86715	1.04686
10	0.40	1.1	0.75	1	1.00	1.12	0.86715	1.056232
20	0.40	1.1	0.75	1	1.00	1.16	0.86715	1.074976
30	0.40	1.1	0.75	1	1.00	1.2	0.86715	1.09372
45	0.40	1.1	0.75	1	1.00	1.25	0.86715	1.11715
60	0.40	1.1	0.75	1	1.00	1.3	0.86715	1.140581

Tilt	$R''_{Downforce}$	R''_{Uplift}	R''_{GCm}	R''_{GCm}
0	1.04686	1.02343	1.04686	1.04686
5	1.04686	1.02343	1.04686	1.04686
10	1.041652	1.02343	1.056232	1.056232
20	1.03124	1.02343	1.074976	1.074976
30	1.01562	1.02343	1.09372	1.09372
45	1.01562	1.02343	1.11715	1.11715
60	1.01562	1.02343	1.140581	1.140581

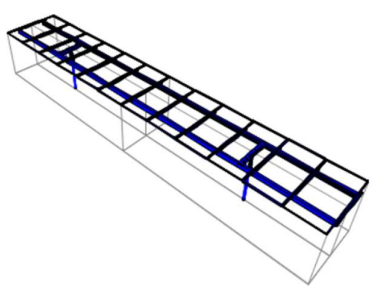
BASIS OF STRUCTURAL ANALYSIS

The SAP2000 program was used to analyze the structure of Polar Axsus Tracker systems. The program allows for 3D modeling of whole structure with creation of custom sections, load cases and combinations, and boundary conditions depending on the requirements for each element or node.

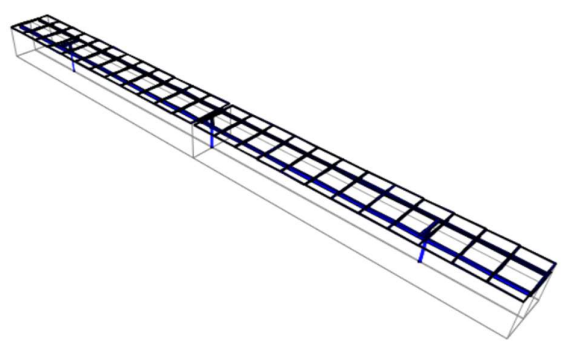
In order to apply the area loads, including dead, snow, wind and ice, modules were created with proper boundary conditions. Mesh areas on the modules allows to define various wind loads cases based on the wind tunnel report requirements. As the module is connected by 4 clamps on the omega beams, the separate nodes are defined for each point of connection to simulate boundary condition between modules and omega beams. Same technique is used to create connection of omega beams and purlins. Pivot Arms are modeled in connection with Purlins with fixity in all 6 degrees of freedom. They are supported by Pivot Brackets with hinge connection. Actuator like a brace member is defined between Pivot Arms and Drive Bracket which is an element modeled with fix connection to top of the Piles at the end of Pivot Bracket. Pivot Bracket is fix at the top of the Piles and Piles are cantilever elements with fix connection to the ground level.

Since the structure carries different loads in various tilts, an automated system is developed in order to communicate with the software to create the structure in each possible position considering corresponding loads amounts calculated in previous section.

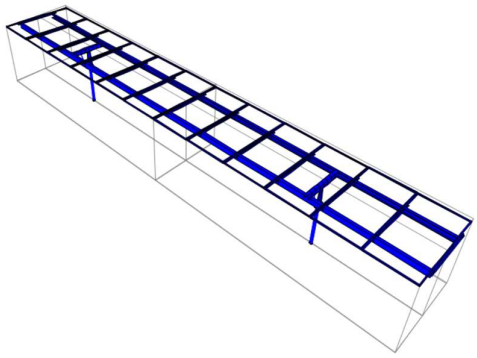
The following figures show structural 3D model of X20 and X25 in various position using the SAP2000. (Tilt: 0, 3, 30, -3, -30, -60)



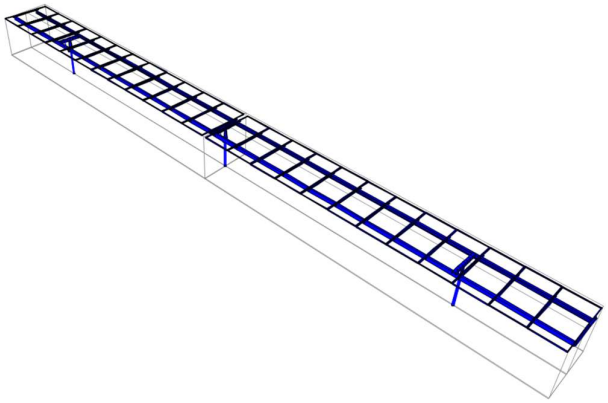
X20_0 deg



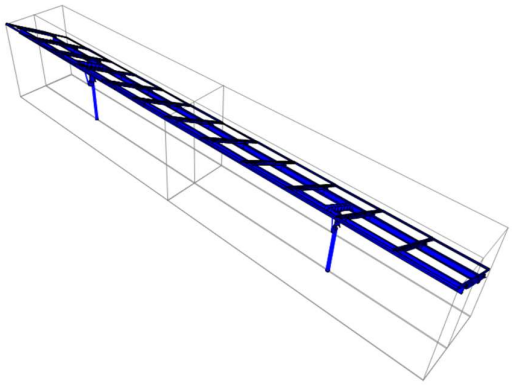
X25_0 deg



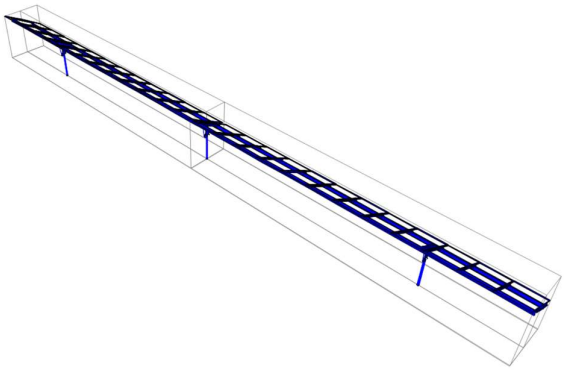
X20_3 deg



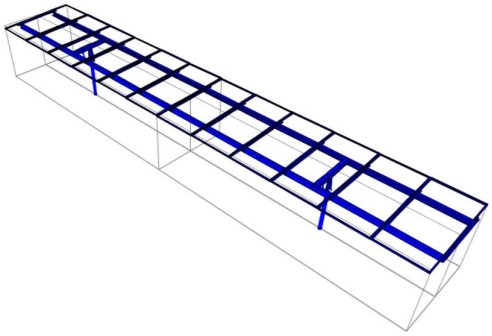
X25_3 deg



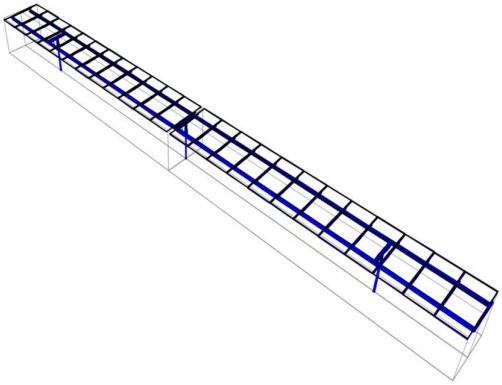
X20_30 deg



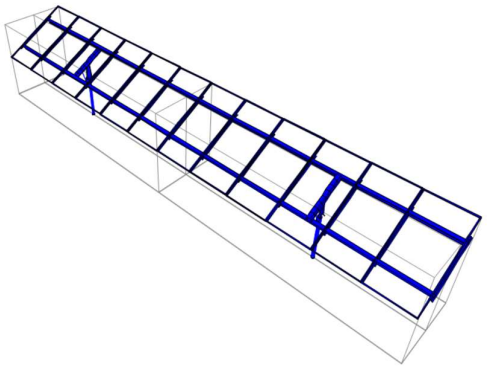
X25_30 deg



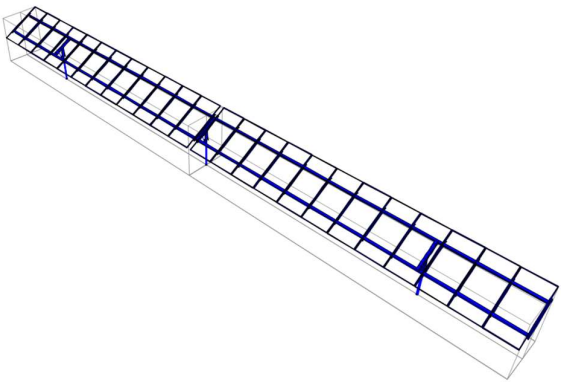
X20_-3 deg



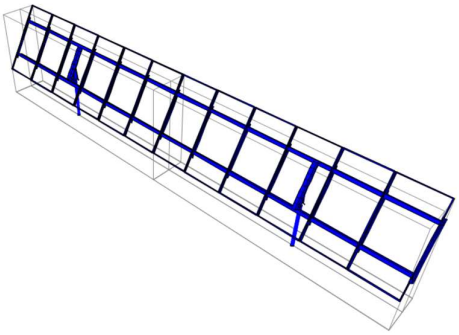
X25_-3 deg



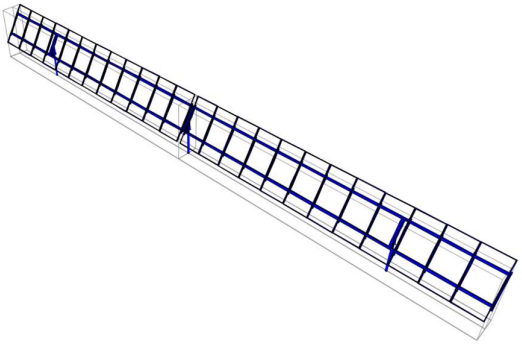
X20_-30 deg



X25_-30 deg



X20_-60 deg



X25_-60 deg

LOAD CASES AND COMBINATIONS

Load cases are defined as the following methods.

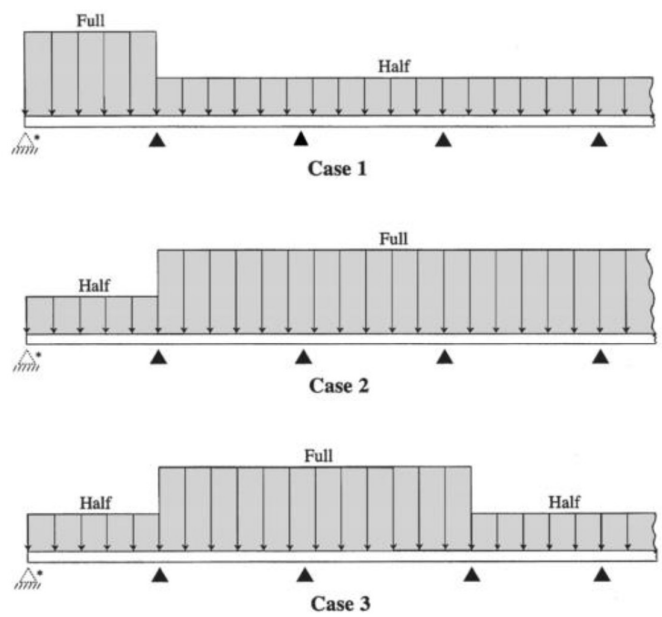
Dead load case: module dead load is defined based on the weight of panel and applied as uniform distributed load on module area in gravity direction and not subjected to the area. For the other members (structural), the self weight calculates based on the section properties that are defined in the software. Note: the self weight and module area dead load is considered as a mass for modal analysis case.

Wind load cases: wind load cases are defined based on the previous calculation amounts and distributed to the defined mesh areas in its normal border direction. There are full-chord, half-chord, torque and over-turning cases and combination of torque and normal cases, in statis form only and total static and dynamic form.

Snow load cases: uniform snow load case is defined based on the previous calculation amount and distributed to the defined area in gravity direction and subjected to the area.

In ASCE 7-16, requirements are given for partial snow loading. ASCE 7-16 Section 7.5.1 gives specific guidelines for the application of half and full snow load to different portions of continuous beam systems to produce the greatest load effect. The uniform snow load is the full snow load applied across the whole system at the corresponding angle. The other snow load cases correspond to the cases below and have been altered to match the number of spans for both the X20 and X25.

CHAPTER 7 SNOW LOADS



* The left supports are dashed since they would not exist when a cantilever is present.

FIGURE 7-4 Partial Loading Diagrams for Continuous Beams.

Seismic load cases: seismic load cases are applied based on previous calculation amounts and as point loads at the clamps connection joints and in both horizontal directions (x and y global coordinate system).

Ice load cases: There are dead-ice and wind-on-ice load cases which are applied based on the previous calculation amount and like dead and wind cases on the modules respectively.

The loads combinations are defined based on the code requirements and analysis and design method. Static and modal analysis are performed for the structure. The simulation methodology is verified by comparing reactions, displacements and natural frequencies with handy calculation, full-scale load testing and full-scale frequency pluck test of baseline model respectively.

The following table summaries load cases and combinations in this analysis.

Load Cases and Combinations		
#	*#*	*note*
Rows	ID	Name
1	cs_ 1	Dead
2	cs_ 2	Snow
3	cs_ 3	WxDNstF
4	cs_ 4	WxDNalF
5	cs_ 5	WxUPstF
6	cs_ 6	WxUPalF
7	cs_ 7	Ice_dead
8	cs_ 8	Ice_wDN
9	cs_ 9	S1_hlll
10	cs_ 10	S2_lhhh
11	cs_ 11	S3_lhhl
12	cs_ 12	S4_s2s_+
13	cs_ 13	S4_s2s_-
14	cs_ 14	WxDNstH
15	cs_ 15	WxDNalH
16	cs_ 16	WxUPstH
17	cs_ 17	WxUPalH
18	cs_ 18	WxDNstH-
19	cs_ 19	WxDNalH-
20	cs_ 20	WxUPstH-
21	cs_ 21	WxUPalH-
22	cs_ 22	WyDN
23	cs_ 23	WyUP

24	cs_ 24	Quake_x
25	cs_ 25	Quake_y
26	cs_ 26	WxTQdy.6
27	cs_ 27	WxOTal
28	cs_ 28	WyHOR
29	cs_ 29	WyDN+H
30	cs_ 30	WyUP+H
31	cs_ 31	WxDNst+T
32	cs_ 32	WxDNal+T
33	cs_ 33	WxUPst+T
34	cs_ 34	WxUPal+T
35	Cs_ 35	modal1
36	cm_ 1	1. 1. 1) 1 Dead
37	cm_ 2	2. 2. 1) 1 Dead + 1 Snow
38	cm_ 3	3. 2. 2) 1 Dead + 1 S1_hlll
39	cm_ 4	4. 2. 3) 1 Dead + 1 S2_lhhh
40	cm_ 5	5. 2. 4) 1 Dead + 1 S3_lhhl
41	cm_ 6	6. 2. 5) 1 Dead + 1 S4_s2s_+
42	cm_ 7	7. 2. 6) 1 Dead + 1 S4_s2s_-
43	cm_ 8	8. 3. 1) 1 Dead + .75 Snow + .45 WxDNstF
44	cm_ 9	9. 3. 3) 1 Dead + .75 Snow + .45 WxUPstF
45	cm_ 10	10. 3. 5) 1 Dead + .75 Snow + .45 WxDNstH
46	cm_ 11	11. 3. 7) 1 Dead + .75 Snow + .45 WxUPstH
47	cm_ 12	12. 3. 9) 1 Dead + .75 Snow + .45 WxDNstH-
48	cm_ 13	13. 3. 11) 1 Dead + .75 Snow + .45 WxUPstH-
49	cm_ 14	14. 3. 13) 1 Dead + .75 Snow + .45 WyDN
50	cm_ 15	15. 3. 14) 1 Dead + .75 Snow + .45 WyUP
51	cm_ 16	16. 3. 15) 1 Dead + .75 Snow + .45 WxTQdy.6
52	cm_ 17	17. 3. 17) 1 Dead + .75 Snow + .45 WyHOR
53	cm_ 18	18. 3. 18) 1 Dead + .75 Snow + .45 WyDN+H
54	cm_ 19	19. 3. 19) 1 Dead + .75 Snow + .45 WyUP+H
55	cm_ 20	20. 3. 20) 1 Dead + .75 Snow + .45 WxDNst+T
56	cm_ 21	21. 3. 22) 1 Dead + .75 Snow + .45 WxUPst+T
57	cm_ 22	22. 3. 24) 1 Dead + .75 S1_hlll + .45 WxDNstF
58	cm_ 23	23. 3. 26) 1 Dead + .75 S1_hlll + .45 WxUPstF
59	cm_ 24	24. 3. 28) 1 Dead + .75 S1_hlll + .45 WxDNstH
60	cm_ 25	25. 3. 30) 1 Dead + .75 S1_hlll + .45 WxUPstH

61	cm_ 26	26. 3. 32) 1 Dead + .75 S1_hlll + .45 WxDNstH-
62	cm_ 27	27. 3. 34) 1 Dead + .75 S1_hlll + .45 WxUPstH-
63	cm_ 28	28. 3. 36) 1 Dead + .75 S1_hlll + .45 WyDN
64	cm_ 29	29. 3. 37) 1 Dead + .75 S1_hlll + .45 WyUP
65	cm_ 30	30. 3. 38) 1 Dead + .75 S1_hlll + .45 WxTQdy.6
66	cm_ 31	31. 3. 40) 1 Dead + .75 S1_hlll + .45 WyHOR
67	cm_ 32	32. 3. 41) 1 Dead + .75 S1_hlll + .45 WyDN+H
68	cm_ 33	33. 3. 42) 1 Dead + .75 S1_hlll + .45 WyUP+H
69	cm_ 34	34. 3. 43) 1 Dead + .75 S1_hlll + .45 WxDNst+T
70	cm_ 35	35. 3. 45) 1 Dead + .75 S1_hlll + .45 WxUPst+T
71	cm_ 36	36. 3. 47) 1 Dead + .75 S2_lhhh + .45 WxDNstF
72	cm_ 37	37. 3. 49) 1 Dead + .75 S2_lhhh + .45 WxUPstF
73	cm_ 38	38. 3. 51) 1 Dead + .75 S2_lhhh + .45 WxDNstH
74	cm_ 39	39. 3. 53) 1 Dead + .75 S2_lhhh + .45 WxUPstH
75	cm_ 40	40. 3. 55) 1 Dead + .75 S2_lhhh + .45 WxDNstH-
76	cm_ 41	41. 3. 57) 1 Dead + .75 S2_lhhh + .45 WxUPstH-
77	cm_ 42	42. 3. 59) 1 Dead + .75 S2_lhhh + .45 WyDN
78	cm_ 43	43. 3. 60) 1 Dead + .75 S2_lhhh + .45 WyUP
79	cm_ 44	44. 3. 61) 1 Dead + .75 S2_lhhh + .45 WxTQdy.6
80	cm_ 45	45. 3. 63) 1 Dead + .75 S2_lhhh + .45 WyHOR
81	cm_ 46	46. 3. 64) 1 Dead + .75 S2_lhhh + .45 WyDN+H
82	cm_ 47	47. 3. 65) 1 Dead + .75 S2_lhhh + .45 WyUP+H
83	cm_ 48	48. 3. 66) 1 Dead + .75 S2_lhhh + .45 WxDNst+T
84	cm_ 49	49. 3. 68) 1 Dead + .75 S2_lhhh + .45 WxUPst+T
85	cm_ 50	50. 3. 70) 1 Dead + .75 S3_lhhl + .45 WxDNstF
86	cm_ 51	51. 3. 72) 1 Dead + .75 S3_lhhl + .45 WxUPstF
87	cm_ 52	52. 3. 74) 1 Dead + .75 S3_lhhl + .45 WxDNstH
88	cm_ 53	53. 3. 76) 1 Dead + .75 S3_lhhl + .45 WxUPstH
89	cm_ 54	54. 3. 78) 1 Dead + .75 S3_lhhl + .45 WxDNstH-
90	cm_ 55	55. 3. 80) 1 Dead + .75 S3_lhhl + .45 WxUPstH-
91	cm_ 56	56. 3. 82) 1 Dead + .75 S3_lhhl + .45 WyDN
92	cm_ 57	57. 3. 83) 1 Dead + .75 S3_lhhl + .45 WyUP
93	cm_ 58	58. 3. 84) 1 Dead + .75 S3_lhhl + .45 WxTQdy.6
94	cm_ 59	59. 3. 86) 1 Dead + .75 S3_lhhl + .45 WyHOR
95	cm_ 60	60. 3. 87) 1 Dead + .75 S3_lhhl + .45 WyDN+H
96	cm_ 61	61. 3. 88) 1 Dead + .75 S3_lhhl + .45 WyUP+H
97	cm_ 62	62. 3. 89) 1 Dead + .75 S3_lhhl + .45 WxDNst+T
98	cm_ 63	63. 3. 91) 1 Dead + .75 S3_lhhl + .45 WxUPst+T

99	cm_ 64	64. 3. 93) 1 Dead + .75 S4_s2s_+ + .45 WxDNstF
100	cm_ 65	65. 3. 95) 1 Dead + .75 S4_s2s_+ + .45 WxUPstF
101	cm_ 66	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
102	cm_ 67	67. 3. 99) 1 Dead + .75 S4_s2s_+ + .45 WxUPstH
103	cm_ 68	68. 3. 101) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH-
104	cm_ 69	69. 3. 103) 1 Dead + .75 S4_s2s_+ + .45 WxUPstH-
105	cm_ 70	70. 3. 105) 1 Dead + .75 S4_s2s_+ + .45 WyDN
106	cm_ 71	71. 3. 106) 1 Dead + .75 S4_s2s_+ + .45 WyUP
107	cm_ 72	72. 3. 107) 1 Dead + .75 S4_s2s_+ + .45 WxTQdy.6
108	cm_ 73	73. 3. 109) 1 Dead + .75 S4_s2s_+ + .45 WyHOR
109	cm_ 74	74. 3. 110) 1 Dead + .75 S4_s2s_+ + .45 WyDN+H
110	cm_ 75	75. 3. 111) 1 Dead + .75 S4_s2s_+ + .45 WyUP+H
111	cm_ 76	76. 3. 112) 1 Dead + .75 S4_s2s_+ + .45 WxDNst+T
112	cm_ 77	77. 3. 114) 1 Dead + .75 S4_s2s_+ + .45 WxUPst+T
113	cm_ 78	78. 3. 116) 1 Dead + .75 S4_s2s_- + .45 WxDNstF
114	cm_ 79	79. 3. 118) 1 Dead + .75 S4_s2s_- + .45 WxUPstF
115	cm_ 80	80. 3. 120) 1 Dead + .75 S4_s2s_- + .45 WxDNstH
116	cm_ 81	81. 3. 122) 1 Dead + .75 S4_s2s_- + .45 WxUPstH
117	cm_ 82	82. 3. 124) 1 Dead + .75 S4_s2s_- + .45 WxDNstH-
118	cm_ 83	83. 3. 126) 1 Dead + .75 S4_s2s_- + .45 WxUPstH-
119	cm_ 84	84. 3. 128) 1 Dead + .75 S4_s2s_- + .45 WyDN
120	cm_ 85	85. 3. 129) 1 Dead + .75 S4_s2s_- + .45 WyUP
121	cm_ 86	86. 3. 130) 1 Dead + .75 S4_s2s_- + .45 WxTQdy.6
122	cm_ 87	87. 3. 132) 1 Dead + .75 S4_s2s_- + .45 WyHOR
123	cm_ 88	88. 3. 133) 1 Dead + .75 S4_s2s_- + .45 WyDN+H
124	cm_ 89	89. 3. 134) 1 Dead + .75 S4_s2s_- + .45 WyUP+H
125	cm_ 90	90. 3. 135) 1 Dead + .75 S4_s2s_- + .45 WxDNst+T
126	cm_ 91	91. 3. 137) 1 Dead + .75 S4_s2s_- + .45 WxUPst+T
127	cm_ 92	92. 4. 1) 1 Dead + .6 WxDNstF
128	cm_ 93	93. 4. 2) 1 Dead + .6 WxDNalF
129	cm_ 94	94. 4. 3) 1 Dead + .6 WxUPstF
130	cm_ 95	95. 4. 4) 1 Dead + .6 WxUPalF
131	cm_ 96	96. 4. 5) 1 Dead + .6 WxDNstH
132	cm_ 97	97. 4. 6) 1 Dead + .6 WxDNalH
133	cm_ 98	98. 4. 7) 1 Dead + .6 WxUPstH
134	cm_ 99	99. 4. 8) 1 Dead + .6 WxUPalH
135	cm_ 100	100. 4. 9) 1 Dead + .6 WxDNstH-
136	cm_ 101	101. 4. 10) 1 Dead + .6 WxDNalH-
137	cm_ 102	102. 4. 11) 1 Dead + .6 WxUPstH-
138	cm_ 103	103. 4. 12) 1 Dead + .6 WxUPalH-
139	cm_ 104	104. 4. 13) 1 Dead + .6 WyDN
140	cm_ 105	105. 4. 14) 1 Dead + .6 WyUP
141	cm_ 106	106. 4. 15) 1 Dead + .6 WxTQdy.6
142	cm_ 107	107. 4. 16) 1 Dead + .6 WxOTal
143	cm_ 108	108. 4. 17) 1 Dead + .6 WyHOR
144	cm_ 109	109. 4. 18) 1 Dead + .6 WyDN+H

145	cm_ 110	110. 4. 19) 1 Dead + .6 WyUP+H
146	cm_ 111	111. 4. 20) 1 Dead + .6 WxDNst+T
147	cm_ 112	112. 4. 21) 1 Dead + .6 WxDNal+T
148	cm_ 113	113. 4. 22) 1 Dead + .6 WxUPst+T
149	cm_ 114	114. 4. 23) 1 Dead + .6 WxUPal+T
150	cm_ 115	115. 5. 1) .6 Dead + .6 WxDNstF
151	cm_ 116	116. 5. 2) .6 Dead + .6 WxDNalF
152	cm_ 117	117. 5. 3) .6 Dead + .6 WxUPstF
153	cm_ 118	118. 5. 4) .6 Dead + .6 WxUPalF
154	cm_ 119	119. 5. 5) .6 Dead + .6 WxDNstH
155	cm_ 120	120. 5. 6) .6 Dead + .6 WxDNalH
156	cm_ 121	121. 5. 7) .6 Dead + .6 WxUPstH
157	cm_ 122	122. 5. 8) .6 Dead + .6 WxUPalH
158	cm_ 123	123. 5. 9) .6 Dead + .6 WxDNstH-
159	cm_ 124	124. 5. 10) .6 Dead + .6 WxDNalH-
160	cm_ 125	125. 5. 11) .6 Dead + .6 WxUPstH-
161	cm_ 126	126. 5. 12) .6 Dead + .6 WxUPalH-
162	cm_ 127	127. 5. 13) .6 Dead + .6 WyDN
163	cm_ 128	128. 5. 14) .6 Dead + .6 WyUP
164	cm_ 129	129. 5. 15) .6 Dead + .6 WxTQdy.6
165	cm_ 130	130. 5. 16) .6 Dead + .6 WxOTal
166	cm_ 131	131. 5. 17) .6 Dead + .6 WyHOR
167	cm_ 132	132. 5. 18) .6 Dead + .6 WyDN+H
168	cm_ 133	133. 5. 19) .6 Dead + .6 WyUP+H
169	cm_ 134	134. 5. 20) .6 Dead + .6 WxDNst+T
170	cm_ 135	135. 5. 21) .6 Dead + .6 WxDNal+T
171	cm_ 136	136. 5. 22) .6 Dead + .6 WxUPst+T
172	cm_ 137	137. 5. 23) .6 Dead + .6 WxUPal+T
173	cm_ 138	138. 6. 1) 1 Dead + .7 Ice_dead
174	cm_ 139	139. 7. 1) 1 Dead + .7 Ice_dead + .7 Ice_wDN
175	cm_ 140	140. 8. 1) .6 Dead + .7 Ice_dead + .7 Ice_wDN
176	cm_ 141	141. 9. 1) 1 Dead + .7 Quake_x
177	cm_ 142	142. 9. 2) 1 Dead + .7 Quake_y
178	cm_ 143	143. 10. 1) 1 Dead + .75 Snow + .525 Quake_x
179	cm_ 144	144. 10. 2) 1 Dead + .75 Snow + .525 Quake_y
180	cm_ 145	145. 10. 3) 1 Dead + .75 S1_hlll + .525 Quake_x
181	cm_ 146	146. 10. 4) 1 Dead + .75 S1_hlll + .525 Quake_y
182	cm_ 147	147. 10. 5) 1 Dead + .75 S2_lhhh + .525 Quake_x
183	cm_ 148	148. 10. 6) 1 Dead + .75 S2_lhhh + .525 Quake_y
184	cm_ 149	149. 10. 7) 1 Dead + .75 S3_lhhl + .525 Quake_x
185	cm_ 150	150. 10. 8) 1 Dead + .75 S3_lhhl + .525 Quake_y
186	cm_ 151	151. 10. 9) 1 Dead + .75 S4_s2s_+ + .525 Quake_x
187	cm_ 152	152. 10. 10) 1 Dead + .75 S4_s2s_+ + .525 Quake_y
188	cm_ 153	153. 10. 11) 1 Dead + .75 S4_s2s_- + .525 Quake_x
189	cm_ 154	154. 10. 12) 1 Dead + .75 S4_s2s_- + .525 Quake_y
190	cm_ 155	155. 11. 1) .6 Dead + .7 Quake_x

191	cm_ 156	156. 11. 2) .6 Dead + .7 Quake_y
192	cm_ 157	157. 12. 1) 1 Dead + -.7 Quake_x
193	cm_ 158	158. 12. 2) 1 Dead + -.7 Quake_y
194	cm_ 159	159. 13. 1) 1 Dead + .75 Snow + -.525 Quake_x
195	cm_ 160	160. 13. 2) 1 Dead + .75 Snow + -.525 Quake_y
196	cm_ 161	161. 13. 3) 1 Dead + .75 S1_hlll + -.525 Quake_x
197	cm_ 162	162. 13. 4) 1 Dead + .75 S1_hlll + -.525 Quake_y
198	cm_ 163	163. 13. 5) 1 Dead + .75 S2_lhhh + -.525 Quake_x
199	cm_ 164	164. 13. 6) 1 Dead + .75 S2_lhhh + -.525 Quake_y
200	cm_ 165	165. 13. 7) 1 Dead + .75 S3_lhhl + -.525 Quake_x
201	cm_ 166	166. 13. 8) 1 Dead + .75 S3_lhhl + -.525 Quake_y
202	cm_ 167	167. 13. 9) 1 Dead + .75 S4_s2s_+ + -.525 Quake_x
203	cm_ 168	168. 13. 10) 1 Dead + .75 S4_s2s_+ + -.525 Quake_y
204	cm_ 169	169. 13. 11) 1 Dead + .75 S4_s2s_- + -.525 Quake_x
205	cm_ 170	170. 13. 12) 1 Dead + .75 S4_s2s_- + -.525 Quake_y
206	cm_ 171	171. 14. 1) .6 Dead + -.7 Quake_x
207	cm_ 172	172. 14. 2) .6 Dead + -.7 Quake_y
208	cm_ 173	173) Envelope All Combinations

ANALYSIS RESULT SUMMARY

In the following sections with tables and charts encapsulate a comprehensive breakdown of analysis results from SAP2000 simulation, encompassing reaction loads, connection loads, and internal forces and moment diagrams. The internal forces and moment diagrams are specifically focused on purlins, pivot arms, and posts, which include the pivot bracket and pile (above ground).

<u>Results scope:</u>

- Tables: perimeter X20 with 12 modules, internal X25 with 24 modules
- Positions: 0°, +3°, -3°, +30°, -30°, -60°
- Parameter analysed:
  - Reaction loads
  - Connection loads
  - Forces and moment diagrams for +30°, -30°
- Key observation
  - Internal forces and moment diagrams illustrating push for all load combinations
  - Identification of governing load combination number
  - Reference to a single load combination for comparison
  - Comparison of connection load with relevant test values and verification of safety factor
  - Splice connection check

BASIS OF DESIGN MEMBERS

Although the SAP2000 program has the capability of design cold form structures based on the American and Canadian codes, but because of its limitation for defining custom sections, the RSG CFS program was used for design process of the elements used in the Polar Axsus Tracker systems as a main design check and SAP2000 design part is used as a cross check calculator. Both CFS and SAP2000 have the capability to consider Local-Global, torsional and distortional buckling, however CFS is more professional than SAP2000 in this area.

In this regard, an automation process was developed to extract internal forces and moments for each element along the member in each tilt position and for all loading cases and combinations in order to import to CFS for checking the unity ratios and capacity.

As the RSG CFS program allows for creation of custom sections, forces and moments, and boundary conditions depending on the requirements for each element, automation system calls the section to apply the loading case/combination considering boundary conditions.

The Pivot Arm, Pivot Bracket, Purlin Splice (middle of X25 & end of X20) and Pile sections were evaluated based on an assumed unbraced length, end fixity, and bracing factors: Lx,y,t; Kx,y,t; and Cbx,y,t. Moment capacities in the positive and negative direction for both the X and Y axis, along with shear and axial capacities, were determined for each element in all tilt positions. However, in general, the worst-case and governing loads for each of these elements is the stow position load case (in [-3° ~0~ +3°] range tilt) as it provides the largest wind loads.

For all structural elements, a more robust analysis was performed to evaluate the section at each loading angle. Out-of-plane dead and snow loads due to tilt angle significantly affect the Purlins in comparison to the other members listed above. Purlin is attached to the Pivot Arm, the connection is assumed to provide restraint in the X & Y directions, as well as Torsional restraint. Additionally, torsional restraint and lateral bracing is provided at the mid-span where there is a bottom brace for purlins between each support. The top flange is also considered braced based on the attachment to the omega beams and c-shape joists.

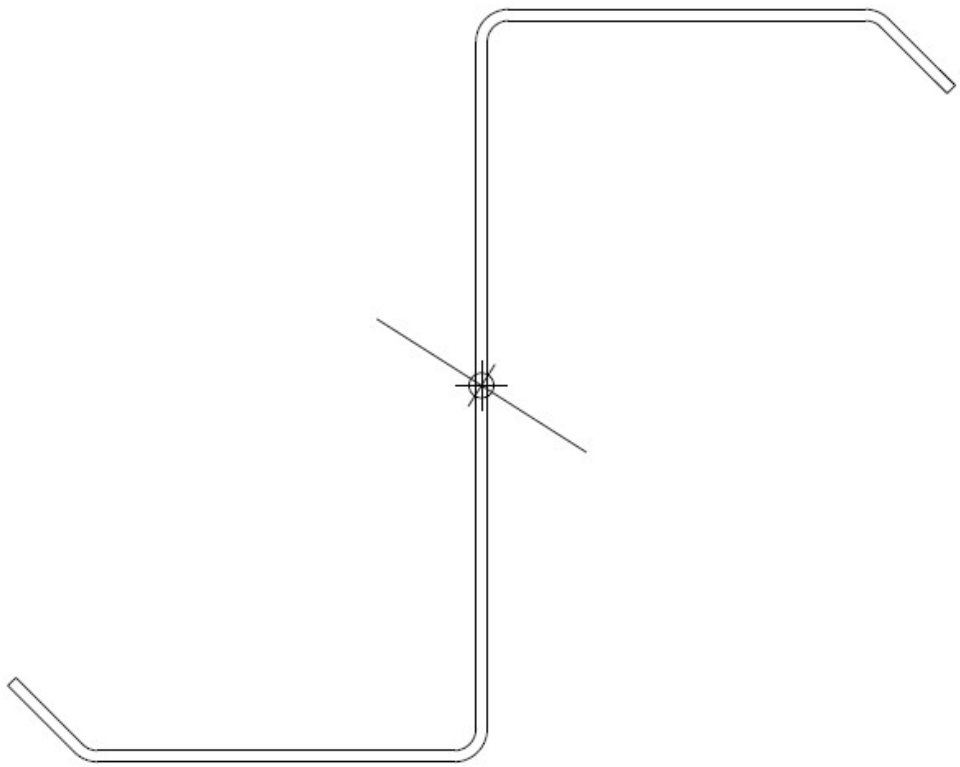
SECTION PROPERTIES AND STRENGTH CAPACITY

The following pages shows members section properties and fully braced strength base on the AISI 2016, ASD method.

CFS Version 13.0.2

Section: Zee 5.5118x2.9528x0.7874x0.076772.cfss

Zee 5.5118x2.9528x0.7874x0.076772 POLARRACKING



Full Section Properties

Area	0.96656 in²	Wt.	0.0032863 k/ft	Flat	12.590 in
Ix	4.9179 in⁴	rx	2.2557 in	Ixy	2.6587 in⁴
Sx(t)	1.7845 in³	y(t)	2.7559 in	α	-32.462 deg
Sx(b)	1.7845 in³	y(b)	2.7559 in		
Zx	2.0270 in³	Height	5.5118 in		

Iy	2.4298 in⁴	ry	1.5855 in	x_o	0.0000 in
Sy(l)	0.7000 in³	x(l)	3.4711 in	y_o	0.0000 in
Sy(r)	0.7000 in³	x(r)	3.4711 in	jx	0.0000 in
Zy	1.0246 in³	Width	6.9423 in	jy	0.0000 in
I_1	6.6092 in⁴	r_1	2.6149 in	Cw	11.210 in⁶
I_2	0.7385 in⁴	r_2	0.8741 in	J	0.001899 in⁴
Ic	7.3477 in⁴	rc	2.7572 in		
I_o	7.3477 in⁴	r_o	2.7572 in		

Fully Braced Strength - AISI S100-16/S1-18, US, ASD

Material Type: A653 HSLAS Grade 70, Fy=70 ksi

Axial		Positive Bending		Positive Bending	
Pao	22.433 k	Maxo	57.344 k-in	Mayo	20.206 k-in
Ae	0.57685 in²	Ixe	4.1766 in⁴	Iye	1.6290 in⁴
Ta	38.662 k	Sxe(t)	1.3681 in³	Sye(l)	0.5132 in³
		Sxe(b)	1.6986 in³	Sye(r)	0.4821 in³
Shear					
Vay	7.342 k	Negative Bending		Negative Bending	
Vax	10.566 k	Maxo	57.344 k-in	Mayo	20.206 k-in
		Ixe	4.1767 in⁴	Iye	1.6290 in⁴
Torsion		Sxe(t)	1.6986 in³	Sye(l)	0.4821 in³
Ba	58.921 k-in²	Sxe(b)	1.3681 in³	Sye(r)	0.5132 in³

Calculation Details - AISI S100-16/S1-18, US, ASD

Axial Tension Strength

Ag=0.96656 in², Fy=70 ksi

Tn=67.659 k Eq. D2-1

Ωt=1.67, ϕt=0.9

An=0.96656 in², Fu=80 ksi

Tn=77.325 k Eq. D3-1

Ωt=2, ϕt=0.75

Shear Strength

Stiffened Zee element 2

Vn=8.4527 k at 0 deg	Eq. G2.1-1
Ωv=1.6, ϕv=0.95	
Stiffened Zee element 3	
Vn=11.746 k at 90 deg	Eq. G2.1-2
Ωv=1.6, ϕv=0.95	
Stiffened Zee element 4	
Vn=8.4528 k at 0 deg	Eq. G2.1-1
Ωv=1.6, ϕv=0.95	

Axial Compression Strength

Effective width calculations for part 1: Stiffened Zee

Element 1: Unstiffened, w=0.69037 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.2.2-1
k=0.43	Eq. 1.2.2-3
λ=0.70266	Eq. 1.1-3
ρ=0.97758	Eq. 1.1-2
b=0.67489 in (ineffective width=0.01548 in)	Eq. 1.1-1
Element 2: Check for lip stiffener reduction	
S=26.277	Eq. 1.3-7
Ia=0.005365 in^4	Eq. 1.3-8
Is=0.0010656 in^4	
ds=0.13404 in (lip ineffective width=0.54085 in)	Eq. 1.3-6
k=2.366	Table 1.3-1
Element 2: Partially stiffened, w=2.6215 in	
f=70 ksi, k=2.366	
λ=1.1375	Eq. 1.1-3
ρ=0.70911	Eq. 1.1-2
b=1.8589 in (ineffective width=0.76256 in)	Eq. 1.1-1
b_1=0.1846 in, b_2=1.6743 in	
Element 3: Stiffened, w=5.0433 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=1.683	Eq. 1.1-3
ρ=0.51651	Eq. 1.1-2
be=2.6049 in	Eq. 1.1-1
b_1=1.3025 in	Eq. 1.1.2-9

b_2=1.3025 in	Eq. 1.1.2-10
Ineffective width=2.4384 in	
Element 5: Unstiffened, w=0.6904 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.2.2-1
k=0.43	Eq. 1.2.2-3
λ=0.70269	Eq. 1.1-3
ρ=0.97755	Eq. 1.1-2
b=0.67491 in (ineffective width=0.015499 in)	Eq. 1.1-1
Element 4: Check for lip stiffener reduction	
S=26.277	Eq. 1.3-7
Ia=0.0053651 in^4	Eq. 1.3-8
Is=0.0010657 in^4	
ds=0.13406 in (lip ineffective width=0.54084 in)	Eq. 1.3-6
k=2.3661	Table 1.3-1
Element 4: Partially stiffened, w=2.6215 in	
f=70 ksi, k=2.3661	
λ=1.1375	Eq. 1.1-3
ρ=0.70912	Eq. 1.1-2
b=1.859 in (ineffective width=0.76256 in)	Eq. 1.1-1
b_1=0.18463 in, b_2=1.6743 in	

Ae=0.57685 in^2, Fy=70 ksi	
Pn=40.38 k	Eq. E3.1-1
Ωc=1.8, ϕc=0.85	

Positive Flexural Strength about X-axis

Effective width calculations for part 1: Stiffened Zee	
Element 1: No compressive stress (fully effective)	
Element 2: No compressive stress (fully effective)	
Element 3: Stiffened, w=5.0433 in	
f_1=64.628 ksi, f_2=-51.019 ksi	
ψ=0.78942	Eq. 1.1.2-1
k=19.038	Eq. 1.1.2-2
λ=0.74124	Eq. 1.1-3
ρ=0.94868	Eq. 1.1-2
be=4.7845 in	Eq. 1.1-1
h_o=5.5118 in, b_o=2.9528 in, h_o/b_o=1.8667	

b_1=1.2626 in	Eq. 1.1.2-3
b_2=2.3922 in	Eq. 1.1.2-4
Compression width=2.8184 in	
b_1+b_2 > compression width (fully effective)	
Element 5: Unstiffened, w=0.6904 in	
f_1=67.805 ksi, f_2=56.61 ksi	
ψ=0.8349	Eq. 1.2.2-1
k=0.49196	Eq. 1.2.2-2
λ=0.64657	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1
Element 4: Check for lip stiffener reduction	
S=26.444	Eq. 1.3-7
Ia=0.0053324 in^4	Eq. 1.3-8
Is=0.0010657 in^4	
ds=0.13798 in (lip ineffective width=0.55242 in)	Eq. 1.3-6
k=2.37	Table 1.3-1
Element 4: Partially stiffened, w=2.6215 in	
f=69.12 ksi, k=2.37	
λ=1.1293	Eq. 1.1-3
ρ=0.71298	Eq. 1.1-2
b=1.8691 in (ineffective width=0.75242 in)	Eq. 1.1-1
b_1=0.18678 in, b_2=1.6823 in	

Center of gravity shift: y=-0.29707 in	
Sxe=1.3681 in^3, Fy=70 ksi	
Mn=95.764 k-in	Eq. F3.1-1
Ωb=1.67, ϕb=0.9	

Negative Flexural Strength about X-axis

Effective width calculations for part 1: Stiffened Zee	
Element 1: Unstiffened, w=0.69037 in	
f_1=67.804 ksi, f_2=56.61 ksi	
ψ=0.83491	Eq. 1.2.2-1
k=0.49195	Eq. 1.2.2-2
λ=0.64654	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1
Element 2: Check for lip stiffener reduction	
S=26.444	Eq. 1.3-7

Ia=0.0053323 in^4	Eq. 1.3-8
Is=0.0010656 in^4	
ds=0.13796 in (lip ineffective width=0.55241 in)	Eq. 1.3-6
k=2.3699	Table 1.3-1
Element 2: Partially stiffened, w=2.6215 in	
f=69.12 ksi, k=2.3699	
λ=1.1293	Eq. 1.1-3
ρ=0.71298	Eq. 1.1-2
b=1.8691 in (ineffective width=0.75242 in)	Eq. 1.1-1
b_1=0.18675 in, b_2=1.6823 in	
Element 3: Stiffened, w=5.0433 in	
f_1=64.628 ksi, f_2=-51.019 ksi	
ψ=0.78942	Eq. 1.1.2-1
k=19.038	Eq. 1.1.2-2
λ=0.74124	Eq. 1.1-3
ρ=0.94868	Eq. 1.1-2
be=4.7845 in	Eq. 1.1-1
h_o=5.5118 in, b_o=2.9528 in, h_o/b_o=1.8667	
b_1=1.2626 in	Eq. 1.1.2-3
b_2=2.3922 in	Eq. 1.1.2-4
Compression width=2.8184 in	
b_1+b_2 > compression width (fully effective)	
Element 5: No compressive stress (fully effective)	
Element 4: No compressive stress (fully effective)	
Center of gravity shift: y=0.29707 in	
Sxe=1.3681 in^3, Fy=70 ksi	
Mn=95.764 k-in	Eq. F3.1-1
Ωb=1.67, ϕb=0.9	
Positive Flexural Strength about Y-axis	
Effective width calculations for part 1: Stiffened Zee	
Element 1: No compressive stress (fully effective)	
Element 2: Stiffened, w=2.6215 in	
f_1=2.0834 ksi, f_2=-52.224 ksi	
ψ=25.067	Eq. 1.1.2-1
k=35481	Eq. 1.1.2-2
λ=0.0016024	Eq. 1.1-3

ρ=1	Eq. 1.1-2
be=2.6215 in	Eq. 1.1-1
h_o=2.9528 in, b_o=5.5118 in, h_o/b_o=0.53571	
b_1=0.0934 in	Eq. 1.1.2-3
b_2=1.3107 in	Eq. 1.1.2-4
Compression width=0.10057 in	
b_1+b_2 > compression width (fully effective)	
Element 3: Stiffened, w=5.0433 in	
f_1=6.141 ksi, f_2=6.141 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.49848	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=5.0433 in	Eq. 1.1-1
b_1=2.5217 in	Eq. 1.1.2-9
b_2=2.5217 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 5: Unstiffened, w=0.6904 in	
f_1=77.488 ksi, f_2=67.375 ksi, f=69.438 ksi	
ψ=0.86948	Eq. 1.2.2-1
k=0.44033	Eq. 1.2.2-3
λ=0.69161	Eq. 1.1-3
ρ=0.98596	Eq. 1.1-2
b=0.68071 in (ineffective width=0.0096908 in)	Eq. 1.1-1
Element 4: Check for lip stiffener reduction	
S=27.373	Eq. 1.3-7
Ia=0.0051572 in^4	Eq. 1.3-8
Is=0.0010657 in^4	
ds=0.14067 in (lip ineffective width=0.54005 in)	Eq. 1.3-6
k=2.3917	Table 1.3-1
Element 4: Partially stiffened, w=2.6215 in	
f=64.507 ksi, k=2.3917	
λ=1.086	Eq. 1.1-3
ρ=0.73426	Eq. 1.1-2
b=1.9249 in (ineffective width=0.69665 in)	Eq. 1.1-1
b_1=0.19888 in, b_2=1.726 in	

Center of gravity shift: x=-0.2969 in

Sye=0.48205 in^3, Fy=70 ksi

Mn=33.744 k-in — Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Negative Flexural Strength about Y-axis

Effective width calculations for part 1: Stiffened Zee

Element 1: Unstiffened, w=0.69037 in

f_1=77.488 ksi, f_2=67.375 ksi, f=69.438 ksi

ψ=0.86949 — Eq. 1.2.2-1

k=0.44033 — Eq. 1.2.2-3

λ=0.69158 — Eq. 1.1-3

ρ=0.98599 — Eq. 1.1-2

b=0.6807 in (ineffective width=0.0096732 in) — Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=27.373 — Eq. 1.3-7

Ia=0.0051571 in^4 — Eq. 1.3-8

Is=0.0010656 in^4

ds=0.14064 in (lip ineffective width=0.54005 in) — Eq. 1.3-6

k=2.3916 — Table 1.3-1

Element 2: Partially stiffened, w=2.6215 in

f=64.506 ksi, k=2.3916

λ=1.086 — Eq. 1.1-3

ρ=0.73426 — Eq. 1.1-2

b=1.9248 in (ineffective width=0.69664 in) — Eq. 1.1-1

b_1=0.19885 in, b_2=1.726 in

Element 3: Stiffened, w=5.0433 in

f_1=6.1409 ksi, f_2=6.1409 ksi

ψ=1 — Eq. 1.1.2-1

k=4 — Eq. 1.1.2-8

λ=0.49848 — Eq. 1.1-3

ρ=1 — Eq. 1.1-2

be=5.0433 in — Eq. 1.1-1

b_1=2.5217 in — Eq. 1.1.2-9

b_2=2.5217 in — Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 5: No compressive stress (fully effective)

Element 4: Stiffened, w=2.6215 in

f_1=2.0833 ksi, f_2=-52.225 ksi

ψ=25.069	Eq. 1.1.2-1
k=35487	Eq. 1.1.2-2
λ=0.0016023	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6215 in	Eq. 1.1-1
h_o=2.9528 in, b_o=5.5118 in, h_o/b_o=0.53571	
b_1=0.093397 in	Eq. 1.1.2-3
b_2=1.3108 in	Eq. 1.1.2-4
Compression width=0.10056 in	
b_1+b_2 > compression width (fully effective)	

Center of gravity shift: x=0.2969 in

Sye=0.48205 in^3, Fy=70 ksi

Mn=33.744 k-in — Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Bimoment Strength, Stiffened Zee

Cw=11.21 in^6, Wn=7.9746 in^2, Fy=70 ksi

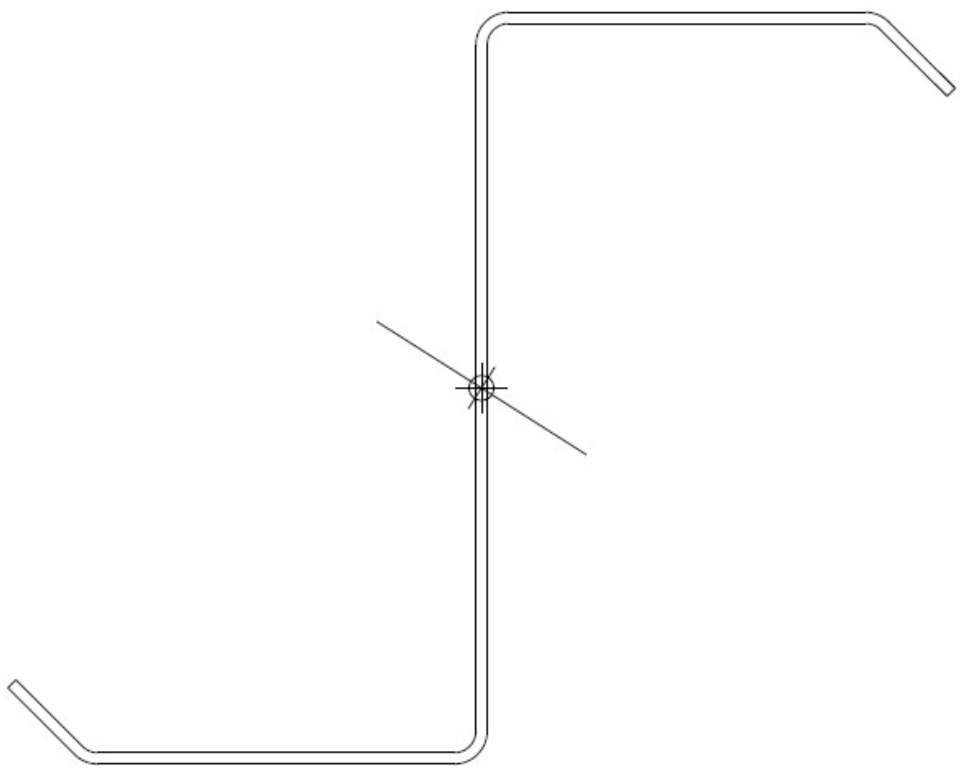
Bn=Fy Cw/Wn=98.398 k-in^2

Ωb=1.67, ϕb=0.9

CFS Version 13.0.2

Section: Zee 5.5118x2.9528x0.7874x0.084650.cfss

Zee 5.5118x2.9528x0.7874x0.08465 POLARRACKING



Full Section Properties

Area	1.0635 in²	Wt.	0.0036160 k/ft	Flat	12.564 in
Ix	5.3945 in⁴	rx	2.2522 in	Ixy	2.9157 in⁴
Sx(t)	1.9575 in³	y(t)	2.7559 in	α	-32.451 deg
Sx(b)	1.9574 in³	y(b)	2.7559 in		
Zx	2.2268 in³	Height	5.5118 in		
Iy	2.6632 in⁴	ry	1.5824 in	x_o	0.0000 in

Sy(l)	0.7681 in³	x(l)	3.4672 in	y_o	0.0000 in
Sy(r)	0.7681 in³	x(r)	3.4672 in	jx	0.0000 in
Zy	1.1261 in³	Width	6.9344 in	jy	0.0000 in
I_1	7.2485 in⁴	r_1	2.6106 in	Cw	12.247 in⁶
I_2	0.8092 in⁴	r_2	0.8723 in	J	0.002540 in⁴
Ic	8.0578 in⁴	rc	2.7525 in		
I_o	8.0578 in⁴	r_o	2.7525 in		

Fully Braced Strength - AISI S100-16/S1-18, US, ASD

Material Type: A653 HSLAS Grade 70, Fy=70 ksi

Axial		Positive Bending		Positive Bending	
Pao	26.009 k	Maxo	64.274 k-in	Mayo	22.568 k-in
Ae	0.66881 in²	Ixe	4.6464 in⁴	Iye	1.8019 in⁴
Ta	42.542 k	Sxe(t)	1.5334 in³	Sye(l)	0.5660 in³
		Sxe(b)	1.8723 in³	Sye(r)	0.5384 in³
Shear					
Vay	8.926 k	Negative Bending		Negative Bending	
Vax	11.601 k	Maxo	64.274 k-in	Mayo	22.568 k-in
		Ixe	4.6464 in⁴	Iye	1.8019 in⁴
Torsion		Sxe(t)	1.8723 in³	Sye(l)	0.5384 in³
Ba	64.605 k-in²	Sxe(b)	1.5334 in³	Sye(r)	0.5660 in³

Calculation Details - AISI S100-16/S1-18, US, ASD

Axial Tension Strength

Ag=1.0635 in², Fy=70 ksi

Tn=74.448 k Eq. D2-1

Ωt=1.67, ϕt=0.9

An=1.0635 in², Fu=80 ksi

Tn=85.083 k Eq. D3-1

Ωt=2, ϕt=0.75

Shear Strength

Stiffened Zee element 2

Vn=9.2805 k at 0 deg Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Stiffened Zee element 3

Vn=14.281 k at 90 deg — Eq. G2.1-2

Ωv=1.6, ϕv=0.95

Stiffened Zee element 4

Vn=9.2806 k at 0 deg — Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Axial Compression Strength

Effective width calculations for part 1: Stiffened Zee

Element 1: Unstiffened, w=0.68711 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.2.2-1

k=0.43 — Eq. 1.2.2-3

λ=0.63425 — Eq. 1.1-3

λ<0.673 (fully effective) — Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=26.277 — Eq. 1.3-7

Ia=0.0071862 in^4 — Eq. 1.3-8

Is=0.0011615 in^4

ds=0.11106 in (lip ineffective width=0.57605 in) — Eq. 1.3-6

k=2.234 — Table 1.3-1

Element 2: Partially stiffened, w=2.6103 in

f=70 ksi, k=2.234

λ=1.0571 — Eq. 1.1-3

ρ=0.7491 — Eq. 1.1-2

b=1.9554 in (ineffective width=0.65494 in) — Eq. 1.1-1

b_1=0.15803 in, b_2=1.7974 in

Element 3: Stiffened, w=5.0276 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.1.2-1

k=4 — Eq. 1.1.2-8

λ=1.5216 — Eq. 1.1-3

ρ=0.56218 — Eq. 1.1-2

be=2.8264 in — Eq. 1.1-1

b_1=1.4132 in — Eq. 1.1.2-9

b_2=1.4132 in — Eq. 1.1.2-10

Ineffective width=2.2011 in

Element 5: Unstiffened, w=0.68714 in

f_1=70 ksi, f_2=70 ksi

ψ=1 Eq. 1.2.2-1

k=0.43 Eq. 1.2.2-3

λ=0.63429 Eq. 1.1-3

λ<0.673 (fully effective) Eq. 1.1-1

Element 4: Check for lip stiffener reduction

S=26.277 Eq. 1.3-7

Ia=0.0071863 in^4 Eq. 1.3-8

Is=0.0011617 in^4

ds=0.11108 in (lip ineffective width=0.57606 in) Eq. 1.3-6

k=2.2341 Table 1.3-1

Element 4: Partially stiffened, w=2.6104 in

f=70 ksi, k=2.2341

λ=1.0571 Eq. 1.1-3

ρ=0.7491 Eq. 1.1-2

b=1.9554 in (ineffective width=0.65494 in) Eq. 1.1-1

b_1=0.15805 in, b_2=1.7974 in

Ae=0.66881 in^2, Fy=70 ksi

Pn=46.816 k Eq. E3.1-1

Ωc=1.8, ϕc=0.85

Positive Flexural Strength about X-axis

Effective width calculations for part 1: Stiffened Zee

Element 1: No compressive stress (fully effective)

Element 2: No compressive stress (fully effective)

Element 3: Stiffened, w=5.0276 in

f_1=64.406 ksi, f_2=-51.75 ksi

ψ=0.80349 Eq. 1.1.2-1

k=19.339 Eq. 1.1.2-2

λ=0.66378 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=5.0276 in Eq. 1.1-1

h_o=5.5118 in, b_o=2.9528 in, h_o/b_o=1.8667

b_1=1.3218 in Eq. 1.1.2-3

b_2=2.5138 in Eq. 1.1.2-4

Compression width=2.7877 in

b_1+b_2 > compression width (fully effective)

Element 5: Unstiffened, w=0.68714 in

f_1=67.671 ksi, f_2=56.445 ksi

ψ=0.83411	Eq. 1.2.2-1
k=0.49229	Eq. 1.2.2-2
λ=0.58286	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1

Element 4: Check for lip stiffener reduction

S=26.462	Eq. 1.3-7
Ia=0.0071378 in^4	Eq. 1.3-8
Is=0.0011617 in^4	
ds=0.11184 in (lip ineffective width=0.57531 in)	Eq. 1.3-6
k=2.2382	Table 1.3-1

Element 4: Partially stiffened, w=2.6104 in

f=69.022 ksi, k=2.2382

λ=1.0488	Eq. 1.1-3
ρ=0.75349	Eq. 1.1-2
b=1.9669 in (ineffective width=0.64347 in)	Eq. 1.1-1
b_1=0.16006 in, b_2=1.8068 in	

Center of gravity shift: y=-0.27422 in

Sxe=1.5334 in^3, Fy=70 ksi

Mn=107.34 k-in	Eq. F3.1-1
Ωb=1.67, ϕb=0.9	

Negative Flexural Strength about X-axis

Effective width calculations for part 1: Stiffened Zee

Element 1: Unstiffened, w=0.68711 in

f_1=67.67 ksi, f_2=56.445 ksi

ψ=0.83412	Eq. 1.2.2-1
k=0.49228	Eq. 1.2.2-2
λ=0.58283	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=26.462	Eq. 1.3-7
Ia=0.0071377 in^4	Eq. 1.3-8
Is=0.0011615 in^4	
ds=0.11182 in (lip ineffective width=0.57529 in)	Eq. 1.3-6

k=2.2381	Table 1.3-1
Element 2: Partially stiffened, w=2.6103 in	
f=69.022 ksi, k=2.2381	
λ=1.0488	Eq. 1.1-3
ρ=0.75349	Eq. 1.1-2
b=1.9669 in (ineffective width=0.64348 in)	Eq. 1.1-1
b_1=0.16004 in, b_2=1.8068 in	
Element 3: Stiffened, w=5.0276 in	
f_1=64.406 ksi, f_2=-51.75 ksi	
ψ=0.80349	Eq. 1.1.2-1
k=19.339	Eq. 1.1.2-2
λ=0.66378	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=5.0276 in	Eq. 1.1-1
h_o=5.5118 in, b_o=2.9528 in, h_o/b_o=1.8667	
b_1=1.3218 in	Eq. 1.1.2-3
b_2=2.5138 in	Eq. 1.1.2-4
Compression width=2.7877 in	
b_1+b_2 > compression width (fully effective)	
Element 5: No compressive stress (fully effective)	
Element 4: No compressive stress (fully effective)	
Center of gravity shift: y=0.27422 in	
Sxe=1.5334 in^3, Fy=70 ksi	
Mn=107.34 k-in	Eq. F3.1-1
Ωb=1.67, ϕb=0.9	
Positive Flexural Strength about Y-axis	
Effective width calculations for part 1: Stiffened Zee	
Element 1: No compressive stress (fully effective)	
Element 2: Stiffened, w=2.6103 in	
f_1=1.7466 ksi, f_2=-52.858 ksi	
ψ=30.264	Eq. 1.1.2-1
k=61186	Eq. 1.1.2-2
λ=0.001009	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6103 in	Eq. 1.1-1
h_o=2.9528 in, b_o=5.5118 in, h_o/b_o=0.53571	

b_1=0.078472 in	Eq. 1.1.2-3
b_2=1.3052 in	Eq. 1.1.2-4
Compression width=0.083492 in	
b_1+b_2 > compression width (fully effective)	
Element 3: Stiffened, w=5.0276 in	
f_1=5.9262 ksi, f_2=5.9262 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.44273	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=5.0276 in	Eq. 1.1-1
b_1=2.5138 in	Eq. 1.1.2-9
b_2=2.5138 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 5: Unstiffened, w=0.68714 in	
f_1=77.83 ksi, f_2=67.666 ksi, f=69.374 ksi	
ψ=0.86941	Eq. 1.2.2-1
k=0.44034	Eq. 1.2.2-3
λ=0.62399	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1
Element 4: Check for lip stiffener reduction	
S=27.329	Eq. 1.3-7
Ia=0.0069194 in^4	Eq. 1.3-8
Is=0.0011617 in^4	
ds=0.11536 in (lip ineffective width=0.57178 in)	Eq. 1.3-6
k=2.257	Table 1.3-1
Element 4: Partially stiffened, w=2.6104 in	
f=64.711 ksi, k=2.257	
λ=1.0112	Eq. 1.1-3
ρ=0.77375	Eq. 1.1-2
b=2.0198 in (ineffective width=0.59059 in)	Eq. 1.1-1
b_1=0.16955 in, b_2=1.8502 in	

Center of gravity shift: x=-0.28372 in	
Sye=0.53841 in^3, Fy=70 ksi	
Mn=37.689 k-in	Eq. F3.1-1
Ωb=1.67, ϕb=0.9	

Negative Flexural Strength about Y-axis

Effective width calculations for part 1: Stiffened Zee

Element 1: Unstiffened, w=0.68711 in

f_1=77.83 ksi, f_2=67.666 ksi, f=69.374 ksi

ψ=0.86941	Eq. 1.2.2-1
k=0.44033	Eq. 1.2.2-3
λ=0.62396	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=27.33	Eq. 1.3-7
Ia=0.0069193 in^4	Eq. 1.3-8
Is=0.0011615 in^4	
ds=0.11534 in (lip ineffective width=0.57176 in)	Eq. 1.3-6
k=2.2569	Table 1.3-1

Element 2: Partially stiffened, w=2.6103 in

f=64.711 ksi, k=2.2569

λ=1.0112	Eq. 1.1-3
ρ=0.77375	Eq. 1.1-2
b=2.0198 in (ineffective width=0.59058 in)	Eq. 1.1-1

b_1=0.16953 in, b_2=1.8502 in

Element 3: Stiffened, w=5.0276 in

f_1=5.9261 ksi, f_2=5.9261 ksi

ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.44273	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=5.0276 in	Eq. 1.1-1
b_1=2.5138 in	Eq. 1.1.2-9
b_2=2.5138 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 5: No compressive stress (fully effective)

Element 4: Stiffened, w=2.6104 in

f_1=1.7465 ksi, f_2=-52.859 ksi

ψ=30.266	Eq. 1.1.2-1
k=61197	Eq. 1.1.2-2
λ=0.0010089	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6104 in	Eq. 1.1-1

h_o=2.9528 in, b_o=5.5118 in, h_o/b_o=0.53571

b_1=0.078469 in Eq. 1.1.2-3

b_2=1.3052 in Eq. 1.1.2-4

Compression width=0.083488 in

b_1+b_2 > compression width (fully effective)

Center of gravity shift: x=0.28372 in

Sye=0.53842 in^3, Fy=70 ksi

Mn=37.689 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Bimoment Strength, Stiffened Zee

Cw=12.247 in^6, Wn=7.9461 in^2, Fy=70 ksi

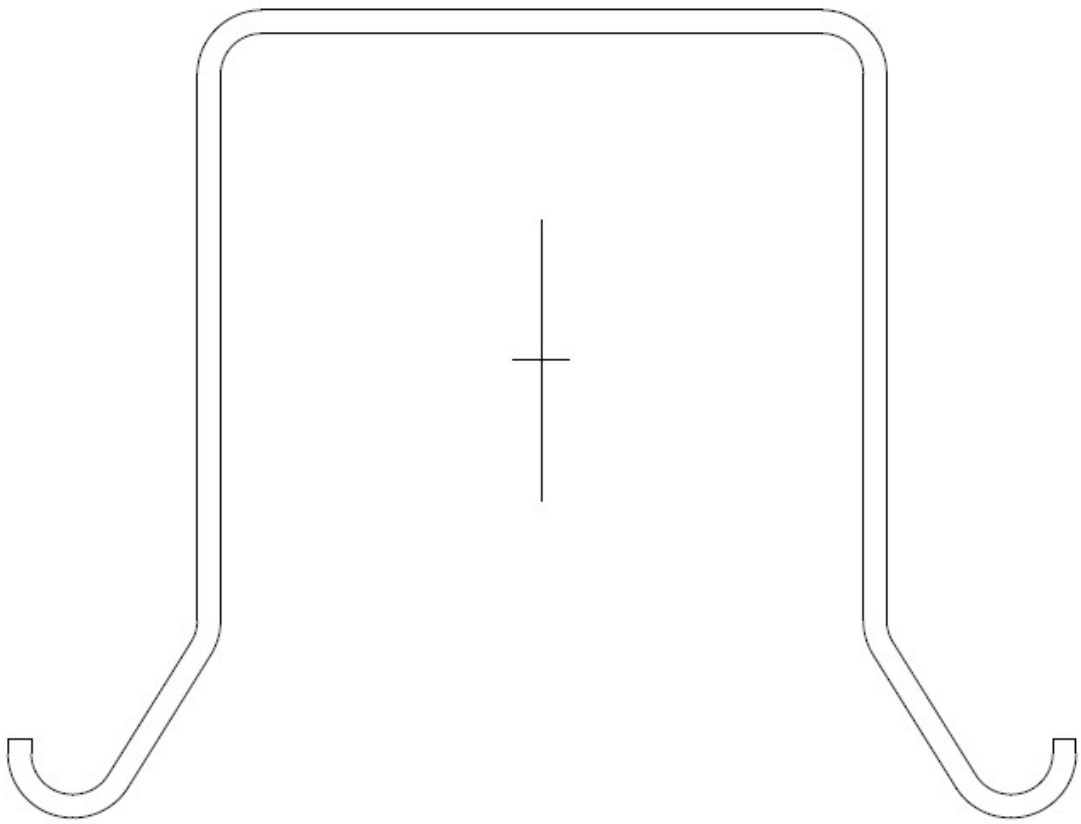
Bn=Fy Cw/Wn=107.89 k-in^2

Ωb=1.67, ϕb=0.9

CFS Version 13.0.2

Section: Hat 4x4.0551x5x 0.12205.cfss

Hat 4x4.0551x5x 0.12205 POLARRACKING



Full Section Properties

Area 1.4814 in² Wt. 0.0050369 k/ft Flat 12.138 in

Ix 2.934 in⁴ rx 1.4073 in Ixy 0.000 in⁴

Sx(t) 1.7162 in³ y(t) 1.7097 in α 90.000 deg

Sx(b) 1.3161 in³ y(b) 2.2294 in

Zx 1.8733 in³ Height 3.9392 in

Iy 3.896 in⁴ ry 1.6218 in x_0 0.0000 in

Sy(l) 1.4916 in³ x(l) 2.6121 in y_0 3.2155 in

Sy(r) 1.4916 in³ x(r) 2.6121 in jx 0.0000 in

Zy 2.2591 in³ Width 5.2243 in jy -3.7793 in

I_1	3.896 in⁴	r_1	1.6218 in	Cw	2.9993 in⁶
I_2	2.934 in⁴	r_2	1.4073 in	J	0.0073556 in⁴
Ic	6.830 in⁴	rc	2.1473 in		
I_0	22.148 in⁴	r_0	3.8665 in		

Fully Braced Strength - AISI S100-16/S1-18, US, ASD

Material Type: A653 HSLAS Grade 70, Fy=70 ksi

Axial		Positive Bending		Positive Bending	
Pao	57.611 k	Maxo	55.166 k-in	Mayo	62.523 k-in
Ae	1.4814 in²	Ixe	2.9342 in⁴	Iye	3.8963 in⁴
Ta	59.257 k	Sxe(t)	1.7162 in³	Sye(l)	1.4916 in³
		Sxe(b)	1.3161 in³	Sye(r)	1.4916 in³
Shear					
Vay	21.113 k	Negative Bending		Negative Bending	
Vax	11.289 k	Maxo	55.166 k-in	Mayo	62.523 k-in
		Ixe	2.9342 in⁴	Iye	3.8963 in⁴
Torsion		Sxe(t)	1.7162 in³	Sye(l)	1.4916 in³
Ba	57.112 k-in²	Sxe(b)	1.3161 in³	Sye(r)	1.4916 in³

Calculation Details - AISI S100-16/S1-18, US, ASD

Axial Tension Strength

Ag=1.4814 in², Fy=70 ksi

Tn=103.7 k — Eq. D2-1

Ωt=1.67, φt=0.9

An=1.4814 in², Fu=80 ksi

Tn=118.51 k — Eq. D3-1

Ωt=2, φt=0.75

Shear Strength

Hat element 3

Vn=3.8785 k at 58 deg — Eq. G2.1-1

Ωv=1.6, φv=0.95

Hat element 4

Vn=13.601 k at 90 deg — Eq. G2.1-1

Ωv=1.6, φv=0.95

Hat element 5

Vn=13.952 k at 0 deg — Eq. G2.1-1

Ωv=1.6, φv=0.95

Hat element 6

Vn=13.601 k at 270 deg — Eq. G2.1-1

Ωv=1.6, φv=0.95

Hat element 7

Vn=3.8785 k at -58 deg — Eq. G2.1-1

Ωv=1.6, φv=0.95

Axial Compression Strength

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.061953 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.2.2-1

k=0.43 — Eq. 1.2.2-3

λ=0.039664 — Eq. 1.1-3

λ<0.673 (fully effective) — Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=26.277 — Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 2: Stiffened, w=0.0061198 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.1.2-1

k=4 — Eq. 1.1.2-8

λ=0.0012846 — Eq. 1.1-3

ρ=1 — Eq. 1.1-2

be=0.0061198 in — Eq. 1.1-1

b_1=0.0030599 in — Eq. 1.1.2-9

b_2=0.0030599 in — Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 3: Stiffened, w=0.75664 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.1.2-1

k=4 — Eq. 1.1.2-8

λ=0.15883 — Eq. 1.1-3

ρ=1 — Eq. 1.1-2

be=0.75664 in — Eq. 1.1-1

b_1=0.37832 in — Eq. 1.1.2-9

b_2=0.37832 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 4: Stiffened, w=2.6534 in

f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.55699	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6534 in	Eq. 1.1-1
b_1=1.3267 in	Eq. 1.1.2-9
b_2=1.3267 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 5: Stiffened, w=2.7219 in

f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.57137	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.7219 in	Eq. 1.1-1
b_1=1.361 in	Eq. 1.1.2-9
b_2=1.361 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 6: Stiffened, w=2.6534 in

f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.55699	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6534 in	Eq. 1.1-1
b_1=1.3267 in	Eq. 1.1.2-9
b_2=1.3267 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 7: Stiffened, w=0.75664 in

f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.15883	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.75664 in	Eq. 1.1-1
b_1=0.37832 in	Eq. 1.1.2-9

b_2=0.37832 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 9: Unstiffened, w=0.061953 in

f_1=70 ksi, f_2=70 ksi

ψ=1 Eq. 1.2.2-1

k=0.43 Eq. 1.2.2-3

λ=0.039664 Eq. 1.1-3

λ<0.673 (fully effective) Eq. 1.1-1

Element 8: Check for lip stiffener reduction

S=26.277 Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 8: Stiffened, w=0.0061198 in

f_1=70 ksi, f_2=70 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.0012846 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.0061198 in Eq. 1.1-1

b_1=0.0030599 in Eq. 1.1.2-9

b_2=0.0030599 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Ae=1.4814 in², Fy=70 ksi

Pn=103.7 k Eq. E3.1-1

Ωc=1.8, φc=0.85

Positive Flexural Strength about X-axis

Effective width calculations for part 1: Hat

Element 1: No compressive stress (fully effective)

Element 2: No compressive stress (fully effective)

Element 3: No compressive stress (fully effective)

Element 4: Stiffened, w=2.6534 in

f_1=43.57 ksi, f_2=-39.741 ksi

ψ=0.91211 Eq. 1.1.2-1

k=21.806 Eq. 1.1.2-2

λ=0.18821 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.6534 in Eq. 1.1-1

h_0=3.0678 in, b_0=3.366 in, h_0/b_0=0.91141

b_1=0.67825 in Eq. 1.1.2-3

b_2=1.3267 in Eq. 1.1.2-4

Compression width=1.3877 in

b_1+b_2 > compression width (fully effective)

Element 5: Stiffened, w=2.7219 in

f_1=51.766 ksi, f_2=51.766 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.49135 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.7219 in Eq. 1.1-1

b_1=1.361 in Eq. 1.1.2-9

b_2=1.361 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 6: Stiffened, w=2.6534 in

f_1=43.57 ksi, f_2=-39.741 ksi

ψ=0.91211 Eq. 1.1.2-1

k=21.806 Eq. 1.1.2-2

λ=0.18821 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.6534 in Eq. 1.1-1

h_0=3.0678 in, b_0=3.366 in, h_0/b_0=0.91141

b_1=0.67825 in Eq. 1.1.2-3

b_2=1.3267 in Eq. 1.1.2-4

Compression width=1.3877 in

b_1+b_2 > compression width (fully effective)

Element 7: No compressive stress (fully effective)

Element 9: No compressive stress (fully effective)

Element 8: No compressive stress (fully effective)

Center of gravity shift: y=0 in

Sxe=1.3161 in³, Fy=70 ksi

Mn=92.127 k-in Eq. F3.1-1

Ωb=1.67, φb=0.9

Negative Flexural Strength about X-axis

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.061953 in

f_1=59.888 ksi, f_2=57.943 ksi

ψ=0.96752 Eq. 1.2.2-1

k=0.44206 Eq. 1.2.2-2

λ=0.036184	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=26.644	Eq. 1.3-7
w/t < 0.328S (no lip reduction)	

Element 2: Stiffened, w=0.0061198 in

f_1=68.084 ksi, f_2=68.084 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.0012669	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.0061198 in	Eq. 1.1-1
b_1=0.0030599 in	Eq. 1.1.2-9
b_2=0.0030599 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 3: Stiffened, w=0.75664 in

f_1=64.231 ksi, f_2=44.084 ksi	
ψ=0.68634	Eq. 1.1.2-1
k=4.689	Eq. 1.1.2-8
λ=0.14052	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.75664 in	Eq. 1.1-1
b_1=0.32703 in	Eq. 1.1.2-9
b_2=0.42961 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 4: Stiffened, w=2.6534 in

f_1=39.741 ksi, f_2=-43.57 ksi	
ψ=1.0964	Eq. 1.1.2-1
k=26.618	Eq. 1.1.2-2
λ=0.16269	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6534 in	Eq. 1.1-1
h_0=3.0678 in, b_0=1.0275 in, h_0/b_0=2.9857	
b_1=0.64775 in	Eq. 1.1.2-3
b_2=1.3267 in	Eq. 1.1.2-4
Compression width=1.2657 in	
b_1+b_2 > compression width (fully effective)	

Element 5: No compressive stress (fully effective)

Element 6: Stiffened, w=2.6534 in

f_1=39.741 ksi, f_2=-43.57 ksi

ψ=1.0964	Eq. 1.1.2-1
k=26.618	Eq. 1.1.2-2
λ=0.16269	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6534 in	Eq. 1.1-1
h_0=3.0678 in, b_0=1.0275 in, h_0/b_0=2.9857	
b_1=0.64775 in	Eq. 1.1.2-3
b_2=1.3267 in	Eq. 1.1.2-4
Compression width=1.2657 in	
b_1+b_2 > compression width (fully effective)	
Element 7: Stiffened, w=0.75664 in	
f_1=64.231 ksi, f_2=44.084 ksi	
ψ=0.68634	Eq. 1.1.2-1
k=4.689	Eq. 1.1.2-8
λ=0.14052	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.75664 in	Eq. 1.1-1
b_1=0.32703 in	Eq. 1.1.2-9
b_2=0.42961 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 9: Unstiffened, w=0.061953 in	
f_1=59.888 ksi, f_2=57.943 ksi	
ψ=0.96752	Eq. 1.2.2-1
k=0.44206	Eq. 1.2.2-2
λ=0.036184	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1
Element 8: Check for lip stiffener reduction	
S=26.644	Eq. 1.3-7
w/t < 0.328S (no lip reduction)	
Element 8: Stiffened, w=0.0061198 in	
f_1=68.084 ksi, f_2=68.084 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.0012669	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.0061198 in	Eq. 1.1-1
b_1=0.0030599 in	Eq. 1.1.2-9
b_2=0.0030599 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Center of gravity shift: y=0 in

Sxe=1.3161 in³, Fy=70 ksi

Mn=92.127 k-in Eq. F3.1-1

Ωb=1.67, φb=0.9

Positive Flexural Strength about Y-axis

Effective width calculations for part 1: Hat

Element 1: No compressive stress (fully effective)

Element 2: No compressive stress (fully effective)

Element 3: No compressive stress (fully effective)

Element 4: No compressive stress (fully effective)

Element 5: Stiffened, w=2.7219 in

f_1=36.471 ksi, f_2=-36.471 ksi

ψ=1 Eq. 1.1.2-1

k=24 Eq. 1.1.2-2

λ=0.16837 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.7219 in Eq. 1.1-1

h_0=3.366 in, b_0=3.0678 in, h_0/b_0=1.0972

b_1=0.68048 in Eq. 1.1.2-3

b_2=1.361 in Eq. 1.1.2-4

Compression width=1.361 in

b_1+b_2 > compression width (fully effective)

Element 6: Stiffened, w=2.6534 in

f_1=43.466 ksi, f_2=43.466 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.43891 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.6534 in Eq. 1.1-1

b_1=1.3267 in Eq. 1.1.2-9

b_2=1.3267 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 7: Stiffened, w=0.75664 in

f_1=55.274 ksi, f_2=44.529 ksi

ψ=0.80561 Eq. 1.1.2-1

k=4.4035 Eq. 1.1.2-8

λ=0.13452 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.75664 in Eq. 1.1-1

b_1=0.34481 in Eq. 1.1.2-9

b_2=0.41183 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 9: Unstiffened, w=0.061953 in

f_1=68.365 ksi, f_2=68.365 ksi

ψ=1 Eq. 1.2.2-1

k=0.43 Eq. 1.2.2-3

λ=0.039198 Eq. 1.1-3

λ<0.673 (fully effective) Eq. 1.1-1

Element 8: Check for lip stiffener reduction

S=28.064 Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 8: Stiffened, w=0.0061198 in

f_1=61.37 ksi, f_2=61.206 ksi

ψ=0.99733 Eq. 1.1.2-1

k=4.0053 Eq. 1.1.2-8

λ=0.001202 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.0061198 in Eq. 1.1-1

b_1=0.0030558 in Eq. 1.1.2-9

b_2=0.003064 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Center of gravity shift: x=0 in

Sye=1.4916 in³, Fy=70 ksi

Mn=104.41 k-in Eq. F3.1-1

Ωb=1.67, φb=0.9

Negative Flexural Strength about Y-axis

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.061953 in

f_1=68.365 ksi, f_2=68.365 ksi

ψ=1 Eq. 1.2.2-1

k=0.43 Eq. 1.2.2-3

λ=0.039198 Eq. 1.1-3

λ<0.673 (fully effective) Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=28.064 Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 2: Stiffened, w=0.0061198 in

f_1=61.37 ksi, f_2=61.206 ksi

ψ=0.99733	Eq. 1.1.2-1
k=4.0053	Eq. 1.1.2-8
λ=0.001202	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.0061198 in	Eq. 1.1-1
b_1=0.0030558 in	Eq. 1.1.2-9
b_2=0.003064 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 3: Stiffened, w=0.75664 in

f_1=55.274 ksi, f_2=44.529 ksi

ψ=0.80561	Eq. 1.1.2-1
k=4.4035	Eq. 1.1.2-8
λ=0.13452	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.75664 in	Eq. 1.1-1
b_1=0.34481 in	Eq. 1.1.2-9
b_2=0.41183 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 4: Stiffened, w=2.6534 in

f_1=43.466 ksi, f_2=43.466 ksi

ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.43891	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6534 in	Eq. 1.1-1
b_1=1.3267 in	Eq. 1.1.2-9
b_2=1.3267 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 5: Stiffened, w=2.7219 in

f_1=36.471 ksi, f_2=-36.471 ksi

ψ=1	Eq. 1.1.2-1
k=24	Eq. 1.1.2-2
λ=0.16837	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.7219 in	Eq. 1.1-1

h_0=3.366 in, b_0=3.0678 in, h_0/b_0=1.0972

b_1=0.68048 in	Eq. 1.1.2-3
b_2=1.361 in	Eq. 1.1.2-4

Compression width=1.361 in

b_1+b_2 > compression width (fully effective)

Element 6: No compressive stress (fully effective)

Element 7: No compressive stress (fully effective)

Element 9: No compressive stress (fully effective)

Element 8: No compressive stress (fully effective)

Center of gravity shift: x=0 in

Sye=1.4916 in³, Fy=70 ksi

Mn=104.41 k-in Eq. F3.1-1

Ωb=1.67, φb=0.9

Bimoment Strength, Hat

Cw=2.9993 in⁶, Wn=2.2012 in², Fy=70 ksi

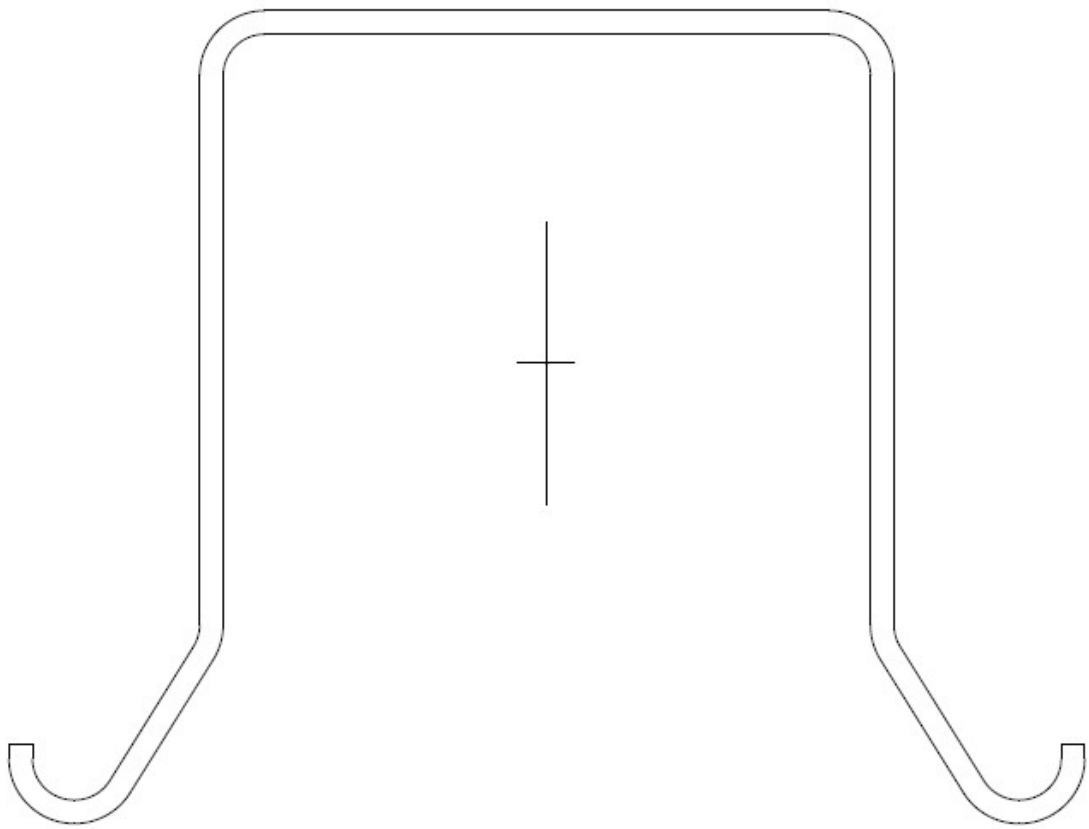
Bn=Fy Cw/Wn=95.377 k-in²

Ωb=1.67, φb=0.9

CFS Version 13.0.2

Section: Hat 4x4.0551x5x0.090551.cfss

Hat 4x4.0551x5x0.090551 POLARRACKING



Full Section Properties

Area	1.1225 in²	Wt.	0.0038166 k/ft	Flat	12.397 in
Ix	2.292 in⁴	rx	1.4288 in	Ixy	0.000 in⁴
Sx(t)	1.3259 in³	y(t)	1.7284 in	α	-90.000 deg
Sx(b)	1.0366 in³	y(b)	2.2108 in		
Zx	1.4435 in³	Height	3.9392 in		
Iy	3.071 in⁴	ry	1.6539 in	x_o	0.0000 in
Sy(l)	1.1509 in³	x(l)	2.6681 in	y_o	3.2387 in
Sy(r)	1.1509 in³	x(r)	2.6681 in	jx	0.0000 in
Zy	1.7437 in³	Width	5.3362 in	jy	-3.8146 in

I_1	3.071 in⁴	r_1	1.6539 in	Cw	2.3900 in⁶
I_2	2.292 in⁴	r_2	1.4288 in	J	0.0030681 in⁴
Ic	5.362 in⁴	rc	2.1856 in		
I_o	17.137 in⁴	r_o	3.9072 in		

Fully Braced Strength - AISI S100-16/S1-18, US, ASD

Material Type: A653 HSLAS Grade 70, Fy=70 ksi

Axial		Positive Bending		Positive Bending	
Pao	41.553 k	Maxo	43.375 k-in	Mayo	48.241 k-in
Ae	1.0685 in²	Ixe	2.2830 in⁴	Iye	3.0707 in⁴
Ta	44.901 k	Sxe(t)	1.3174 in³	Sye(l)	1.1509 in³
		Sxe(b)	1.0348 in³	Sye(r)	1.1509 in³
Shear					
Vay	15.964 k	Negative Bending		Negative Bending	
Vax	8.592 k	Maxo	43.449 k-in	Mayo	48.241 k-in
		Ixe	2.2916 in⁴	Iye	3.0707 in⁴
Torsion		Sxe(t)	1.3259 in³	Sye(l)	1.1509 in³
Ba	43.866 k-in²	Sxe(b)	1.0366 in³	Sye(r)	1.1509 in³

Calculation Details - AISI S100-16/S1-18, US, ASD

Axial Tension Strength

Ag=1.1225 in², Fy=70 ksi

Tn=78.577 k Eq. D2-1

Ωt=1.67, ϕt=0.9

An=1.1225 in², Fu=80 ksi

Tn=89.803 k Eq. D3-1

Ωt=2, ϕt=0.75

Shear Strength

Hat element 3

Vn=2.9784 k at 58 deg Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Hat element 4

Vn=10.245 k at 90 deg Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Hat element 5

Vn=10.591 k at 0 deg — Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Hat element 6

Vn=10.245 k at 270 deg — Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Hat element 7

Vn=2.9784 k at -58 deg — Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Axial Compression Strength

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.093449 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.2.2-1

k=0.43 — Eq. 1.2.2-3

λ=0.080639 — Eq. 1.1-3

λ<0.673 (fully effective) — Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=26.277 — Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 2: Stiffened, w=0.079552 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.1.2-1

k=4 — Eq. 1.1.2-8

λ=0.022507 — Eq. 1.1-3

ρ=1 — Eq. 1.1-2

be=0.079552 in — Eq. 1.1-1

b_1=0.039776 in — Eq. 1.1.2-9

b_2=0.039776 in — Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 3: Stiffened, w=0.78313 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.1.2-1

k=4 — Eq. 1.1.2-8

λ=0.22157 — Eq. 1.1-3

ρ=1 — Eq. 1.1-2

be=0.78313 in	Eq. 1.1-1
b_1=0.39157 in	Eq. 1.1.2-9
b_2=0.39157 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 4: Stiffened, w=2.6939 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.76219	Eq. 1.1-3
ρ=0.93331	Eq. 1.1-2
be=2.5143 in	Eq. 1.1-1
b_1=1.2571 in	Eq. 1.1.2-9
b_2=1.2571 in	Eq. 1.1.2-10
Ineffective width=0.17966 in	
Element 5: Stiffened, w=2.7849 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.78793	Eq. 1.1-3
ρ=0.91479	Eq. 1.1-2
be=2.5476 in	Eq. 1.1-1
b_1=1.2738 in	Eq. 1.1.2-9
b_2=1.2738 in	Eq. 1.1.2-10
Ineffective width=0.2373 in	
Element 6: Stiffened, w=2.6939 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.76219	Eq. 1.1-3
ρ=0.93331	Eq. 1.1-2
be=2.5143 in	Eq. 1.1-1
b_1=1.2571 in	Eq. 1.1.2-9
b_2=1.2571 in	Eq. 1.1.2-10
Ineffective width=0.17966 in	
Element 7: Stiffened, w=0.78313 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8

λ=0.22157	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.78313 in	Eq. 1.1-1
b_1=0.39157 in	Eq. 1.1.2-9
b_2=0.39157 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 9: Unstiffened, w=0.093449 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.2.2-1
k=0.43	Eq. 1.2.2-3
λ=0.080639	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1
Element 8: Check for lip stiffener reduction	
S=26.277	Eq. 1.3-7
w/t < 0.328S (no lip reduction)	
Element 8: Stiffened, w=0.079552 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.022507	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.079552 in	Eq. 1.1-1
b_1=0.039776 in	Eq. 1.1.2-9
b_2=0.039776 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Ae=1.0685 in^2, Fy=70 ksi

Pn=74.796 k	Eq. E3.1-1

Ωc=1.8, ϕc=0.85

Positive Flexural Strength about X-axis

Effective width calculations for part 1: Hat

Element 1: No compressive stress (fully effective)

Element 2: No compressive stress (fully effective)

Element 3: No compressive stress (fully effective)

Element 4: Stiffened, w=2.6939 in

f_1=45.742 ksi, f_2=-39.715 ksi

ψ=0.86824	Eq. 1.1.2-1

k=20.778	Eq. 1.1.2-2
λ=0.27034	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6939 in	Eq. 1.1-1
h_o=3.0678 in, b_o=3.366 in, h_o/b_o=0.91141	
b_1=0.69642 in	Eq. 1.1.2-3
b_2=1.347 in	Eq. 1.1.2-4
Compression width=1.442 in	
b_1+b_2 > compression width (fully effective)	
Element 5: Stiffened, w=2.7849 in	
f_1=53.523 ksi, f_2=53.523 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.68898	Eq. 1.1-3
ρ=0.98796	Eq. 1.1-2
be=2.7514 in	Eq. 1.1-1
b_1=1.3757 in	Eq. 1.1.2-9
b_2=1.3757 in	Eq. 1.1.2-10
Ineffective width=0.033521 in	
Element 6: Stiffened, w=2.6939 in	
f_1=45.742 ksi, f_2=-39.715 ksi	
ψ=0.86824	Eq. 1.1.2-1
k=20.778	Eq. 1.1.2-2
λ=0.27034	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6939 in	Eq. 1.1-1
h_o=3.0678 in, b_o=3.366 in, h_o/b_o=0.91141	
b_1=0.69642 in	Eq. 1.1.2-3
b_2=1.347 in	Eq. 1.1.2-4
Compression width=1.442 in	
b_1+b_2 > compression width (fully effective)	
Element 7: No compressive stress (fully effective)	
Element 9: No compressive stress (fully effective)	
Element 8: No compressive stress (fully effective)	

Center of gravity shift: y=-0.0045635 in

Sxe=1.0348 in³, Fy=70 ksi

Mn=72.436 k-in	Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Negative Flexural Strength about X-axis

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.093449 in

f_1=60.8 ksi, f_2=57.841 ksi

ψ=0.95133	Eq. 1.2.2-1
k=0.4476	Eq. 1.2.2-2
λ=0.073661	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=26.55	Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 2: Stiffened, w=0.079552 in

f_1=68.566 ksi, f_2=68.566 ksi

ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.022276	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.079552 in	Eq. 1.1-1
b_1=0.039776 in	Eq. 1.1.2-9
b_2=0.039776 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 3: Stiffened, w=0.78313 in

f_1=64.916 ksi, f_2=43.887 ksi

ψ=0.67607	Eq. 1.1.2-1
k=4.7159	Eq. 1.1.2-8
λ=0.19651	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.78313 in	Eq. 1.1-1
b_1=0.33698 in	Eq. 1.1.2-9
b_2=0.44615 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 4: Stiffened, w=2.6939 in

f_1=39.772 ksi, f_2=-45.526 ksi

ψ=1.1447	Eq. 1.1.2-1
k=28.019	Eq. 1.1.2-2
λ=0.21707	Eq. 1.1-3

ρ=1	Eq. 1.1-2
be=2.6939 in	Eq. 1.1-1
h_o=3.0678 in, b_o=1.0275 in, h_o/b_o=2.9857	
b_1=0.64997 in	Eq. 1.1.2-3
b_2=1.347 in	Eq. 1.1.2-4
Compression width=1.2561 in	
b_1+b_2 > compression width (fully effective)	

Element 5: No compressive stress (fully effective)

Element 6: Stiffened, w=2.6939 in

f_1=39.772 ksi, f_2=-45.526 ksi	
ψ=1.1447	Eq. 1.1.2-1
k=28.019	Eq. 1.1.2-2
λ=0.21707	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6939 in	Eq. 1.1-1
h_o=3.0678 in, b_o=1.0275 in, h_o/b_o=2.9857	
b_1=0.64997 in	Eq. 1.1.2-3
b_2=1.347 in	Eq. 1.1.2-4
Compression width=1.2561 in	
b_1+b_2 > compression width (fully effective)	

Element 7: Stiffened, w=0.78313 in

f_1=64.916 ksi, f_2=43.887 ksi	
ψ=0.67607	Eq. 1.1.2-1
k=4.7159	Eq. 1.1.2-8
λ=0.19651	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.78313 in	Eq. 1.1-1
b_1=0.33698 in	Eq. 1.1.2-9
b_2=0.44615 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 9: Unstiffened, w=0.093449 in

f_1=60.8 ksi, f_2=57.841 ksi	
ψ=0.95133	Eq. 1.2.2-1
k=0.4476	Eq. 1.2.2-2
λ=0.073661	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1

Element 8: Check for lip stiffener reduction

S=26.55	Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 8: Stiffened, w=0.079552 in

f_1=68.566 ksi, f_2=68.566 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.022276 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.079552 in Eq. 1.1-1

b_1=0.039776 in Eq. 1.1.2-9

b_2=0.039776 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Center of gravity shift: y=0 in

Sxe=1.0366 in^3, Fy=70 ksi

Mn=72.559 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Positive Flexural Strength about Y-axis

Effective width calculations for part 1: Hat

Element 1: No compressive stress (fully effective)

Element 2: No compressive stress (fully effective)

Element 3: No compressive stress (fully effective)

Element 4: No compressive stress (fully effective)

Element 5: Stiffened, w=2.7849 in

f_1=36.532 ksi, f_2=-36.532 ksi

ψ=1 Eq. 1.1.2-1

k=24 Eq. 1.1.2-2

λ=0.23238 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.7849 in Eq. 1.1-1

h_o=3.366 in, b_o=3.0678 in, h_o/b_o=1.0972

b_1=0.69622 in Eq. 1.1.2-3

b_2=1.3924 in Eq. 1.1.2-4

Compression width=1.3924 in

b_1+b_2 > compression width (fully effective)

Element 6: Stiffened, w=2.6939 in

f_1=42.967 ksi, f_2=42.967 ksi

ψ=1 Eq. 1.1.2-1

$k=4$	Eq. 1.1.2-8
$\lambda=0.59715$	Eq. 1.1-3
$\rho=1$	Eq. 1.1-2
$be=2.6939$ in	Eq. 1.1-1
$b_1=1.347$ in	Eq. 1.1.2-9
$b_2=1.347$ in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 7: Stiffened, w=0.78313 in	
$f_1=54.833$ ksi, $f_2=43.945$ ksi	
$\psi=0.80144$	Eq. 1.1.2-1
$k=4.4128$	Eq. 1.1.2-8
$\lambda=0.1867$	Eq. 1.1-3
$\rho=1$	Eq. 1.1-2
$be=0.78313$ in	Eq. 1.1-1
$b_1=0.3562$ in	Eq. 1.1.2-9
$b_2=0.42693$ in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 9: Unstiffened, w=0.093449 in	
$f_1=68.812$ ksi, $f_2=68.812$ ksi	
$\psi=1$	Eq. 1.2.2-1
$k=0.43$	Eq. 1.2.2-3
$\lambda=0.079952$	Eq. 1.1-3
$\lambda<0.673$ (fully effective)	Eq. 1.1-1
Element 8: Check for lip stiffener reduction	
$S=27.836$	Eq. 1.3-7
$w/t < 0.328S$ (no lip reduction)	
Element 8: Stiffened, w=0.079552 in	
$f_1=62.377$ ksi, $f_2=60.29$ ksi	
$\psi=0.96654$	Eq. 1.1.2-1
$k=4.067$	Eq. 1.1.2-8
$\lambda=0.021071$	Eq. 1.1-3
$\rho=1$	Eq. 1.1-2
$be=0.079552$ in	Eq. 1.1-1
$b_1=0.039121$ in	Eq. 1.1.2-9
$b_2=0.04043$ in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Center of gravity shift: x=0 in

Sye=1.1509 in³, Fy=70 ksi

Mn=80.562 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Negative Flexural Strength about Y-axis

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.093449 in

f_1=68.812 ksi, f_2=68.812 ksi

ψ=1 Eq. 1.2.2-1

k=0.43 Eq. 1.2.2-3

λ=0.079952 Eq. 1.1-3

λ<0.673 (fully effective) Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=27.836 Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 2: Stiffened, w=0.079552 in

f_1=62.377 ksi, f_2=60.29 ksi

ψ=0.96654 Eq. 1.1.2-1

k=4.067 Eq. 1.1.2-8

λ=0.021071 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.079552 in Eq. 1.1-1

b_1=0.039121 in Eq. 1.1.2-9

b_2=0.04043 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 3: Stiffened, w=0.78313 in

f_1=54.833 ksi, f_2=43.945 ksi

ψ=0.80144 Eq. 1.1.2-1

k=4.4128 Eq. 1.1.2-8

λ=0.1867 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.78313 in Eq. 1.1-1

b_1=0.3562 in Eq. 1.1.2-9

b_2=0.42693 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 4: Stiffened, w=2.6939 in

f_1=42.967 ksi, f_2=42.967 ksi

ψ=1 Eq. 1.1.2-1

$k=4$	Eq. 1.1.2-8
$\lambda=0.59715$	Eq. 1.1-3
$\rho=1$	Eq. 1.1-2
$be=2.6939$ in	Eq. 1.1-1
$b_1=1.347$ in	Eq. 1.1.2-9
$b_2=1.347$ in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 5: Stiffened, w=2.7849 in	
$f_1=36.532$ ksi, $f_2=-36.532$ ksi	
$\psi=1$	Eq. 1.1.2-1
$k=24$	Eq. 1.1.2-2
$\lambda=0.23238$	Eq. 1.1-3
$\rho=1$	Eq. 1.1-2
$be=2.7849$ in	Eq. 1.1-1
$h_o=3.366$ in, $b_o=3.0678$ in, $h_o/b_o=1.0972$	
$b_1=0.69622$ in	Eq. 1.1.2-3
$b_2=1.3924$ in	Eq. 1.1.2-4
Compression width=1.3924 in	
b_1+b_2 > compression width (fully effective)	
Element 6: No compressive stress (fully effective)	
Element 7: No compressive stress (fully effective)	
Element 9: No compressive stress (fully effective)	
Element 8: No compressive stress (fully effective)	

Center of gravity shift: x=0 in

$Sye=1.1509$ in^3, $Fy=70$ ksi

$Mn=80.562$ k-in — Eq. F3.1-1

$\Omega b=1.67$, $\phi b=0.9$

Bimoment Strength, Hat

$Cw=2.39$ in^6, $Wn=2.2838$ in^2, $Fy=70$ ksi

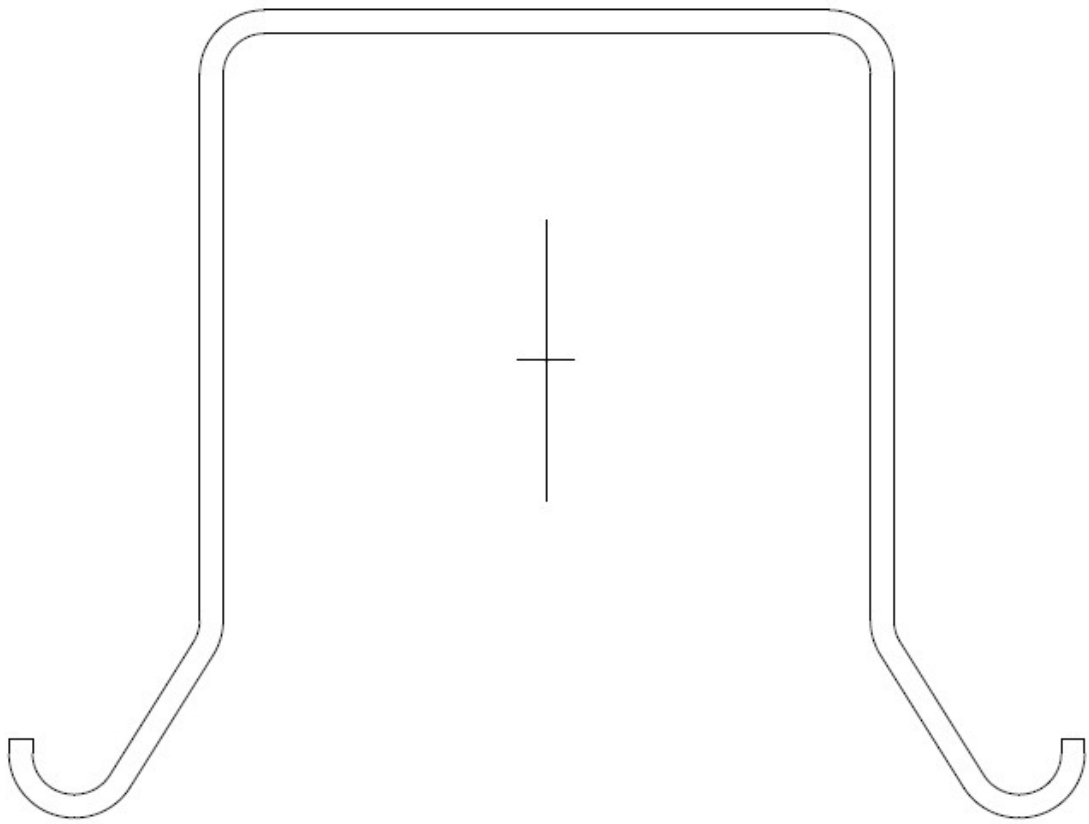
$Bn=Fy\ Cw/Wn=73.257$ k-in^2

$\Omega b=1.67$, $\phi b=0.9$

CFS Version 13.0.2

Section: Hat 4x4.0551x5x0.106299.cfss

Hat 4x4.0551x5x0.106299 POLARRACKING



Full Section Properties

Area	1.2988 in²	Wt.	0.0044160 k/ft	Flat	12.219 in
Ix	2.598 in⁴	rx	1.4143 in	Ixy	0.000 in⁴
Sx(t)	1.5189 in³	y(t)	1.7104 in	α	90.000 deg
Sx(b)	1.1657 in³	y(b)	2.2287 in		
Zx	1.6511 in³	Height	3.9392 in		
Iy	3.457 in⁴	ry	1.6315 in	x_o	0.0000 in
Sy(l)	1.3218 in³	x(l)	2.6156 in	y_o	3.2280 in
Sy(r)	1.3218 in³	x(r)	2.6156 in	jx	0.0000 in

Zy	1.9925 in³	Width	5.2313 in	jy	-3.7952 in
I_1	3.457 in⁴	r_1	1.6315 in	Cw	2.6808 in⁶
I_2	2.598 in⁴	r_2	1.4143 in	J	0.0048920 in⁴
Ic	6.055 in⁴	rc	2.1592 in		
I_o	19.589 in⁴	r_o	3.8836 in		

Fully Braced Strength - AISI S100-16/S1-18, US, ASD

Material Type: A653 HSLAS Grade 70, Fy=70 ksi

Axial		Positive Bending		Positive Bending	
Pao	50.509 k	Maxo	48.861 k-in	Mayo	55.404 k-in
Ae	1.2988 in²	Ixe	2.5980 in⁴	Iye	3.4573 in⁴
Ta	51.953 k	Sxe(t)	1.5189 in³	Sye(l)	1.3218 in³
		Sxe(b)	1.1657 in³	Sye(r)	1.3218 in³
Shear					
Vay	18.565 k	Negative Bending		Negative Bending	
Vax	9.960 k	Maxo	48.861 k-in	Mayo	55.404 k-in
		Ixe	2.5980 in⁴	Iye	3.4573 in⁴
Torsion		Sxe(t)	1.5189 in³	Sye(l)	1.3218 in³
Ba	50.466 k-in²	Sxe(b)	1.1657 in³	Sye(r)	1.3218 in³

Calculation Details - AISI S100-16/S1-18, US, ASD

Axial Tension Strength

Ag=1.2988 in², Fy=70 ksi

Tn=90.917 k Eq. D2-1

Ωt=1.67, ϕt=0.9

An=1.2988 in², Fu=80 ksi

Tn=103.91 k Eq. D3-1

Ωt=2, ϕt=0.75

Shear Strength

Hat element 3

Vn=3.4372 k at 58 deg Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Hat element 4

Vn=11.937 k at 90 deg	Eq. G2.1-1
Ωv=1.6, ϕv=0.95	
Hat element 5	
Vn=12.293 k at 0 deg	Eq. G2.1-1
Ωv=1.6, ϕv=0.95	
Hat element 6	
Vn=11.937 k at 270 deg	Eq. G2.1-1
Ωv=1.6, ϕv=0.95	
Hat element 7	
Vn=3.4372 k at -58 deg	Eq. G2.1-1
Ωv=1.6, ϕv=0.95	

Axial Compression Strength

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.077701 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.2.2-1
k=0.43	Eq. 1.2.2-3
λ=0.057117	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1
Element 2: Check for lip stiffener reduction	
S=26.277	Eq. 1.3-7
w/t < 0.328S (no lip reduction)	
Element 2: Stiffened, w=0.018358 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.0044246	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.018358 in	Eq. 1.1-1
b_1=0.0091792 in	Eq. 1.1.2-9
b_2=0.0091792 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	
Element 3: Stiffened, w=0.76989 in	
f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.18555	Eq. 1.1-3

ρ=1	Eq. 1.1-2
be=0.76989 in	Eq. 1.1-1
b_1=0.38494 in	Eq. 1.1.2-9
b_2=0.38494 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 4: Stiffened, w=2.6737 in

f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.64439	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6737 in	Eq. 1.1-1
b_1=1.3368 in	Eq. 1.1.2-9
b_2=1.3368 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 5: Stiffened, w=2.7534 in

f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.66361	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.7534 in	Eq. 1.1-1
b_1=1.3767 in	Eq. 1.1.2-9
b_2=1.3767 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 6: Stiffened, w=2.6737 in

f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.64439	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6737 in	Eq. 1.1-1
b_1=1.3368 in	Eq. 1.1.2-9
b_2=1.3368 in	Eq. 1.1.2-10
b_1+b_2 > compression width (fully effective)	

Element 7: Stiffened, w=0.76989 in

f_1=70 ksi, f_2=70 ksi	
ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8

```
      λ=0.18555                                          Eq. 1.1-3
      ρ=1                                                Eq. 1.1-2
      be=0.76989 in                                      Eq. 1.1-1
      b₁=0.38494 in                                      Eq. 1.1.2-9
      b₂=0.38494 in                                      Eq. 1.1.2-10
      b₁+b₂ > compression width (fully effective)
    Element 9: Unstiffened, w=0.077701 in
      f₁=70 ksi, f₂=70 ksi
      ψ=1                                                Eq. 1.2.2-1
      k=0.43                                             Eq. 1.2.2-3
      λ=0.057117                                         Eq. 1.1-3
      λ<0.673 (fully effective)                          Eq. 1.1-1
    Element 8: Check for lip stiffener reduction
      S=26.277                                           Eq. 1.3-7
      w/t < 0.328S (no lip reduction)
    Element 8: Stiffened, w=0.018358 in
      f₁=70 ksi, f₂=70 ksi
      ψ=1                                                Eq. 1.1.2-1
      k=4                                                Eq. 1.1.2-8
      λ=0.0044246                                        Eq. 1.1-3
      ρ=1                                                Eq. 1.1-2
      be=0.018358 in                                     Eq. 1.1-1
      b₁=0.0091792 in                                    Eq. 1.1.2-9
      b₂=0.0091792 in                                    Eq. 1.1.2-10
      b₁+b₂ > compression width (fully effective)

  Ae=1.2988 in², Fy=70 ksi
  Pn=90.917 k                                            Eq. E3.1-1
  Ωc=1.8, ϕc=0.85

Positive Flexural Strength about X-axis
  Effective width calculations for part 1: Hat
    Element 1: No compressive stress (fully effective)
    Element 2: No compressive stress (fully effective)
    Element 3: No compressive stress (fully effective)
    Element 4: Stiffened, w=2.6737 in
      f₁=44.101 ksi, f₂=-39.873 ksi
      ψ=0.90413                                          Eq. 1.1.2-1
      k=21.616                                           Eq. 1.1.2-2
```

λ=0.22002 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.6737 in Eq. 1.1-1

h_o=3.0678 in, b_o=3.366 in, h_o/b_o=0.91141

b_1=0.68483 in Eq. 1.1.2-3

b_2=1.3368 in Eq. 1.1.2-4

Compression width=1.4041 in

b_1+b_2 > compression width (fully effective)

Element 5: Stiffened, w=2.7534 in

f_1=52.052 ksi, f_2=52.052 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.57224 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.7534 in Eq. 1.1-1

b_1=1.3767 in Eq. 1.1.2-9

b_2=1.3767 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 6: Stiffened, w=2.6737 in

f_1=44.101 ksi, f_2=-39.873 ksi

ψ=0.90413 Eq. 1.1.2-1

k=21.616 Eq. 1.1.2-2

λ=0.22002 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.6737 in Eq. 1.1-1

h_o=3.0678 in, b_o=3.366 in, h_o/b_o=0.91141

b_1=0.68483 in Eq. 1.1.2-3

b_2=1.3368 in Eq. 1.1.2-4

Compression width=1.4041 in

b_1+b_2 > compression width (fully effective)

Element 7: No compressive stress (fully effective)

Element 9: No compressive stress (fully effective)

Element 8: No compressive stress (fully effective)

Center of gravity shift: y=0 in

Sxe=1.1657 in^3, Fy=70 ksi

Mn=81.599 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Negative Flexural Strength about X-axis

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.077701 in

f_1=60.38 ksi, f_2=57.939 ksi

ψ=0.95958	Eq. 1.2.2-1
k=0.44476	Eq. 1.2.2-2
λ=0.052159	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=26.596	Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 2: Stiffened, w=0.018358 in

f_1=68.331 ksi, f_2=68.331 ksi

ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.0043716	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.018358 in	Eq. 1.1-1
b_1=0.0091792 in	Eq. 1.1.2-9
b_2=0.0091792 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 3: Stiffened, w=0.76989 in

f_1=64.593 ksi, f_2=44.087 ksi

ψ=0.68253	Eq. 1.1.2-1
k=4.6989	Eq. 1.1.2-8
λ=0.16445	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.76989 in	Eq. 1.1-1
b_1=0.33221 in	Eq. 1.1.2-9
b_2=0.43768 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 4: Stiffened, w=2.6737 in

f_1=39.873 ksi, f_2=-44.101 ksi

ψ=1.106	Eq. 1.1.2-1
k=26.894	Eq. 1.1.2-2
λ=0.18756	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6737 in	Eq. 1.1-1

h_o=3.0678 in, b_o=1.0275 in, h_o/b_o=2.9857

b_1=0.65116 in Eq. 1.1.2-3

b_2=1.3368 in Eq. 1.1.2-4

Compression width=1.2695 in

b_1+b_2 > compression width (fully effective)

Element 5: No compressive stress (fully effective)

Element 6: Stiffened, w=2.6737 in

f_1=39.873 ksi, f_2=-44.101 ksi

ψ=1.106 Eq. 1.1.2-1

k=26.894 Eq. 1.1.2-2

λ=0.18756 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.6737 in Eq. 1.1-1

h_o=3.0678 in, b_o=1.0275 in, h_o/b_o=2.9857

b_1=0.65116 in Eq. 1.1.2-3

b_2=1.3368 in Eq. 1.1.2-4

Compression width=1.2695 in

b_1+b_2 > compression width (fully effective)

Element 7: Stiffened, w=0.76989 in

f_1=64.593 ksi, f_2=44.087 ksi

ψ=0.68253 Eq. 1.1.2-1

k=4.6989 Eq. 1.1.2-8

λ=0.16445 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.76989 in Eq. 1.1-1

b_1=0.33221 in Eq. 1.1.2-9

b_2=0.43768 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 9: Unstiffened, w=0.077701 in

f_1=60.38 ksi, f_2=57.939 ksi

ψ=0.95958 Eq. 1.2.2-1

k=0.44476 Eq. 1.2.2-2

λ=0.052159 Eq. 1.1-3

λ<0.673 (fully effective) Eq. 1.1-1

Element 8: Check for lip stiffener reduction

S=26.596 Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 8: Stiffened, w=0.018358 in

f_1=68.331 ksi, f_2=68.331 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.0043716 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.018358 in Eq. 1.1-1

b_1=0.0091792 in Eq. 1.1.2-9

b_2=0.0091792 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Center of gravity shift: y=0 in

Sxe=1.1657 in³, Fy=70 ksi

Mn=81.599 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Positive Flexural Strength about Y-axis

Effective width calculations for part 1: Hat

Element 1: No compressive stress (fully effective)

Element 2: No compressive stress (fully effective)

Element 3: No compressive stress (fully effective)

Element 4: No compressive stress (fully effective)

Element 5: Stiffened, w=2.7534 in

f_1=36.843 ksi, f_2=-36.843 ksi

ψ=1 Eq. 1.1.2-1

k=24 Eq. 1.1.2-2

λ=0.19655 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.7534 in Eq. 1.1-1

h_o=3.366 in, b_o=3.0678 in, h_o/b_o=1.0972

b_1=0.68835 in Eq. 1.1.2-3

b_2=1.3767 in Eq. 1.1.2-4

Compression width=1.3767 in

b_1+b_2 > compression width (fully effective)

Element 6: Stiffened, w=2.6737 in

f_1=43.618 ksi, f_2=43.618 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.50867 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.6737 in Eq. 1.1-1

b_1=1.3368 in Eq. 1.1.2-9

b_2=1.3368 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 7: Stiffened, w=0.76989 in

f_1=55.566 ksi, f_2=44.648 ksi

ψ=0.80351 Eq. 1.1.2-1

k=4.4082 Eq. 1.1.2-8

λ=0.15748 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.76989 in Eq. 1.1-1

b_1=0.35051 in Eq. 1.1.2-9

b_2=0.41938 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 9: Unstiffened, w=0.077701 in

f_1=68.578 ksi, f_2=68.578 ksi

ψ=1 Eq. 1.2.2-1

k=0.43 Eq. 1.2.2-3

λ=0.056533 Eq. 1.1-3

λ<0.673 (fully effective) Eq. 1.1-1

Element 8: Check for lip stiffener reduction

S=27.965 Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 8: Stiffened, w=0.018358 in

f_1=61.803 ksi, f_2=61.311 ksi

ψ=0.99205 Eq. 1.1.2-1

k=4.0159 Eq. 1.1.2-8

λ=0.0041493 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=0.018358 in Eq. 1.1-1

b_1=0.0091429 in Eq. 1.1.2-9

b_2=0.0092156 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Center of gravity shift: x=0 in

Sye=1.3218 in^3, Fy=70 ksi

Mn=92.525 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Negative Flexural Strength about Y-axis

Effective width calculations for part 1: Hat

Element 1: Unstiffened, w=0.077701 in

f_1=68.578 ksi, f_2=68.578 ksi

ψ=1	Eq. 1.2.2-1
k=0.43	Eq. 1.2.2-3
λ=0.056533	Eq. 1.1-3
λ<0.673 (fully effective)	Eq. 1.1-1

Element 2: Check for lip stiffener reduction

S=27.965	Eq. 1.3-7

w/t < 0.328S (no lip reduction)

Element 2: Stiffened, w=0.018358 in

f_1=61.803 ksi, f_2=61.311 ksi

ψ=0.99205	Eq. 1.1.2-1
k=4.0159	Eq. 1.1.2-8
λ=0.0041493	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.018358 in	Eq. 1.1-1
b_1=0.0091429 in	Eq. 1.1.2-9
b_2=0.0092156 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 3: Stiffened, w=0.76989 in

f_1=55.566 ksi, f_2=44.648 ksi

ψ=0.80351	Eq. 1.1.2-1
k=4.4082	Eq. 1.1.2-8
λ=0.15748	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=0.76989 in	Eq. 1.1-1
b_1=0.35051 in	Eq. 1.1.2-9
b_2=0.41938 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 4: Stiffened, w=2.6737 in

f_1=43.618 ksi, f_2=43.618 ksi

ψ=1	Eq. 1.1.2-1
k=4	Eq. 1.1.2-8
λ=0.50867	Eq. 1.1-3
ρ=1	Eq. 1.1-2
be=2.6737 in	Eq. 1.1-1
b_1=1.3368 in	Eq. 1.1.2-9
b_2=1.3368 in	Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Element 5: Stiffened, w=2.7534 in

f_1=36.843 ksi, f_2=-36.843 ksi

ψ=1 Eq. 1.1.2-1

k=24 Eq. 1.1.2-2

λ=0.19655 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=2.7534 in Eq. 1.1-1

h_o=3.366 in, b_o=3.0678 in, h_o/b_o=1.0972

b_1=0.68835 in Eq. 1.1.2-3

b_2=1.3767 in Eq. 1.1.2-4

Compression width=1.3767 in

b_1+b_2 > compression width (fully effective)

Element 6: No compressive stress (fully effective)

Element 7: No compressive stress (fully effective)

Element 9: No compressive stress (fully effective)

Element 8: No compressive stress (fully effective)

Center of gravity shift: x=0 in

Sye=1.3218 in^3, Fy=70 ksi

Mn=92.525 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Bimoment Strength, Hat

Cw=2.6808 in^6, Wn=2.2266 in^2, Fy=70 ksi

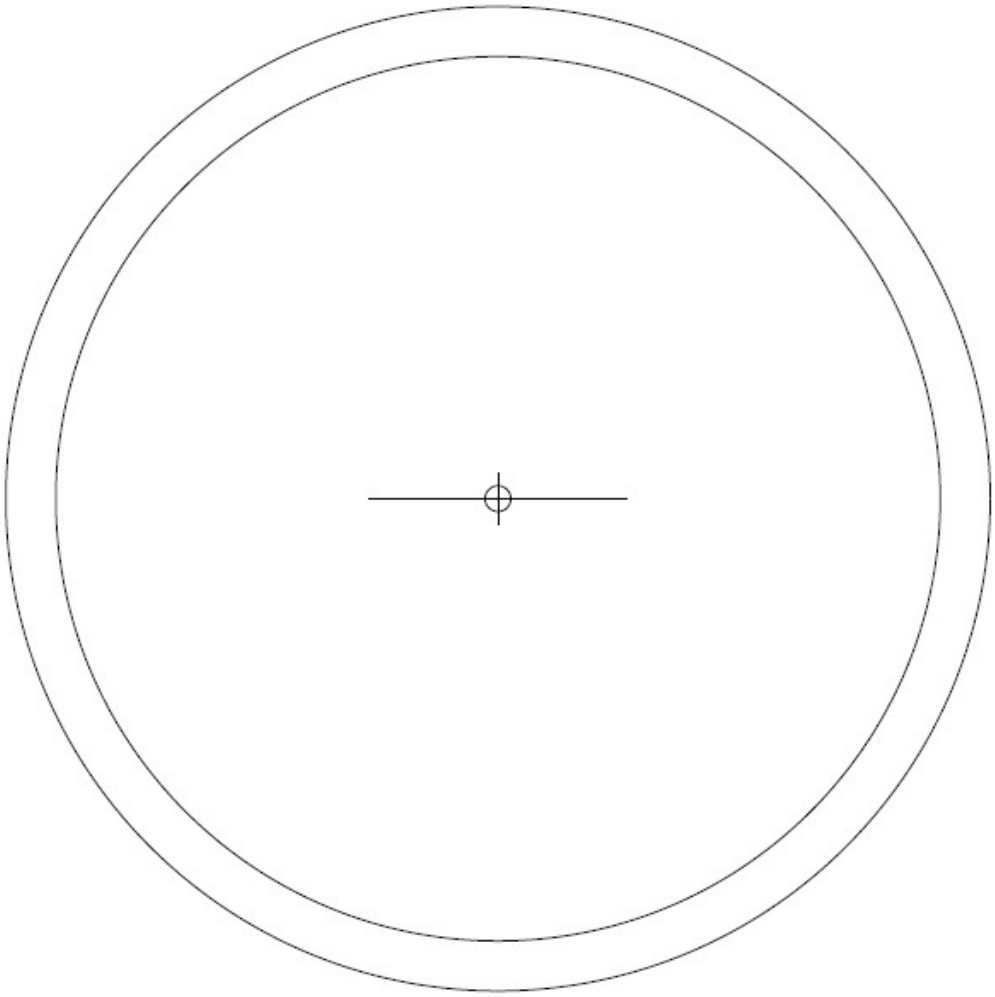
Bn=Fy Cw/Wn=84.279 k-in^2

Ωb=1.67, ϕb=0.9

CFS Version 13.0.2

Section: Cylindrical Tube 3.5øx0.17717.cfss

Cylindrical Tube 3.5øx0.17717 POLARRACKING



Full Section Properties

Area	1.8494 in²	Wt.	0.0062880 k/ft	Flat	10.439 in
Ix	2.5598 in⁴	rx	1.1765 in	Ixy	0.0000 in⁴
Sx(t)	1.4627 in³	y(t)	1.7500 in	α	0.000 deg
Sx(b)	1.4627 in³	y(b)	1.7500 in		
Zx	1.9580 in³	Height	3.5000 in		

Iy	2.5597 in^4	ry	1.1765 in	x_o	0.0000 in
Sy(l)	1.4627 in^3	x(l)	1.7500 in	y_o	0.0000 in
Sy(r)	1.4627 in^3	x(r)	1.7500 in	jx	0.0000 in
Zy	1.9580 in^3	Width	3.5000 in	jy	0.0000 in
I_1	2.5598 in^4	r_1	1.1765 in	Cw	0.000 in^6
I_2	2.5597 in^4	r_2	1.1765 in	J	5.1050 in^4
Ic	5.1195 in^4	rc	1.6638 in		
I_o	5.1195 in^4	r_o	1.6638 in		

Fully Braced Strength - AISI S100-16/S1-18, US, ASD

Material Type: A653 HSLAS Grade 50, Fy=50 ksi

Axial		Positive Bending		Positive Bending	
Pao	51.373 k	Maxo	54.742 k-in	Mayo	54.742 k-in
Ae	1.8494 in^2	Ixe	2.5598 in^4	Iye	2.5597 in^4
Ta	55.372 k	Sxe(t)	1.4627 in^3	Sye(l)	1.4627 in^3
		Sxe(b)	1.4627 in^3	Sye(r)	1.4627 in^3
Shear					
Vay	17.371 k	Negative Bending		Negative Bending	
Vax	17.371 k	Maxo	54.742 k-in	Mayo	54.742 k-in
		Ixe	2.5598 in^4	Iye	2.5597 in^4
Torsion		Sxe(t)	1.4627 in^3	Sye(l)	1.4627 in^3
Ba	0 $k\text{-}in^2$	Sxe(b)	1.4627 in^3	Sye(r)	1.4627 in^3

Calculation Details - AISI S100-16/S1-18, US, ASD

Axial Tension Strength

Ag=1.8494 in^2, Fy=50 ksi

Tn=92.471 k Eq. D2-1

Ωt=1.67, ϕt=0.9

Shear Strength

Av=0.92646 in^2, Fy=30 ksi

Vn=27.794 k

Ωv=1.6, ϕv=0.95

Axial Compression Strength

F_n=50 ksi

A_e=A_o=1.8494 in^2 Eq. E3.1.1.1-2

P_n=92.471 k Eq. E3.1-1

Ω_c=1.8, ϕ_c=0.85

Flexural Strength

F_n=62.5 ksi Eq. F2.3-2

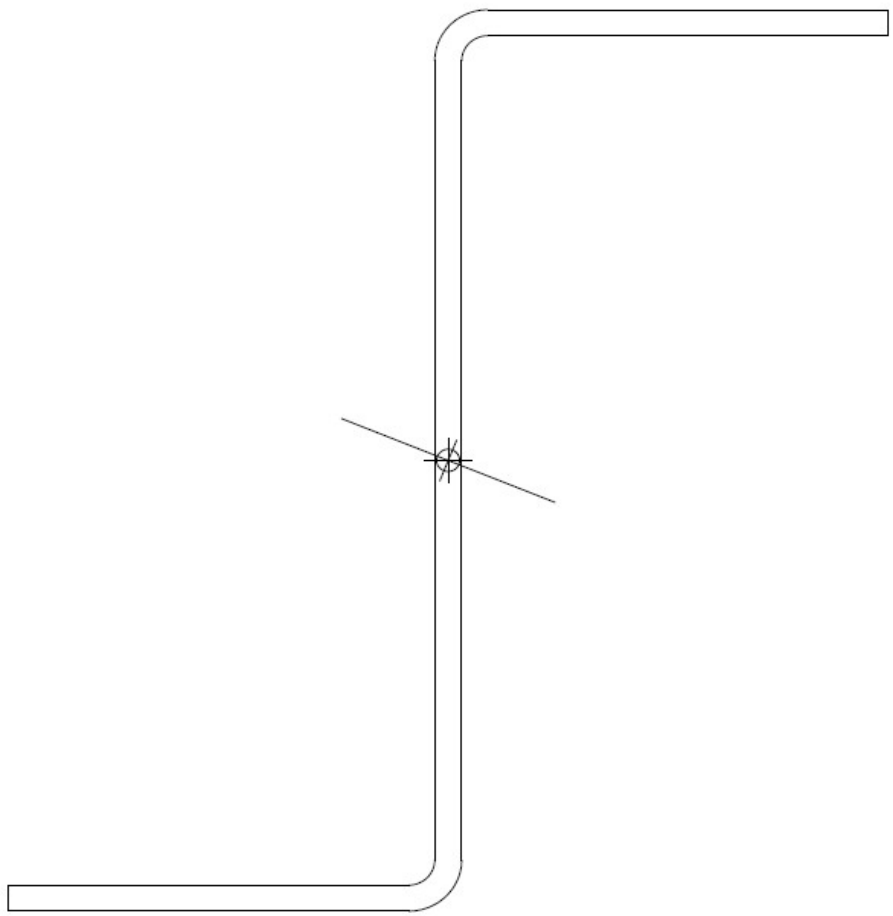
M_n=91.419 k-in Eq. F2.3-1

Ω_b=1.67, ϕ_b=0.95

CFS Version 13.0.2

Section: Zee 5.6024x2.7165x0.165350.cfss

Zee 5.6024x2.7165x0.16535 POLARRACKING



Full Section Properties

Area	1.7348 in²	Wt.	0.0058984 k/ft	Flat	10.492 in
Ix	8.390 in⁴	rx	2.1991 in	Ixy	3.120 in⁴
Sx(t)	2.9951 in³	y(t)	2.8012 in	α	-22.196 deg
Sx(b)	2.9951 in³	y(b)	2.8012 in		
Zx	3.4935 in³	Height	5.6024 in		
Iy	2.016 in⁴	ry	1.0780 in	x_o	0.0000 in

Sy(l)	0.7655 in³	x(l)	2.6339 in	y_o	0.0000 in
Sy(r)	0.7655 in³	x(r)	2.6339 in	jx	0.0000 in
Zy	1.1815 in³	Width	5.2677 in	jy	0.0000 in
I_1	9.663 in⁴	r_1	2.3601 in	Cw	9.1836 in⁶
I_2	0.743 in⁴	r_2	0.6545 in	J	0.015810 in⁴
Ic	10.406 in⁴	rc	2.4491 in		
I_o	10.406 in⁴	r_o	2.4491 in		

Fully Braced Strength - AISI S100-16/S1-18, US, ASD

Material Type: A653 HSLAS Grade 70, Fy=70 ksi

Axial		Positive Bending		Positive Bending	
Pao	56.490 k	Maxo	105.64 k-in	Mayo	25.82 k-in
Ae	1.4526 in²	Ixe	7.5227 in⁴	Iye	1.5543 in⁴
Ta	69.393 k	Sxe(t)	2.5202 in³	Sye(l)	0.6159 in³
		Sxe(b)	2.8741 in³	Sye(r)	0.6807 in³
Shear					
Vay	21.446 k	Negative Bending		Negative Bending	
Vax	20.711 k	Maxo	105.64 k-in	Mayo	25.82 k-in
		Ixe	7.5227 in⁴	Iye	1.5543 in⁴
Torsion		Sxe(t)	2.8741 in³	Sye(l)	0.6807 in³
Ba	71.992 k-in²	Sxe(b)	2.5202 in³	Sye(r)	0.6159 in³

Calculation Details - AISI S100-16/S1-18, US, ASD

Axial Tension Strength

Ag=1.7348 in², Fy=70 ksi

Tn=121.44 k Eq. D2-1

Ωt=1.67, ϕt=0.9

An=1.7348 in², Fu=80 ksi

Tn=138.79 k Eq. D3-1

Ωt=2, ϕt=0.75

Shear Strength

Zee element 1

Vn=16.569 k at 0 deg Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Zee element 2

Vn=34.314 k at 90 deg — Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Zee element 3

Vn=16.569 k at 0 deg — Eq. G2.1-1

Ωv=1.6, ϕv=0.95

Axial Compression Strength

Effective width calculations for part 1: Zee

Element 1: Unstiffened, w=2.3858 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.2.2-1

k=0.43 — Eq. 1.2.2-3

λ=1.1275 — Eq. 1.1-3

ρ=0.71388 — Eq. 1.1-2

b=1.7032 in (ineffective width=0.68264 in) — Eq. 1.1-1

Element 3: Unstiffened, w=2.3858 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.2.2-1

k=0.43 — Eq. 1.2.2-3

λ=1.1275 — Eq. 1.1-3

ρ=0.71388 — Eq. 1.1-2

b=1.7032 in (ineffective width=0.68264 in) — Eq. 1.1-1

Element 2: Stiffened, w=4.941 in

f_1=70 ksi, f_2=70 ksi

ψ=1 — Eq. 1.1.2-1

k=4 — Eq. 1.1.2-8

λ=0.76556 — Eq. 1.1-3

ρ=0.93086 — Eq. 1.1-2

be=4.5994 in — Eq. 1.1-1

b_1=2.2997 in — Eq. 1.1.2-9

b_2=2.2997 in — Eq. 1.1.2-10

Ineffective width=0.34161 in

Ae=1.4526 in², Fy=70 ksi

Pn=101.68 k — Eq. E3.1-1

Ωc=1.8, ϕc=0.85

Positive Flexural Strength about X-axis

Effective width calculations for part 1: Zee

Element 1: No compressive stress (fully effective)

Element 3: Unstiffened, w=2.3858 in

f_1=68.061 ksi, f_2=68.061 ksi

ψ=1 Eq. 1.2.2-1

k=0.43 Eq. 1.2.2-3

λ=1.1117 Eq. 1.1-3

ρ=0.72149 Eq. 1.1-2

b=1.7214 in (ineffective width=0.66447 in) Eq. 1.1-1

Element 2: Stiffened, w=4.941 in

f_1=62.244 ksi, f_2=-53.639 ksi

ψ=0.86175 Eq. 1.1.2-1

k=20.63 Eq. 1.1.2-2

λ=0.31788 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=4.941 in Eq. 1.1-1

h_o=5.6024 in, b_o=2.7165 in, h_o/b_o=2.0623

b_1=1.2795 in Eq. 1.1.2-3

b_2=2.4705 in Eq. 1.1.2-4

Compression width=2.6539 in

b_1+b_2 > compression width (fully effective)

Center of gravity shift: y=-0.18381 in

Sxe=2.5202 in³, Fy=70 ksi

Mn=176.41 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Negative Flexural Strength about X-axis

Effective width calculations for part 1: Zee

Element 1: Unstiffened, w=2.3858 in

f_1=68.061 ksi, f_2=68.061 ksi

ψ=1 Eq. 1.2.2-1

k=0.43 Eq. 1.2.2-3

λ=1.1117 Eq. 1.1-3

ρ=0.72149 Eq. 1.1-2

b=1.7214 in (ineffective width=0.66447 in) Eq. 1.1-1

Element 3: No compressive stress (fully effective)

Element 2: Stiffened, w=4.941 in

f_1=62.244 ksi, f_2=-53.639 ksi

ψ=0.86175 Eq. 1.1.2-1

k=20.63 Eq. 1.1.2-2

λ=0.31788 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=4.941 in Eq. 1.1-1

h_o=5.6024 in, b_o=2.7165 in, h_o/b_o=2.0623

b_1=1.2795 in Eq. 1.1.2-3

b_2=2.4705 in Eq. 1.1.2-4

Compression width=2.6539 in

b_1+b_2 > compression width (fully effective)

Center of gravity shift: y=0.18381 in

Sxe=2.5202 in^3, Fy=70 ksi

Mn=176.41 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Positive Flexural Strength about Y-axis

Effective width calculations for part 1: Zee

Element 1: No compressive stress (fully effective)

Element 3: Unstiffened, w=2.3858 in

f_1=76.149 ksi, f_2=9.9558 ksi, f=63.315 ksi

ψ=0.13074 Eq. 1.2.2-1

k=0.54374 Eq. 1.2.2-3

λ=0.95355 Eq. 1.1-3

ρ=0.80676 Eq. 1.1-2

b=1.9248 in (ineffective width=0.46105 in) Eq. 1.1-1

Element 2: Stiffened, w=4.941 in

f_1=3.0745 ksi, f_2=3.0745 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.16044 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=4.941 in Eq. 1.1-1

b_1=2.4705 in Eq. 1.1.2-9

b_2=2.4705 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Center of gravity shift: x=-0.11046 in

Sye=0.61594 in³, Fy=70 ksi

Mn=43.116 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Negative Flexural Strength about Y-axis

Effective width calculations for part 1: Zee

Element 1: Unstiffened, w=2.3858 in

f_1=76.149 ksi, f_2=9.9558 ksi, f=63.315 ksi

ψ=0.13074 Eq. 1.2.2-1

k=0.54374 Eq. 1.2.2-3

λ=0.95355 Eq. 1.1-3

ρ=0.80676 Eq. 1.1-2

b=1.9248 in (ineffective width=0.46105 in) Eq. 1.1-1

Element 3: No compressive stress (fully effective)

Element 2: Stiffened, w=4.941 in

f_1=3.0745 ksi, f_2=3.0745 ksi

ψ=1 Eq. 1.1.2-1

k=4 Eq. 1.1.2-8

λ=0.16044 Eq. 1.1-3

ρ=1 Eq. 1.1-2

be=4.941 in Eq. 1.1-1

b_1=2.4705 in Eq. 1.1.2-9

b_2=2.4705 in Eq. 1.1.2-10

b_1+b_2 > compression width (fully effective)

Center of gravity shift: x=0.11046 in

Sye=0.61594 in³, Fy=70 ksi

Mn=43.116 k-in Eq. F3.1-1

Ωb=1.67, ϕb=0.9

Bimoment Strength, Zee

Cw=9.1836 in⁶, Wn=5.347 in², Fy=70 ksi

Bn=Fy Cw/Wn=120.23 k-in²

Ωb=1.67, ϕb=0.9

MEMBER DESIGN CHECK SUMMARY

The following tables and charts summarize member sizing and design capacity check from RSG CFS, considering all load combinations for purlins, pivot arm, pivot bracket and pile. The capacity charts check the capacity along the member.

Unity Capacity Check:

- Tables: perimeter X20 with 12 modules, internal X25 with 24 modules
- Positions: 0°, -30, -60°
- Key observation
  - Identification of governing load combination number
  - Identification of governing unity ratio factor
  - Reference to a single load combination unity ratio for comparison

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

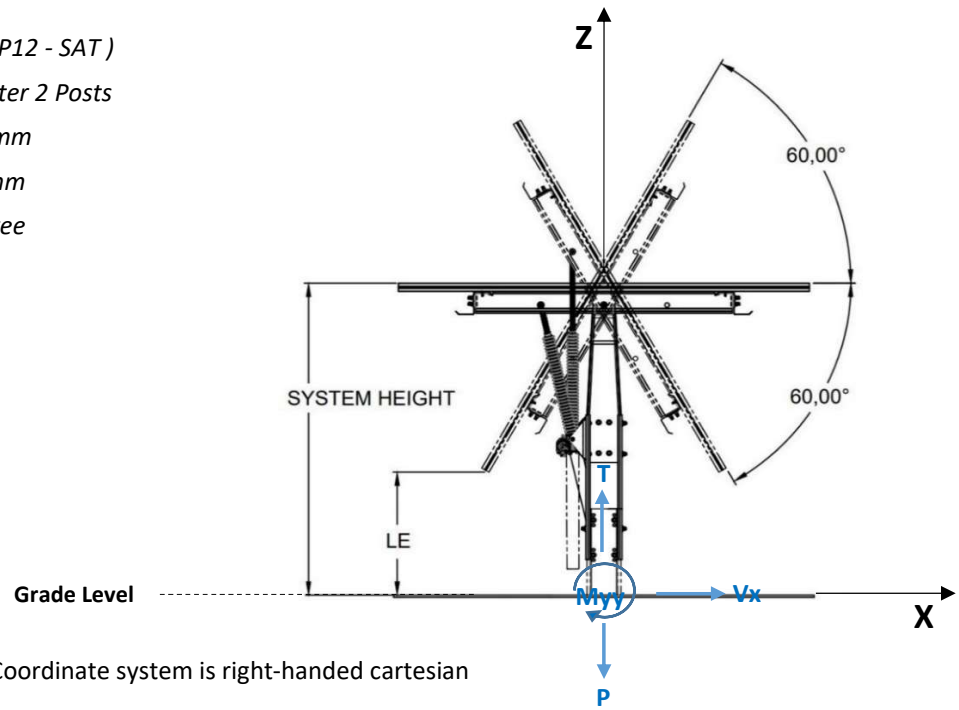
TABLE : *X20 (1P12 - SAT)*

CLASS : *Perimeter 2 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *-3 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.64	0.80	0.00	3.36	≈ 0	0.36	1.58
	T	n/a	0.00	n/a	-3.65	≈ 0	n/a	-1.87
	V_x	0.00	0 , 0	0.00	± 0.19	± 0.09	-0.02	-0.08 , 0.1
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.00	-0.37 , 0.37	0.00	± 6.68	± 0.57	-0.11	-1.91 , 3.42
	M_{xx}	-0.01	-0.02 , 0	0.00	± 0.05	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02
2ND	**P**	0.64	0.82	0.00	3.36	≈ 0	0.36	1.58
	T	n/a	0.00	n/a	-3.65	≈ 0	n/a	-1.87
	V_x	0.00	0 , 0	0.00	± 0.19	± 0.09	-0.02	-0.08 , 0.1
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.00	-0.37 , 0.37	0.00	± 6.68	± 0.57	-0.11	-1.91 , 3.42
	M_{xx}	0.01	0 , 0.02	0.00	± 0.05	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

Reaction Loads & Member Sizing Summary

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X20 (1P12 - SAT)*

LENGTH : *2279 mm*

CLASS : *Perimeter 2 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *-3 degree*

CHORD LENGTH : *13784 mm*

POST SPAN : *8340 mm*

CHORD CONTILEVER : *2722 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	1.95	4	20	45
Splice / Z	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		3.1	note * : standard baseline section		
Pivot Arm - Mid / Ω	N/A	N/A		N/A	N/A		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O	GR_50	88.9	n/a	4.5	n/a	n/a	n/a

Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

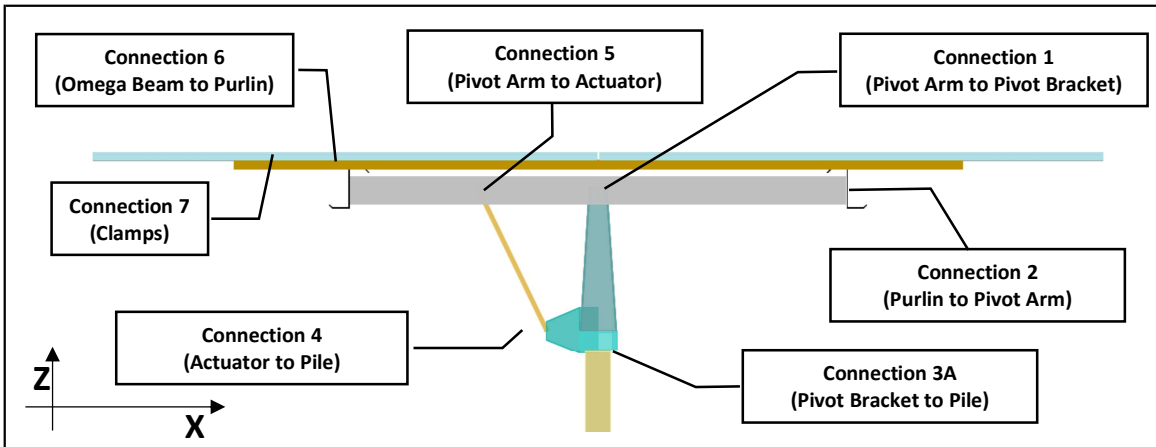
Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.64	0.80	0.00	3.36	≈ 0	0.36	1.58
	T	n/a	0.00	n/a	-3.65	≈ 0	n/a	-1.87
	V_x	0.00	0 , 0	0.00	± 0.19	± 0.09	-0.02	-0.08 , 0.1
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.00	-0.37 , 0.37	0.00	± 6.68	± 0.57	-0.11	-1.91 , 3.42
	M_{xx}	-0.01	-0.02 , 0	0.00	± 0.05	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02
2ND	**P**	0.64	0.82	0.00	3.36	≈ 0	0.36	1.58
	T	n/a	0.00	n/a	-3.65	≈ 0	n/a	-1.87
	V_x	0.00	0 , 0	0.00	± 0.19	± 0.09	-0.02	-0.08 , 0.1
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.00	-0.37 , 0.37	0.00	± 6.68	± 0.57	-0.11	-1.91 , 3.42
	M_{xx}	0.01	0 , 0.02	0.00	± 0.05	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

Connection Loads

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



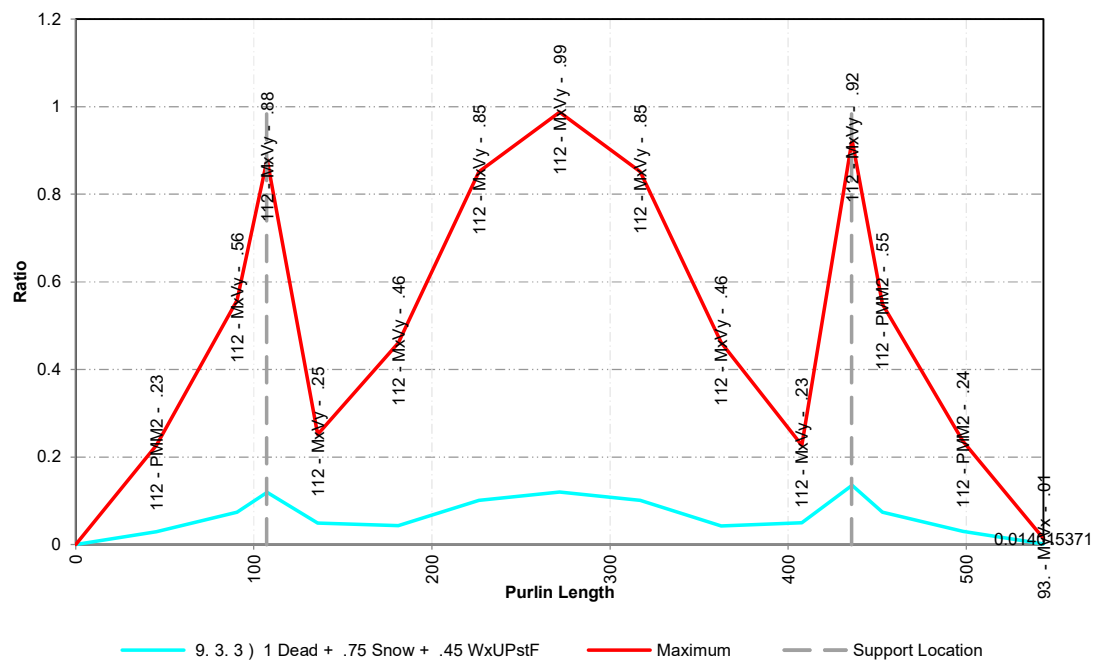
Note: coordinate system is right-handed cartesian

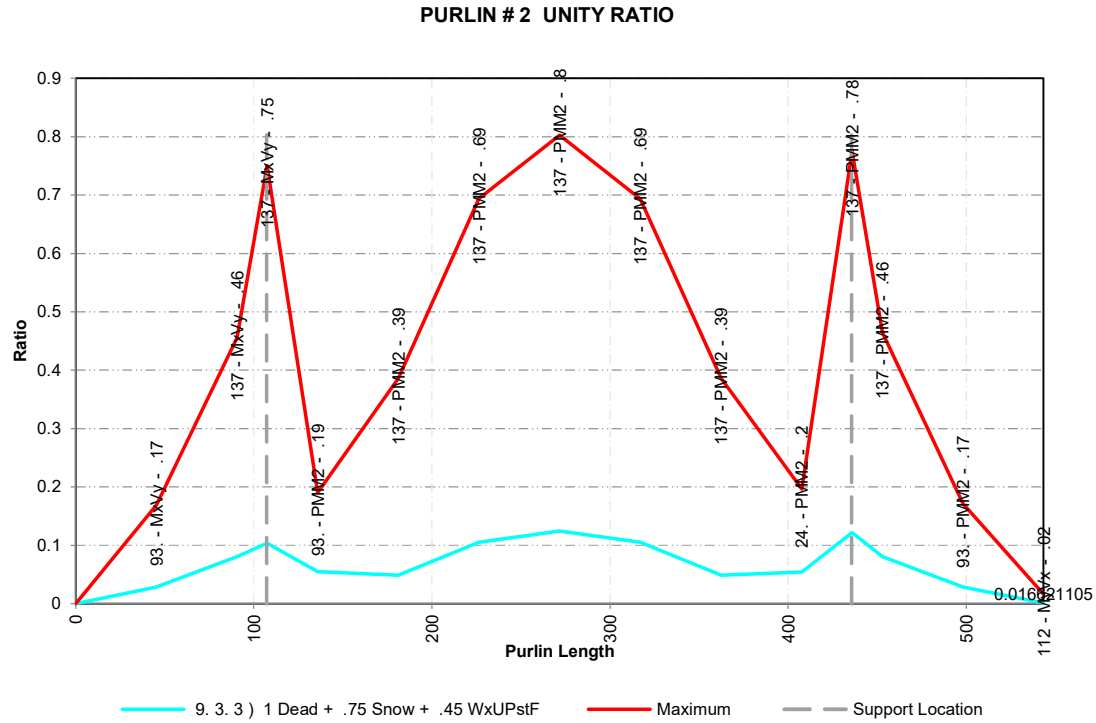
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
4.64	-0.87	0.00	0.00	0.00	0.00	137. 5. 23) .6 Dead + .6 WxUPal+T
-0.59	0.00	0.06	0.00	0.00	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 2						
0.20	0.30	0.00	0.00	-0.01	0.01	97. 4. 6) 1 Dead + .6 WxDNalH
0.03	2.00	0.02	0.00	0.01	-0.06	112. 4. 21) 1 Dead + .6 WxDNal+T
Connection : 3						
1.81	-0.11	0.00	0.00	-0.02	-0.70	118. 5. 4) .6 Dead + .6 WxUPalF
-2.65	0.11	0.01	0.00	0.03	-2.13	112. 4. 21) 1 Dead + .6 WxDNal+T
1.55	-0.11	0.00	0.00	-0.02	-3.48	114. 4. 23) 1 Dead + .6 WxUPal+T
-0.64	0.00	0.00	0.00	0.01	-4.01	107. 4. 16) 1 Dead + .6 WxOTal
-0.64	0.00	0.08	-0.01	0.47	0.00	142. 9. 2) 1 Dead + .7 Quake_y
-0.64	0.00	0.08	-0.01	0.47	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
-2.90	*	0.00	0.00	0.00	0.00	137. 5. 23) .6 Dead + .6 WxUPal+T
Connection : 5		** Note : the load is axial in actuator direction*				
-2.90	*	0.00	0.00	0.00	0.00	137. 5. 23) .6 Dead + .6 WxUPal+T
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.28						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.28						0.6 WLup

Purlin Unity Ratio Charts

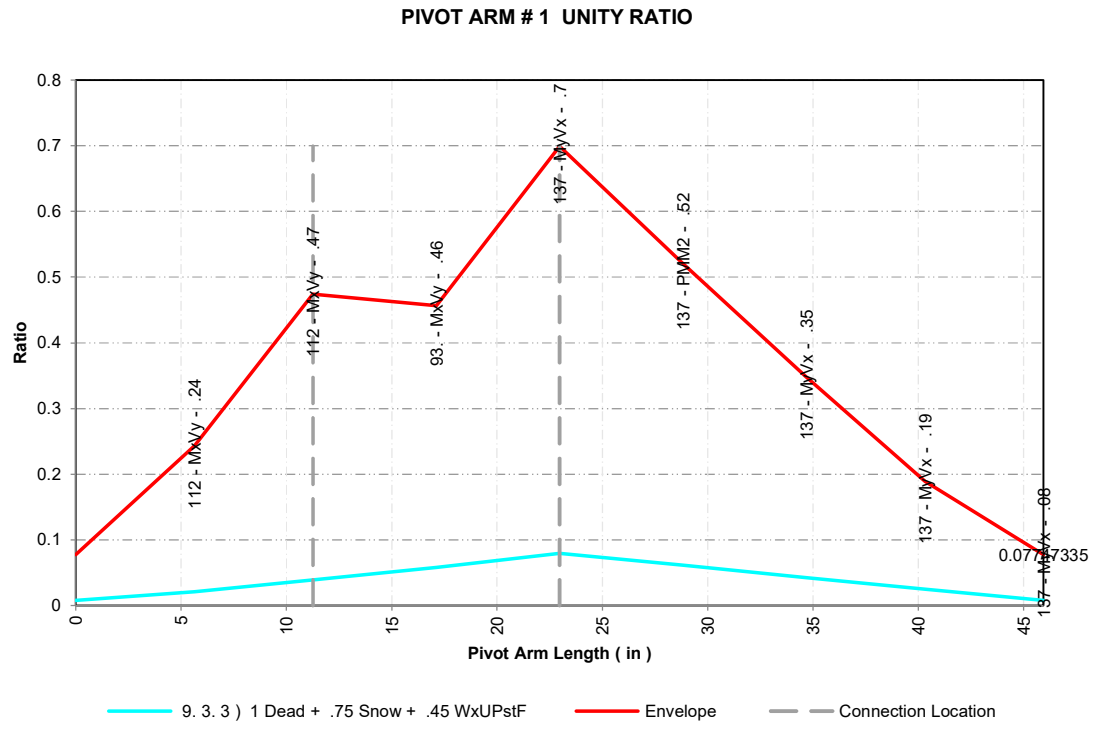
DESIGN PART page ⑬-004

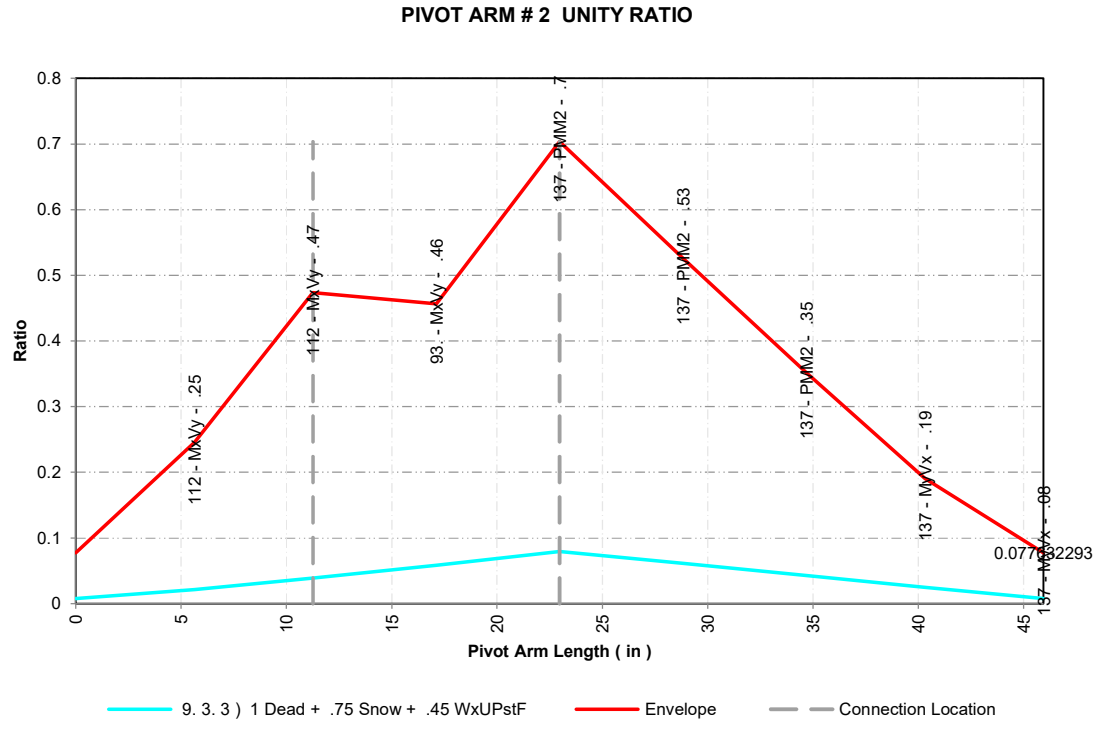
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*





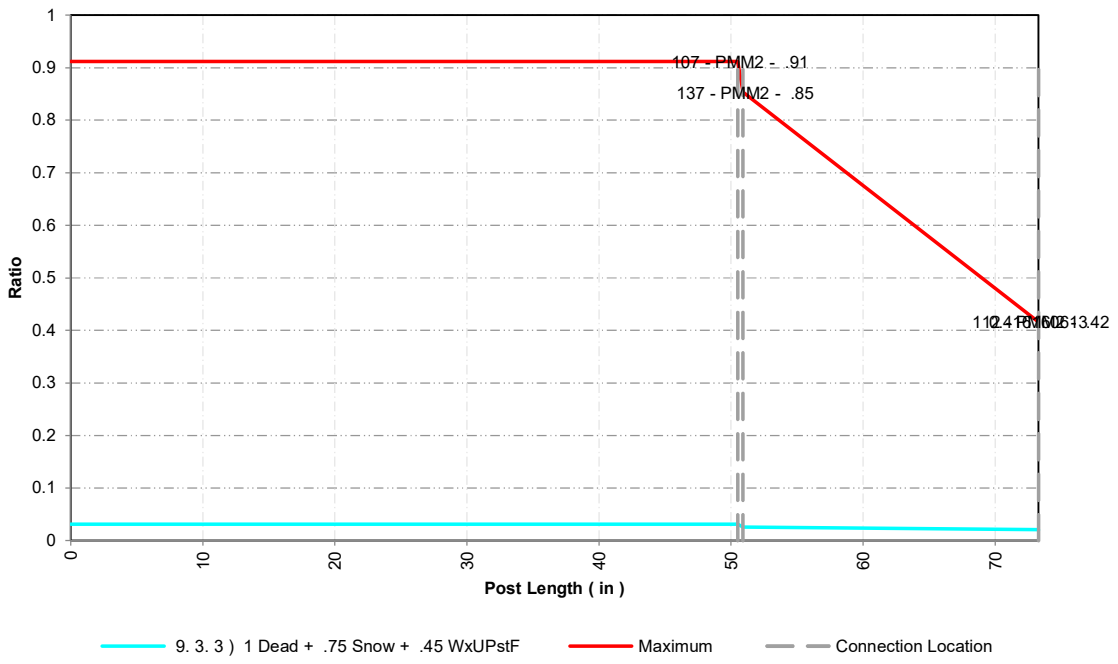
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



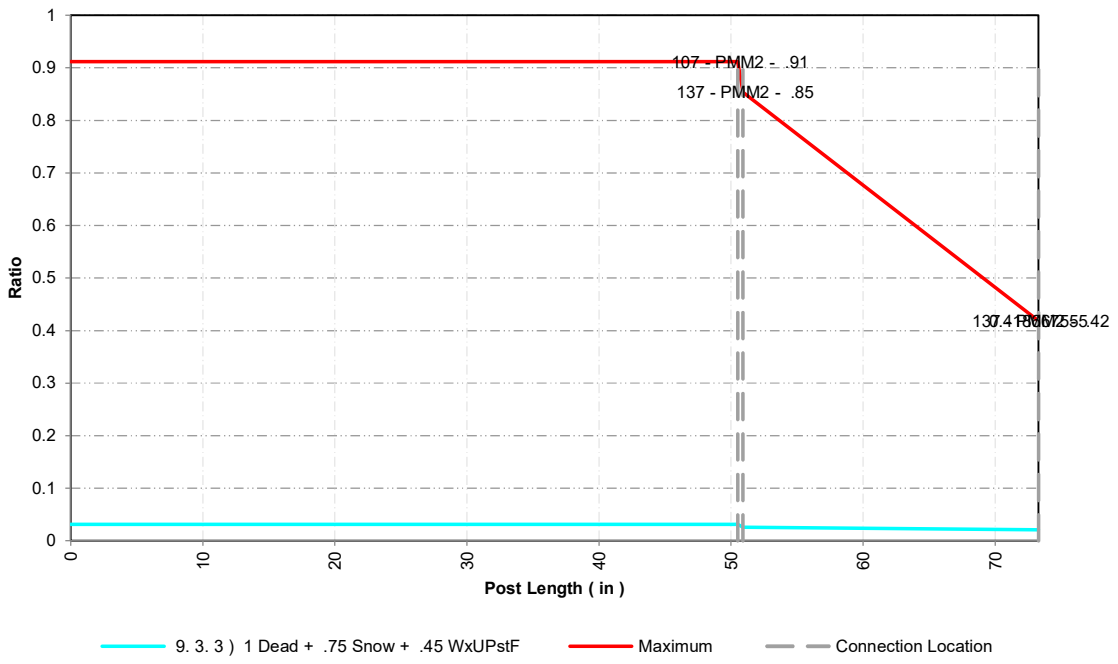


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*

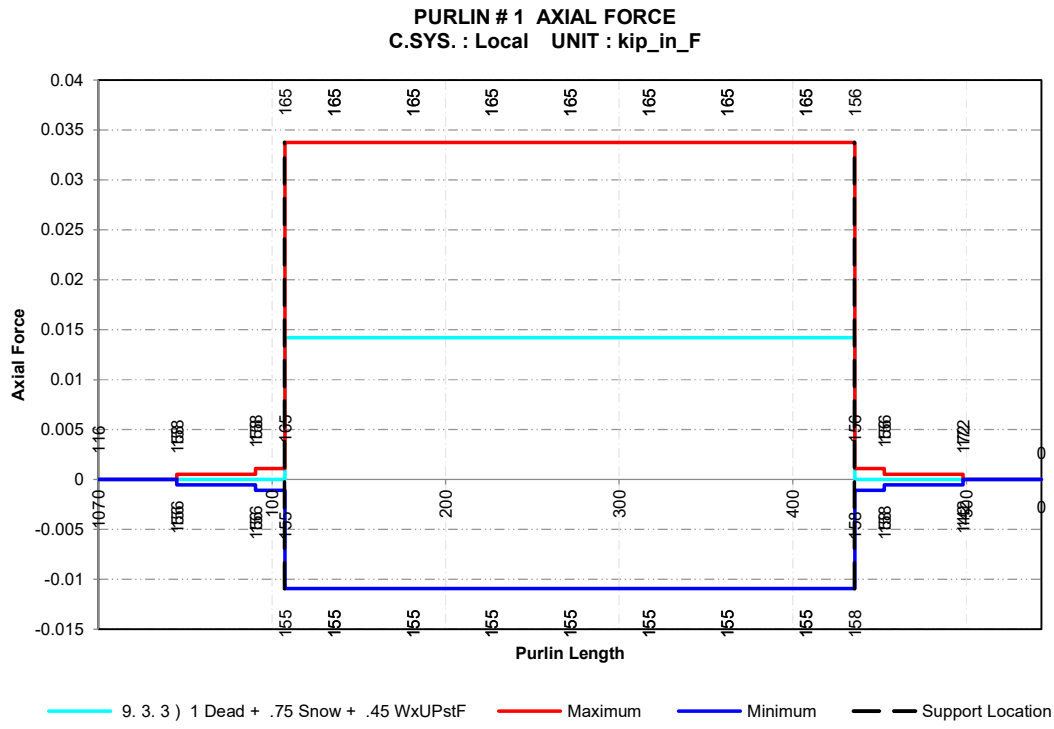
POST # 1 UNITY RATIO

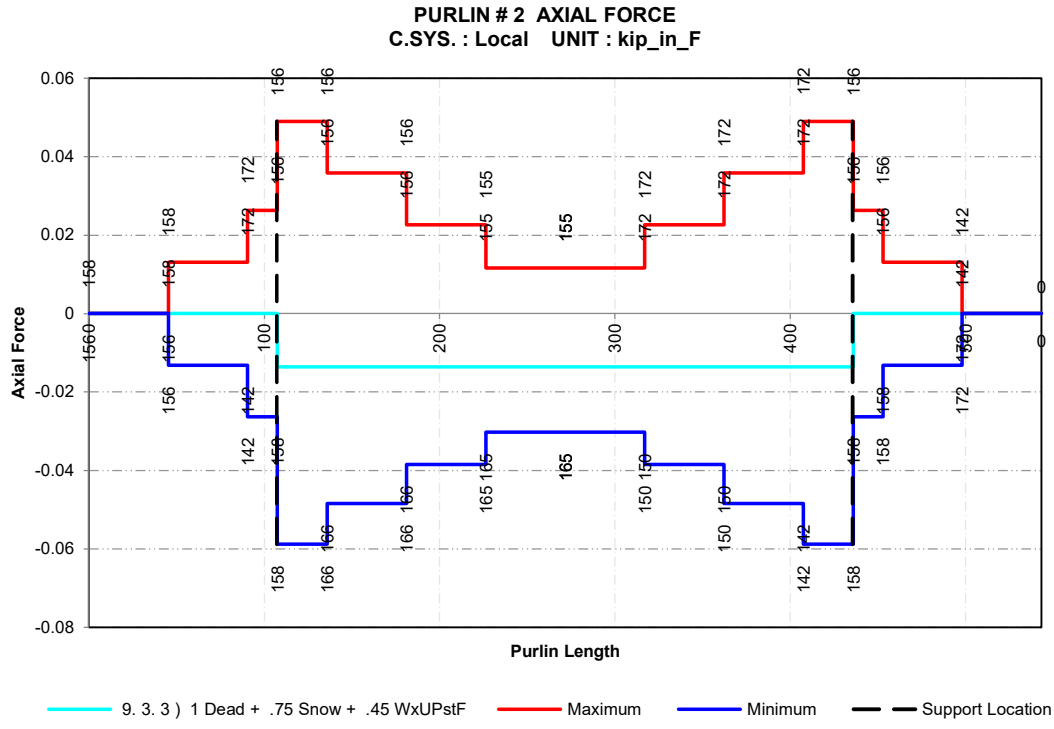


POST # 2 UNITY RATIO

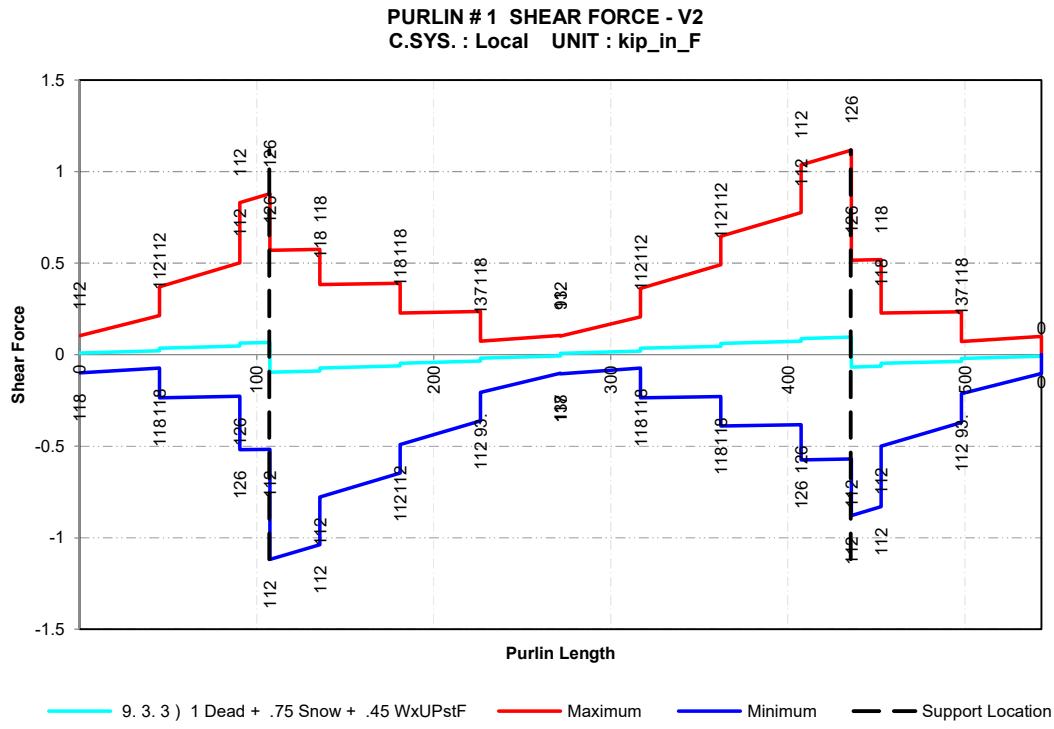


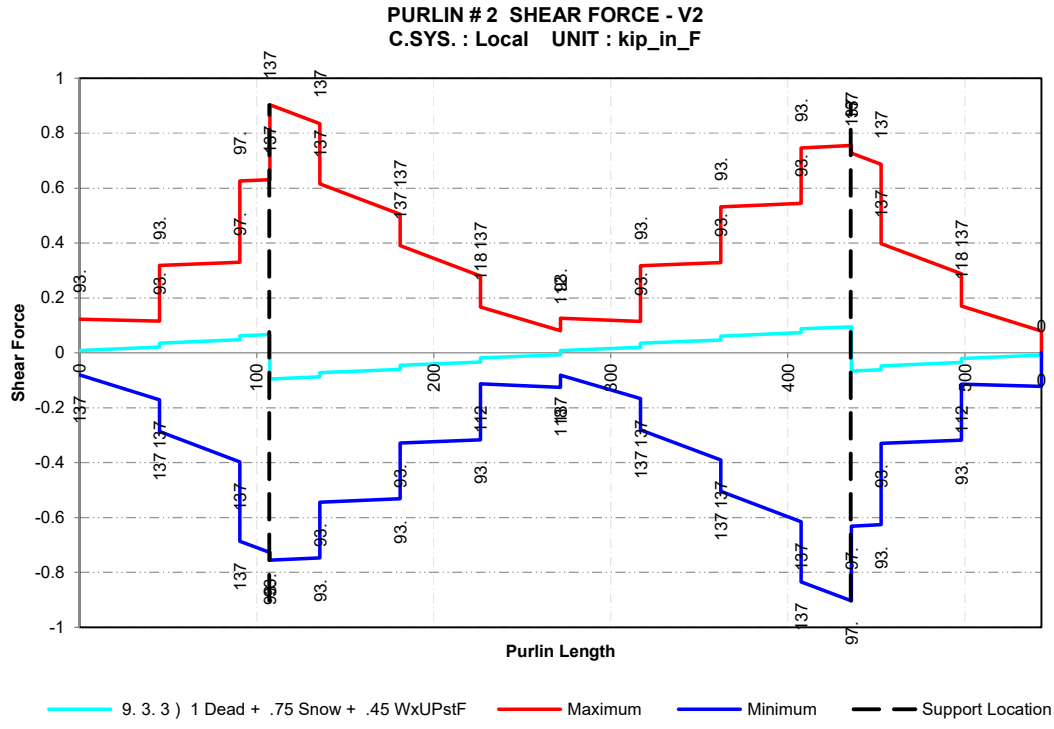
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



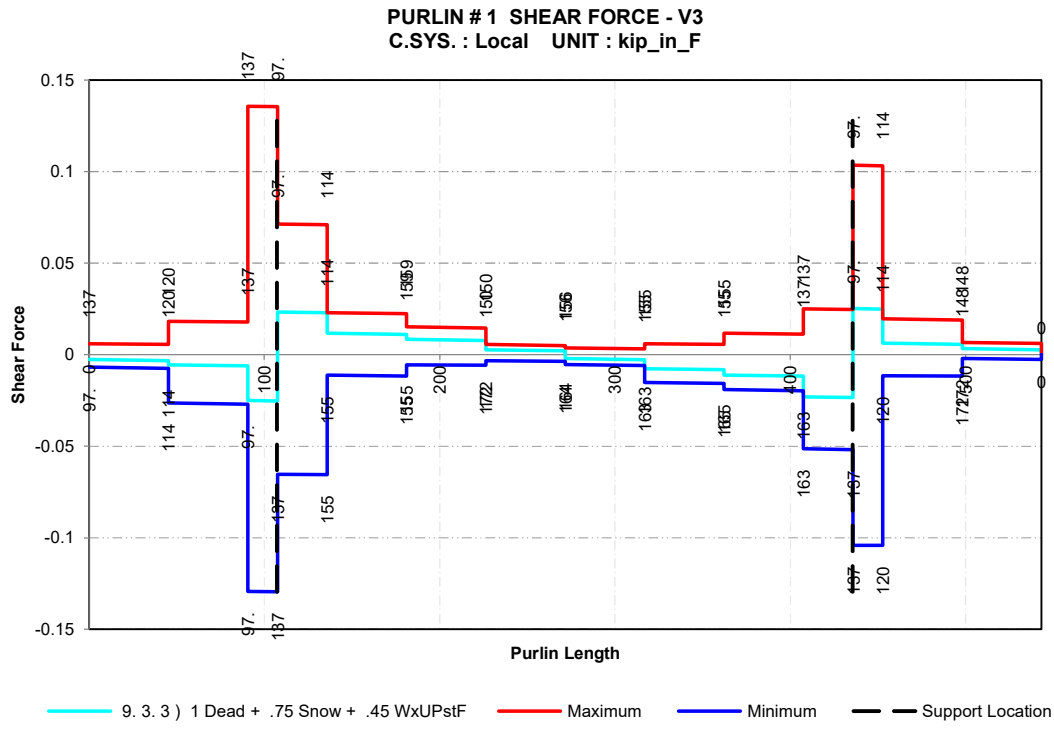


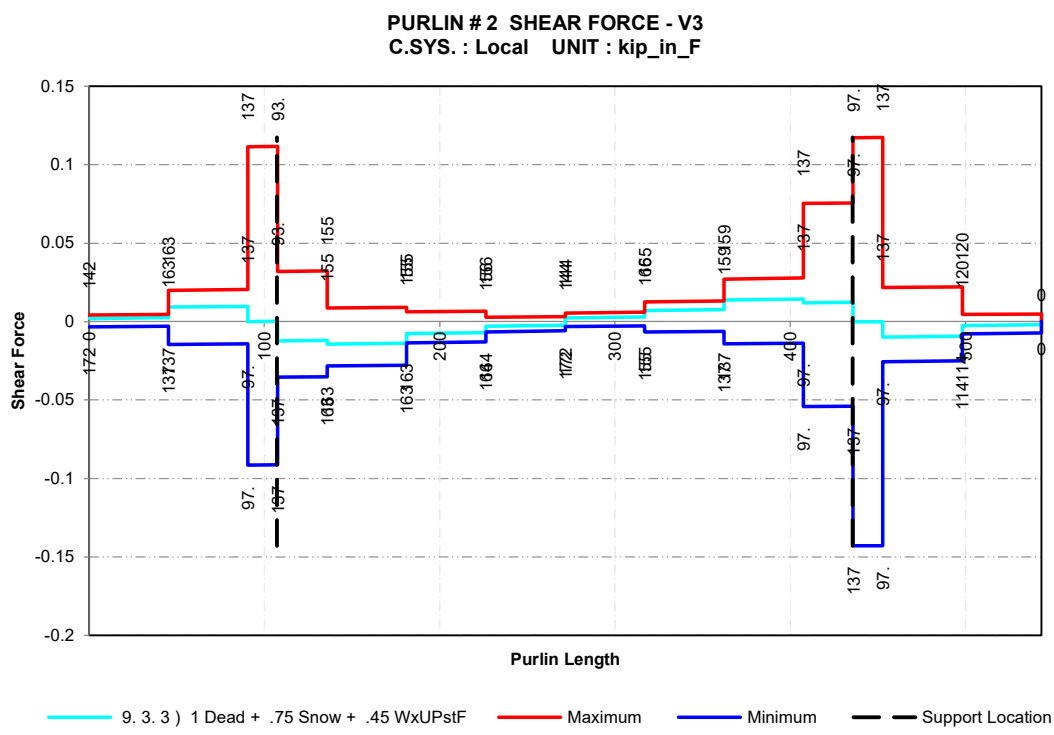
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



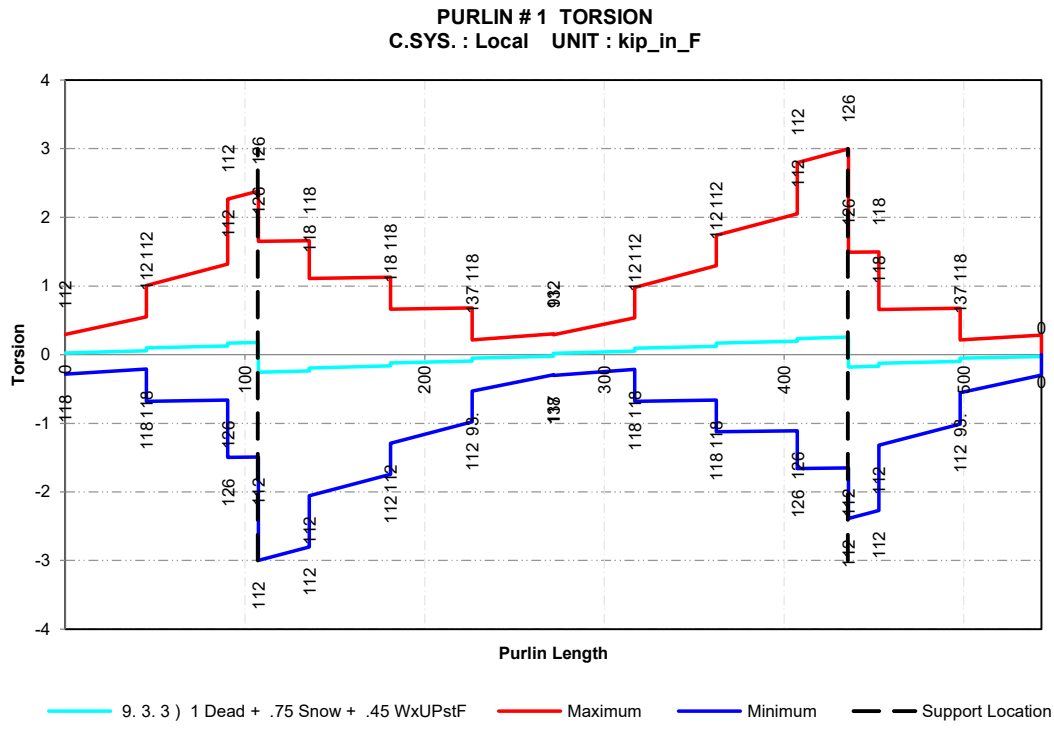


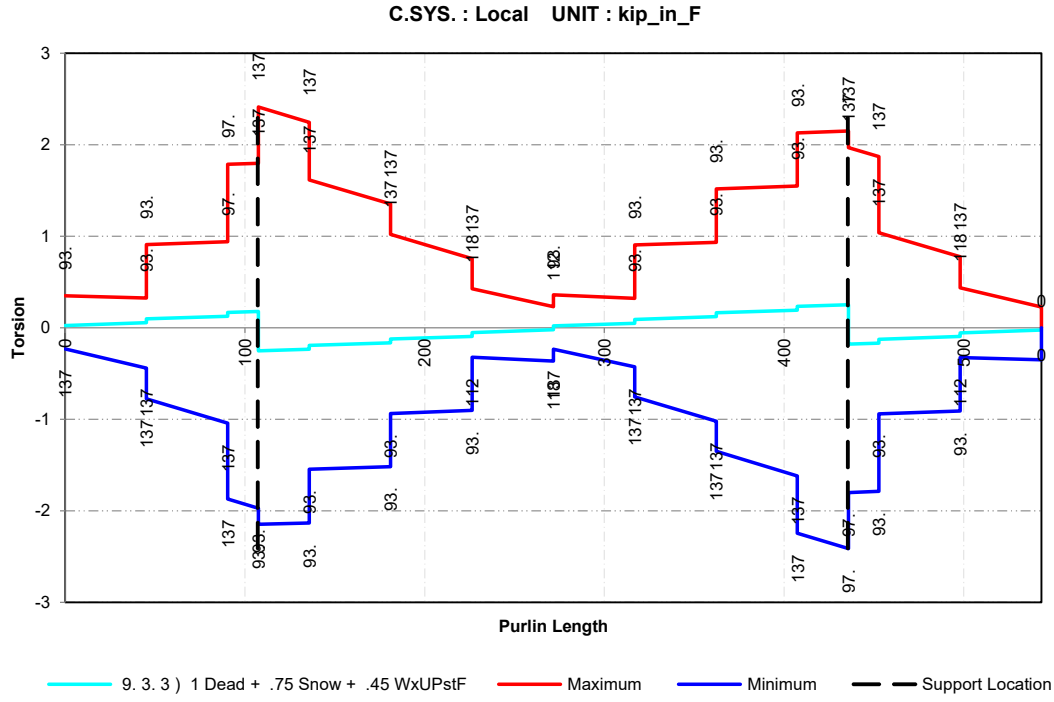
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



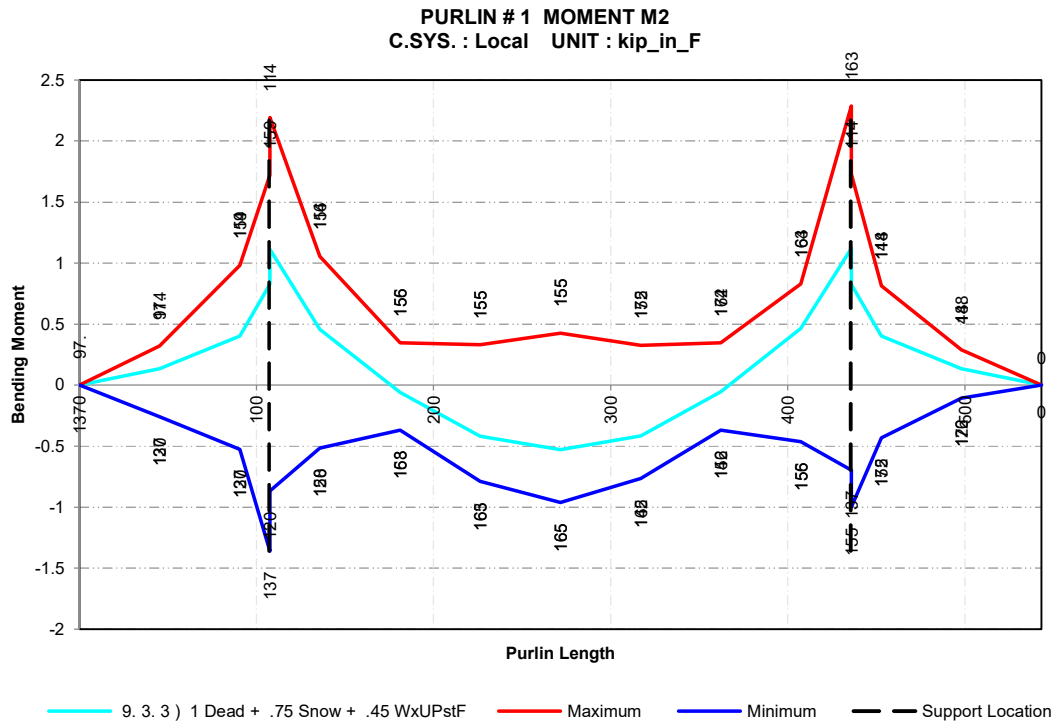


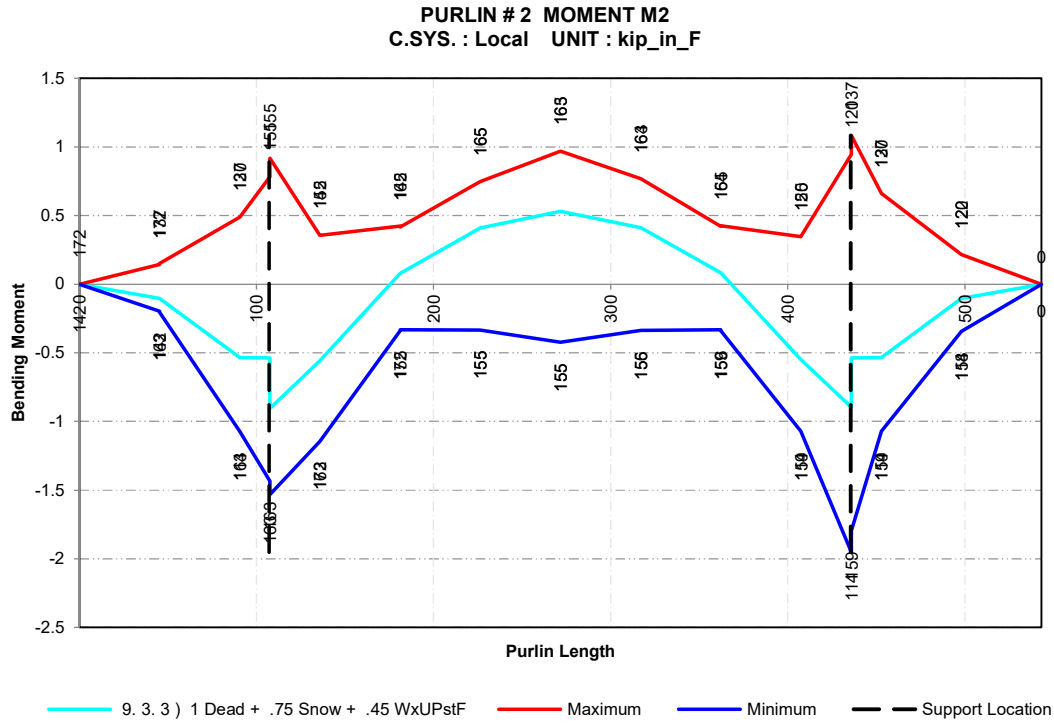
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*





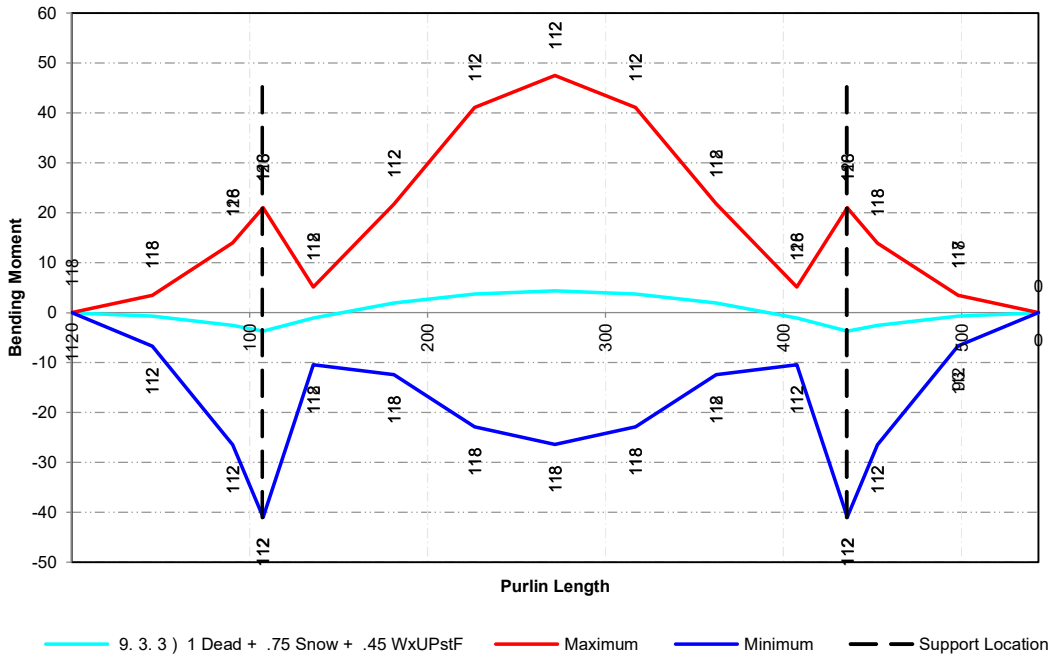
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



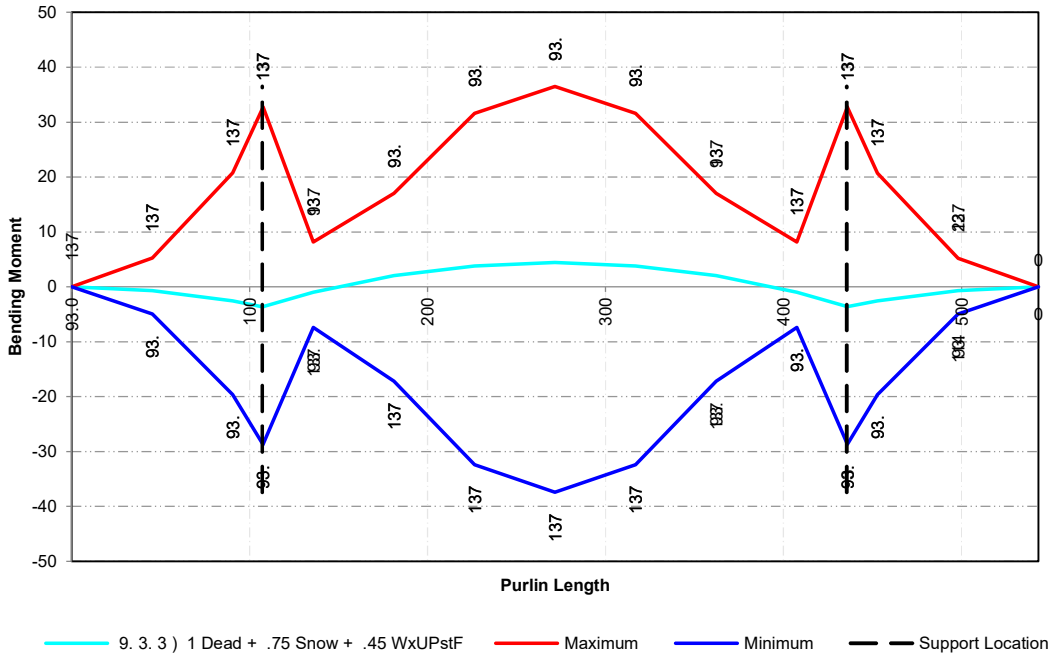


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*

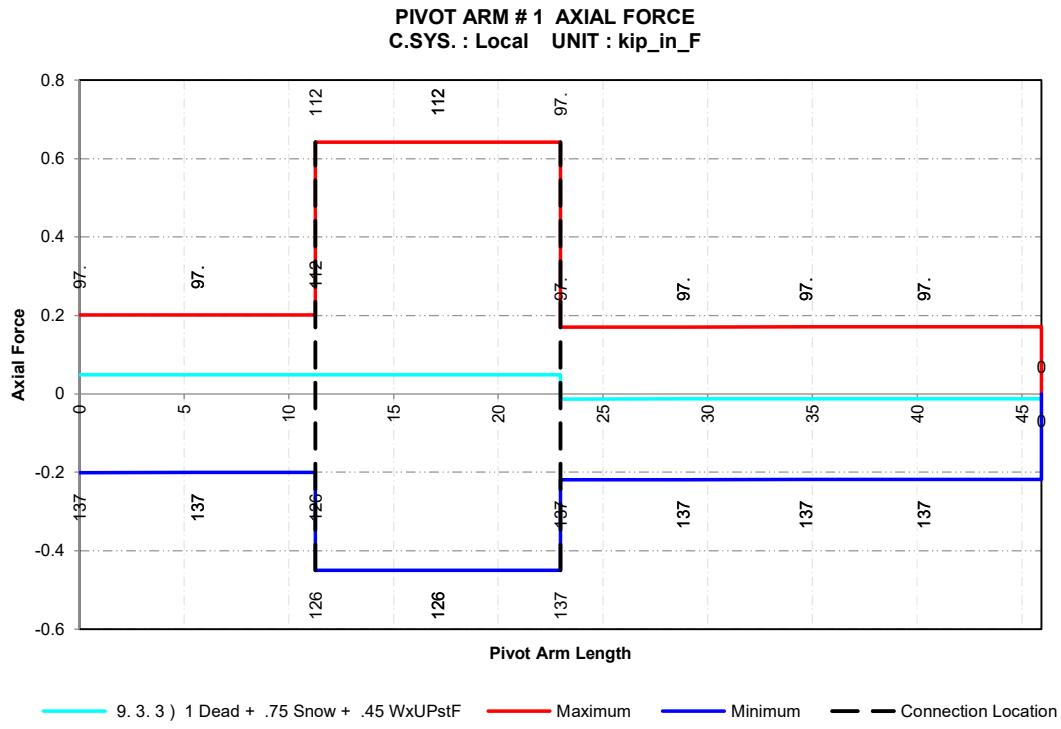
PURLIN # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

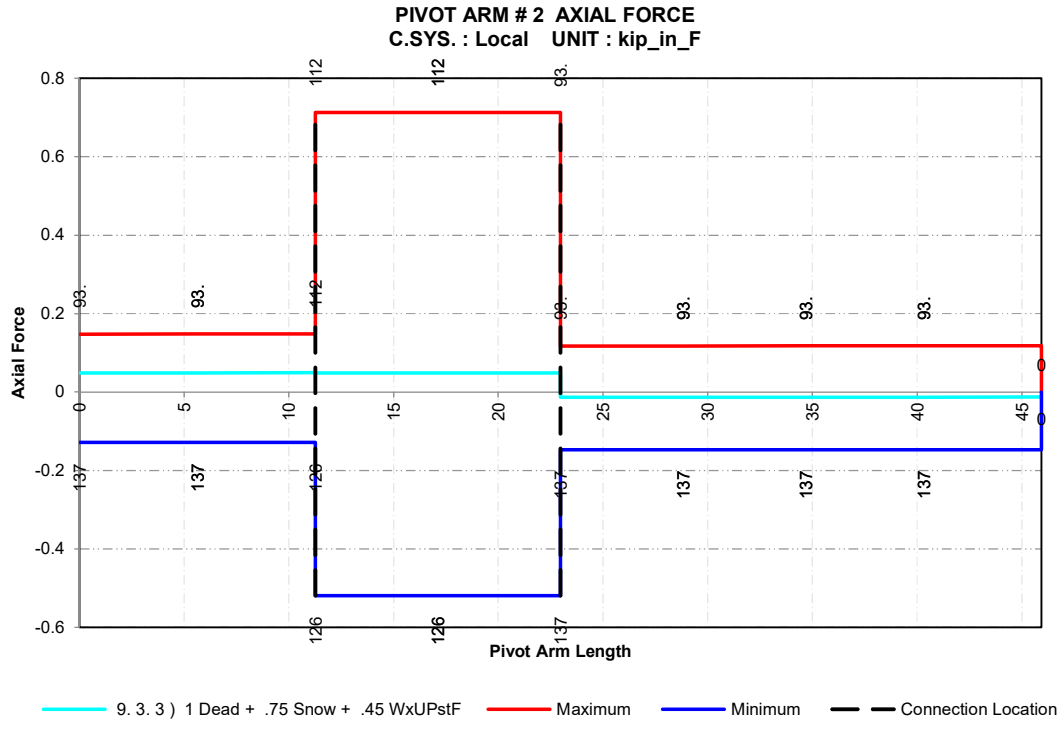


PURLIN # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

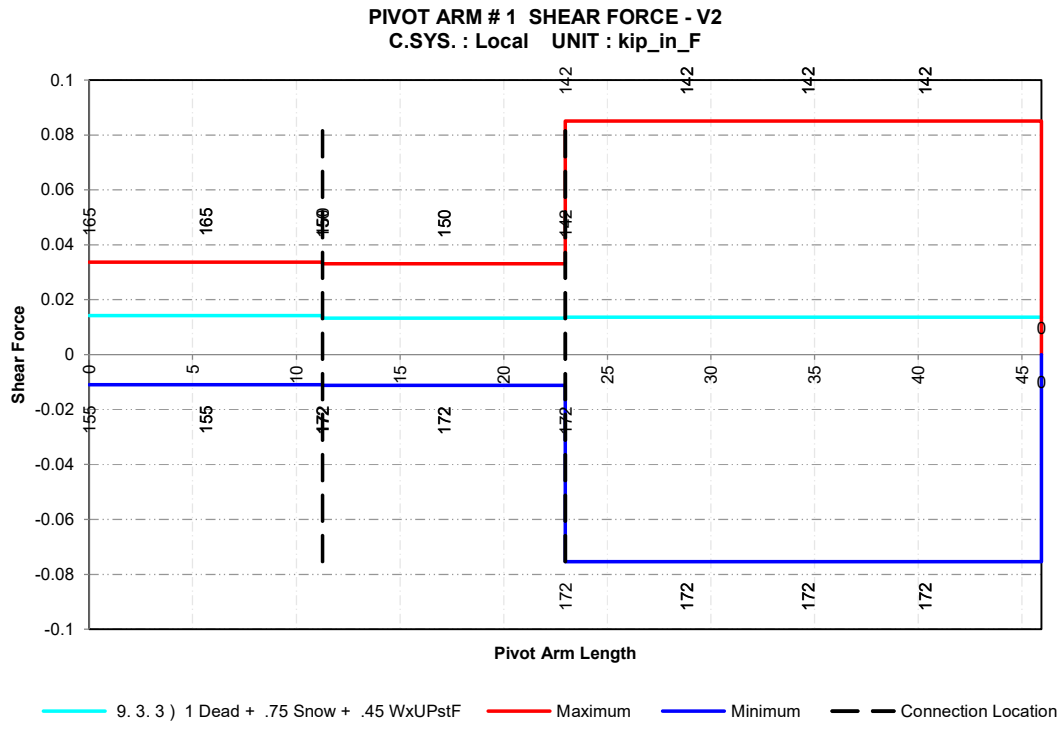


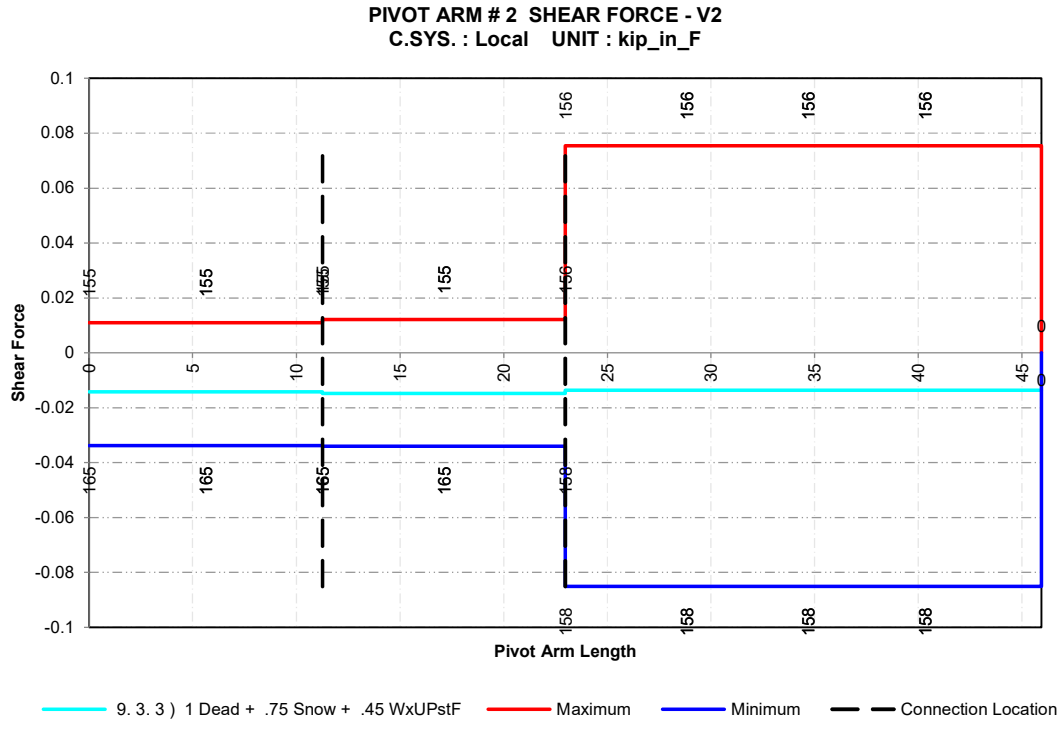
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



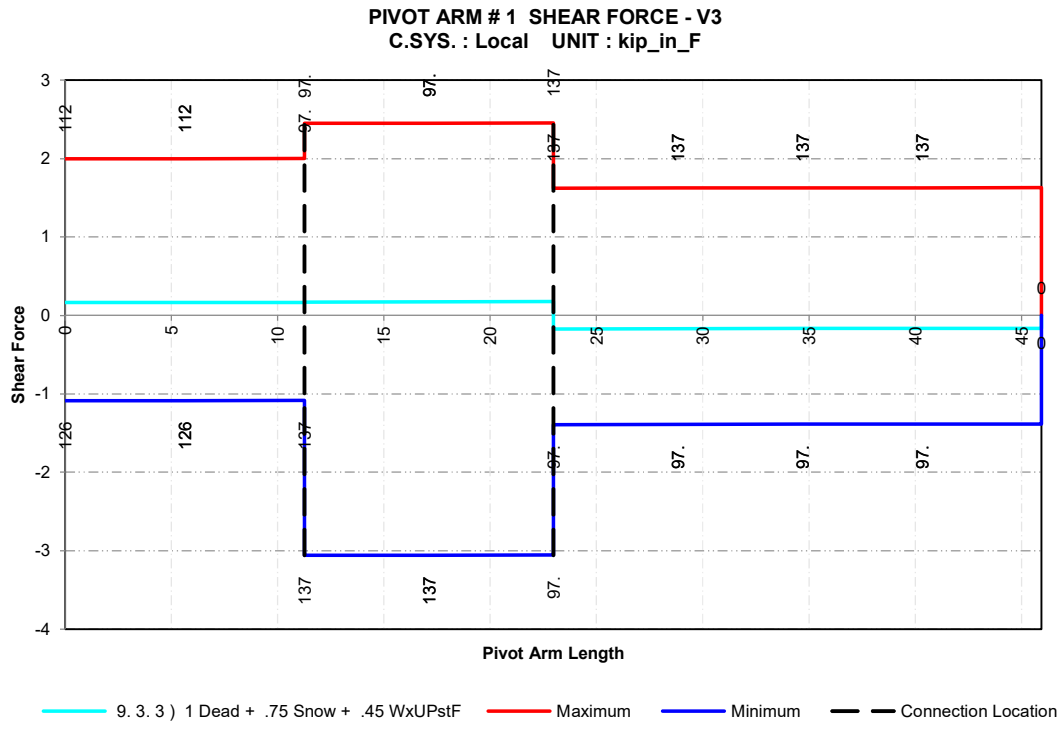


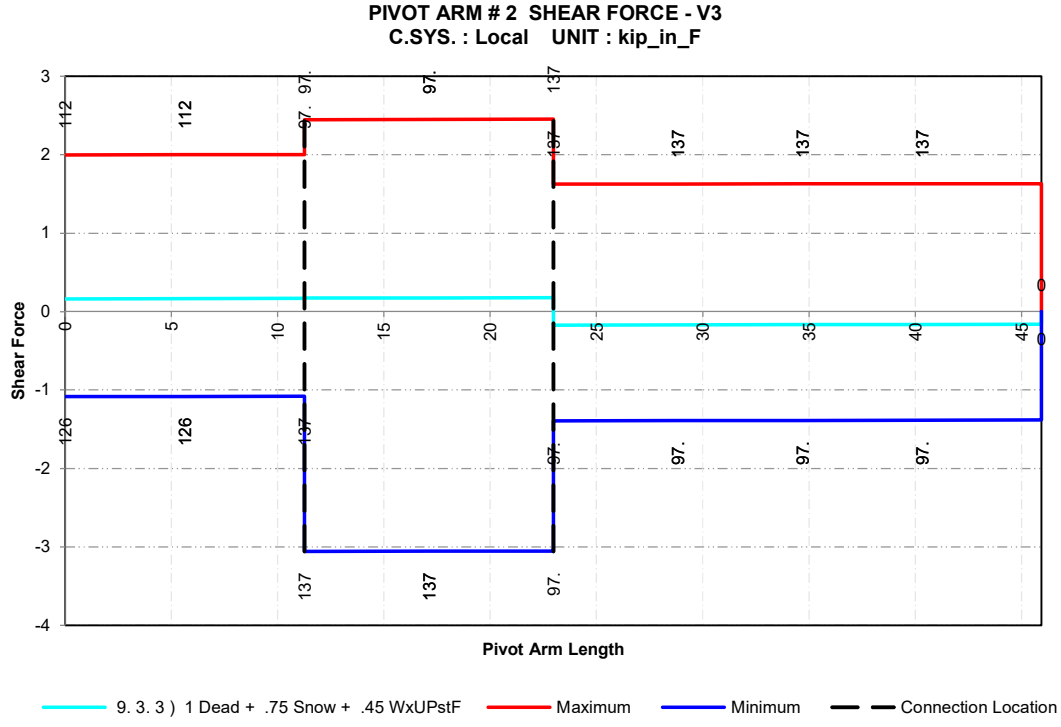
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



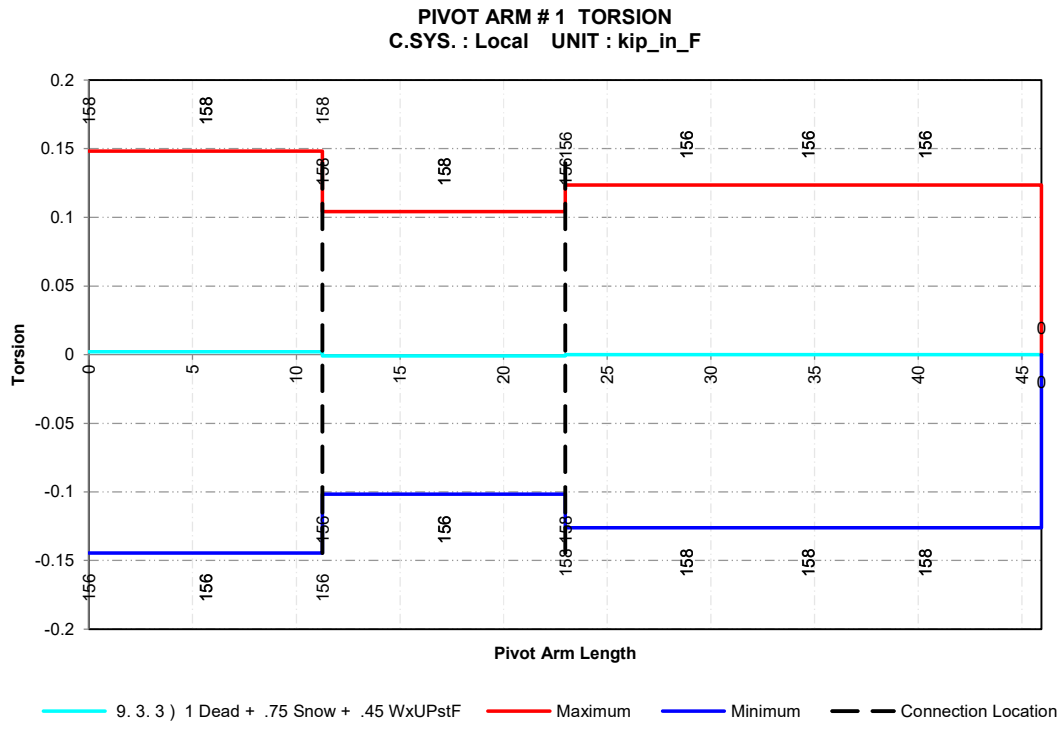


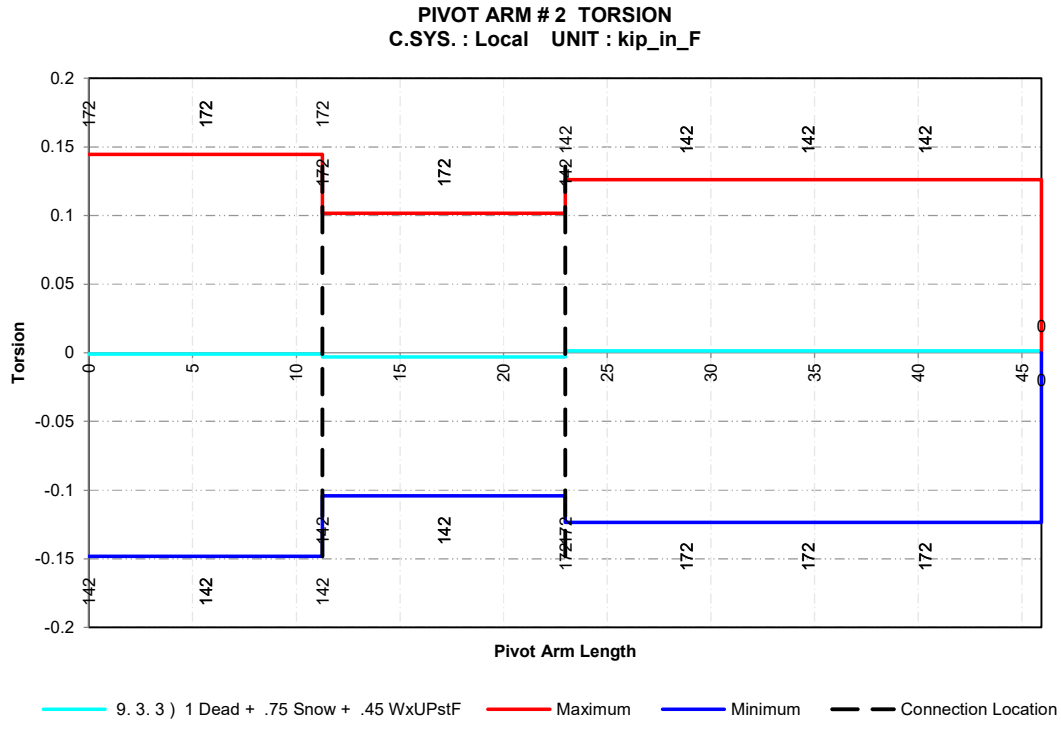
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*





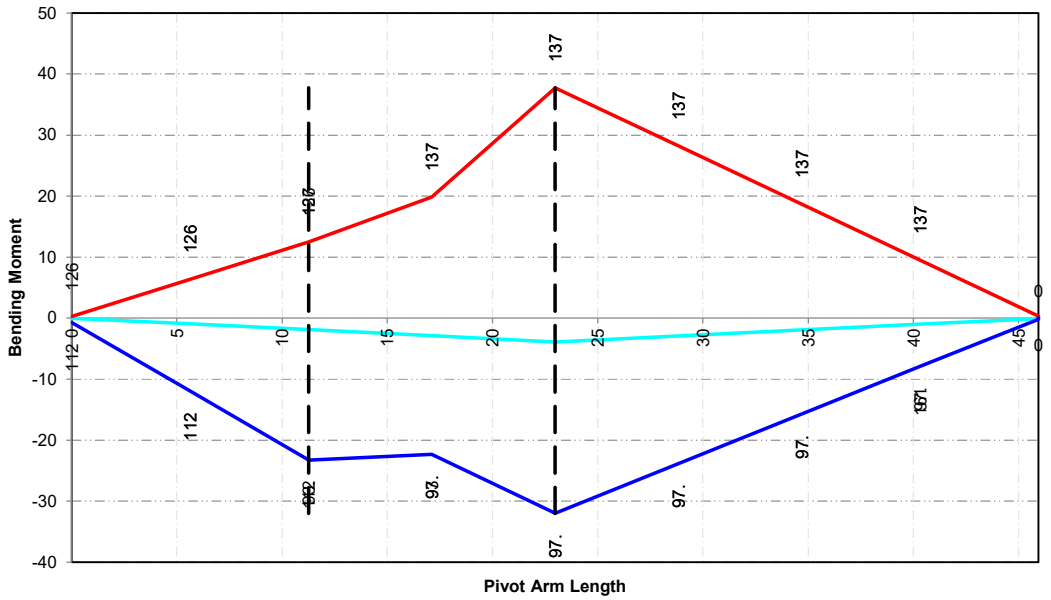
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



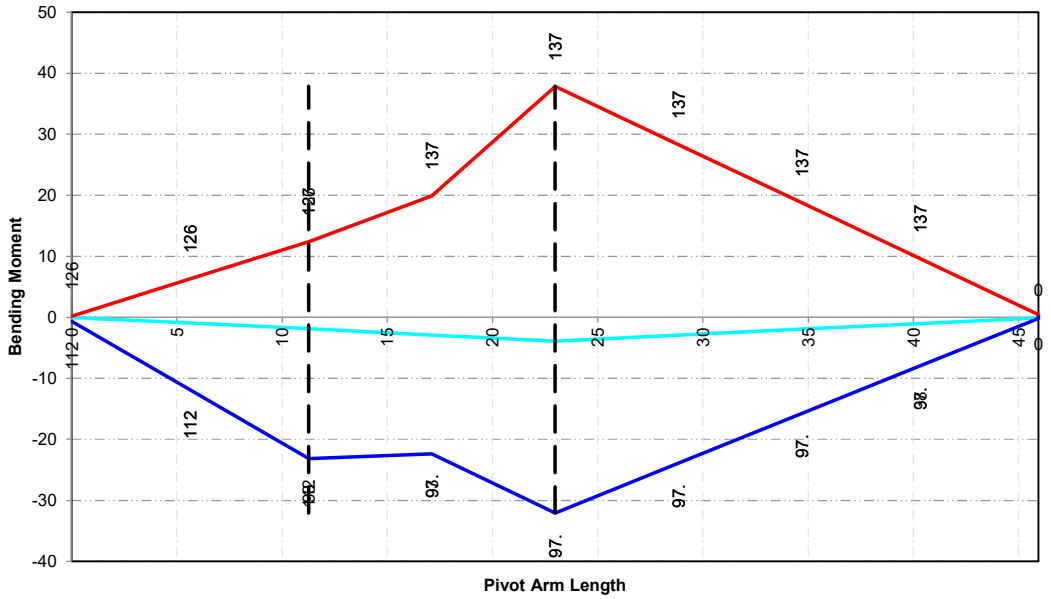


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*

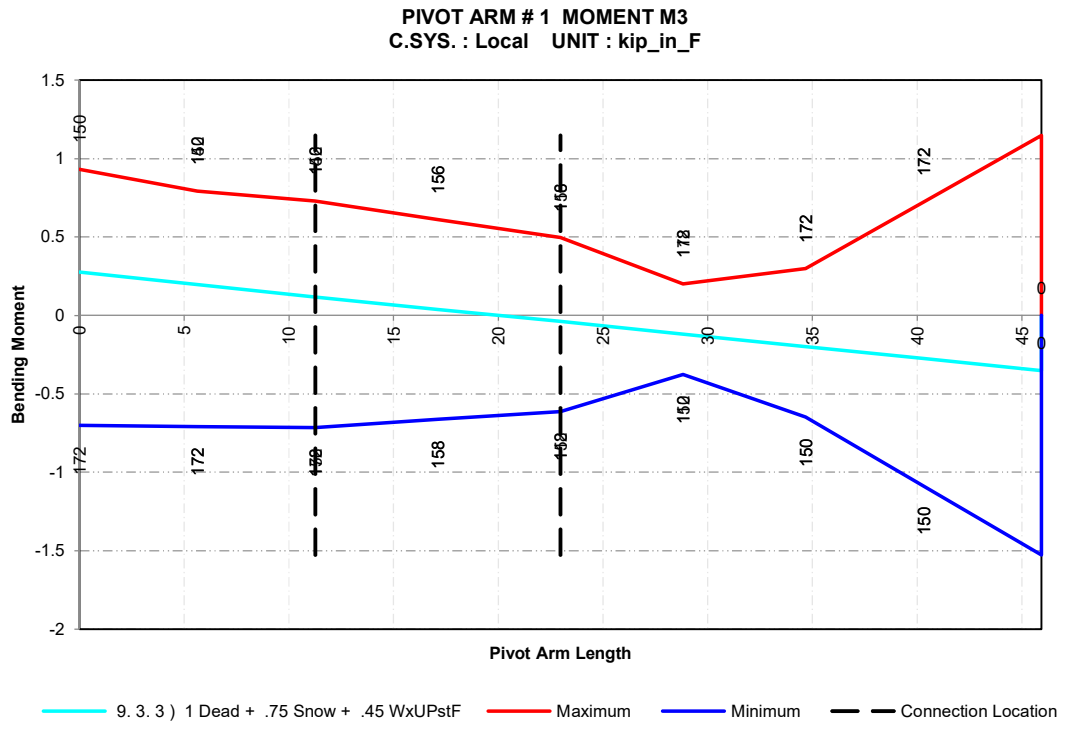
PIVOT ARM # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

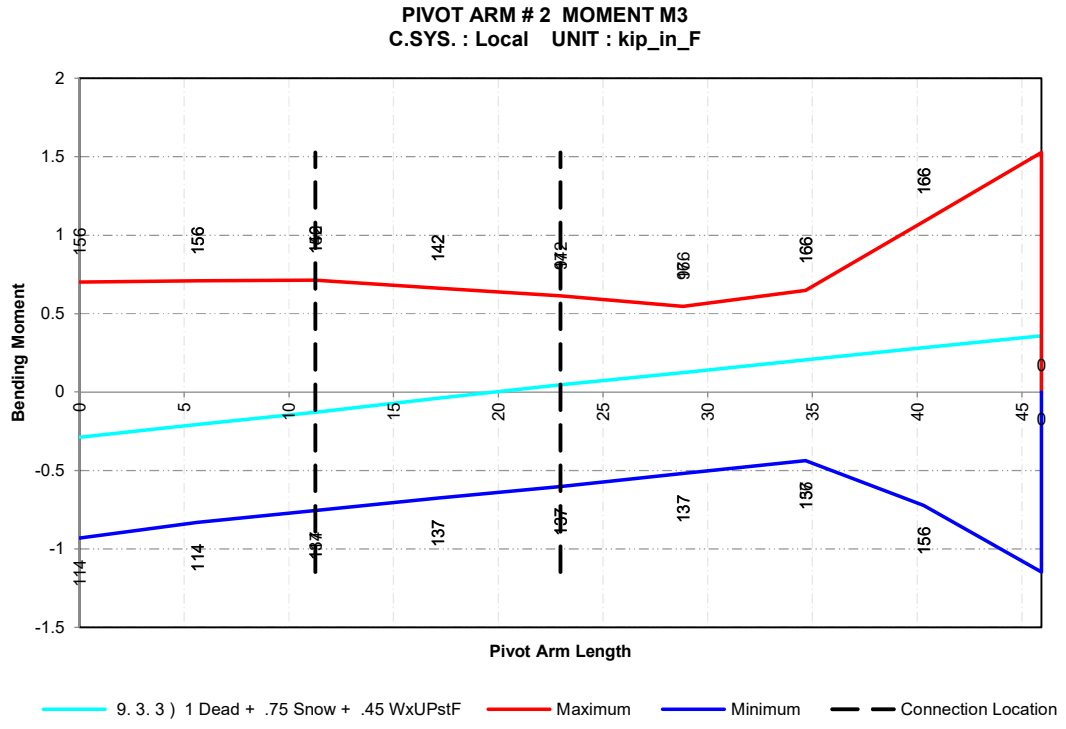


PIVOT ARM # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



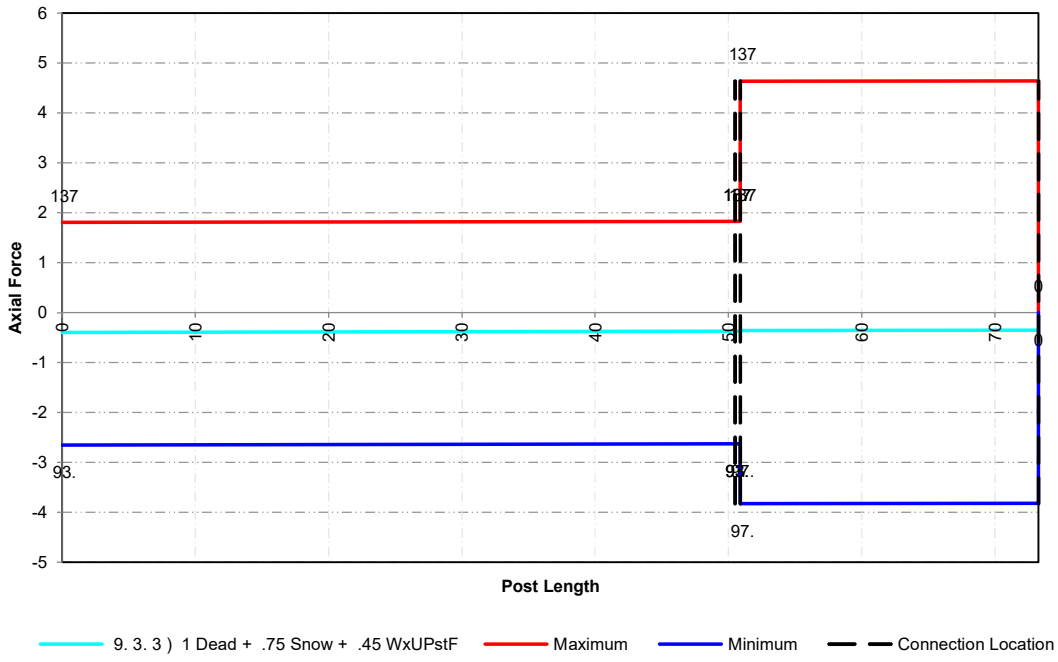
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



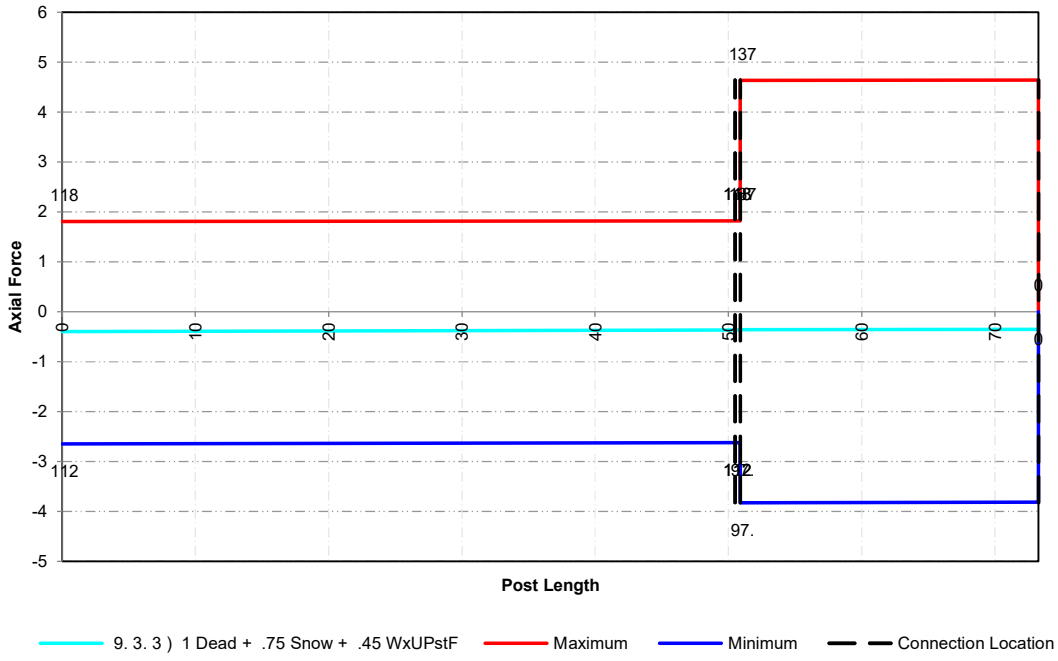


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*

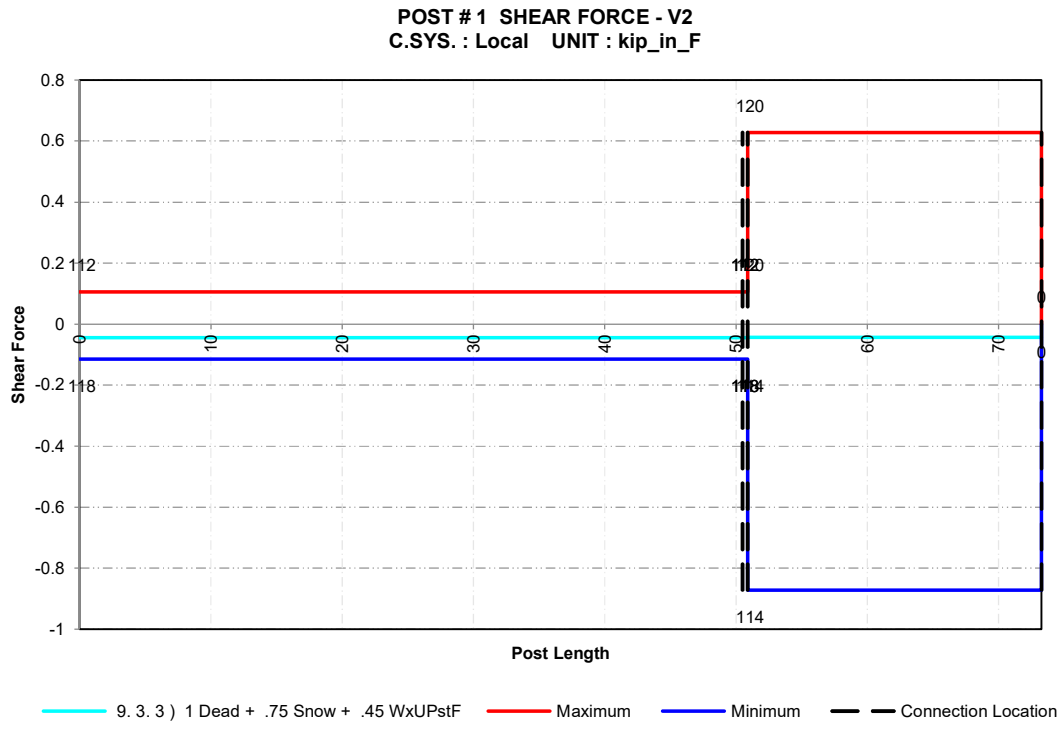
POST # 1 AXIAL FORCE
C.SYS. : Local UNIT : kip_in_F

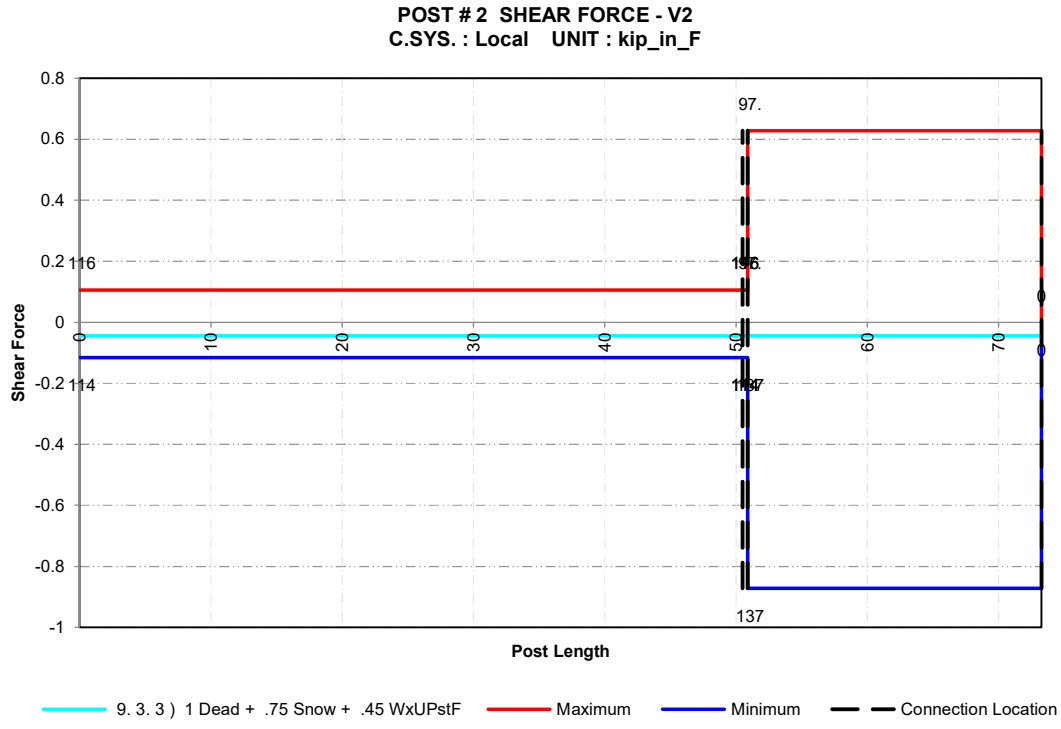


POST # 2 AXIAL FORCE
C.SYS. : Local UNIT : kip_in_F

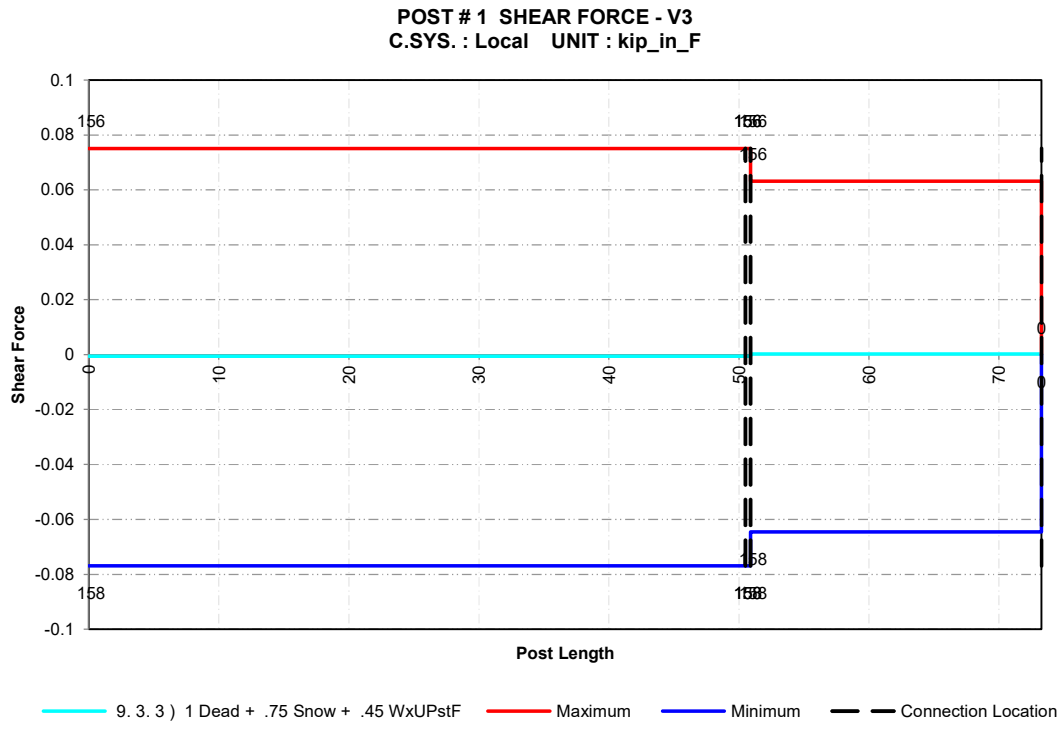


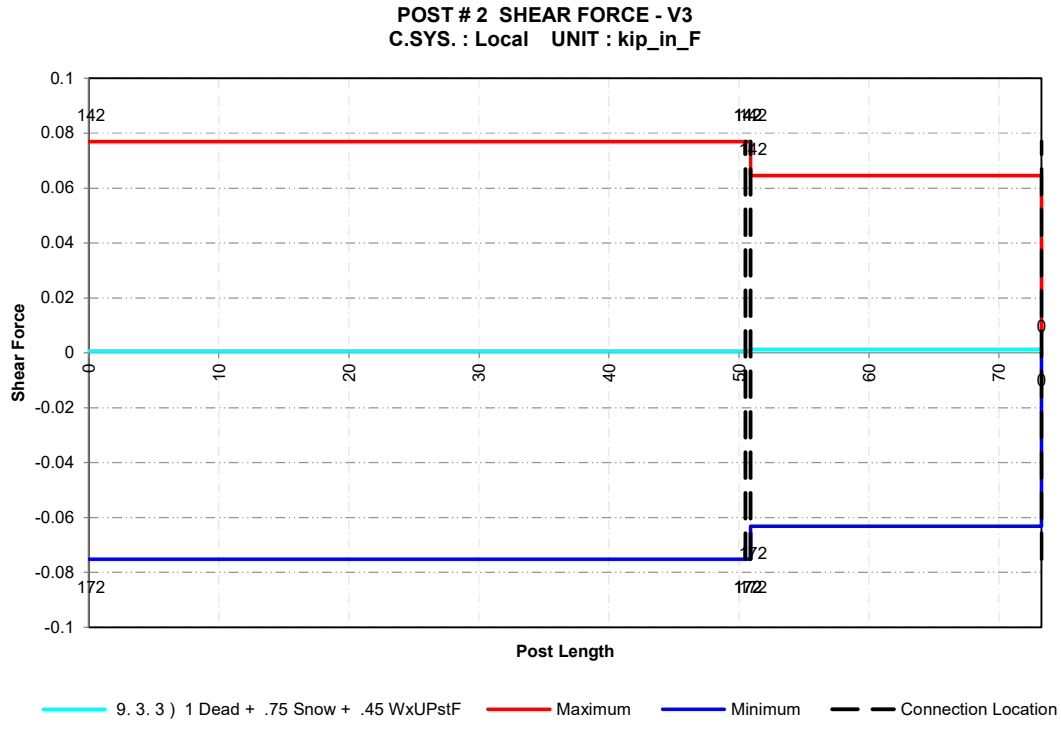
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*





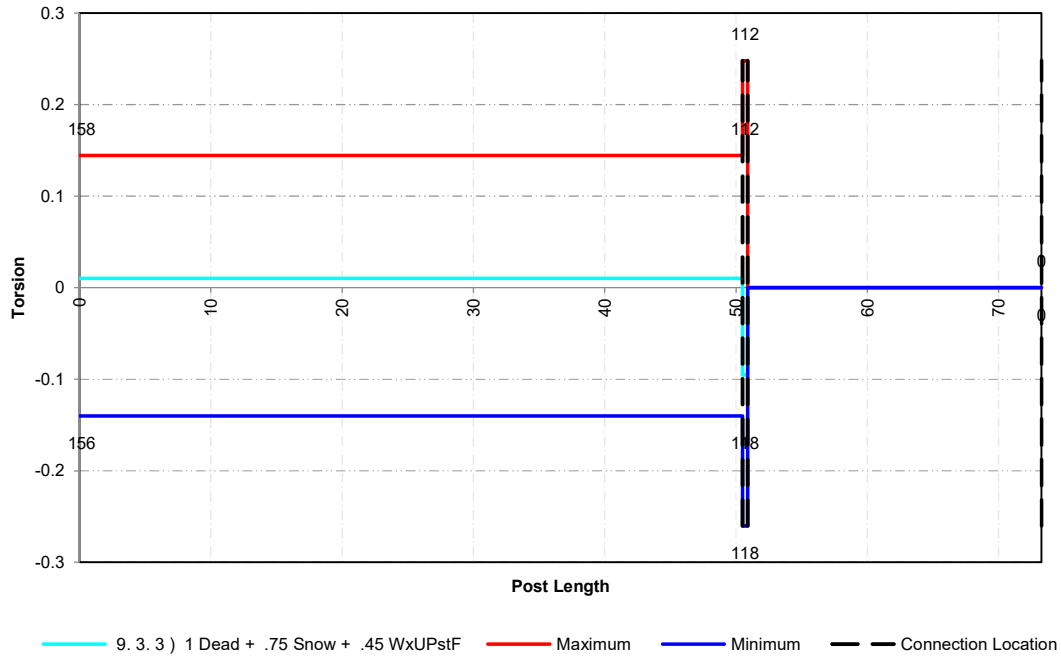
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*



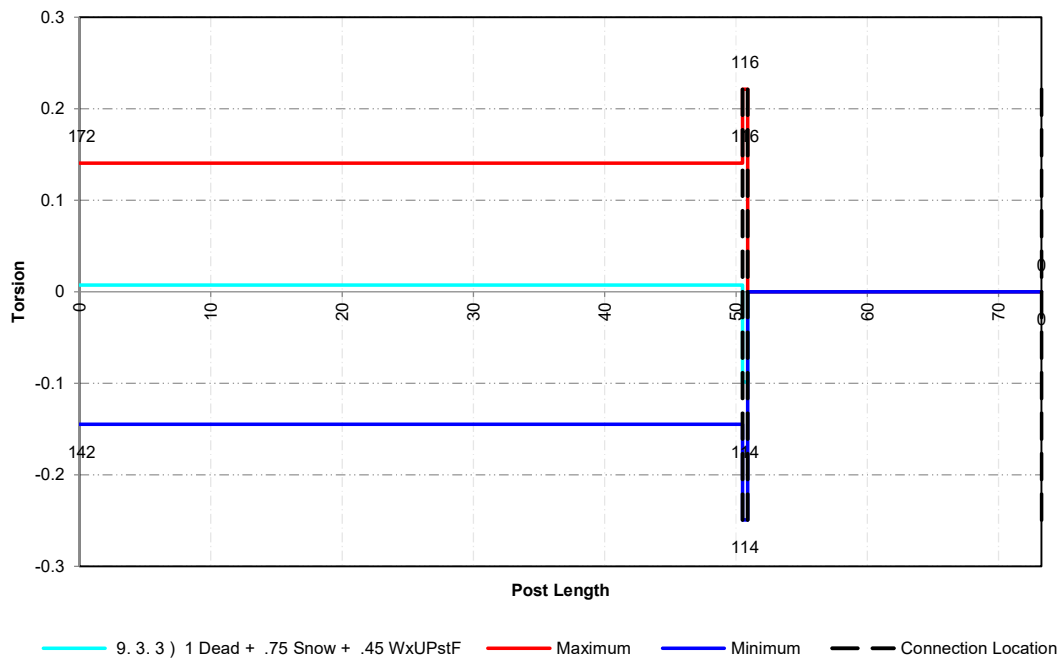


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*

POST # 1 TORSION
C.SYS. : Local UNIT : kip_in_F

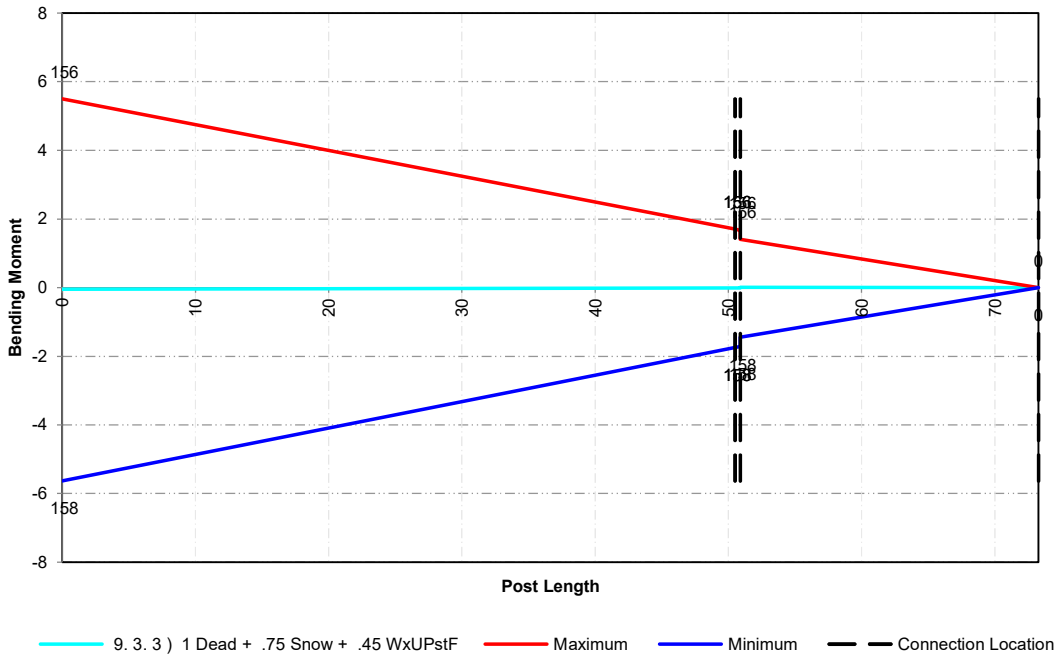


POST # 2 TORSION
C.SYS. : Local UNIT : kip_in_F

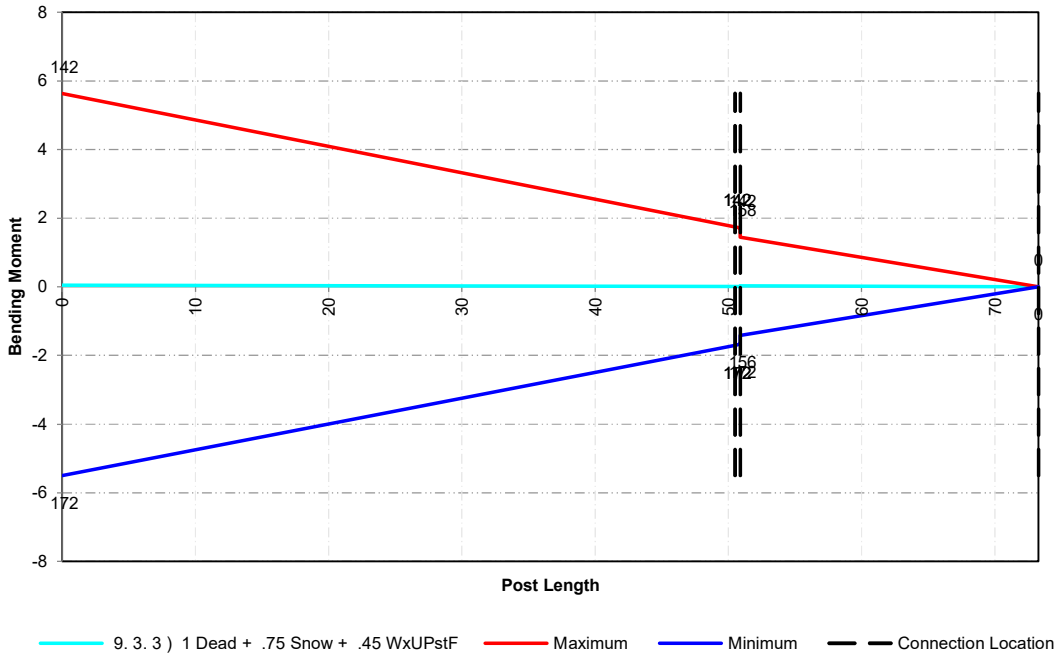


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*

POST # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

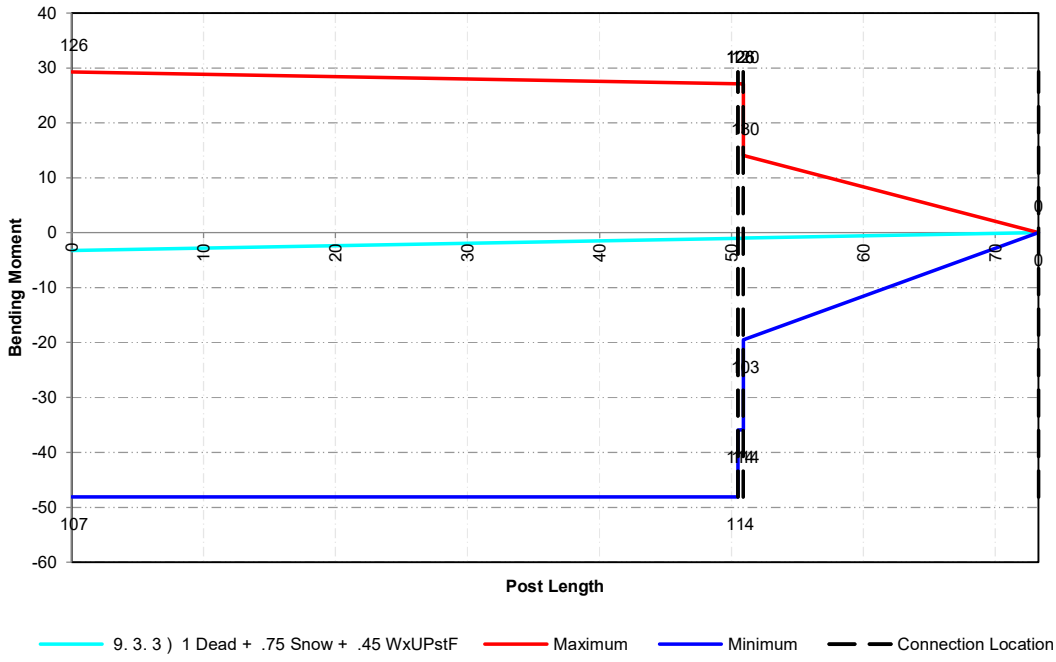


POST # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

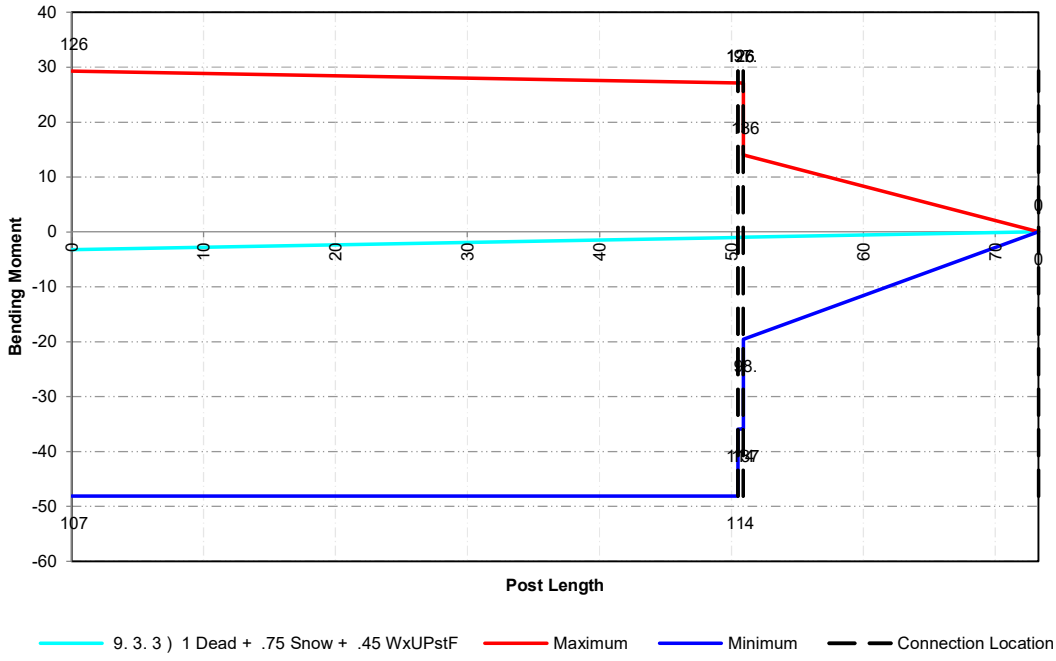


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-3 degree*

POST # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



POST # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

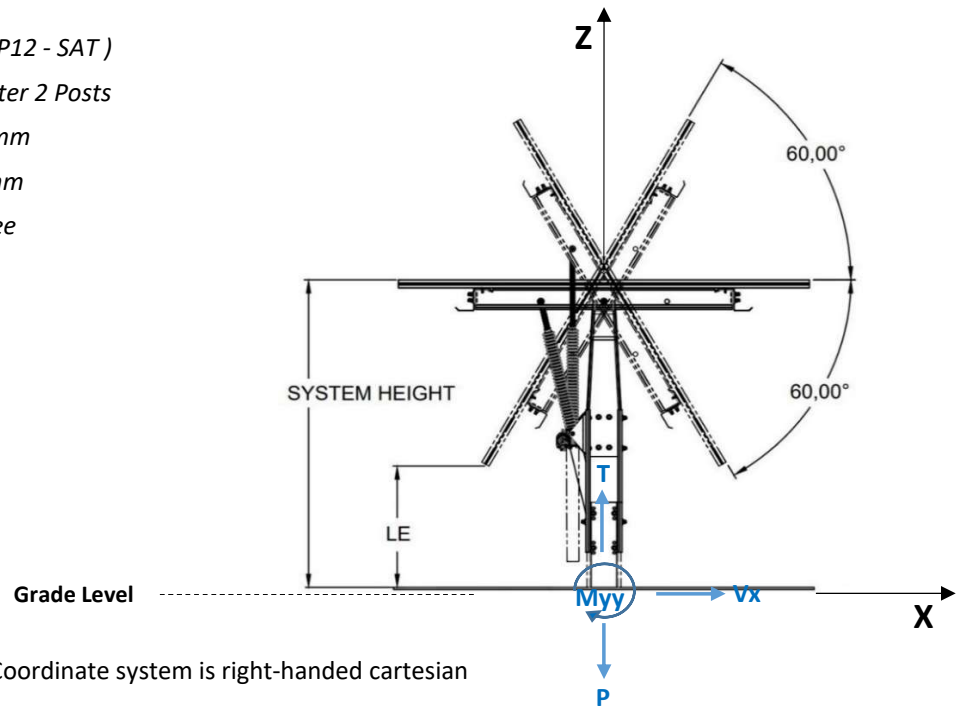
TABLE : *X20 (1P12 - SAT)*

CLASS : *Perimeter 2 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *3 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.64	0.80	0.00	3.36	≈ 0	0.36	1.58
	T	n/a	0.00	n/a	-3.65	≈ 0	n/a	-1.87
	V_x	0.00	0 , 0	0.00	± 0.19	± 0.09	0.02	-0.1 , 0.08
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.01	-0.37 , 0.38	0.00	± 6.68	± 0.57	0.11	-3.42 , 1.92
	M_{xx}	-0.01	-0.02 , 0	0.00	± 0.05	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02
2ND	**P**	0.64	0.82	0.00	3.36	≈ 0	0.36	1.58
	T	n/a	0.00	n/a	-3.65	≈ 0	n/a	-1.87
	V_x	0.00	0 , 0	0.00	± 0.19	± 0.09	0.02	-0.1 , 0.08
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.01	-0.37 , 0.37	0.00	± 6.68	± 0.57	0.11	-3.42 , 1.91
	M_{xx}	0.01	0 , 0.02	0.00	± 0.05	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X20 (1P12 - SAT)*

LENGTH : *2279 mm*

CLASS : *Perimeter 2 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *3 degree*

CHORD LENGTH : *13784 mm*

POST SPAN : *8340 mm*

CHORD CONTILEVER : *2722 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	1.95	4	20	45
Splice / Z	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		3.1	note * : standard baseline section		
Pivot Arm - Mid / Ω	N/A	N/A		N/A	N/A		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O	GR_50	88.9	n/a	4.5	n/a	n/a	n/a

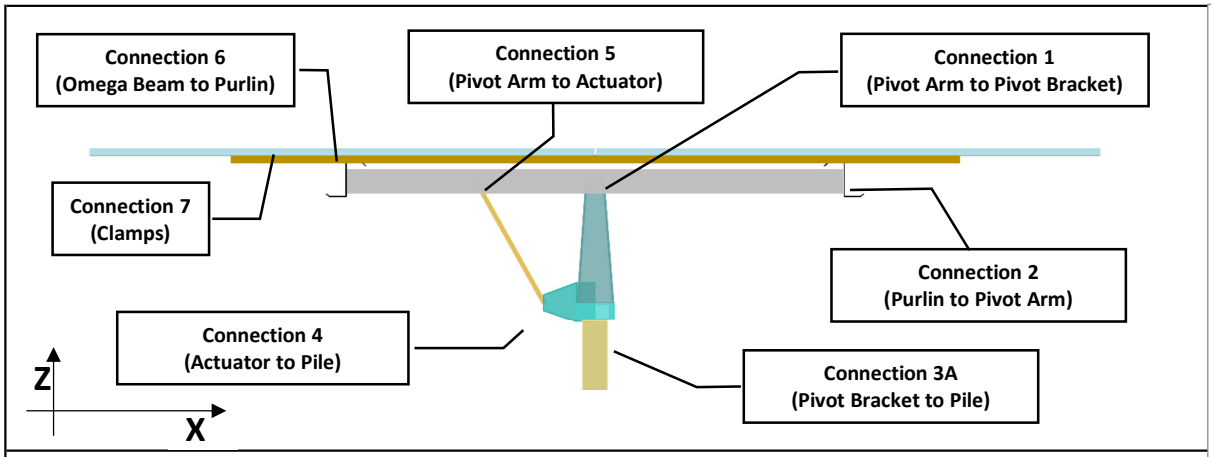
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.64	0.80	0.00	3.36	≈ 0	0.36	1.58
	T	n/a	0.00	n/a	-3.65	≈ 0	n/a	-1.87
	V_x	0.00	0 , 0	0.00	± 0.19	± 0.09	0.02	-0.1 , 0.08
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.01	-0.37 , 0.38	0.00	± 6.68	± 0.57	0.11	-3.42 , 1.92
	M_{xx}	-0.01	-0.02 , 0	0.00	± 0.05	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02
2ND	**P**	0.64	0.82	0.00	3.36	≈ 0	0.36	1.58
	T	n/a	0.00	n/a	-3.65	≈ 0	n/a	-1.87
	V_x	0.00	0 , 0	0.00	± 0.19	± 0.09	0.02	-0.1 , 0.08
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.01	-0.37 , 0.37	0.00	± 6.68	± 0.57	0.11	-3.42 , 1.91
	M_{xx}	0.01	0 , 0.02	0.00	± 0.05	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

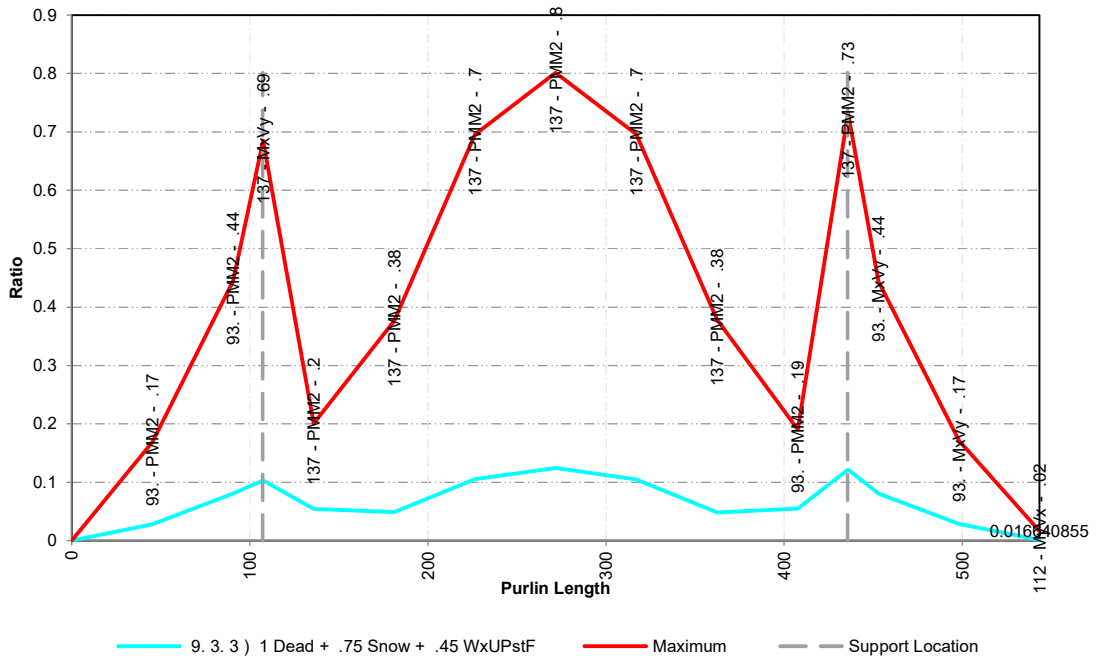


Note: coordinate system is right-handed cartesian

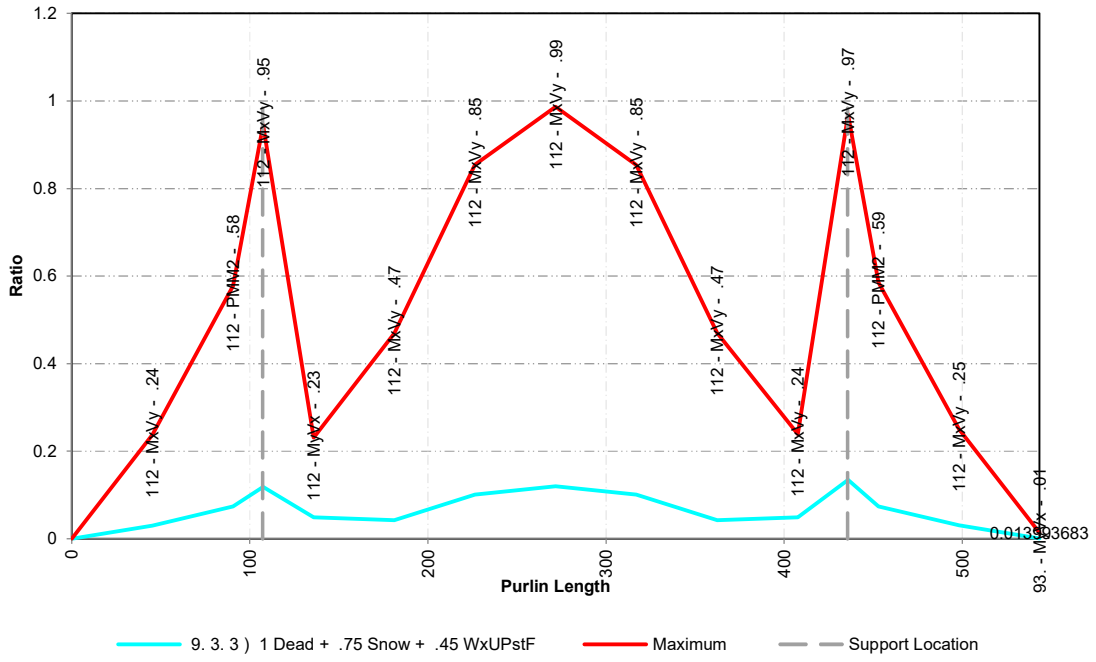
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-5.49	0.63	0.01	0.00	0.00	0.00	112. 4. 21) 1 Dead + .6 WxDNal+T
-0.59	0.00	0.07	0.00	0.00	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 2						
0.27	-2.00	-0.02	0.00	0.00	-0.04	112. 4. 21) 1 Dead + .6 WxDNal+T
0.19	-2.00	0.02	0.00	0.03	-0.04	112. 4. 21) 1 Dead + .6 WxDNal+T
Connection : 3						
1.81	0.11	0.00	0.00	-0.02	0.70	118. 5. 4) .6 Dead + .6 WxUPalF
-2.65	-0.11	0.01	0.00	0.03	2.12	112. 4. 21) 1 Dead + .6 WxDNal+T
1.81	0.11	0.00	0.00	-0.02	3.47	137. 5. 23) .6 Dead + .6 WxUPal+T
-0.38	0.00	0.00	0.00	0.00	4.00	130. 5. 16) .6 Dead + .6 WxOTal
-0.64	0.00	0.08	-0.01	0.47	0.00	142. 9. 2) 1 Dead + .7 Quake_y
-0.64	0.00	0.08	-0.01	0.47	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
2.97	*	0.00	0.00	0.00	0.00	135. 5. 21) .6 Dead + .6 WxDNal+T
Connection : 5		** Note : the load is axial in actuator direction*				
2.97	*	0.00	0.00	0.00	0.00	135. 5. 21) .6 Dead + .6 WxDNal+T
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.28						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.28						0.6 WLup

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

PURLIN # 1 UNITY RATIO

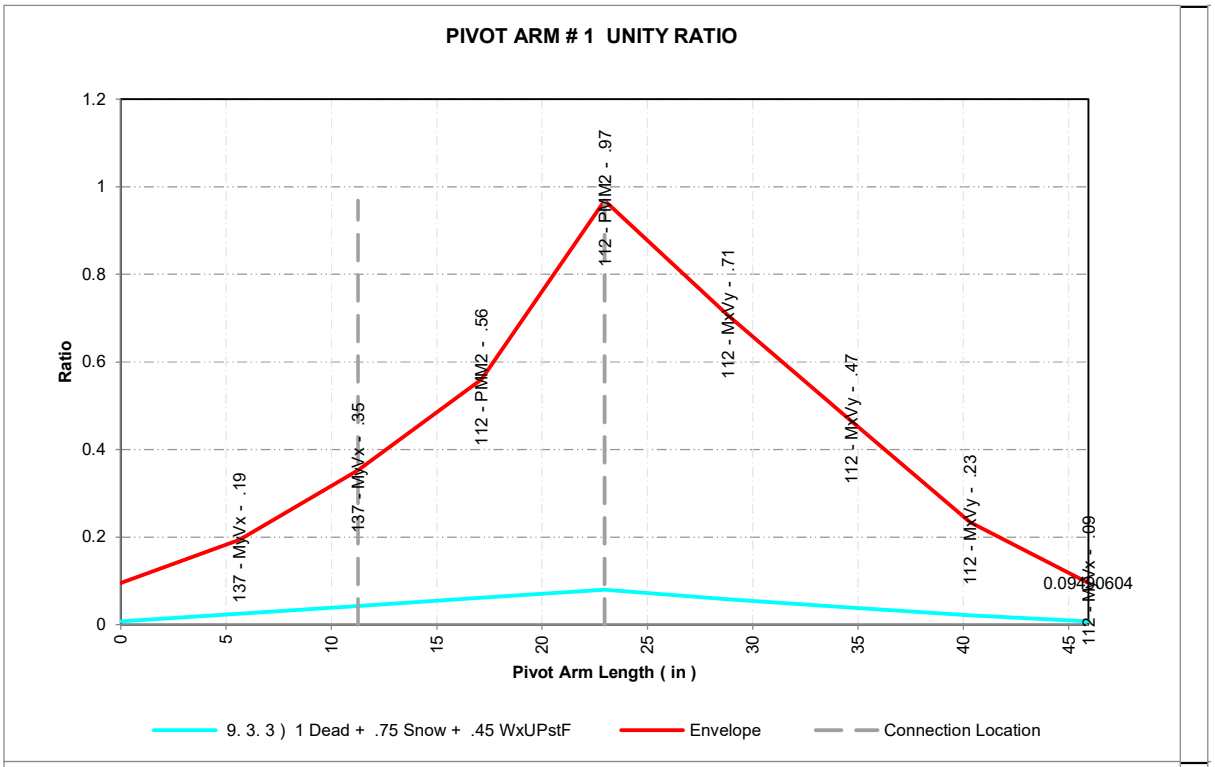


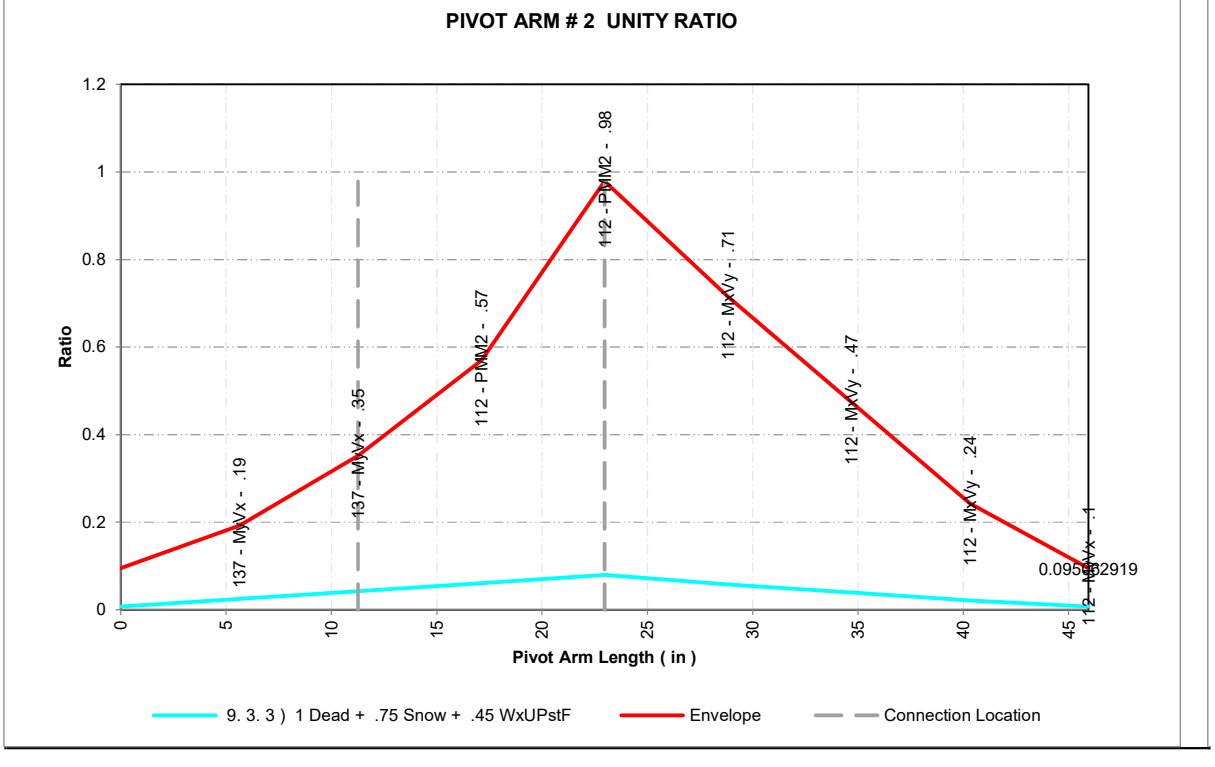
PURLIN # 2 UNITY RATIO



Pivot Arm Unity Ratio Charts

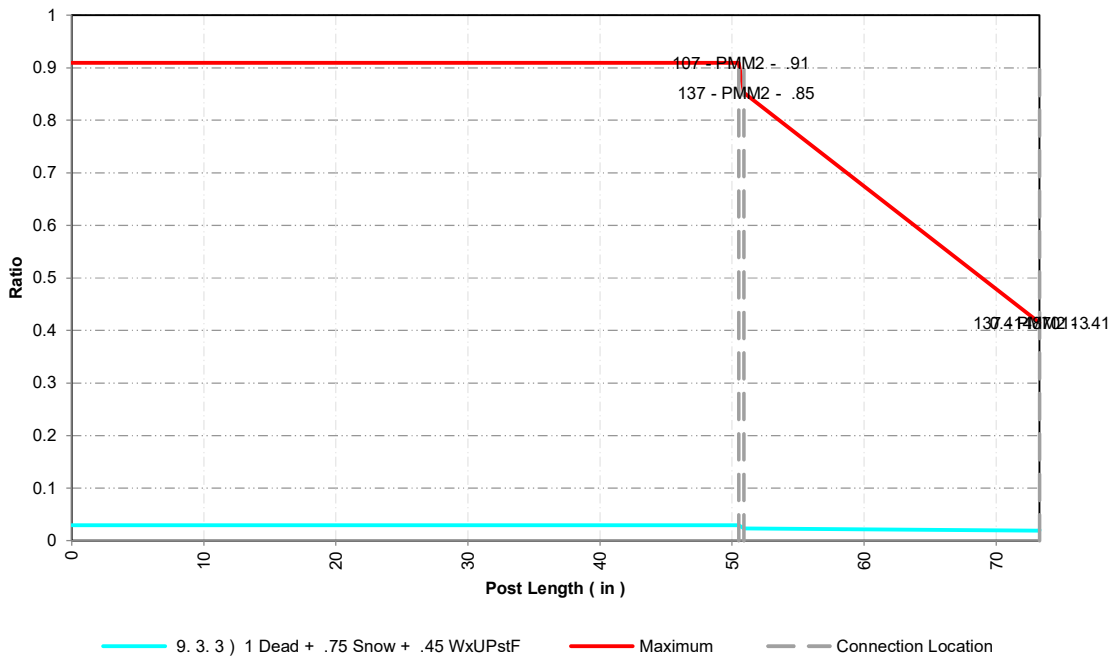
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

POST # 1 UNITY RATIO



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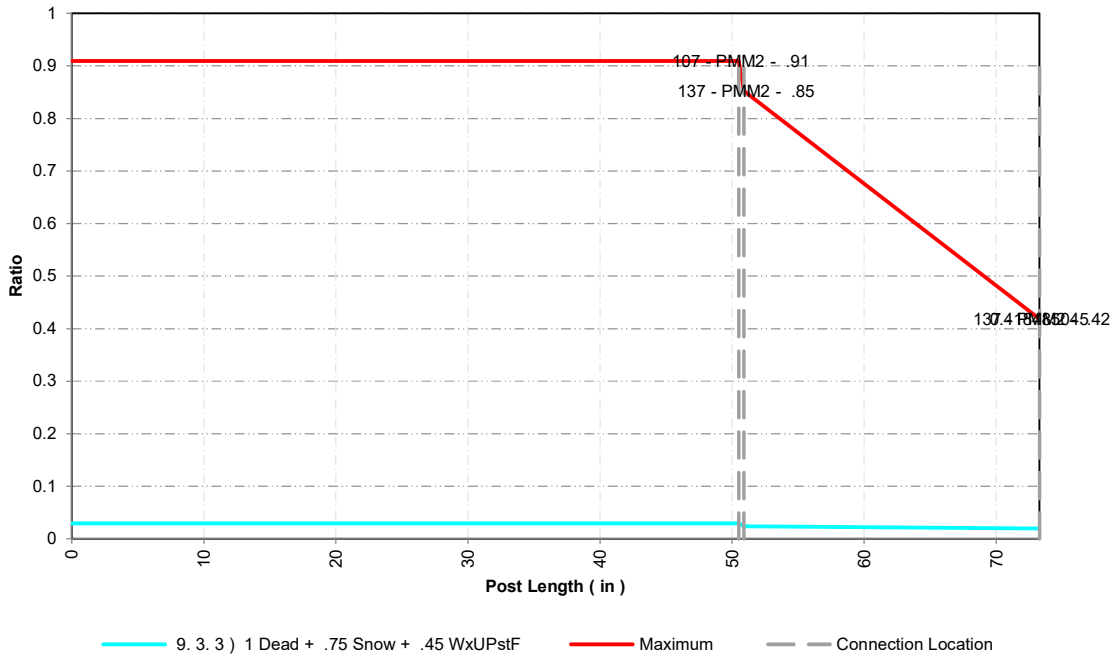
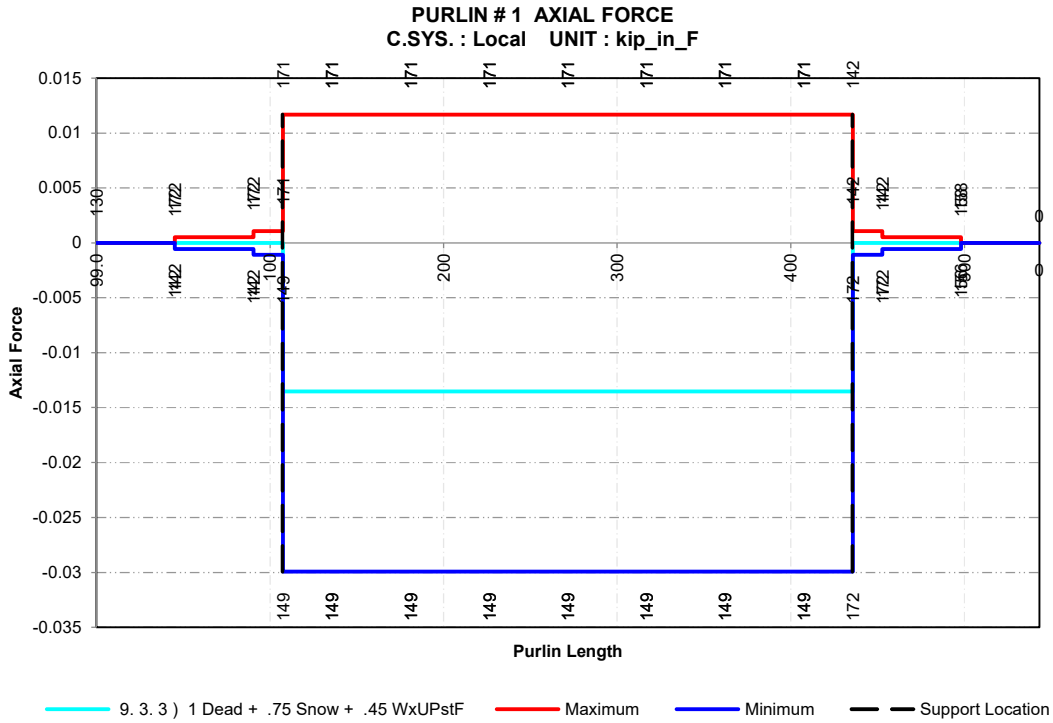
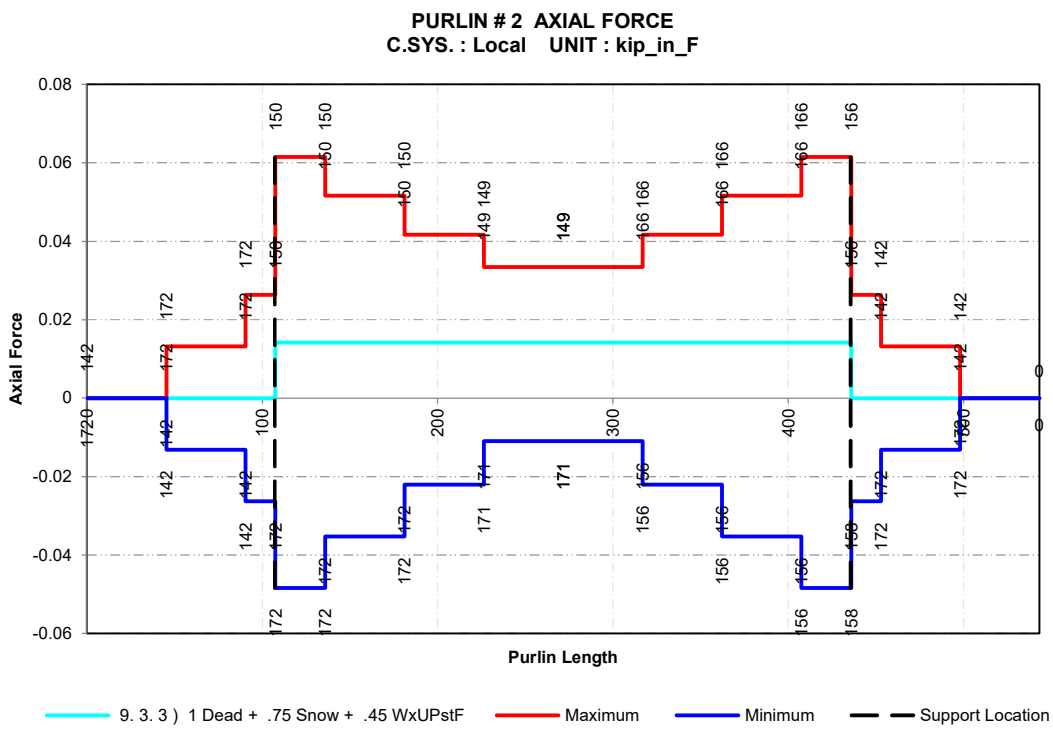
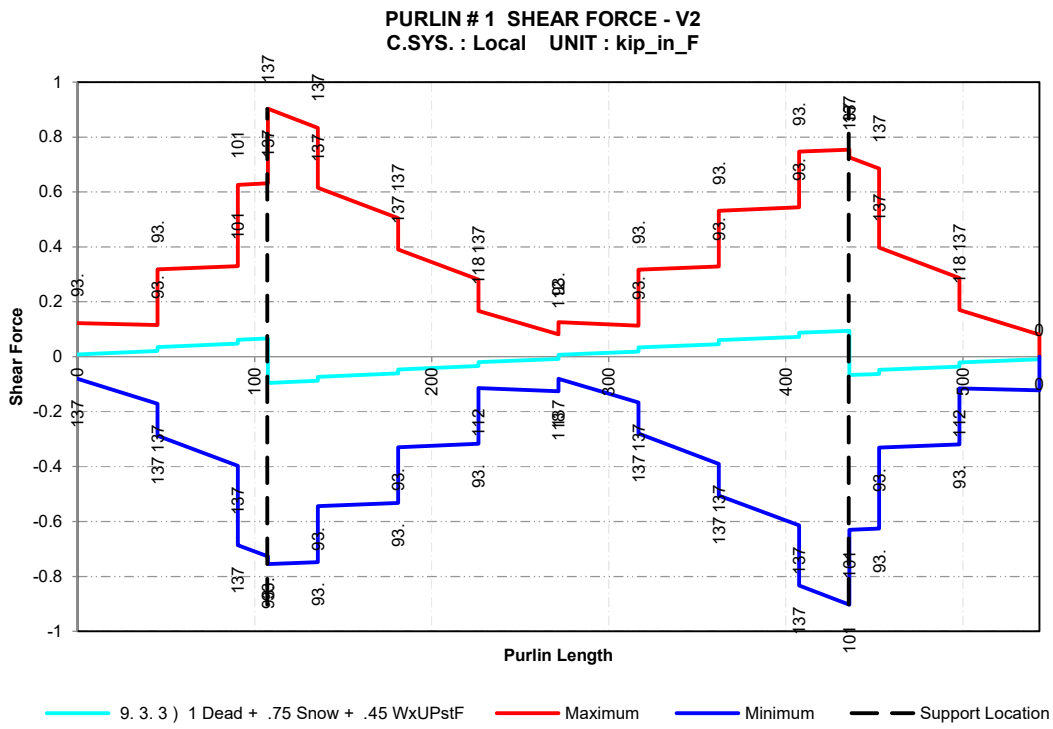


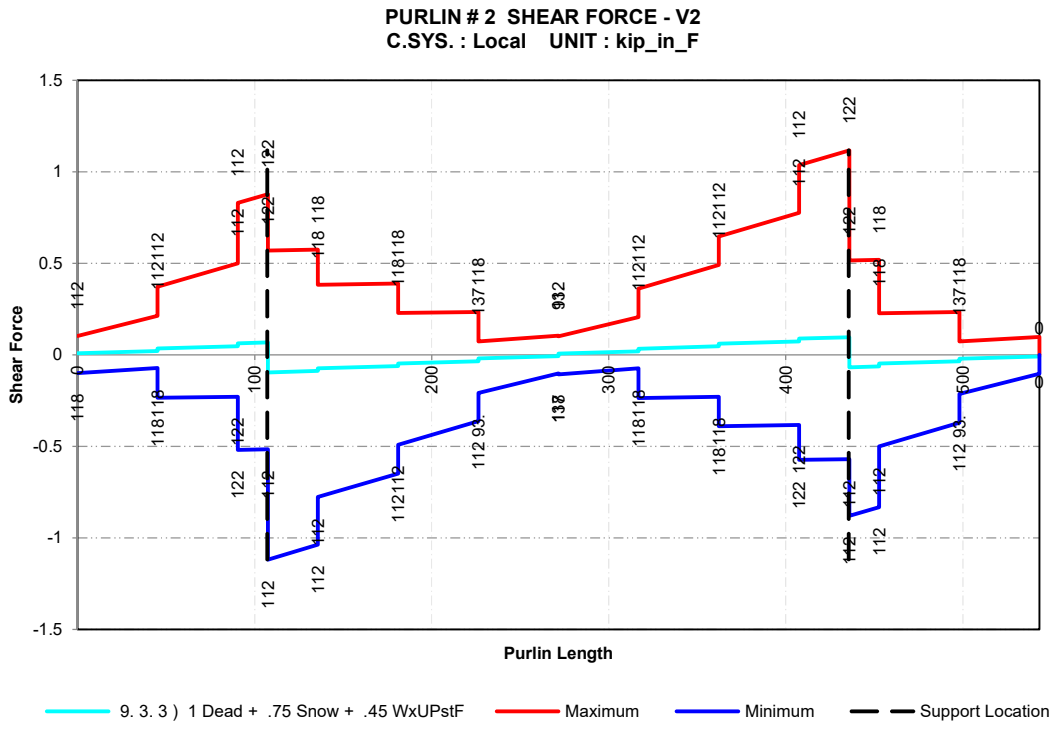
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*



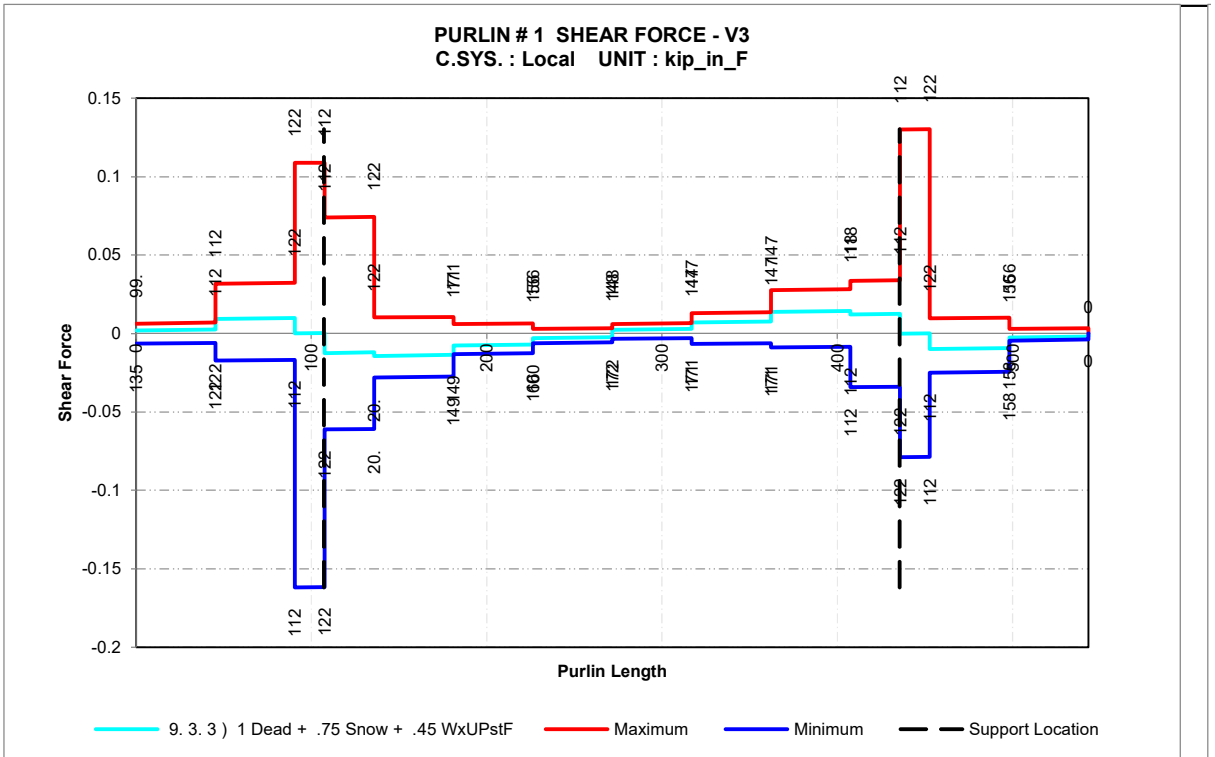


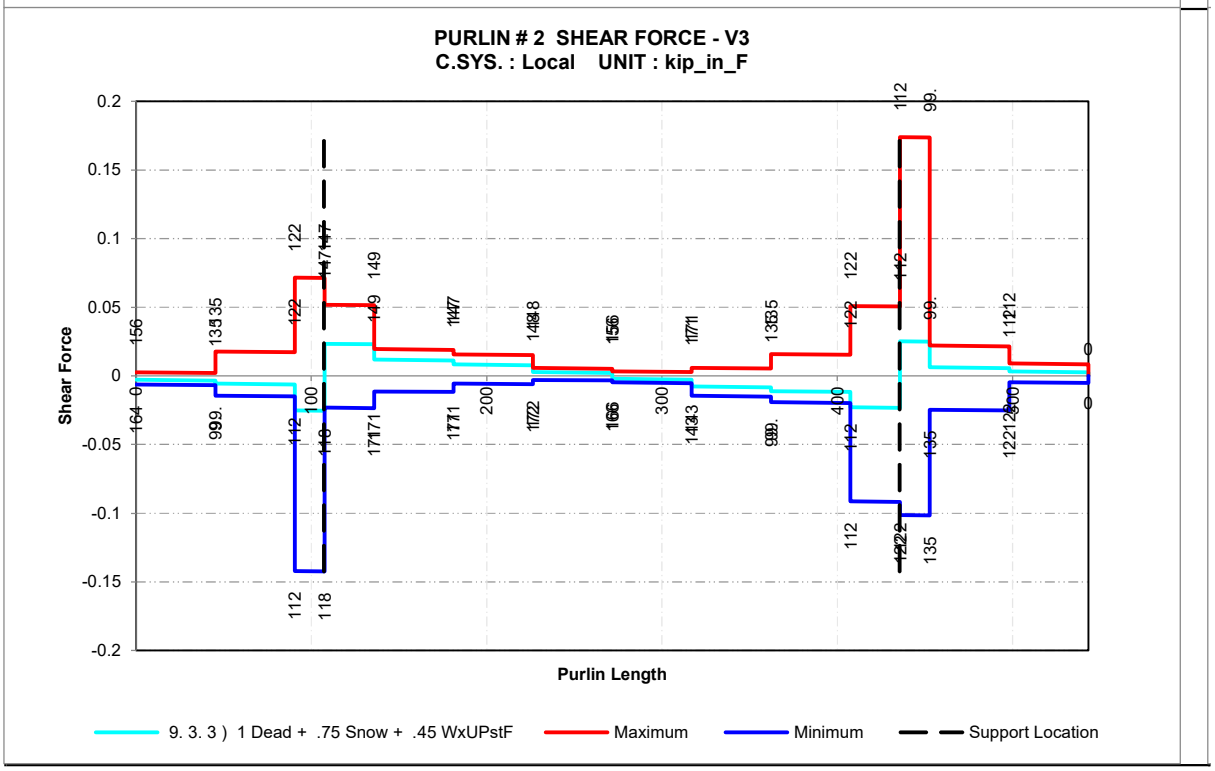
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*



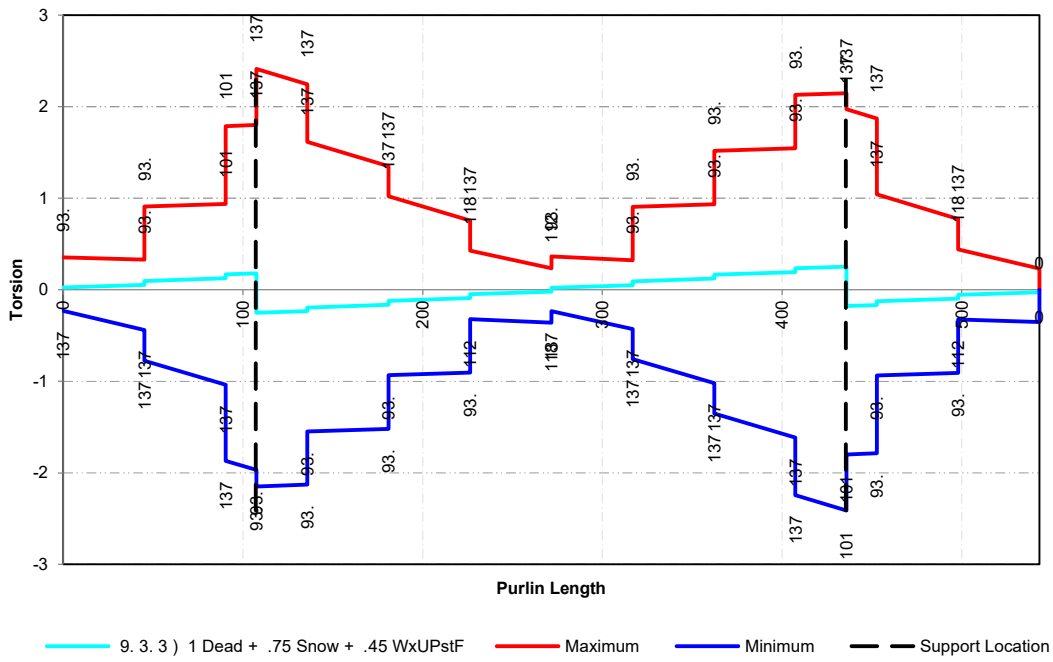


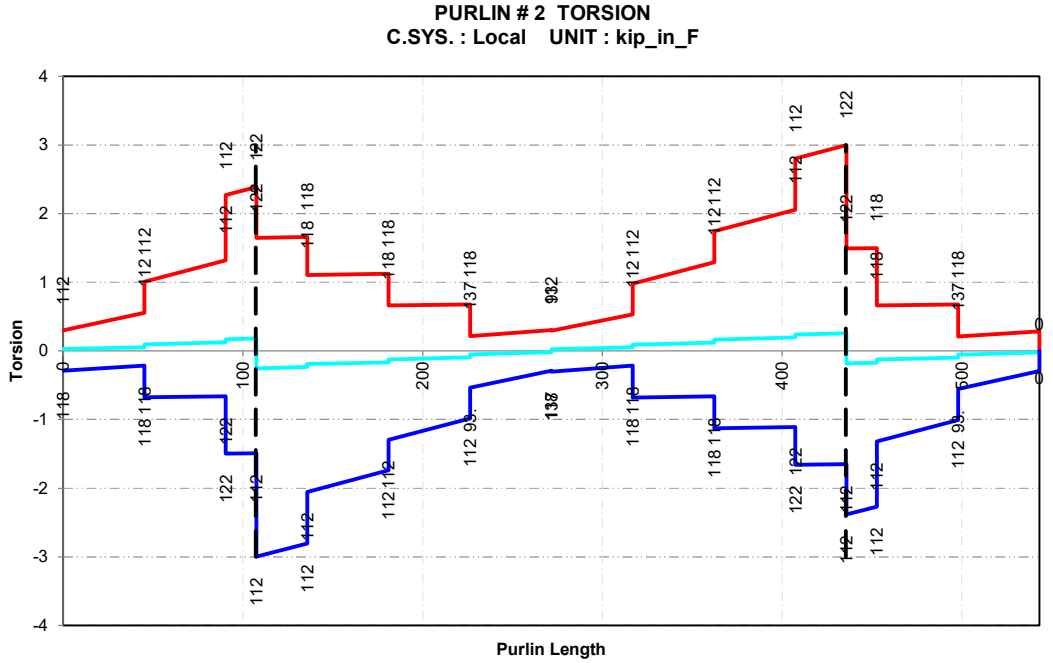
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*





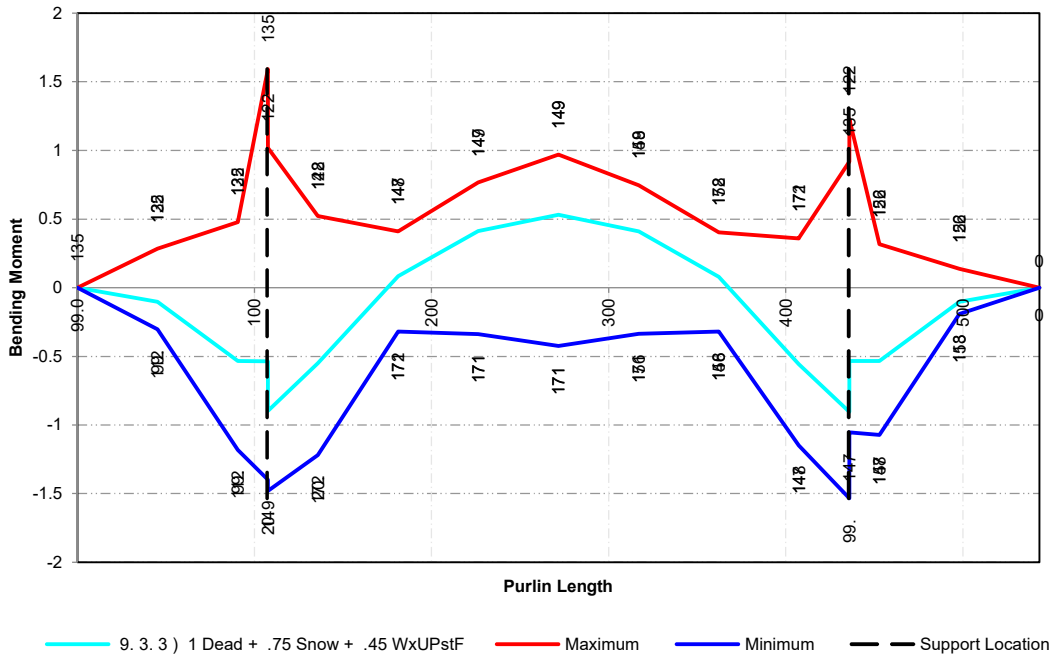
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*



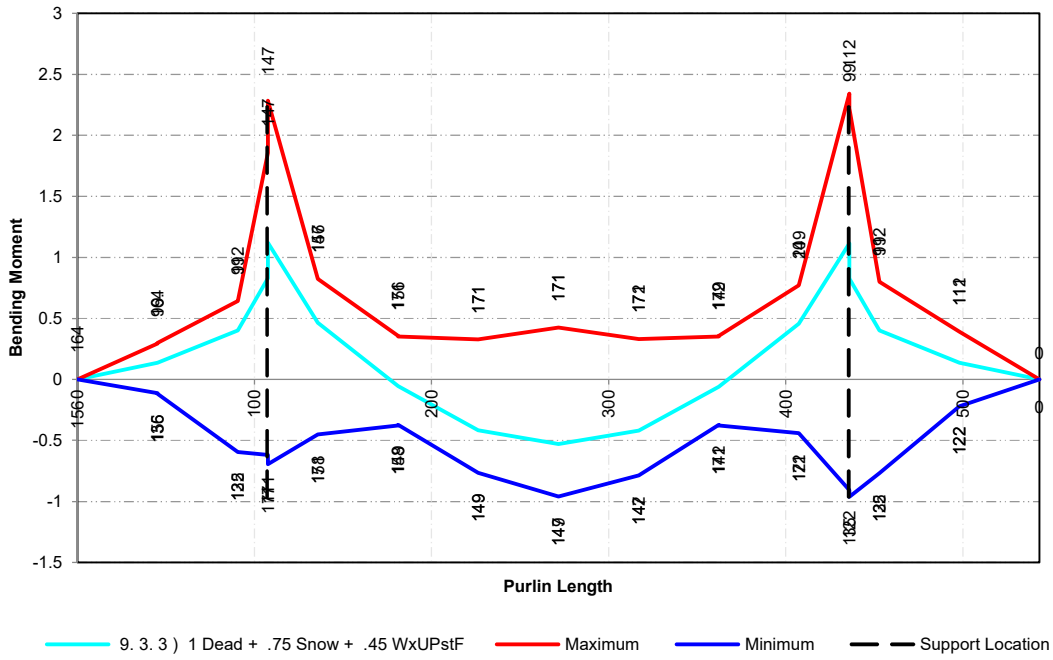


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

PURLIN # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



PURLIN # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

PURLIN # 1 MOMENT M3
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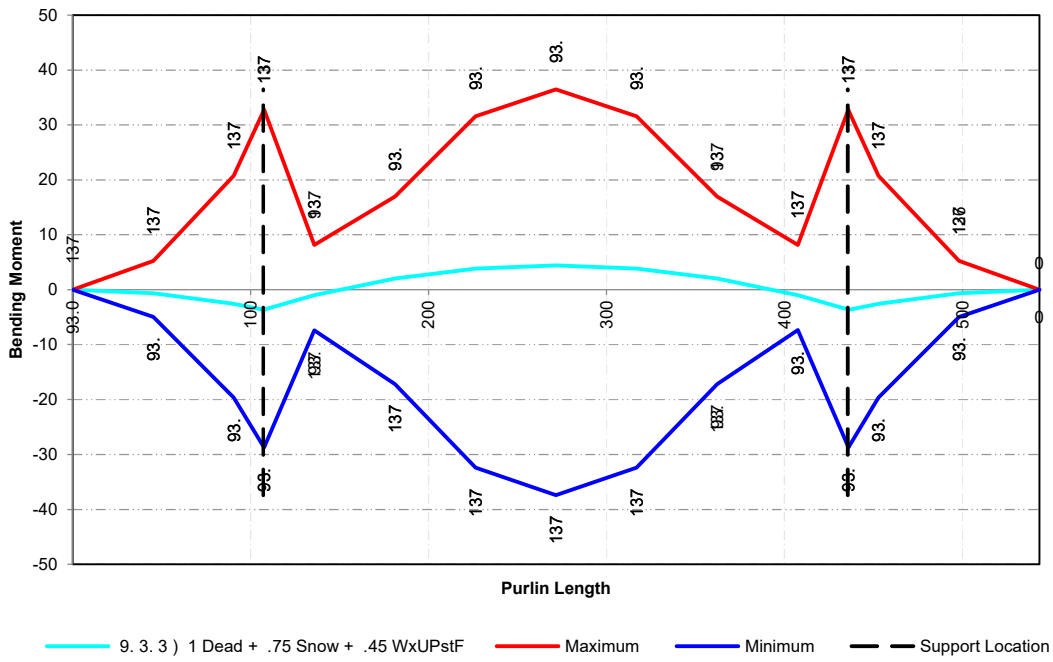

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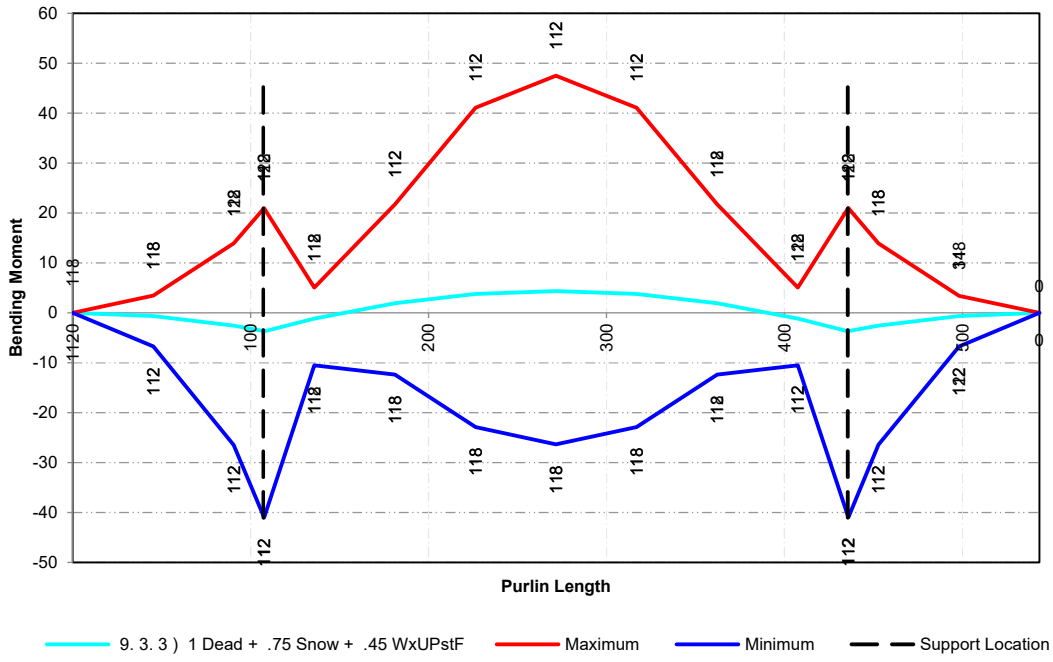
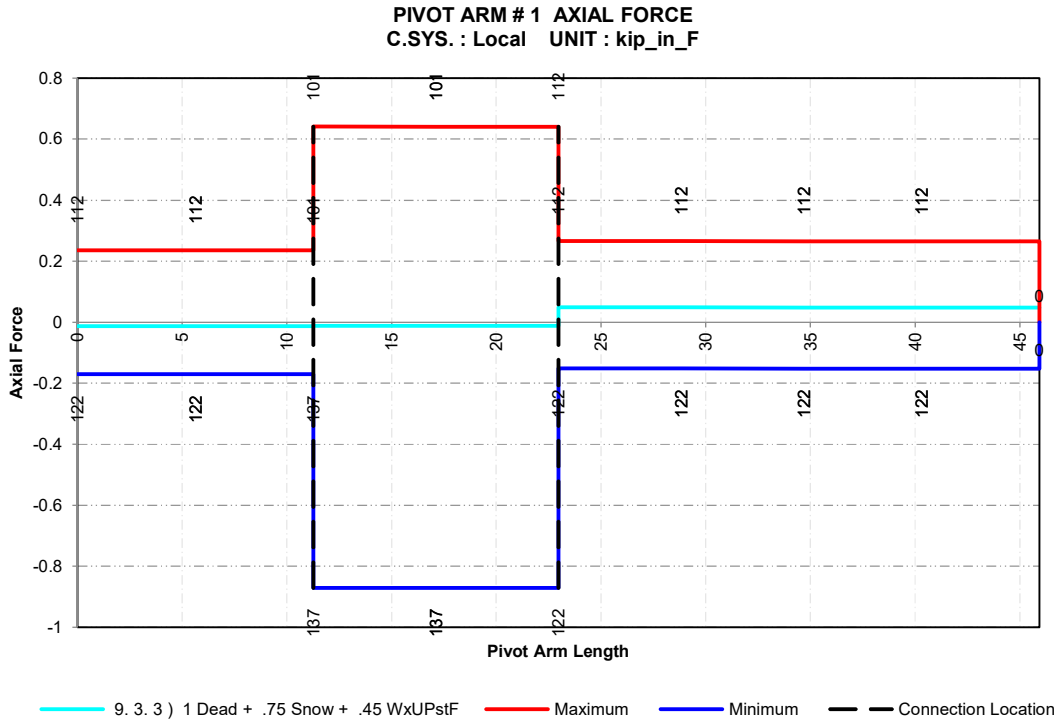
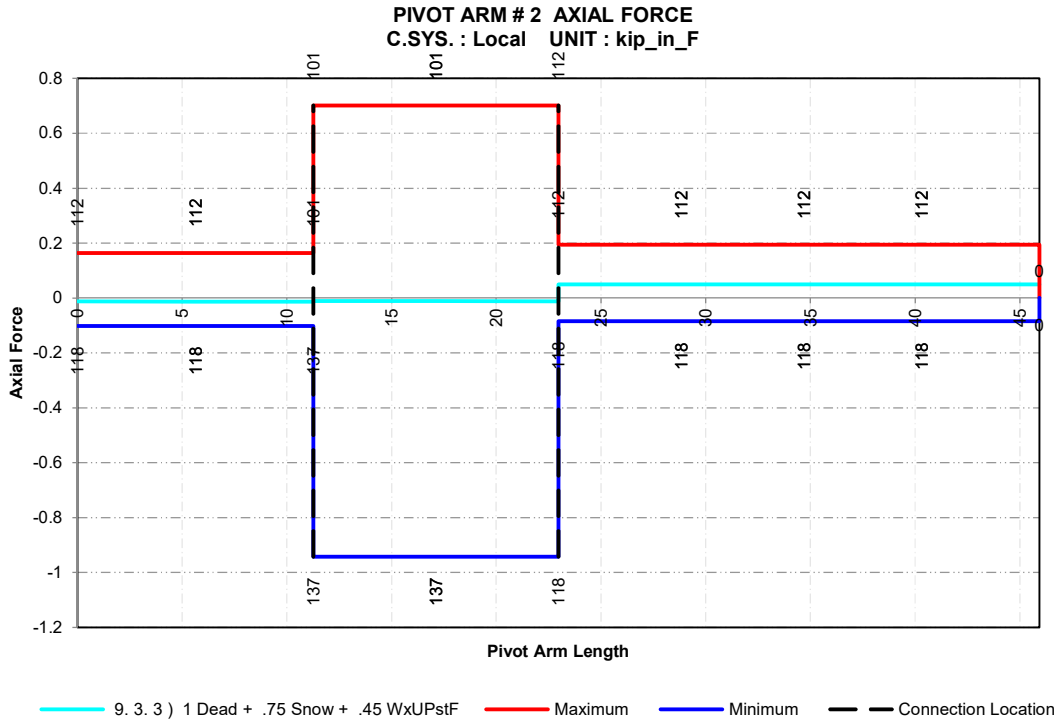
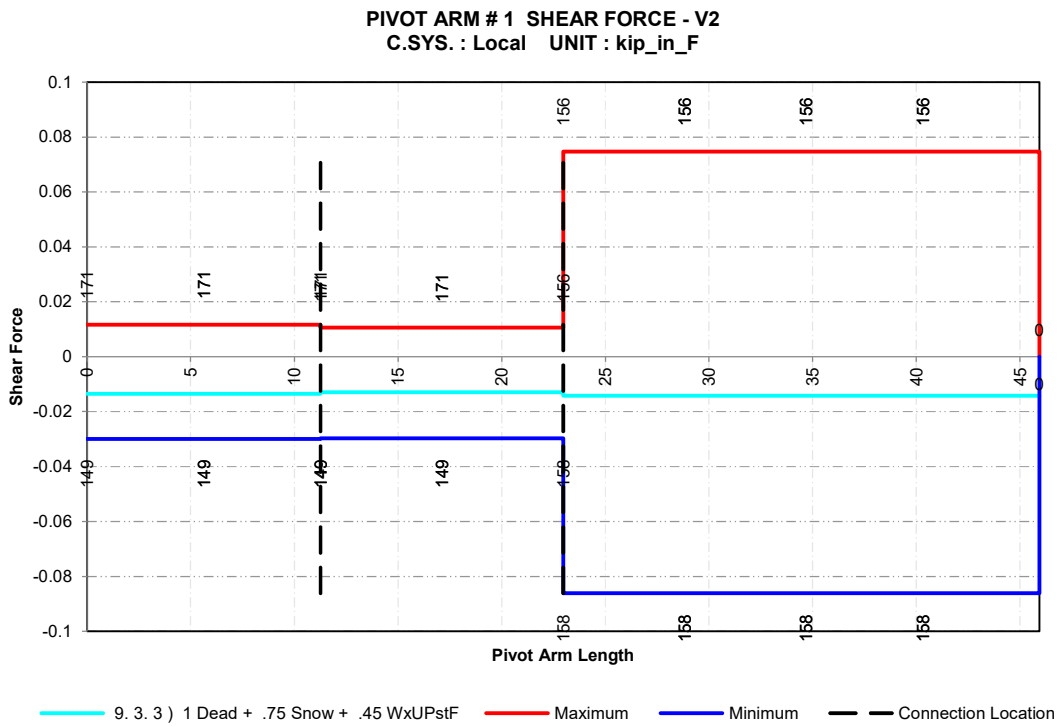


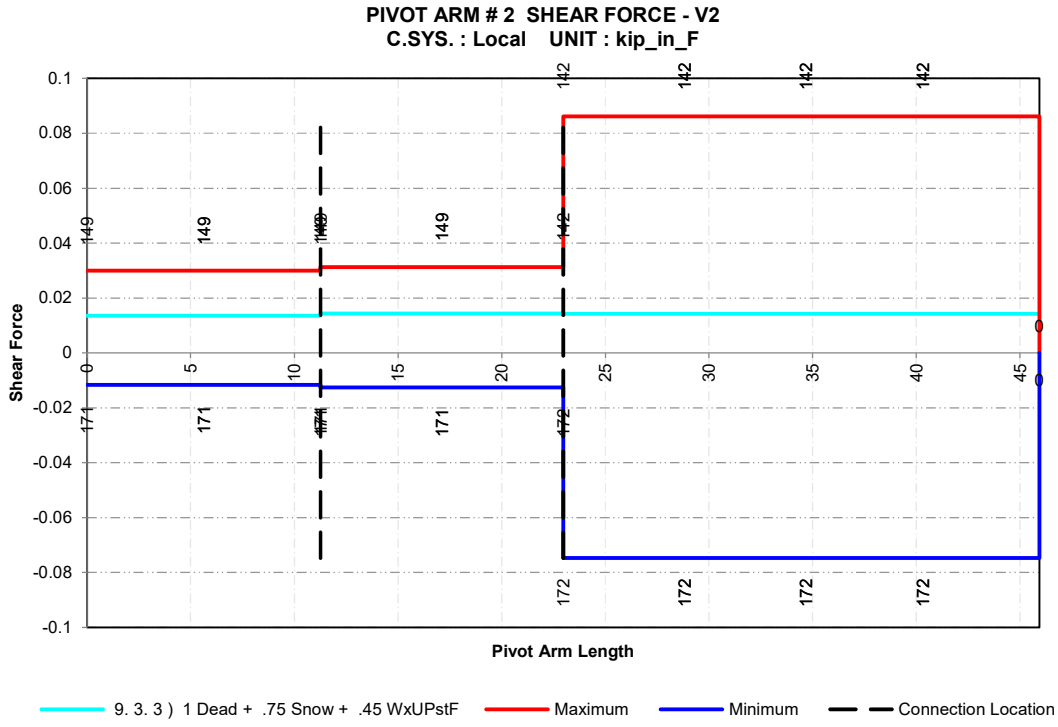
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*



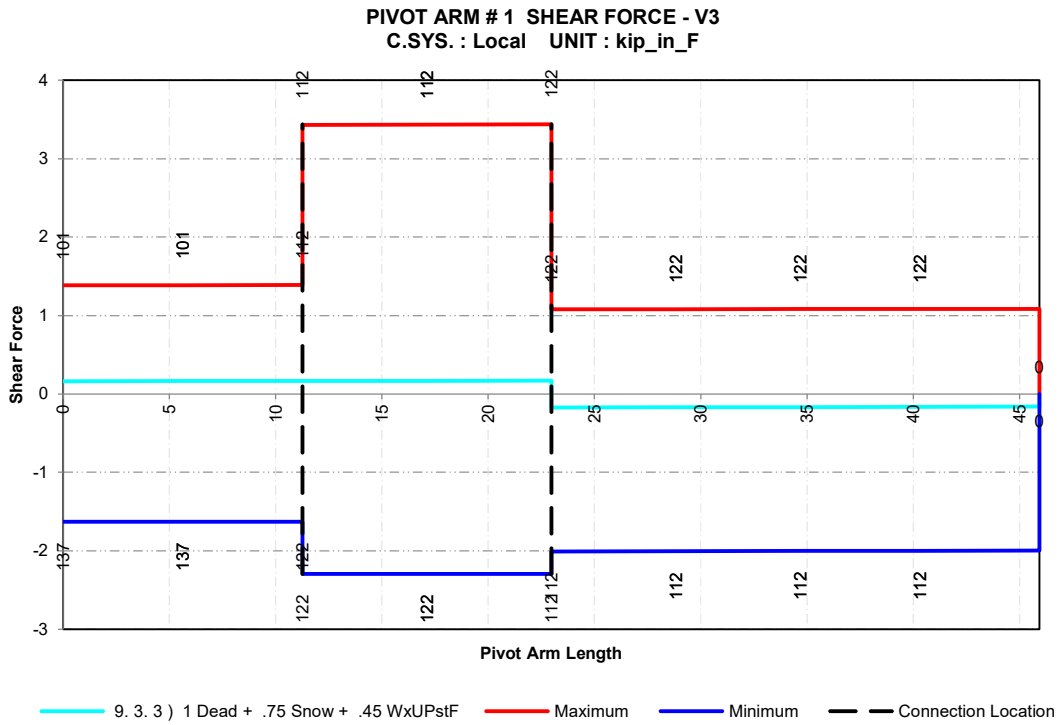


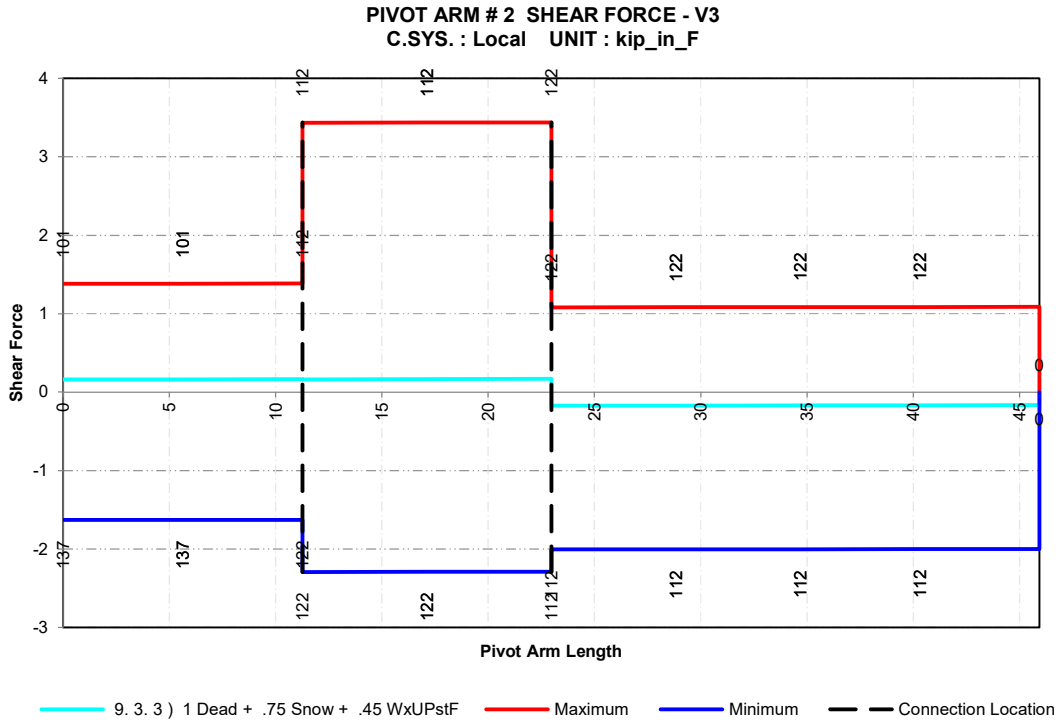
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*



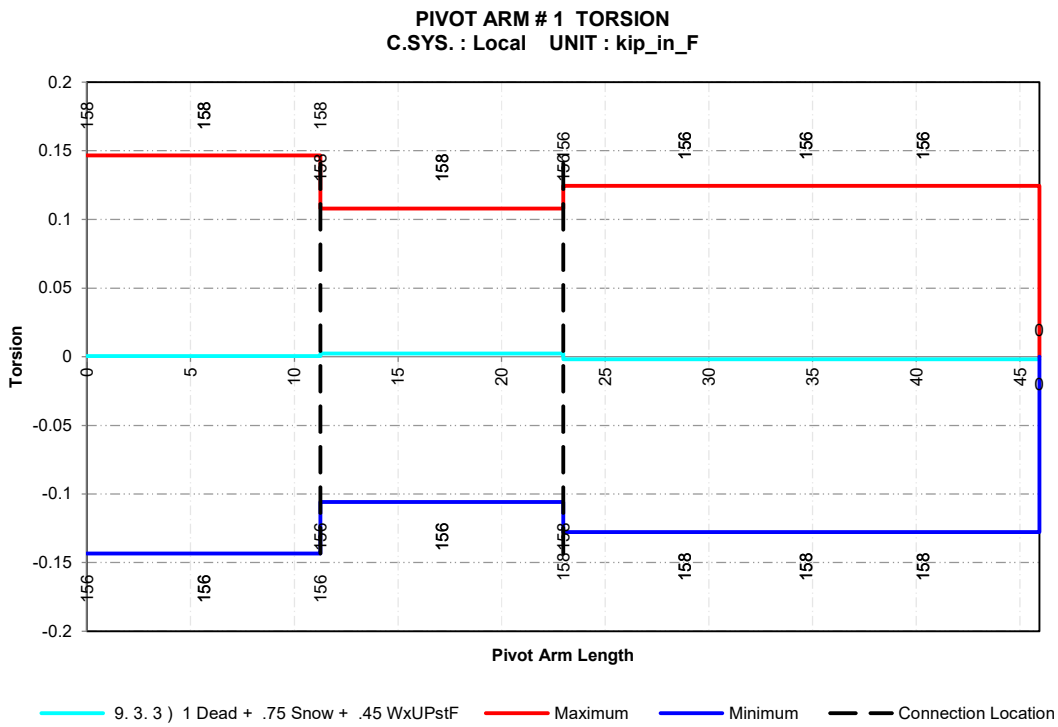


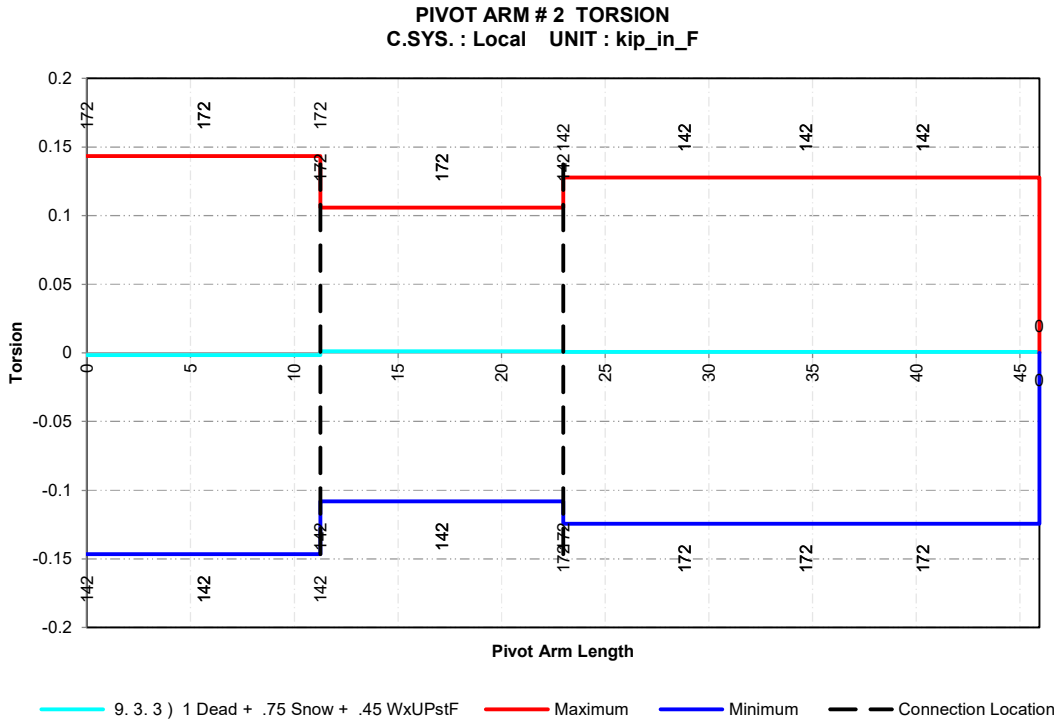
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*



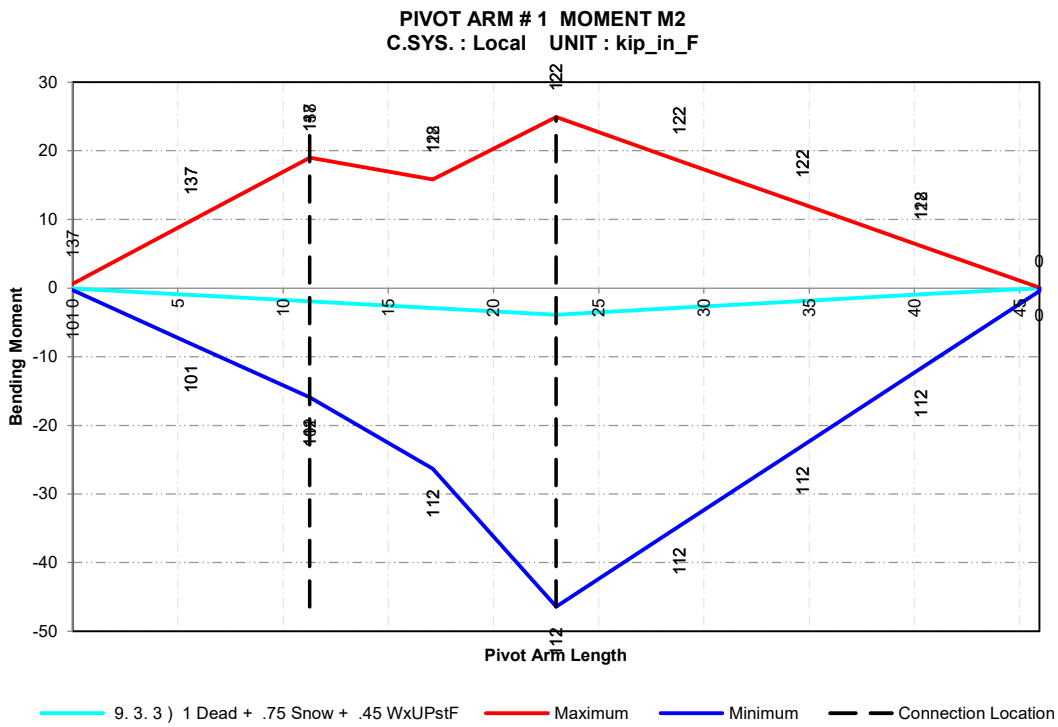


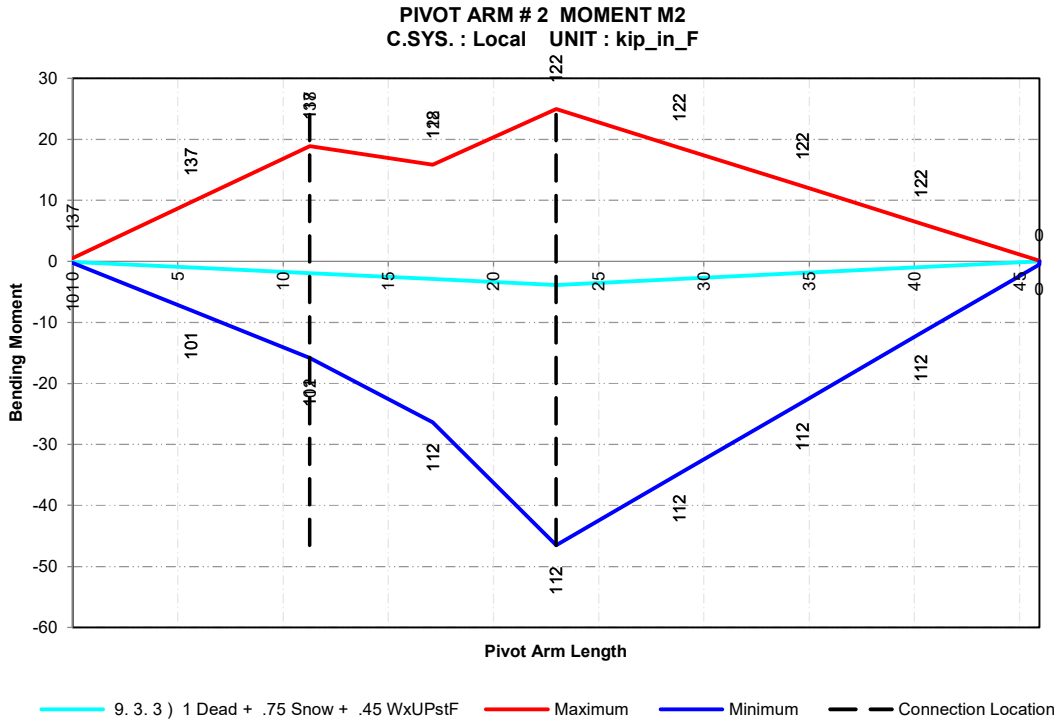
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*



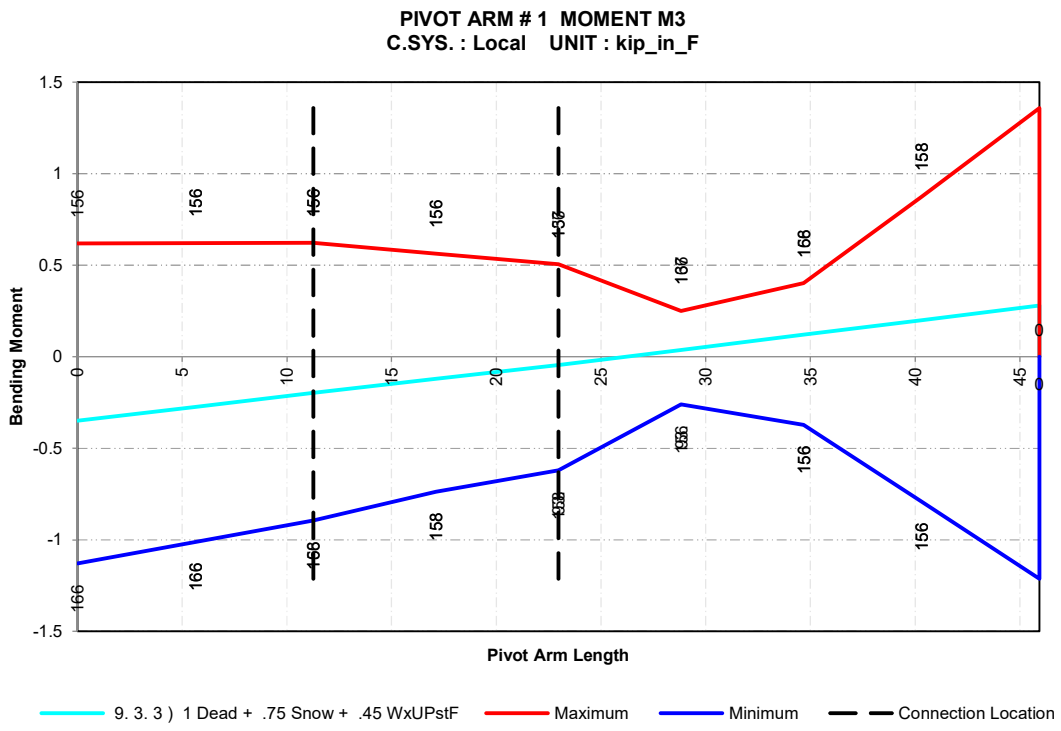


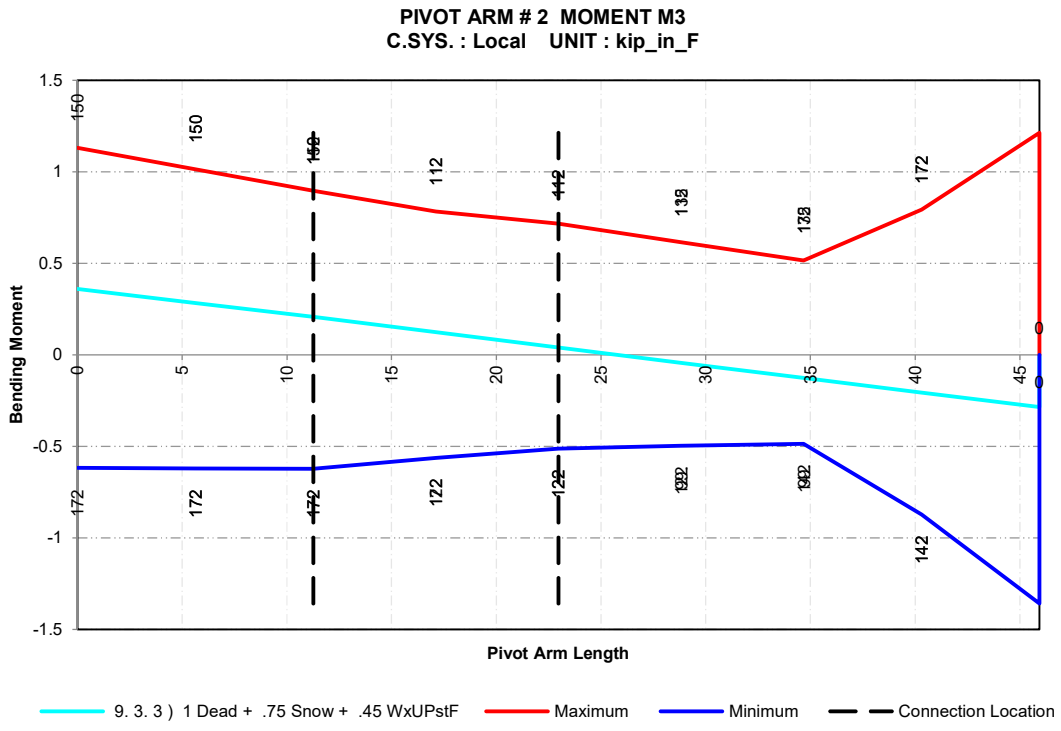
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*





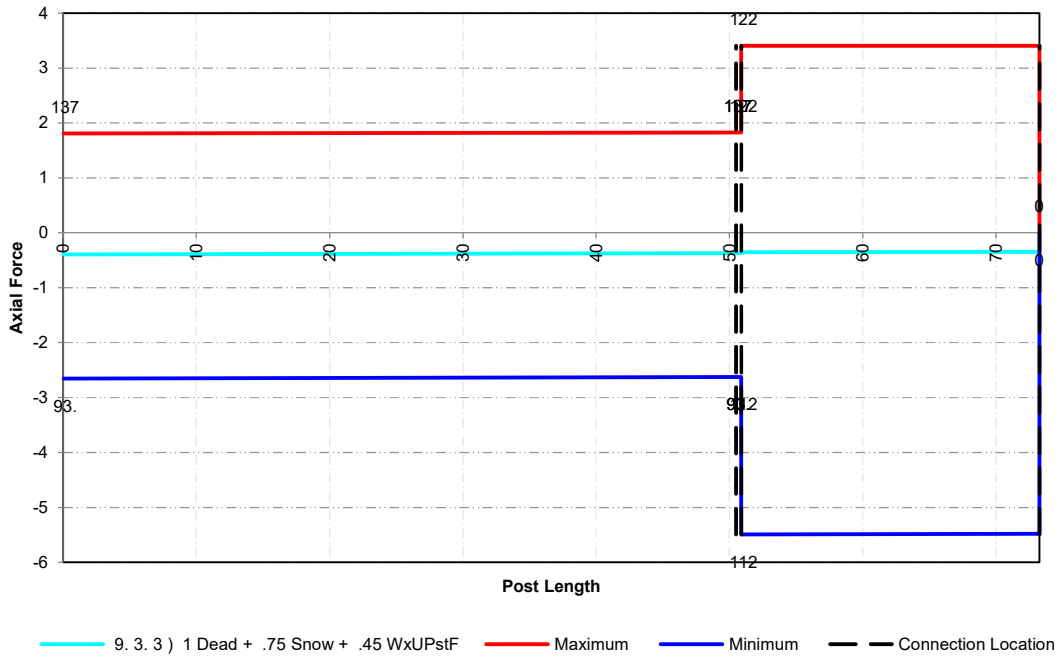
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*



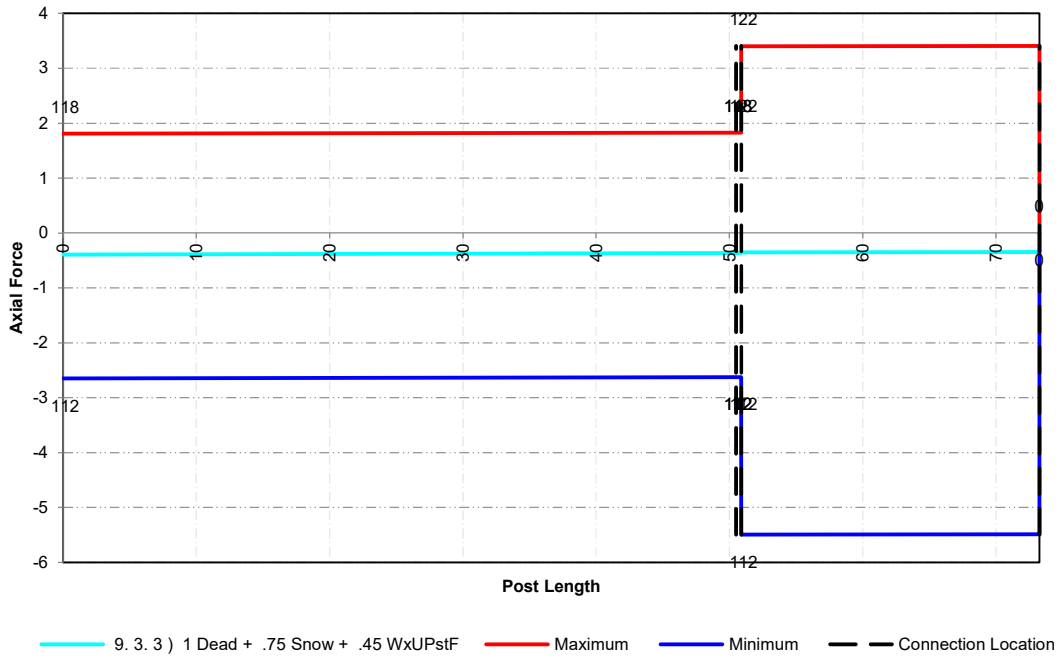


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

POST # 1 AXIAL FORCE
C.SYS. : Local UNIT : kip_in_F

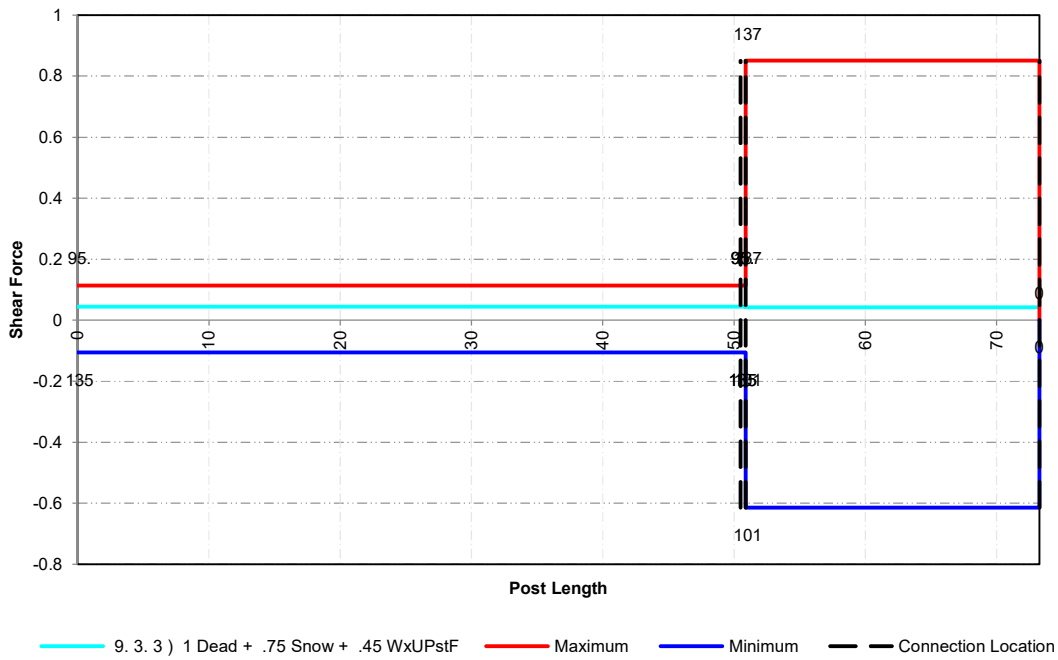


POST # 2 AXIAL FORCE
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

POST # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



POST # 2 SHEAR FORCE - V2
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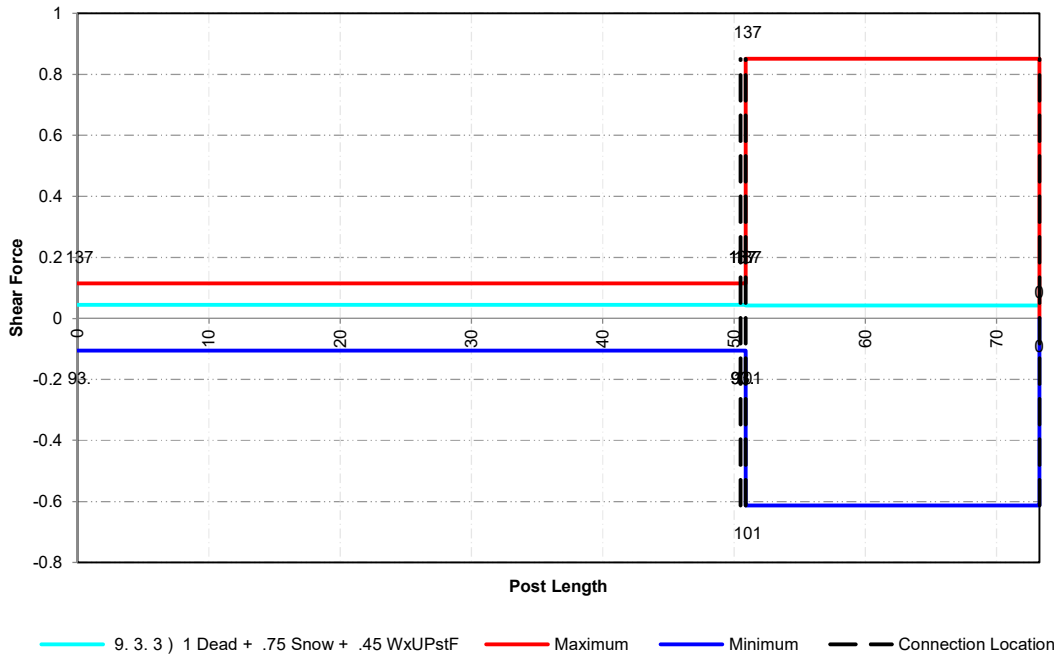
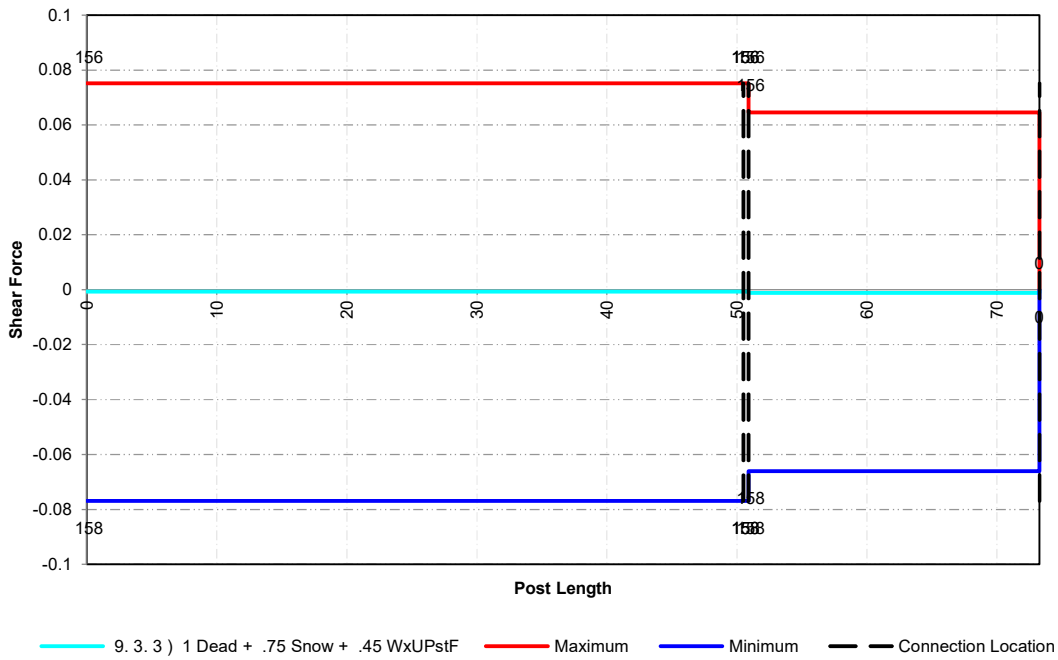
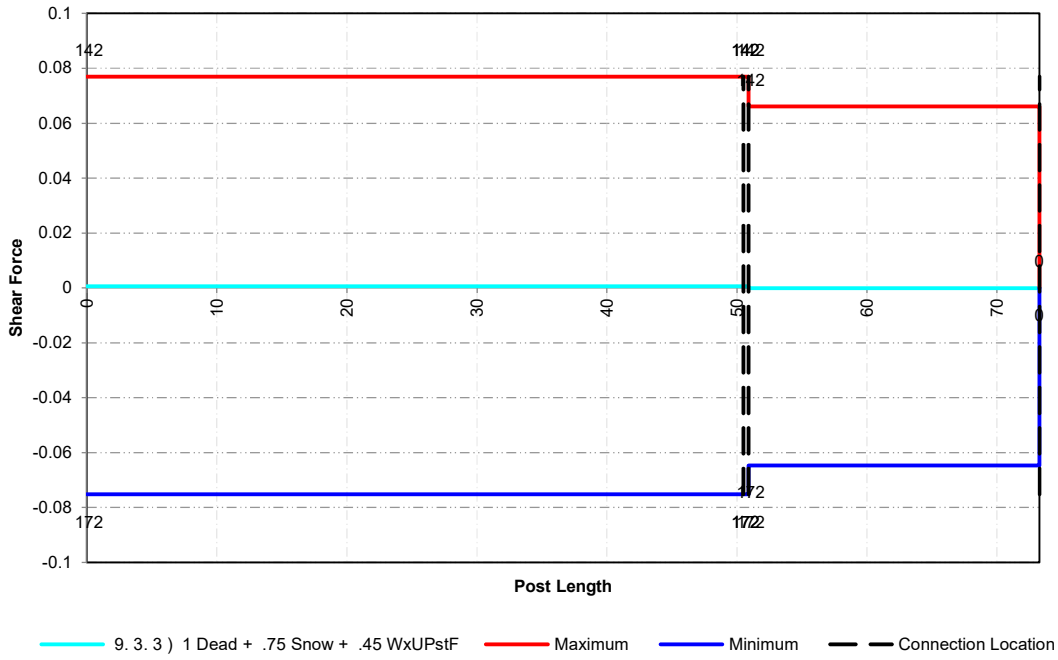


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

POST # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

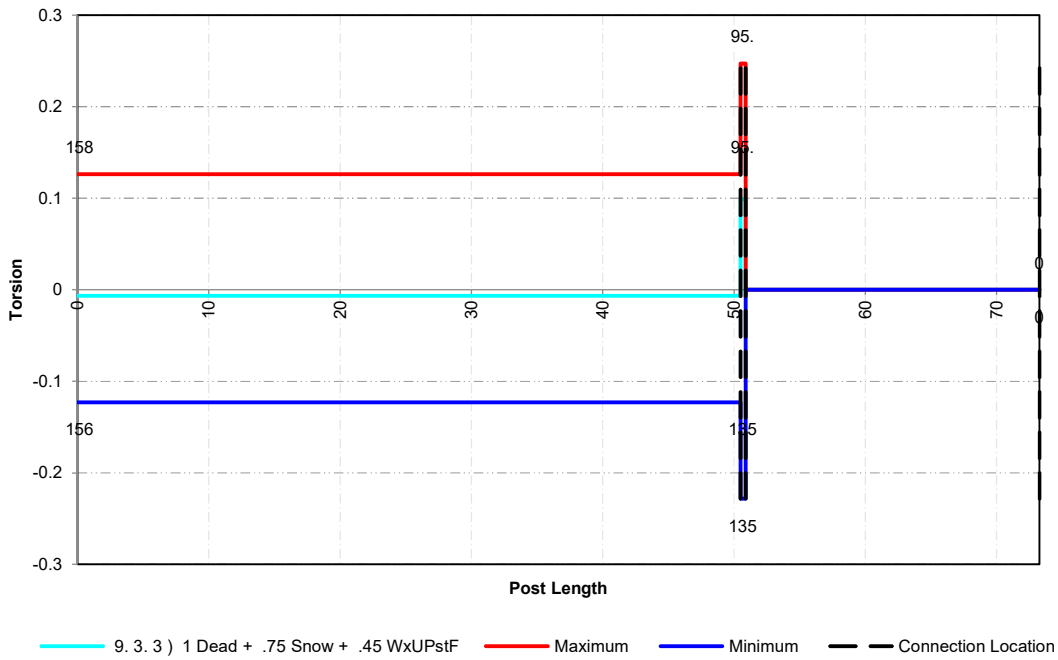


POST # 2 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

POST # 1 TORSION
C.SYS. : Local UNIT : kip_in_F



POST # 2 TORSION
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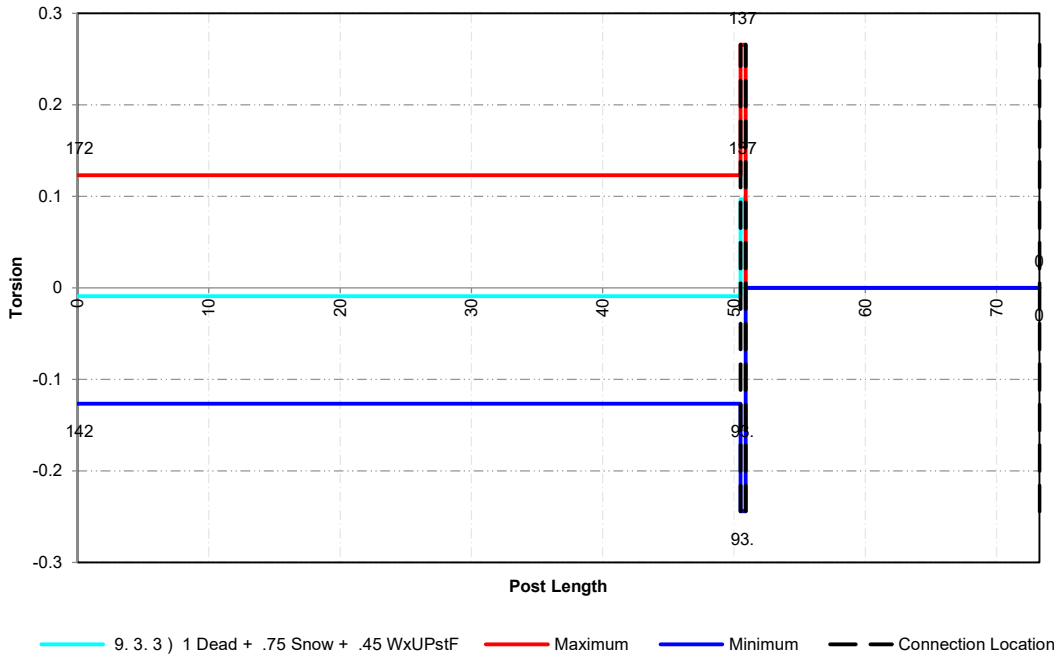
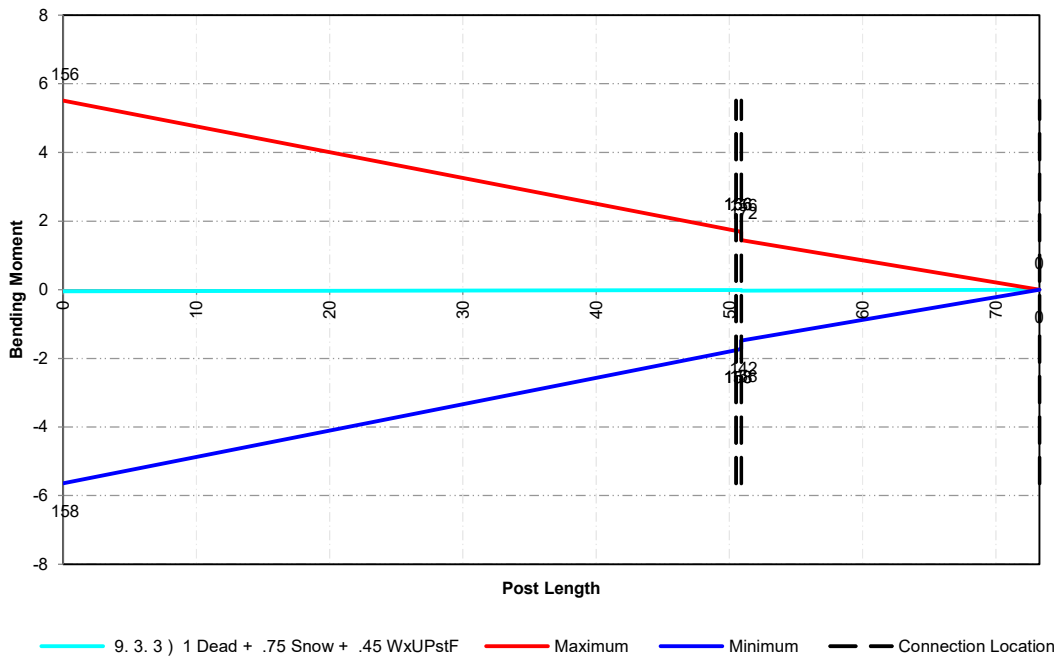
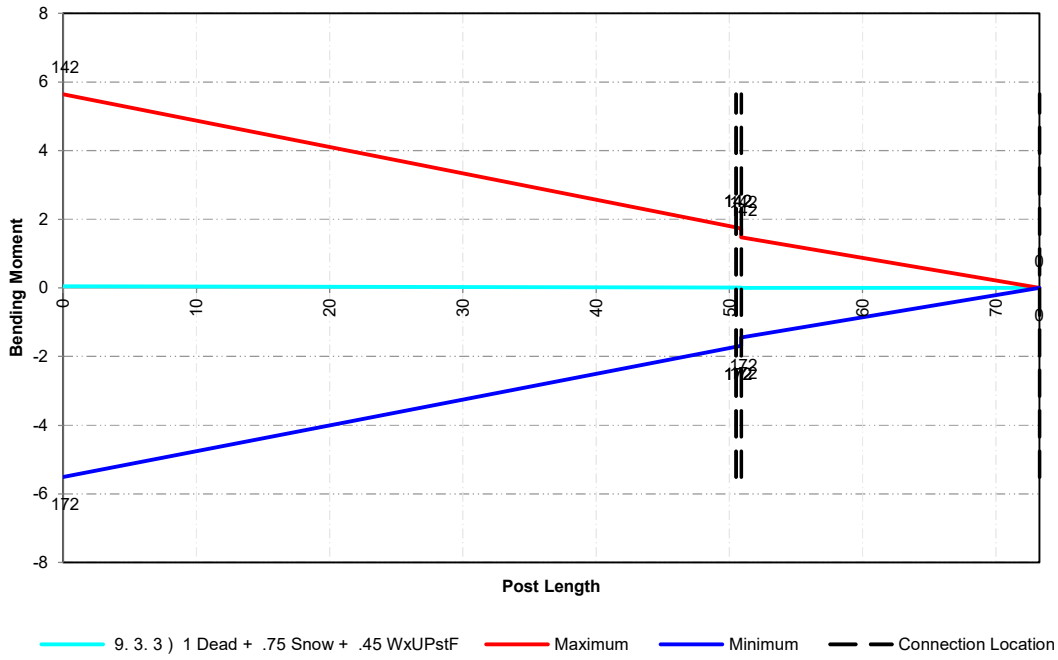


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

POST # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

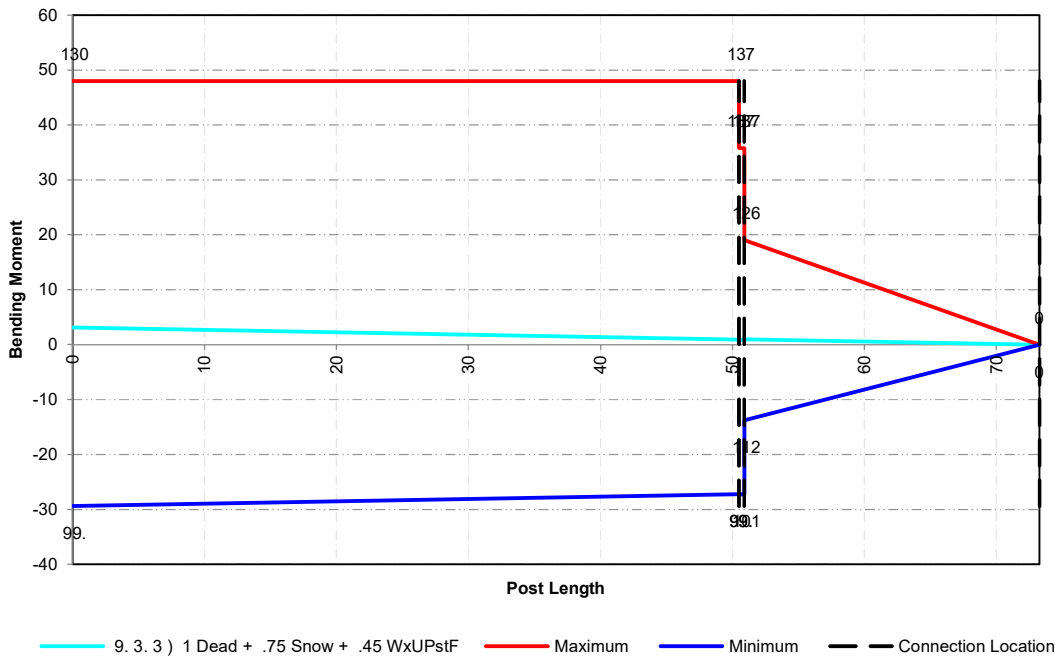


POST # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *3 degree*

POST # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



POST # 2 MOMENT M3
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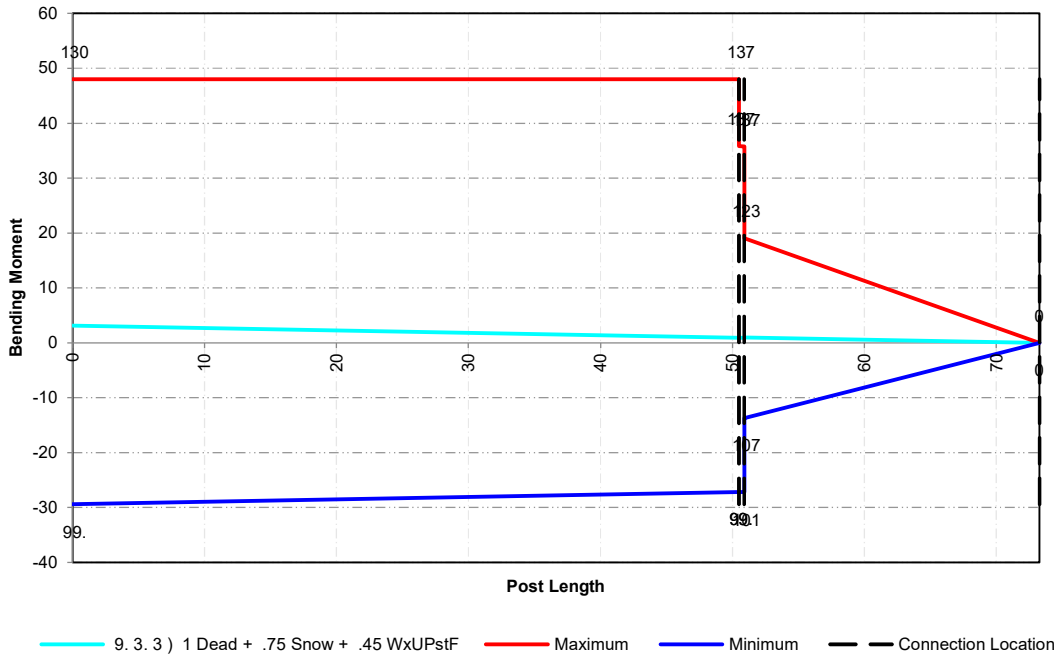


PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

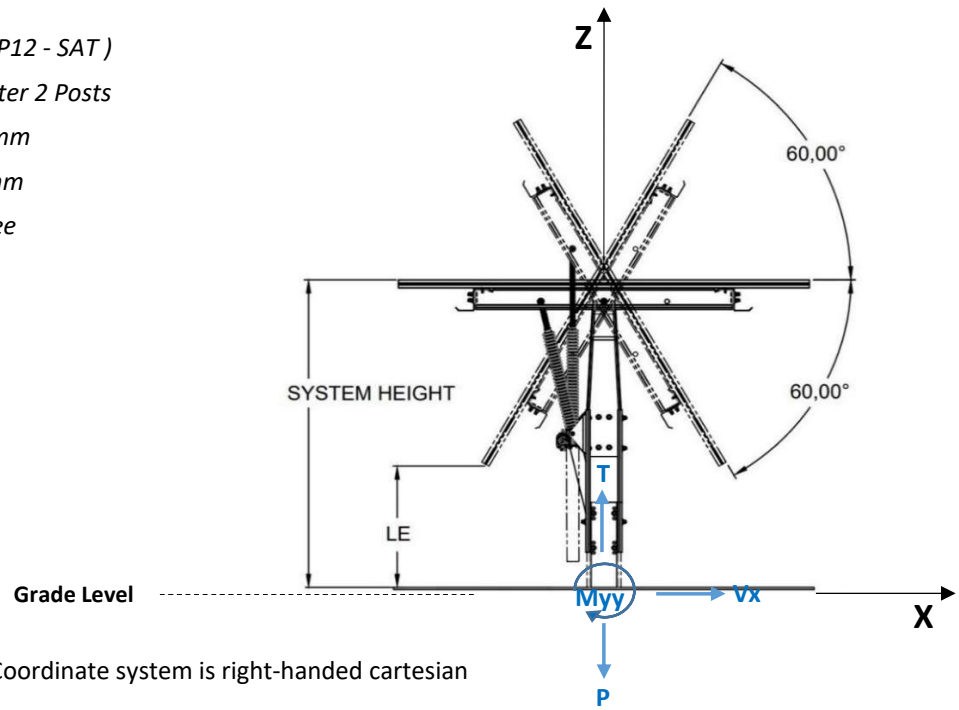
TABLE : *X20 (1P12 - SAT)*

CLASS : *Perimeter 2 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *0 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.64	0.80	1.02	2.61	≈ 0	0.19	0.83
	T	n/a	0.00	n/a	-3.08	≈ 0	n/a	-1.30
	V_x	0.00	0 , 0	0.00	± 0	± 0.09	0.00	0 , 0
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.00	-0.37 , 0.37	0.00	± 6.03	± 0.57	0.00	-2.38 , 3.22
	M_{xx}	-0.01	-0.02 , 0	± 0.01	± 0.04	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02
2ND	**P**	0.64	0.83	1.02	2.61	≈ 0	0.19	0.83
	T	n/a	0.00	n/a	-3.08	≈ 0	n/a	-1.30
	V_x	0.00	0 , 0	0.00	± 0	± 0.09	0.00	0 , 0
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.00	-0.37 , 0.37	0.00	± 6.03	± 0.57	0.00	-2.38 , 3.22
	M_{xx}	0.01	0 , 0.02	± 0.01	± 0.04	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.01

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

Reaction Loads & Member Sizing Summary

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X20 (1P12 - SAT)*

LENGTH : *2279 mm*

CLASS : *Perimeter 2 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *0 degree*

CHORD LENGTH : *13784 mm*

POST SPAN : *8340 mm*

CHORD CONTILEVER : *2722 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	1.95	4	20	45
Splice / Z	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		3.1	note * : standard baseline section		
Pivot Arm - Mid / Ω	N/A	N/A		N/A	N/A		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O	GR_50	88.9	n/a	4.5	n/a	n/a	n/a

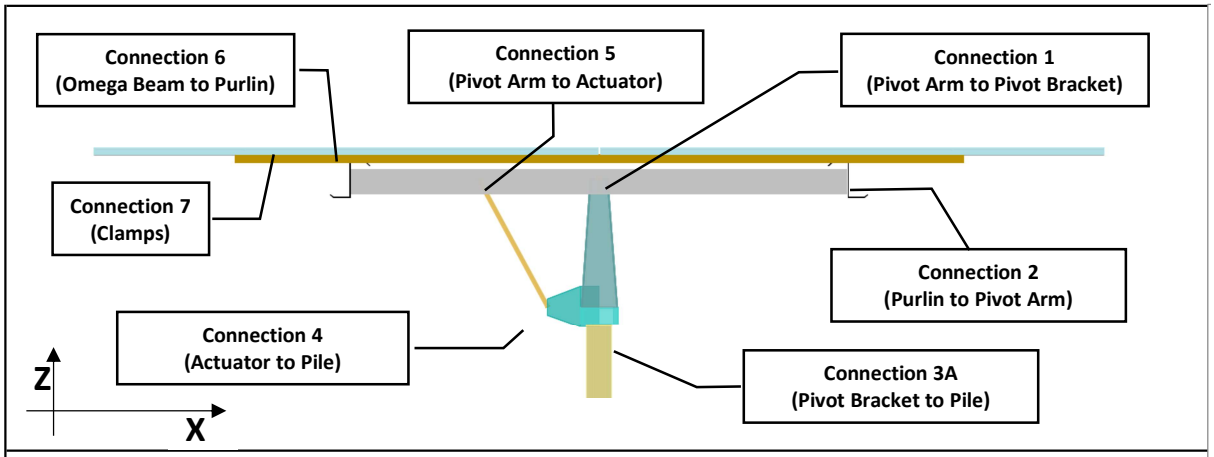
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.64	0.80	1.02	2.61	≈ 0	0.19	0.83
	T	n/a	0.00	n/a	-3.08	≈ 0	n/a	-1.30
	V_x	0.00	0 , 0	0.00	± 0	± 0.09	0.00	0 , 0
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.00	-0.37 , 0.37	0.00	± 6.03	± 0.57	0.00	-2.38 , 3.22
	M_{xx}	-0.01	-0.02 , 0	± 0.01	± 0.04	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.02
2ND	**P**	0.64	0.83	1.02	2.61	≈ 0	0.19	0.83
	T	n/a	0.00	n/a	-3.08	≈ 0	n/a	-1.30
	V_x	0.00	0 , 0	0.00	± 0	± 0.09	0.00	0 , 0
	V_y	0.00	0 , 0	0.00	± 0.01	± 0.11	0.00	± 0
	M_{yy}	0.00	-0.37 , 0.37	0.00	± 6.03	± 0.57	0.00	-2.38 , 3.22
	M_{xx}	0.01	0 , 0.02	± 0.01	± 0.04	± 0.66	0.00	± 0.02
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0.01

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

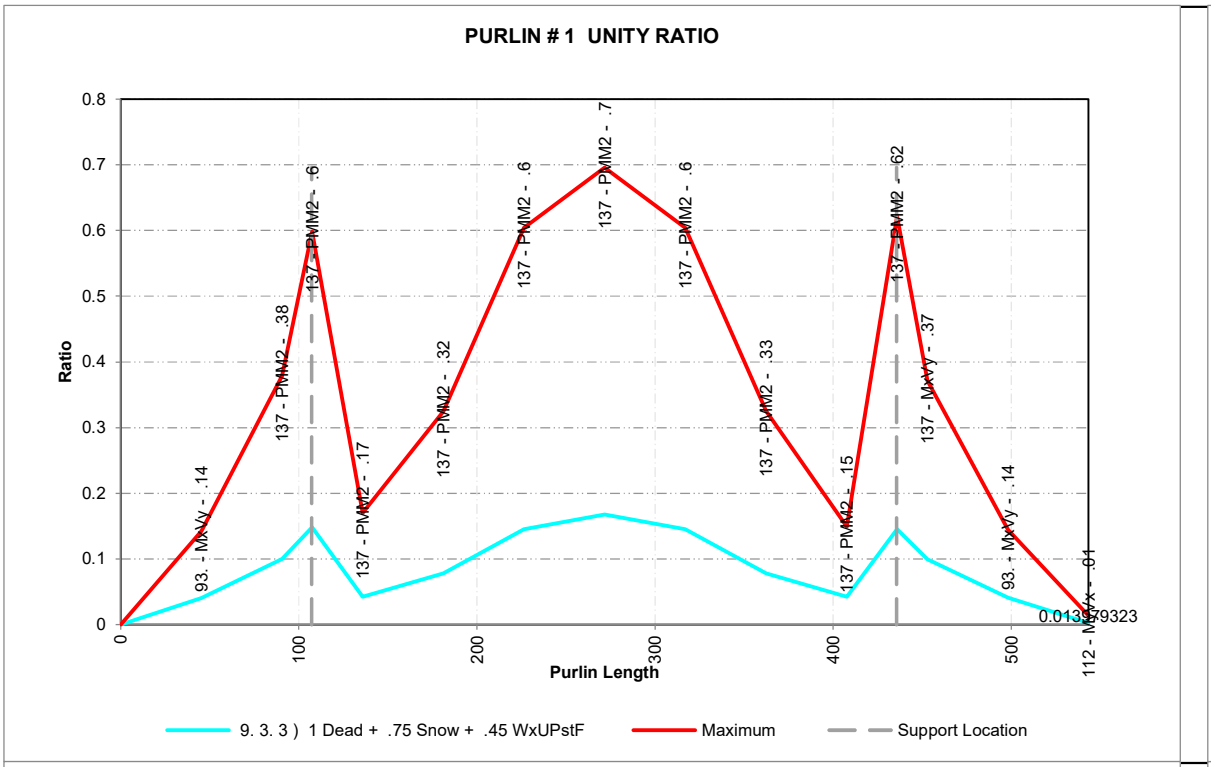
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *0 degree*

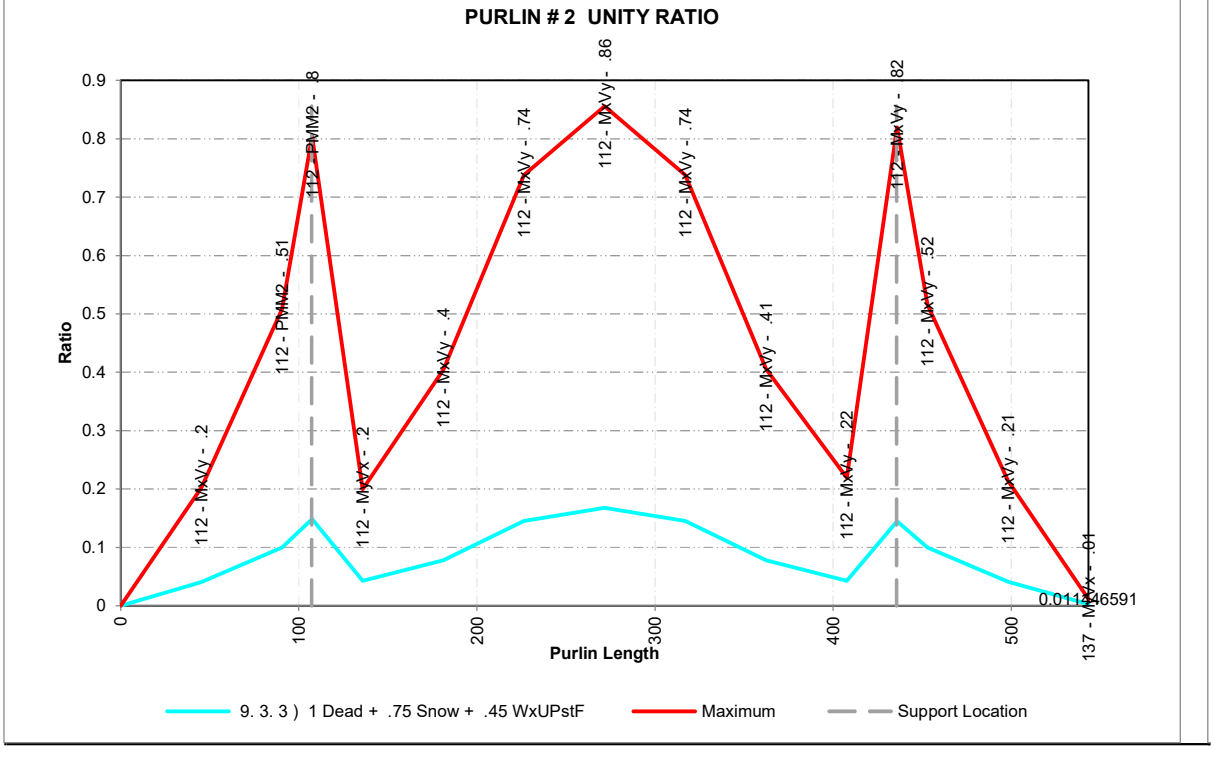


Note: coordinate system is right-handed cartesian

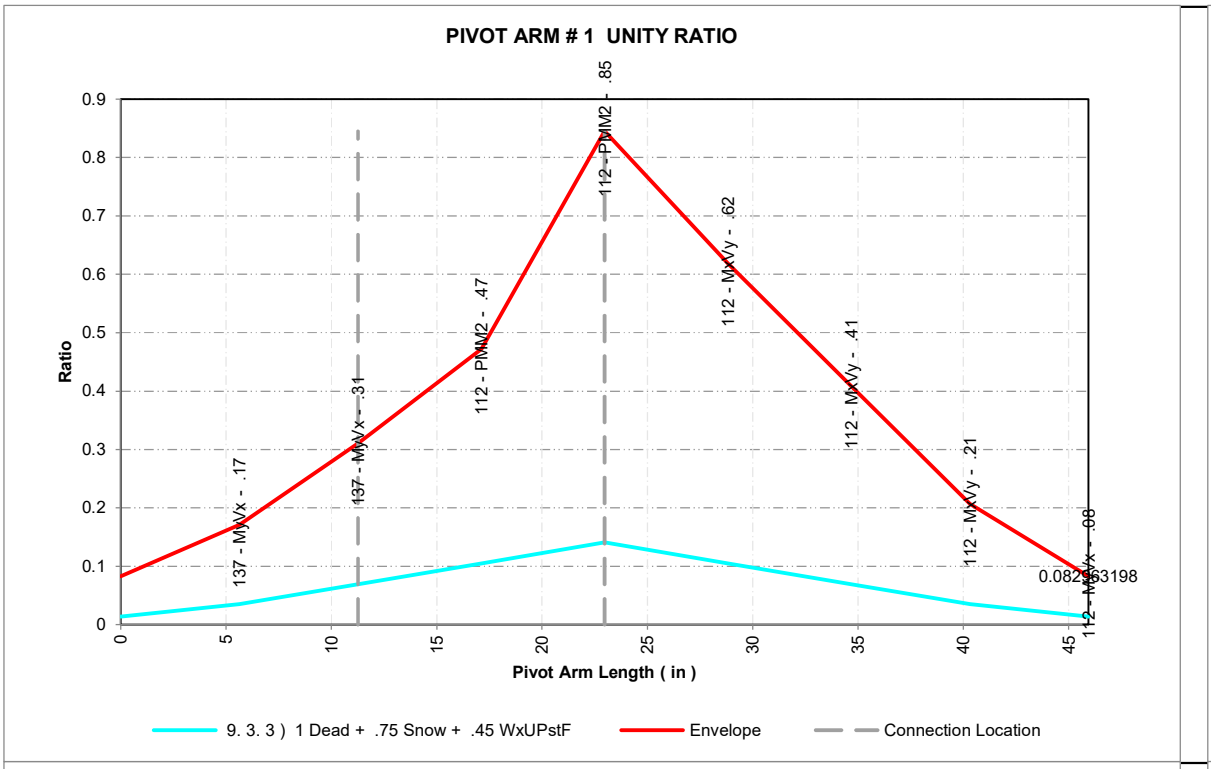
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-4.89	0.72	0.00	0.00	0.00	0.00	112. 4. 21) 1 Dead + .6 WxDNal+T
-0.59	0.00	0.07	0.00	0.00	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 2						
0.22	0.39	-0.01	0.00	-0.04	0.04	112. 4. 21) 1 Dead + .6 WxDNal+T
0.15	-1.74	0.01	0.00	0.03	-0.04	112. 4. 21) 1 Dead + .6 WxDNal+T
Connection : 3						
1.47	0.00	0.00	0.00	-0.02	2.66	137. 5. 23) .6 Dead + .6 WxUPal+T
-2.20	0.00	0.00	0.00	0.03	0.00	93. 4. 2) 1 Dead + .6 WxDNalF
-0.64	-0.07	0.00	0.00	0.01	-0.40	157. 12. 1) 1 Dead + -.7 Quake_x
-0.64	0.00	0.00	0.00	0.01	-3.62	107. 4. 16) 1 Dead + .6 WxOTal
-0.64	0.00	0.08	-0.01	0.47	0.00	142. 9. 2) 1 Dead + .7 Quake_y
-0.64	0.00	0.08	-0.01	0.47	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
2.82	*	0.00	0.00	0.00	0.00	112. 4. 21) 1 Dead + .6 WxDNal+T
Connection : 5		** Note : the load is axial in actuator direction*				
2.82	*	0.00	0.00	0.00	0.00	112. 4. 21) 1 Dead + .6 WxDNal+T
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.23						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.23						0.6 WLup

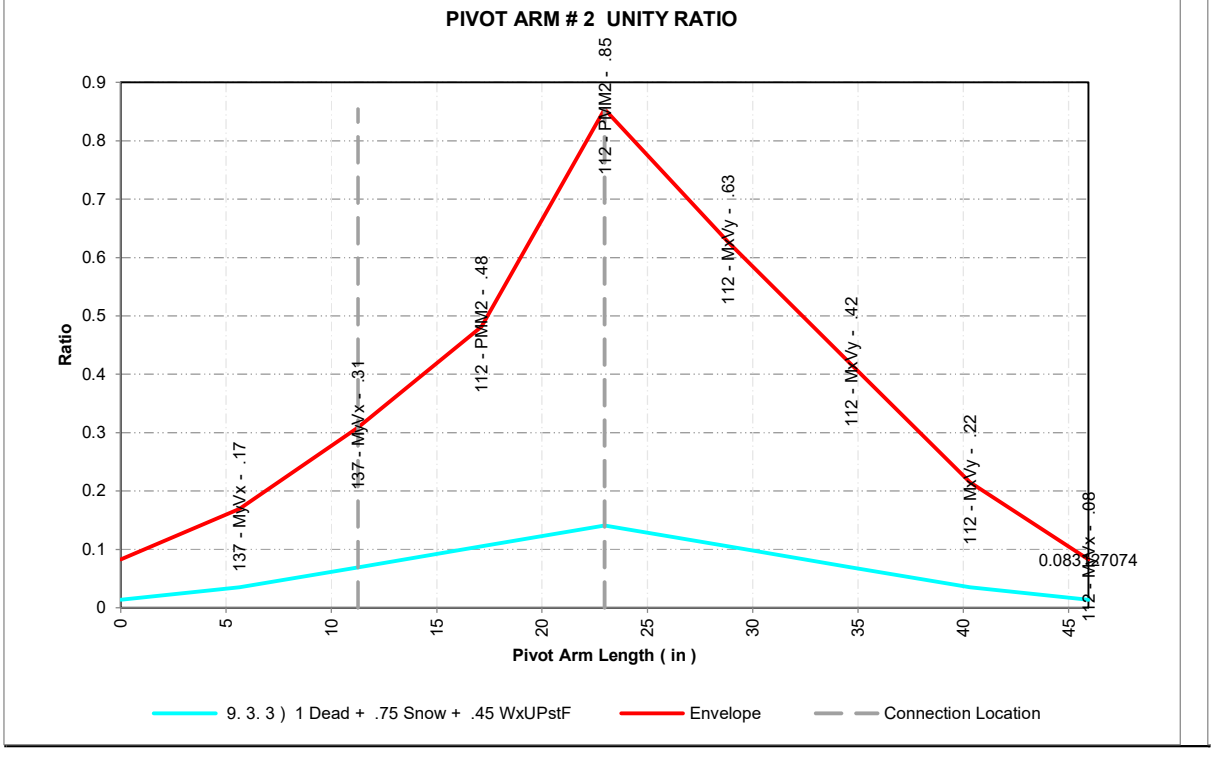
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *0 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *0 degree*



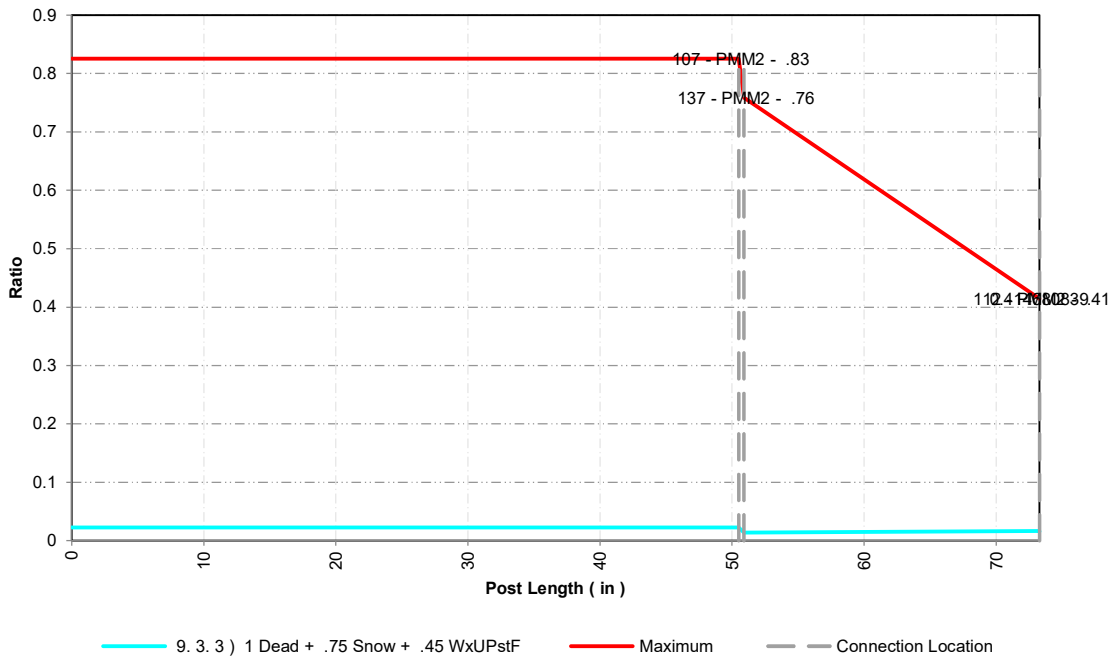


Post Unity Ratio Charts

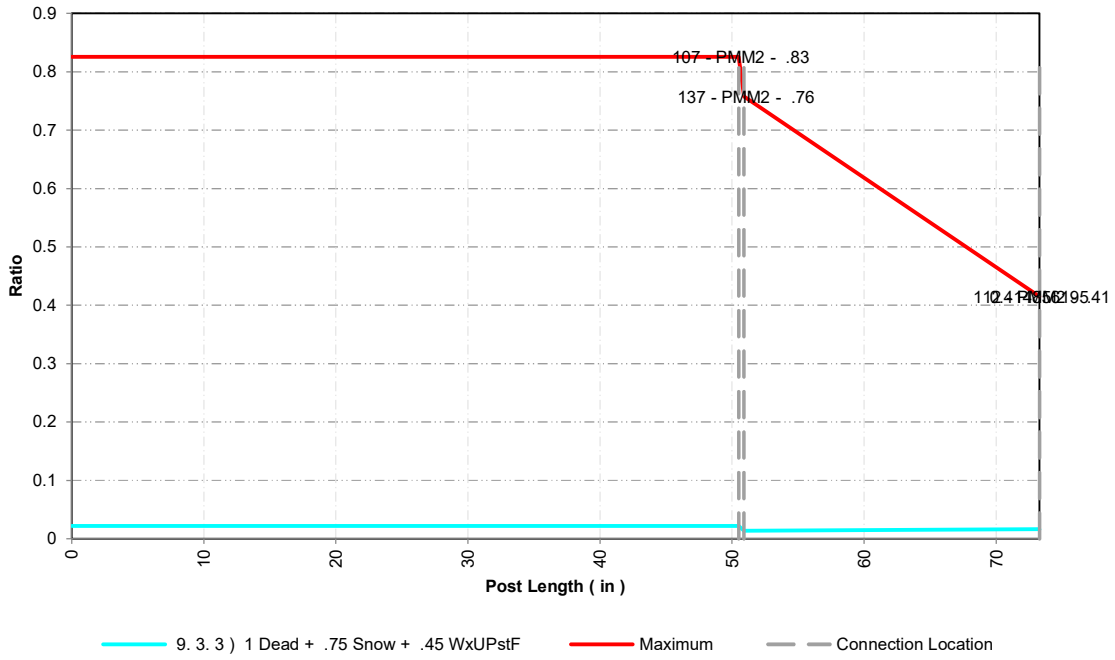
DESIGN PART *page A-006*

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *0 degree*

POST # 1 UNITY RATIO



POST # 2 UNITY RATIO



PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

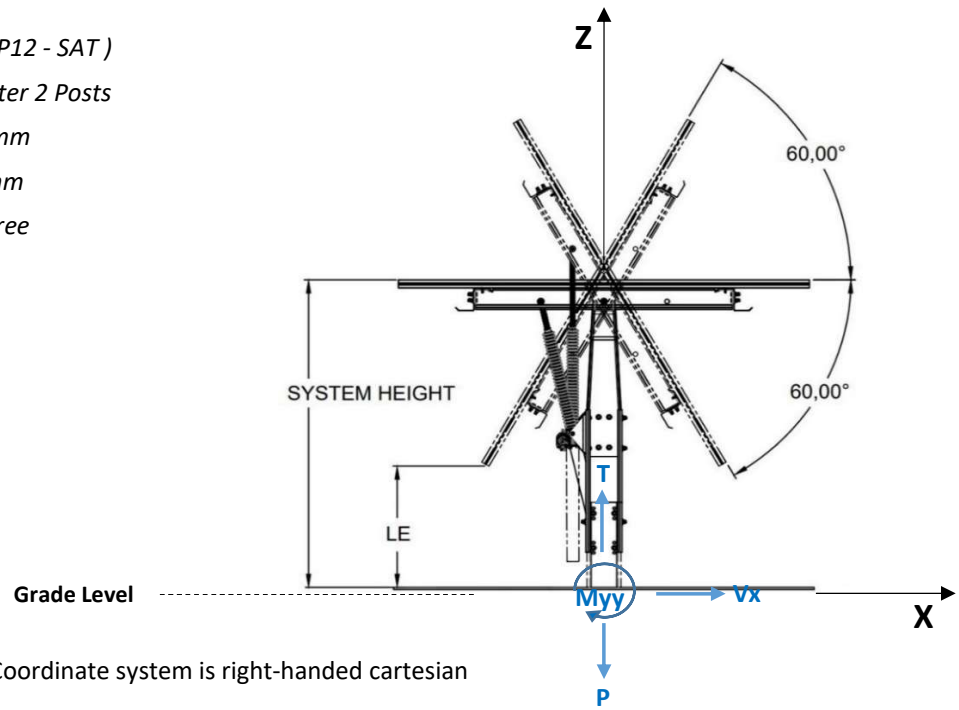
TABLE : *X20 (1P12 - SAT)*

CLASS : *Perimeter 2 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *30 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.64	0.50	0.00	0.25	≈ 0	0.00	0.25
	T	n/a	0.00	n/a	-0.20	≈ 0	n/a	-0.20
	V_x	0.00	0 , 0	0.00	± 0.14	± 0.09	0.00	-0.11 , 0.14
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	0.02	-0.2 , 0.21	0.00	± 1.2	± 0.57	0.00	-1.2 , 0.88
	M_{xx}	-0.01	-0.01 , 0	0.00	± 0	± 0.67	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
2ND	**P**	0.64	0.52	0.00	0.25	≈ 0	0.00	0.25
	T	n/a	0.00	n/a	-0.20	≈ 0	n/a	-0.20
	V_x	0.00	0 , 0	0.00	± 0.14	± 0.09	0.00	-0.11 , 0.14
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	0.02	-0.2 , 0.21	0.00	± 1.2	± 0.57	0.00	-1.2 , 0.88
	M_{xx}	0.01	0 , 0.01	0.00	± 0	± 0.67	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X20 (1P12 - SAT)*

LENGTH : *2279 mm*

CLASS : *Perimeter 2 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *30 degree*

CHORD LENGTH : *13784 mm*

POST SPAN : *8340 mm*

CHORD CONTILEVER : *2722 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	1.95	4	20	45
Splice / Z	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		3.1	note * : standard baseline section		
Pivot Arm - Mid / Ω	N/A	N/A		N/A	N/A		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O	GR_50	88.9	n/a	4.5	n/a	n/a	n/a

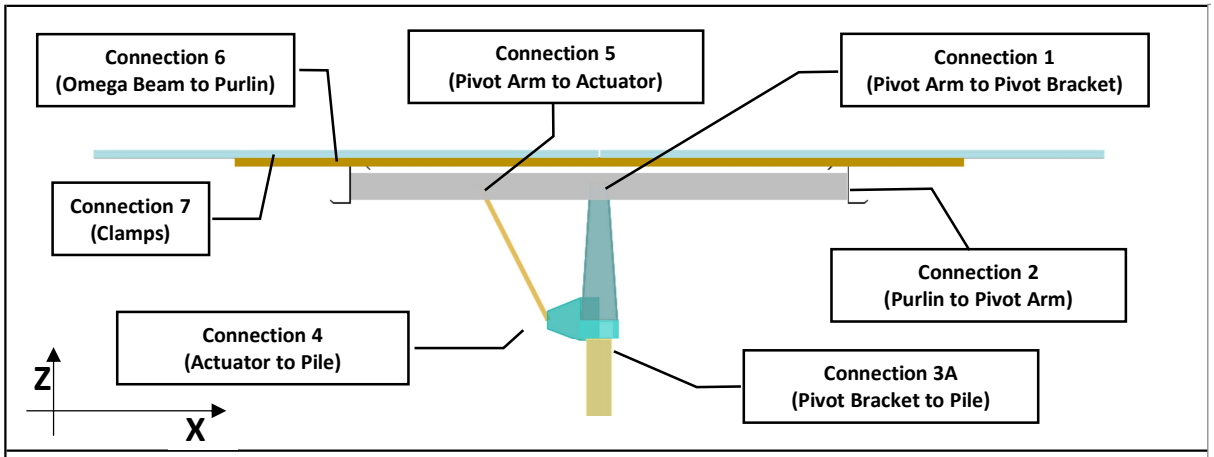
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.64	0.50	0.00	0.25	≈ 0	0.00	0.25
	T	n/a	0.00	n/a	-0.20	≈ 0	n/a	-0.20
	V_x	0.00	0 , 0	0.00	± 0.14	± 0.09	0.00	-0.11 , 0.14
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	0.02	-0.2 , 0.21	0.00	± 1.2	± 0.57	0.00	-1.2 , 0.88
	M_{xx}	-0.01	-0.01 , 0	0.00	± 0	± 0.67	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
2ND	**P**	0.64	0.52	0.00	0.25	≈ 0	0.00	0.25
	T	n/a	0.00	n/a	-0.20	≈ 0	n/a	-0.20
	V_x	0.00	0 , 0	0.00	± 0.14	± 0.09	0.00	-0.11 , 0.14
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	0.02	-0.2 , 0.21	0.00	± 1.2	± 0.57	0.00	-1.2 , 0.88
	M_{xx}	0.01	0 , 0.01	0.00	± 0	± 0.67	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

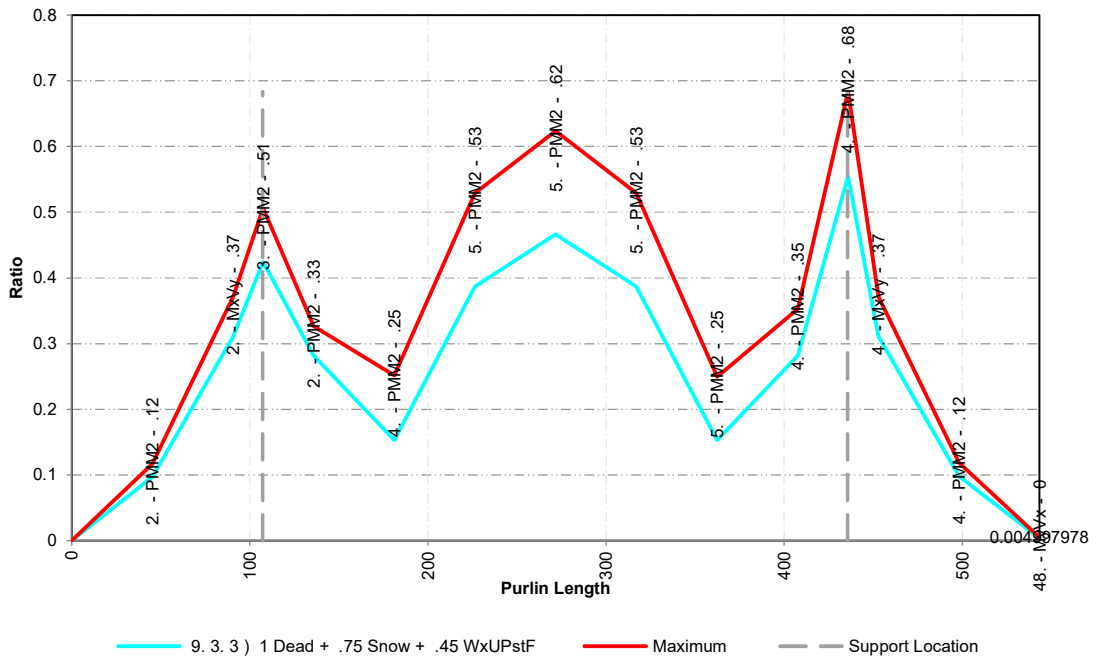


Note: coordinate system is right-handed cartesian

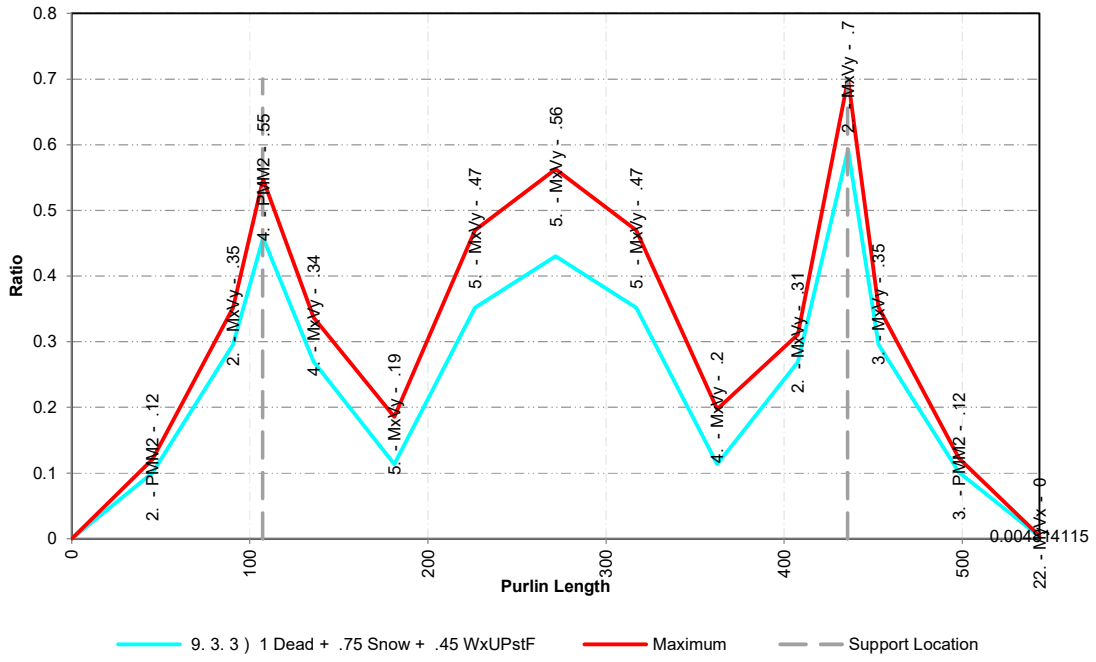
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-1.32	-0.01	0.00	0.00	0.00	0.00	76. 3. 112) 1 Dead + .75 S4_s2s_+ + .45 WxDNst+T
-0.57	0.00	0.07	0.00	0.00	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 2						
0.32	-0.48	0.15	0.00	-0.27	0.02	4. 2. 3) 1 Dead + 1 S2_lhhh
0.29	-0.52	0.13	0.00	-0.23	0.02	48. 3. 66) 1 Dead + .75 S2_lhhh + .45 WxDNst+T
Connection : 3						
-0.27	0.07	0.00	0.00	0.00	0.40	117. 5. 3) .6 Dead + .6 WxUPstF
-1.16	0.00	0.00	0.00	0.01	-0.03	4. 2. 3) 1 Dead + 1 S2_lhhh
-0.79	-0.09	0.00	0.00	0.01	-0.55	92. 4. 1) 1 Dead + .6 WxDNstF
-0.38	0.00	0.00	0.00	0.00	0.71	130. 5. 16) .6 Dead + .6 WxOTal
-0.64	0.00	0.08	-0.01	0.47	-0.02	142. 9. 2) 1 Dead + .7 Quake_y
-0.64	0.00	0.08	-0.01	0.47	-0.02	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
-0.37	*	0.00	0.00	0.00	0.00	82. 3. 124) 1 Dead + .75 S4_s2s_- + .45 WxDNstH-
Connection : 5		** Note : the load is axial in actuator direction*				
-0.37	*	0.00	0.00	0.00	0.00	82. 3. 124) 1 Dead + .75 S4_s2s_- + .45 WxDNstH-
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.02						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.02						0.6 WLup

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

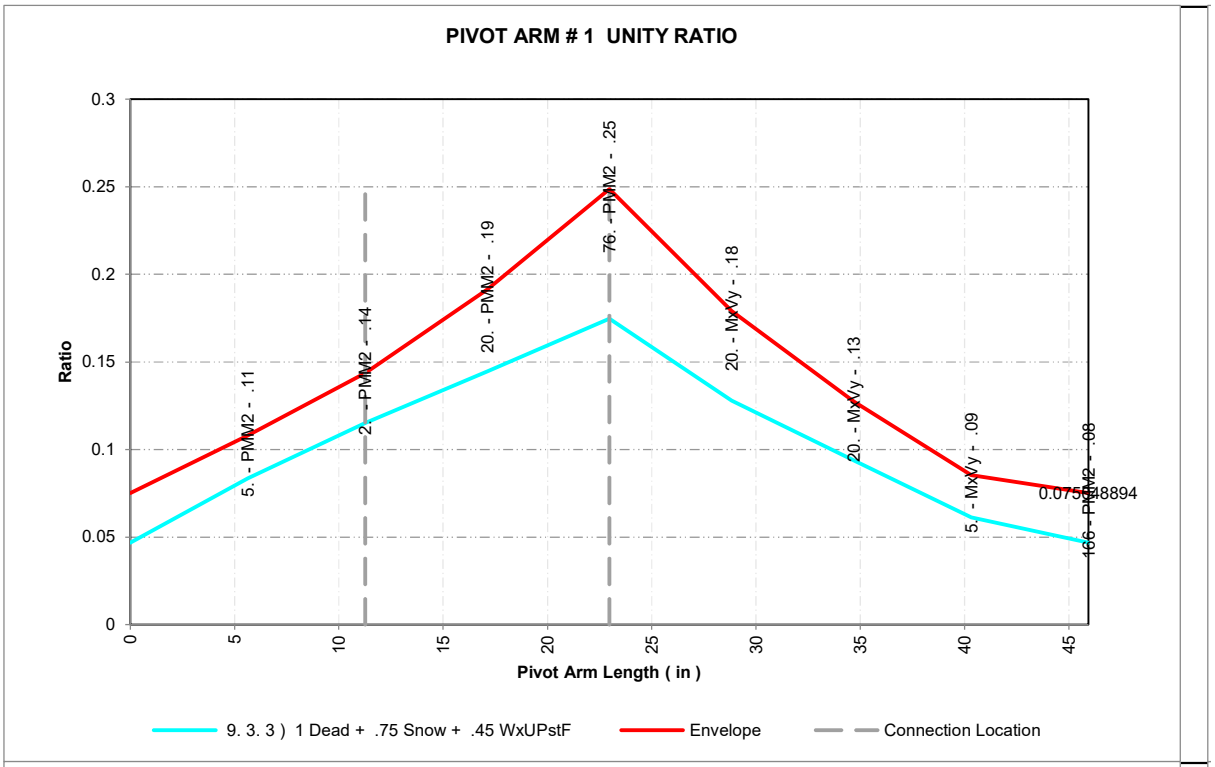
PURLIN # 1 UNITY RATIO

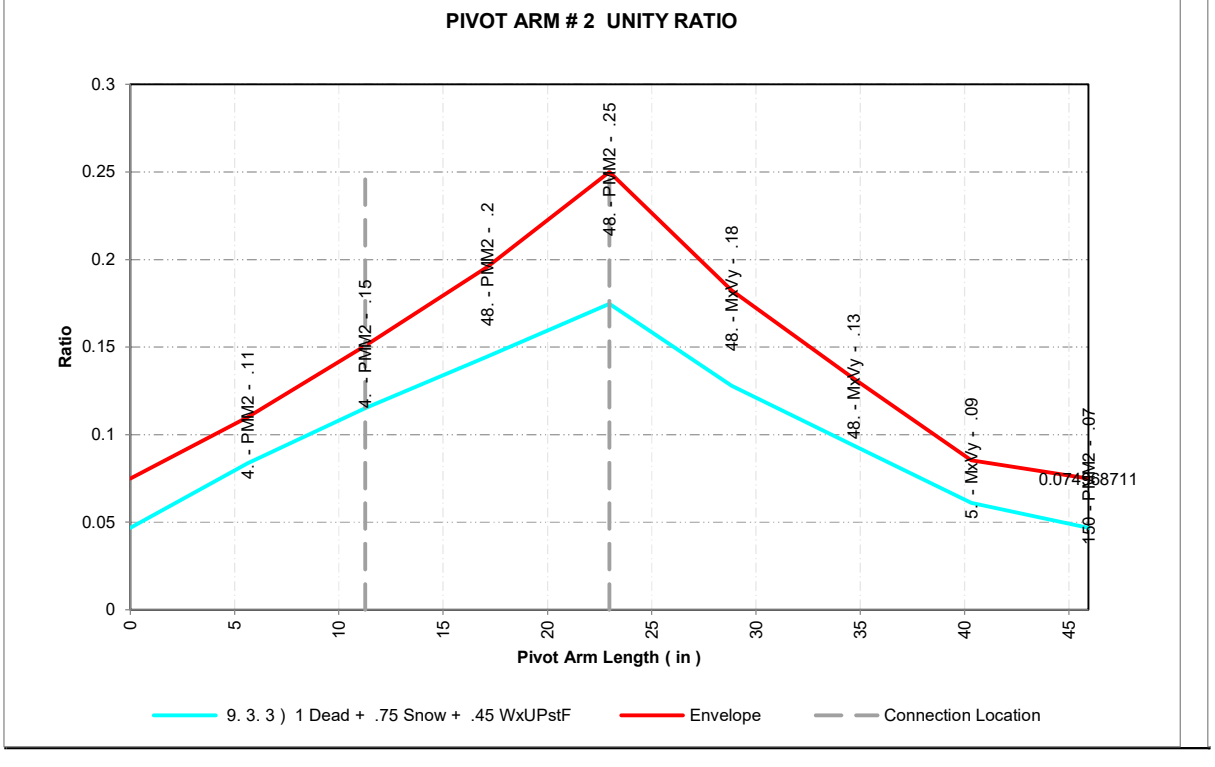


PURLIN # 2 UNITY RATIO



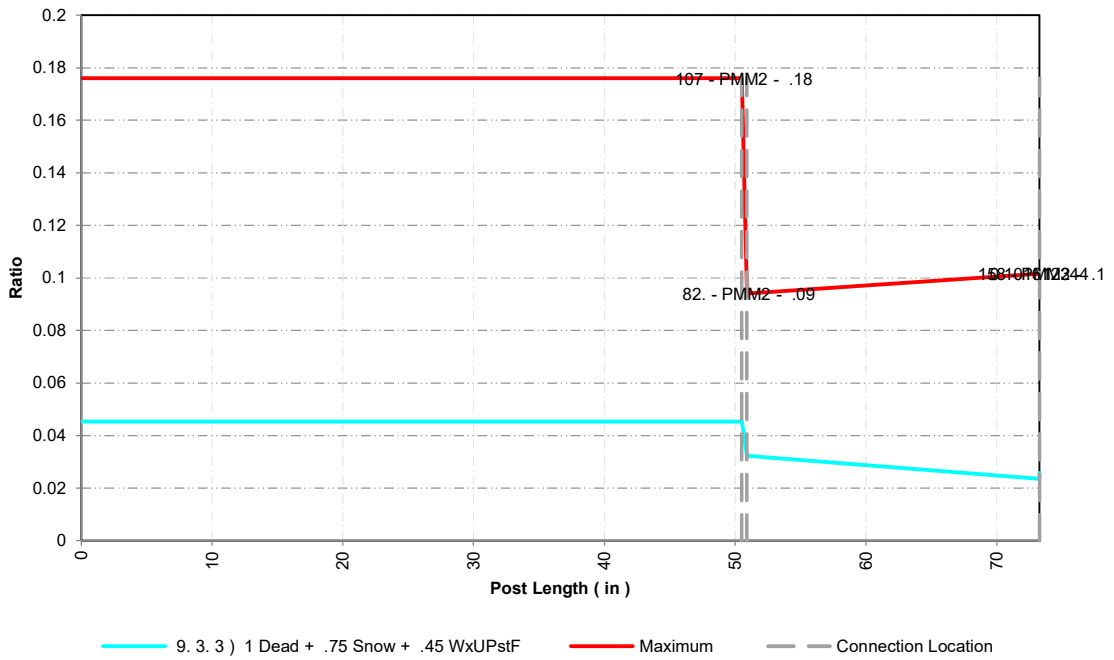
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*



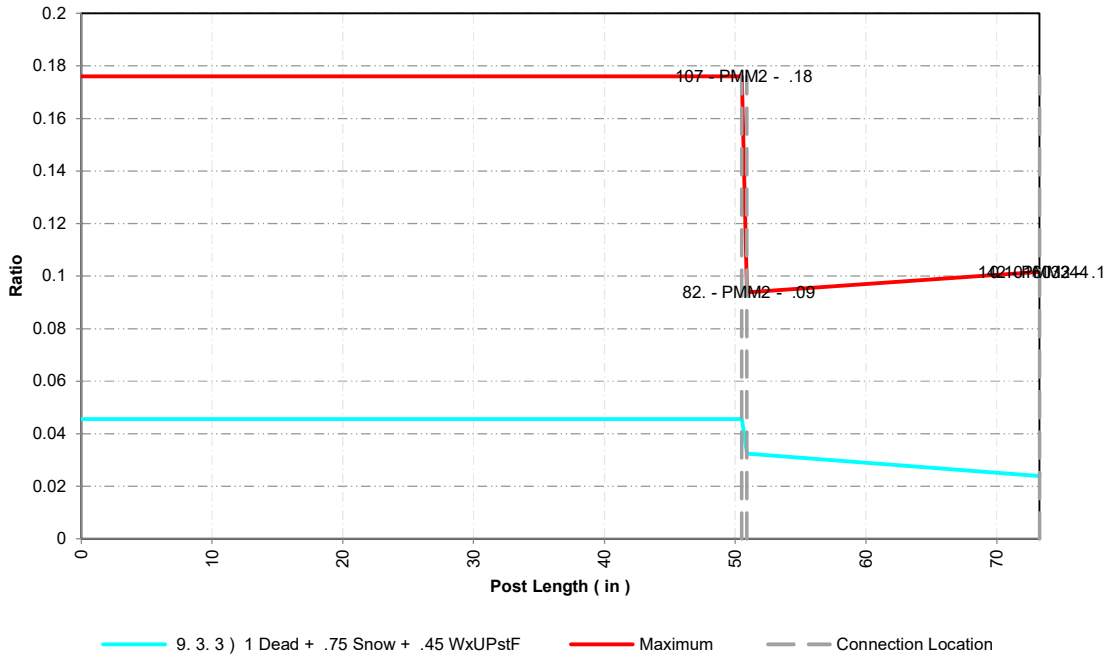


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

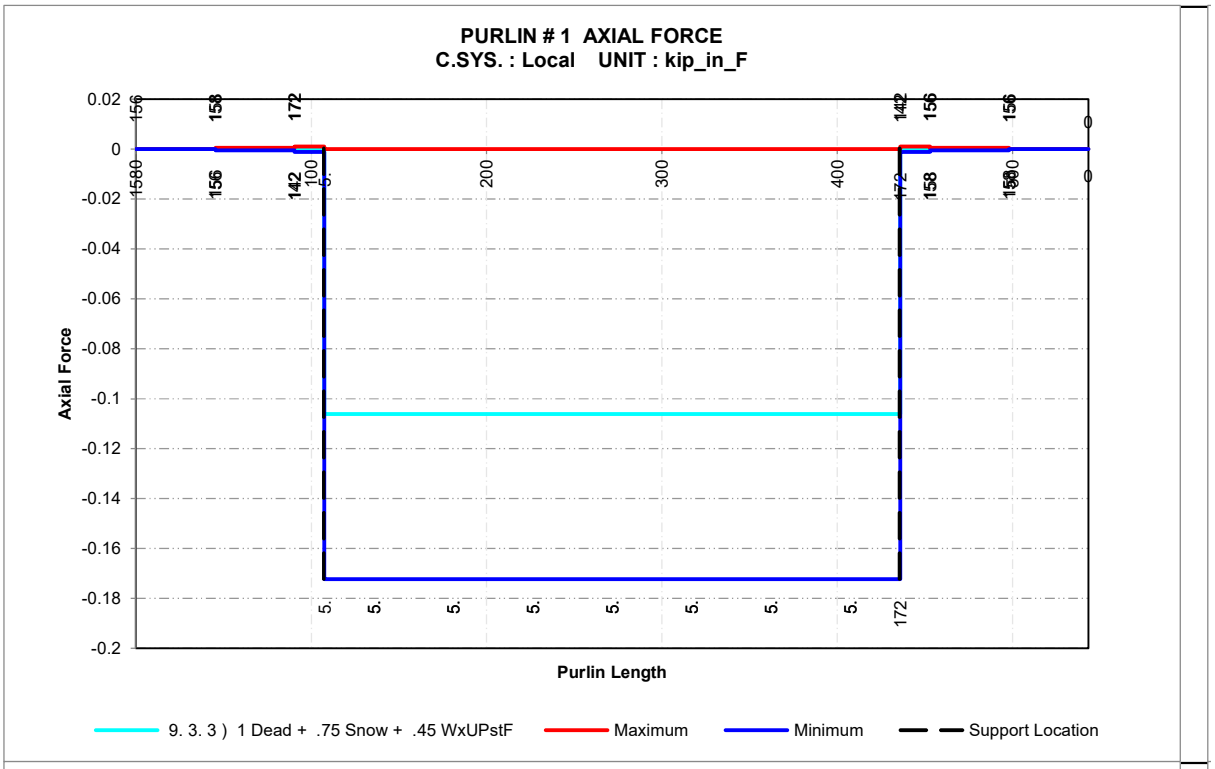
POST # 1 UNITY RATIO

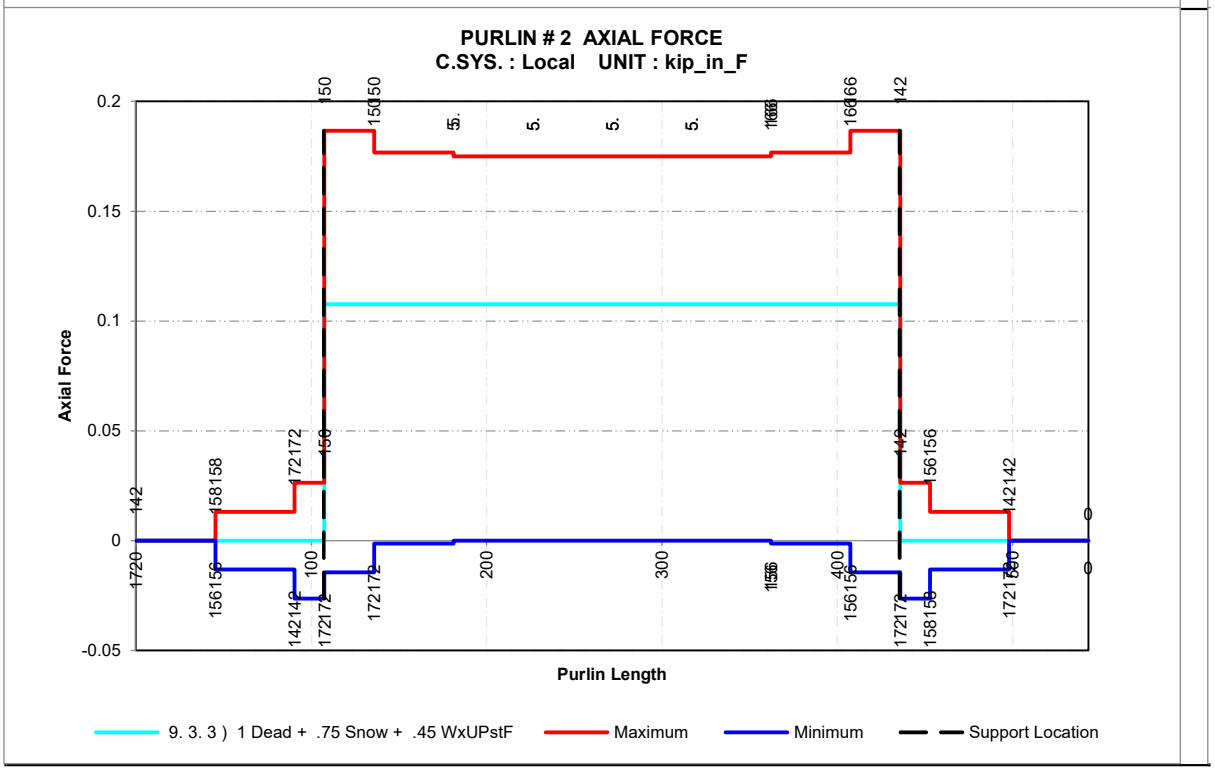


POST # 2 UNITY RATIO



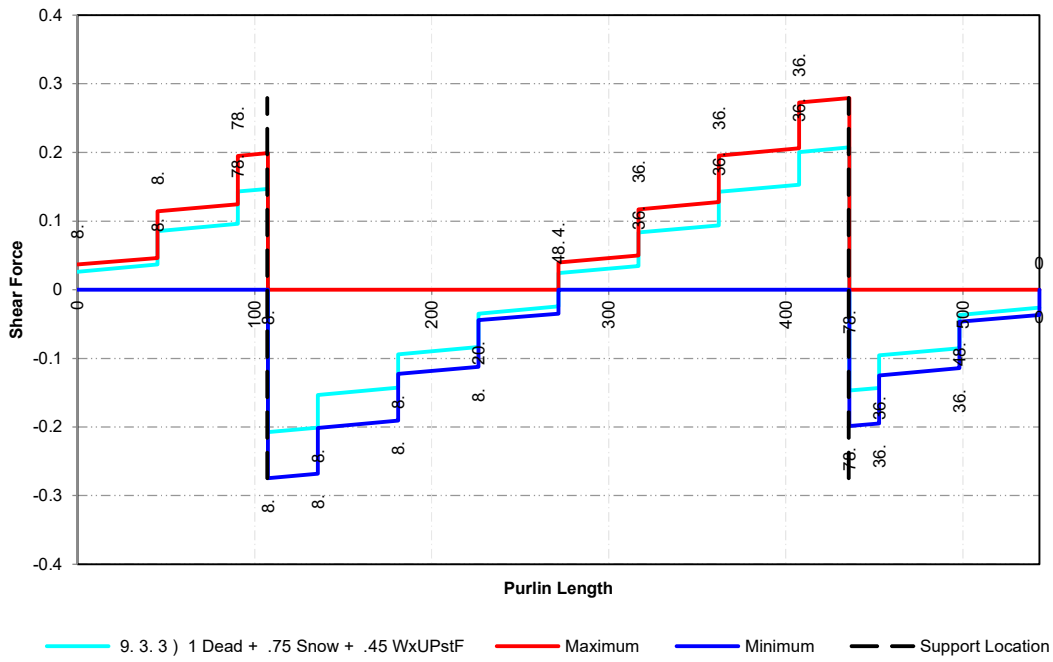
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

PURLIN # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



PURLIN # 2 SHEAR FORCE - V2
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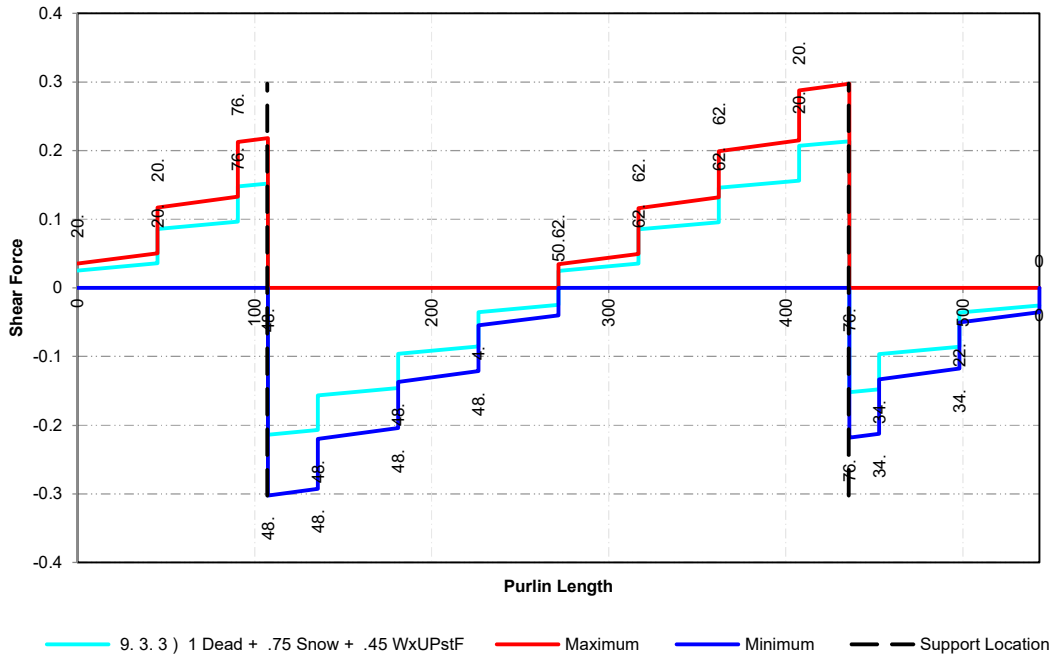
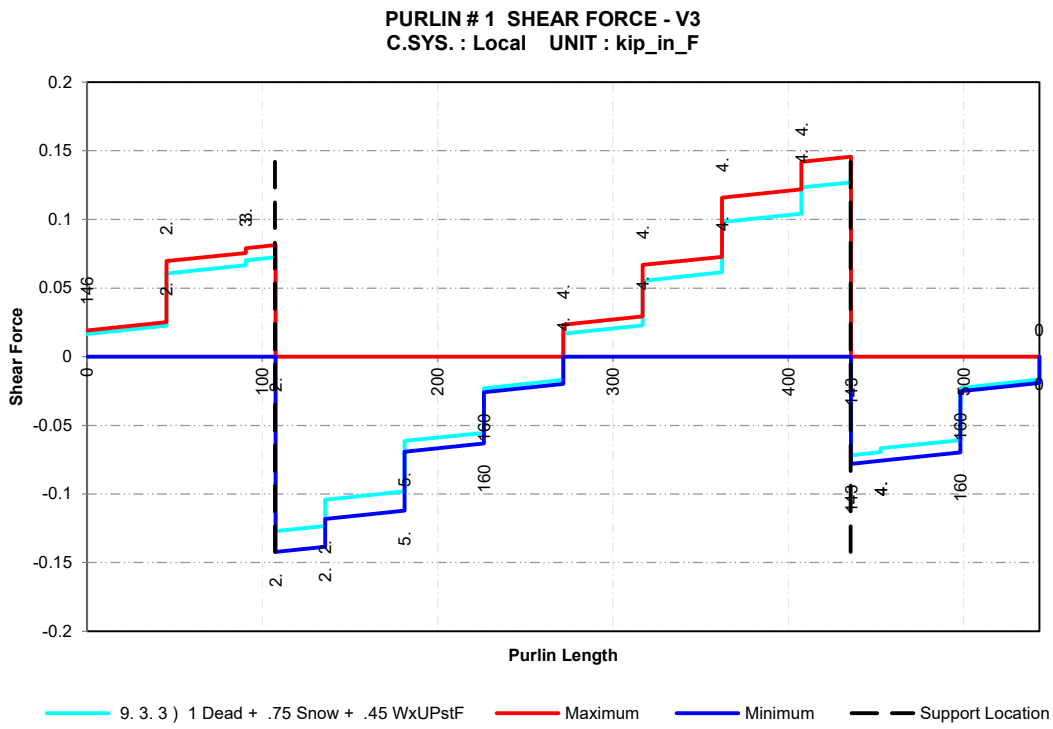
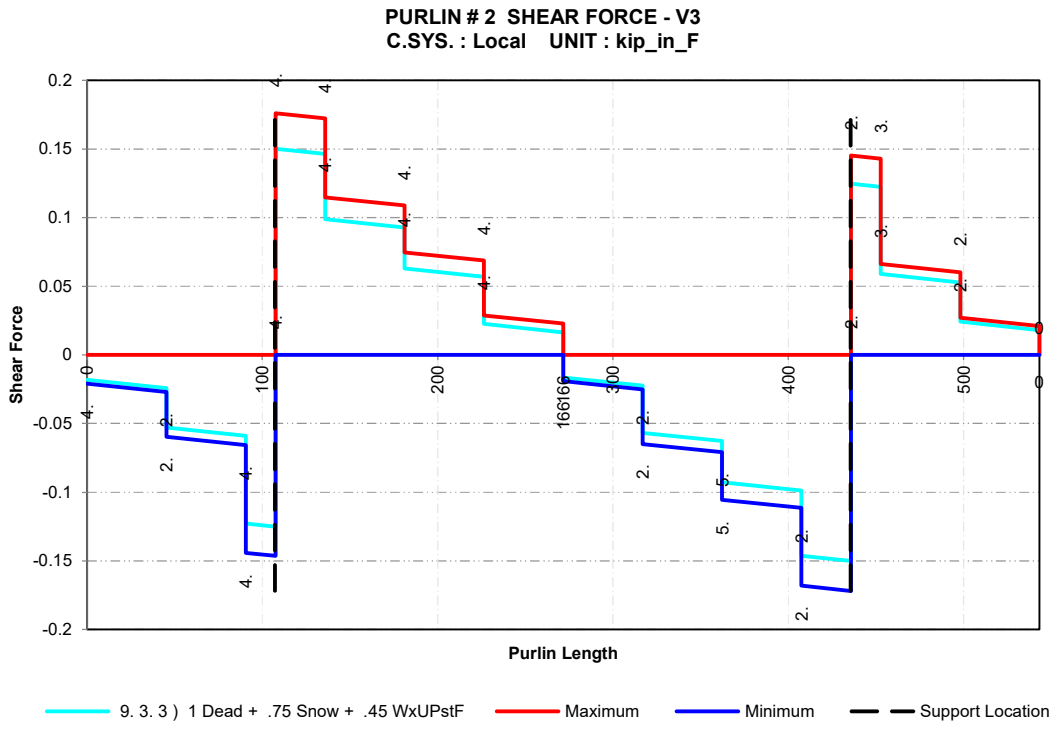


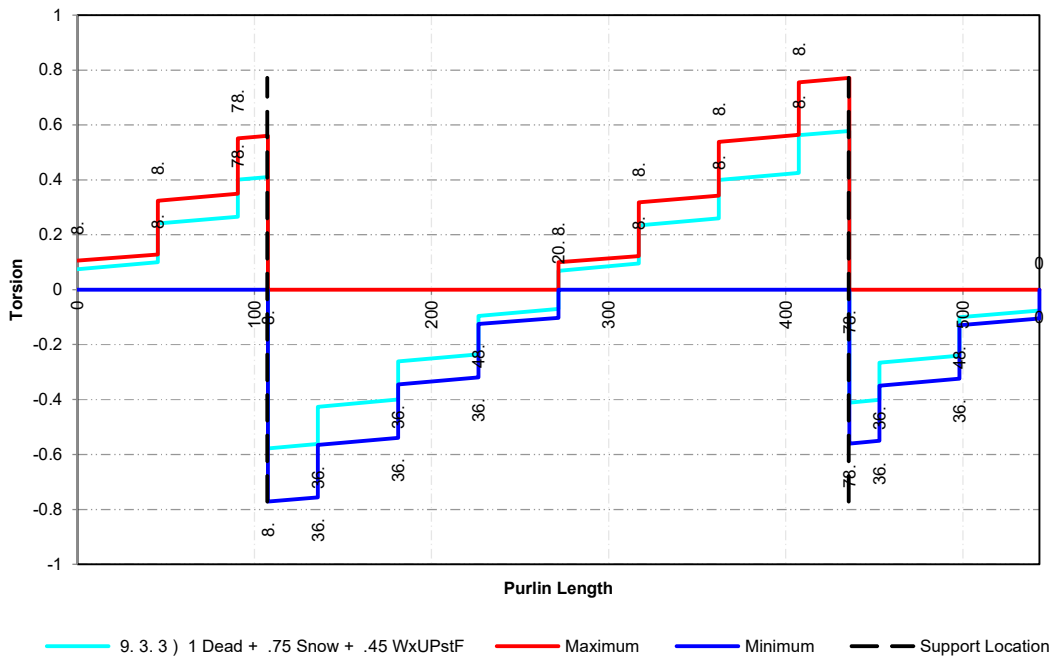
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*



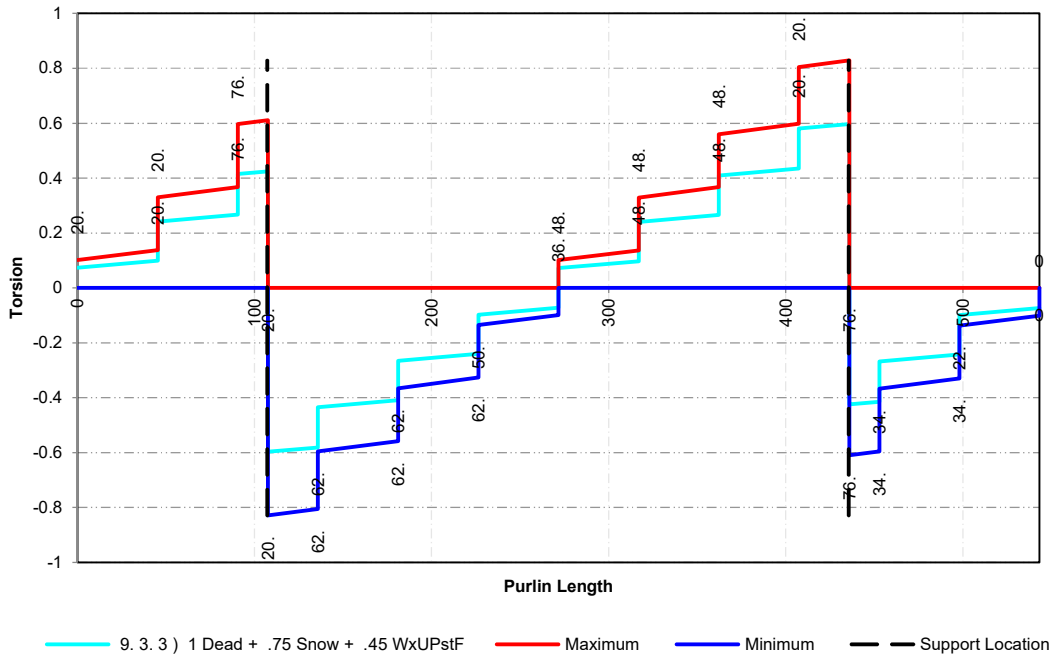


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

PURLIN # 1 TORSION
C.SYS. : Local UNIT : kip_in_F

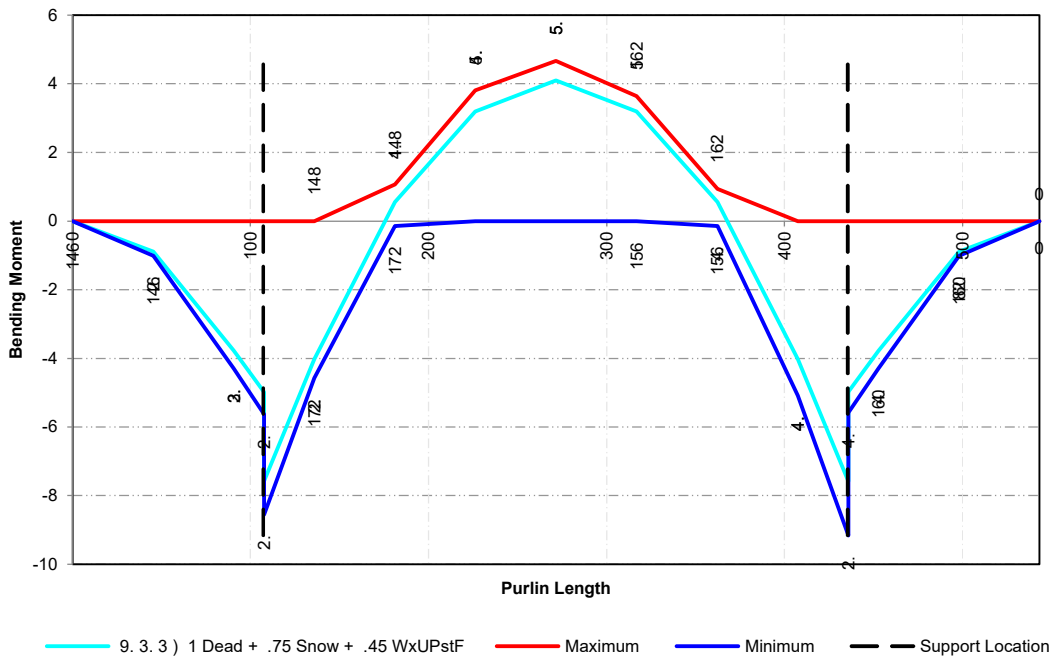


PURLIN # 2 TORSION
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

PURLIN # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



PURLIN # 2 MOMENT M2
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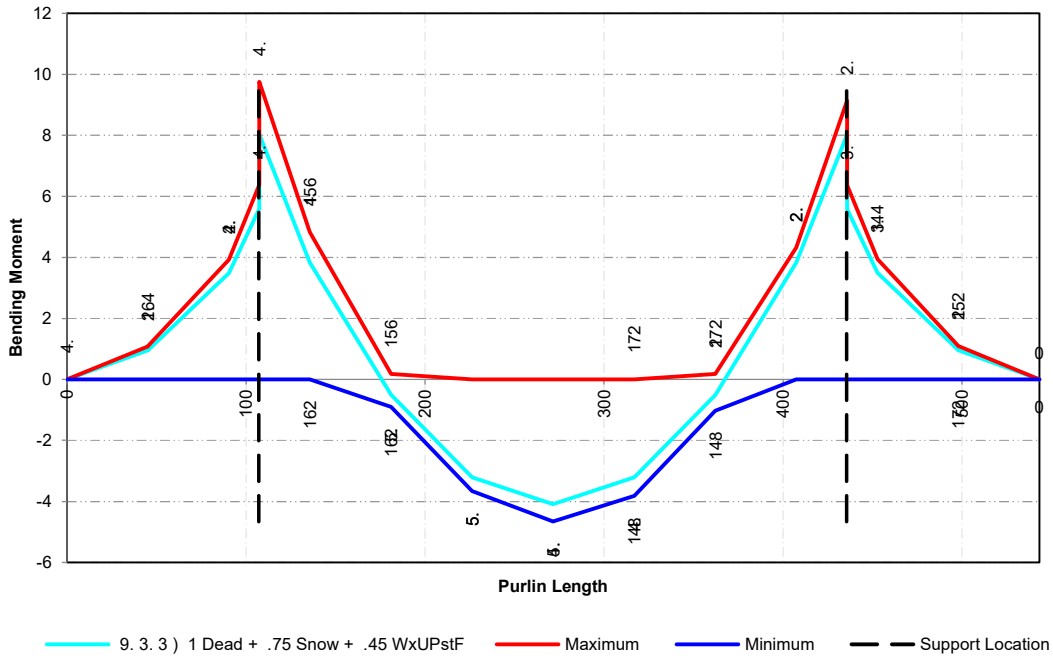
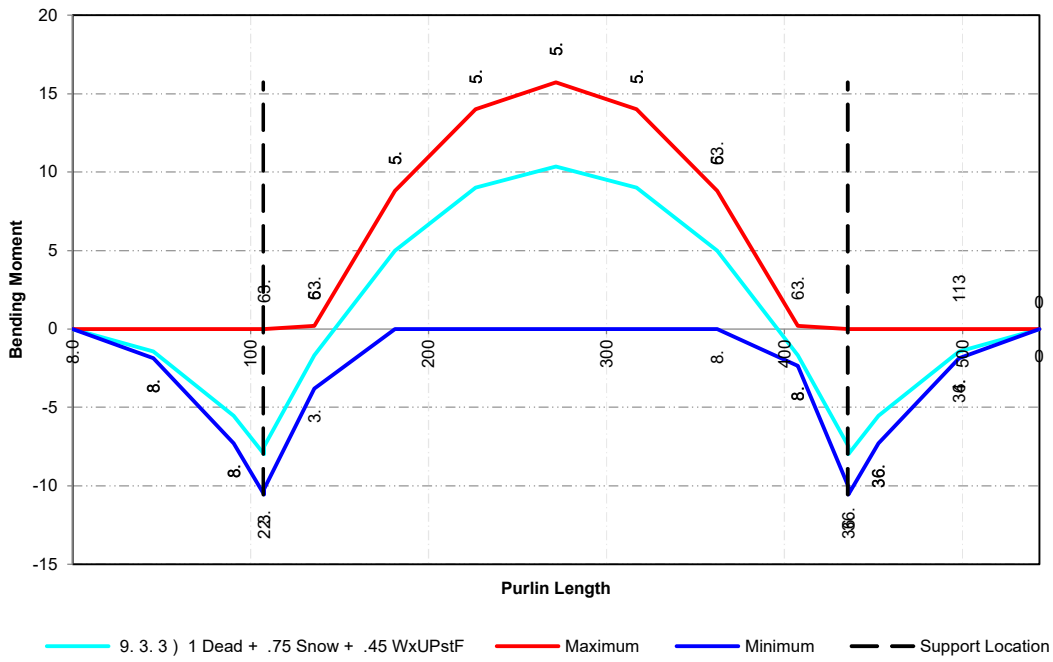
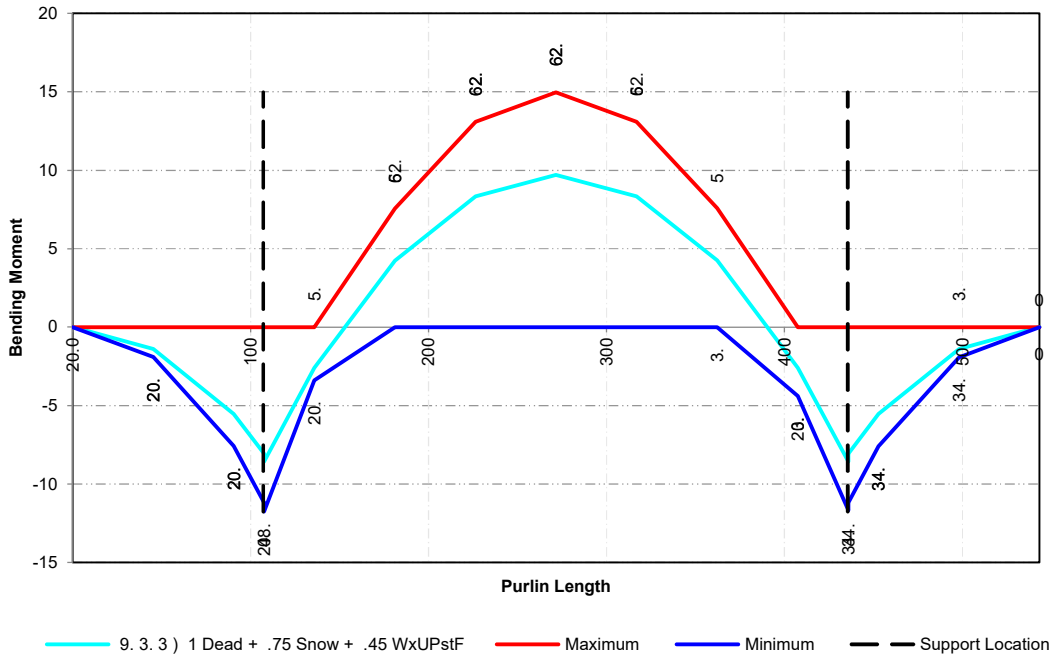


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

PURLIN # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

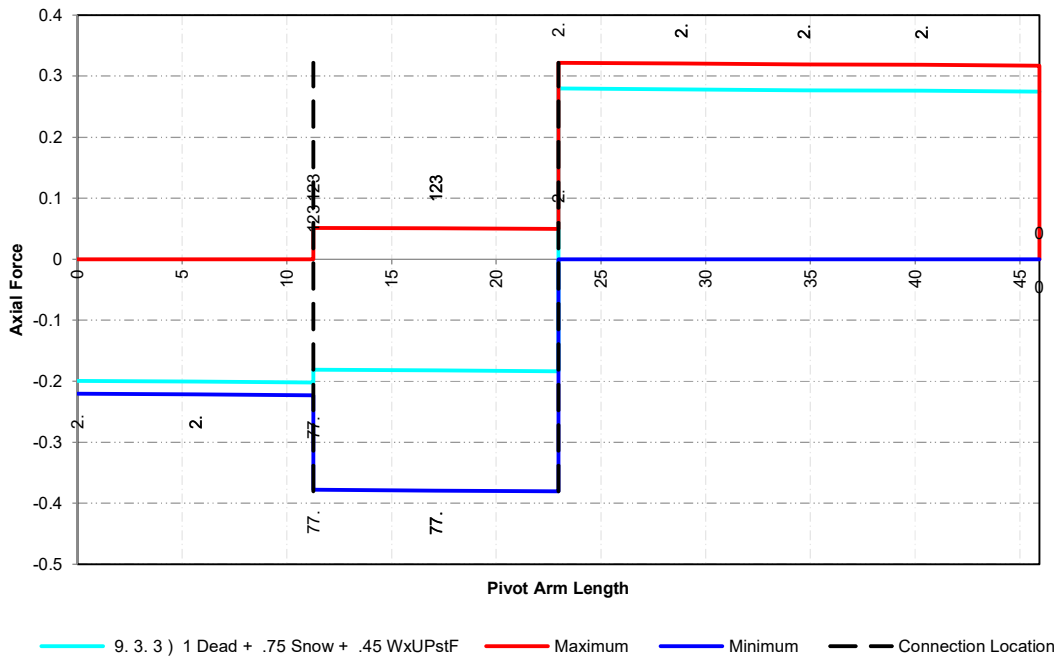


PURLIN # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

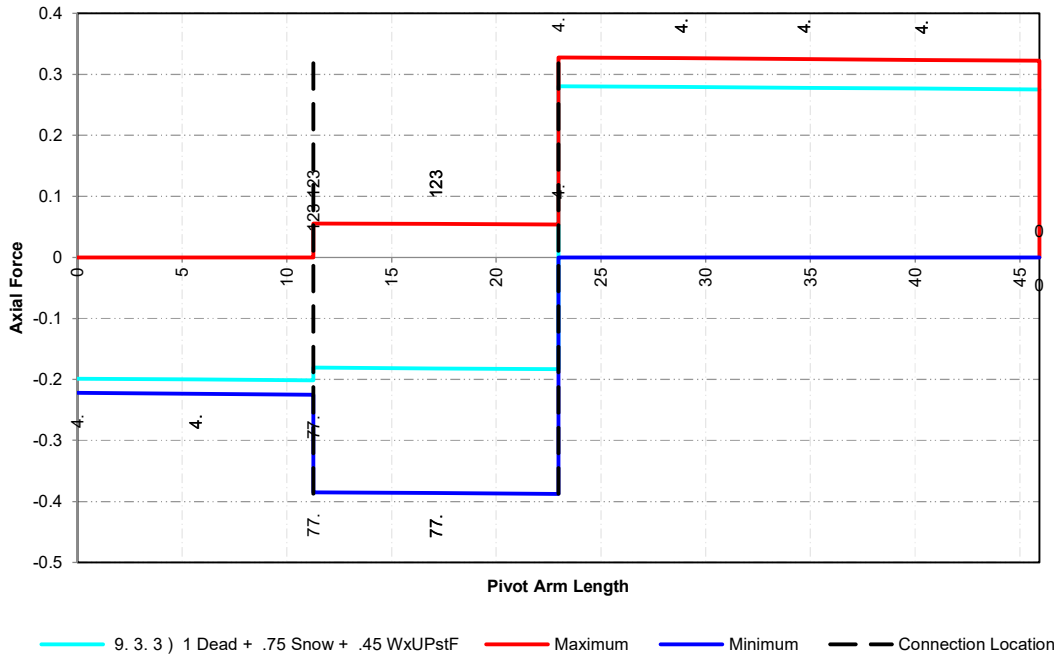


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

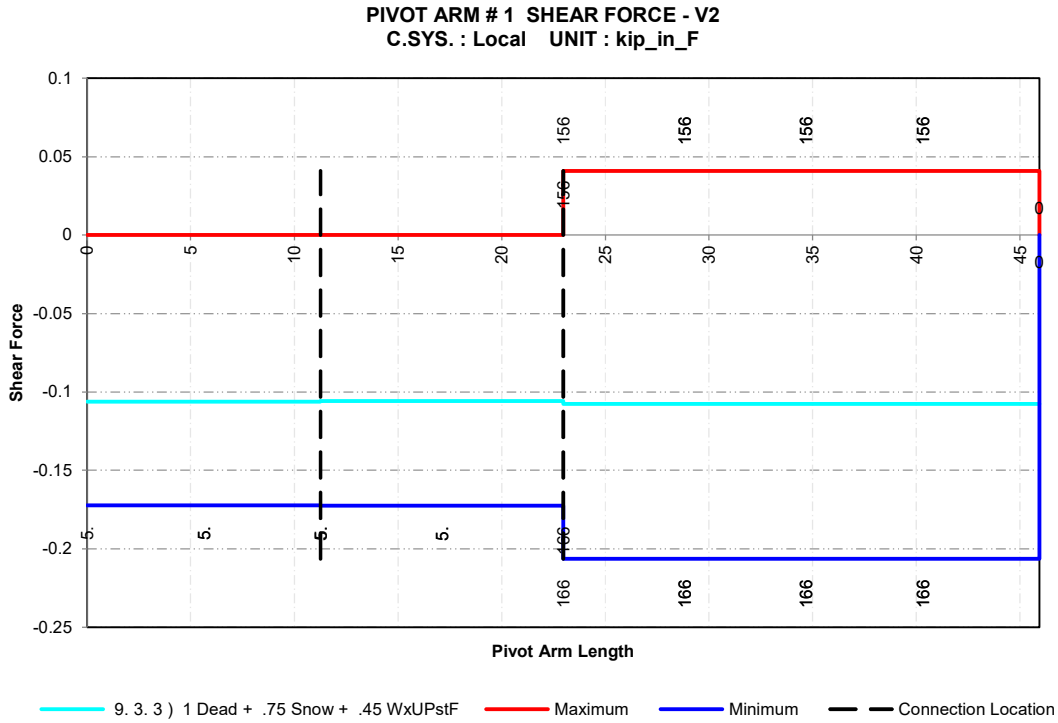
PIVOT ARM # 1 AXIAL FORCE
C.SYS. : Local UNIT : kip_in_F

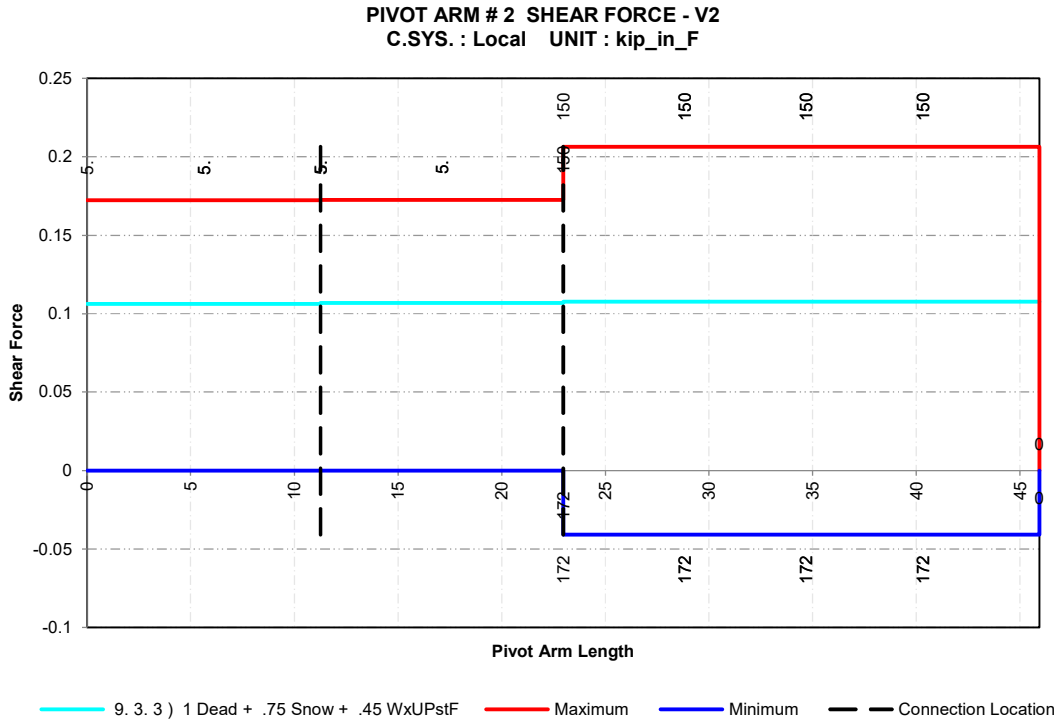


PIVOT ARM # 2 AXIAL FORCE
C.SYS. : Local UNIT : kip_in_F

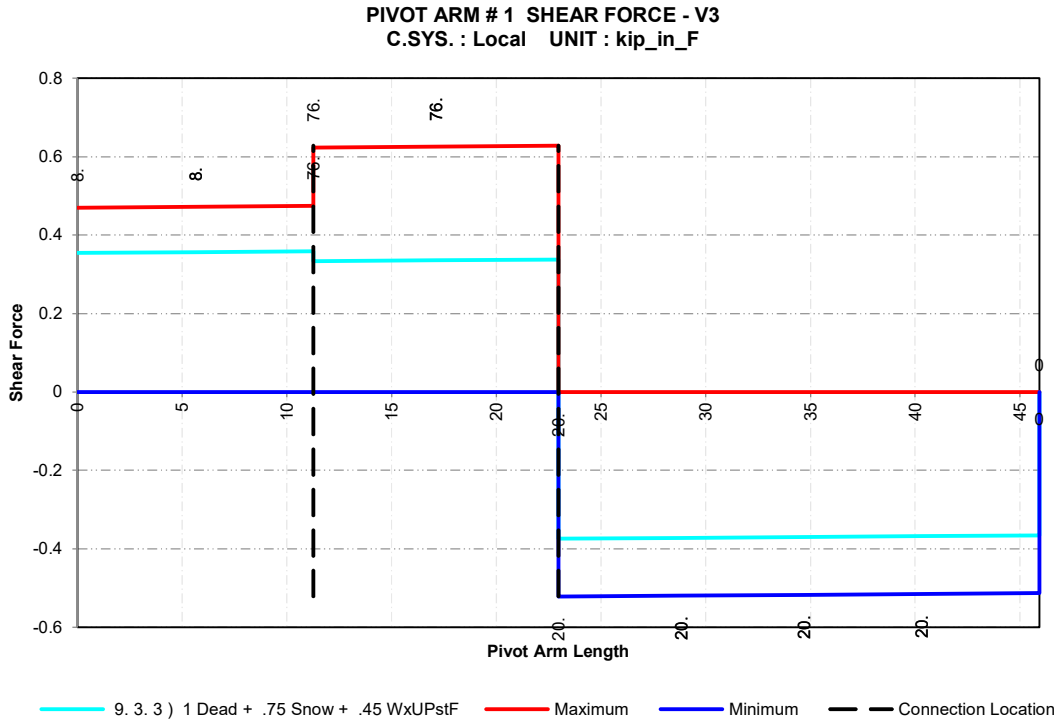


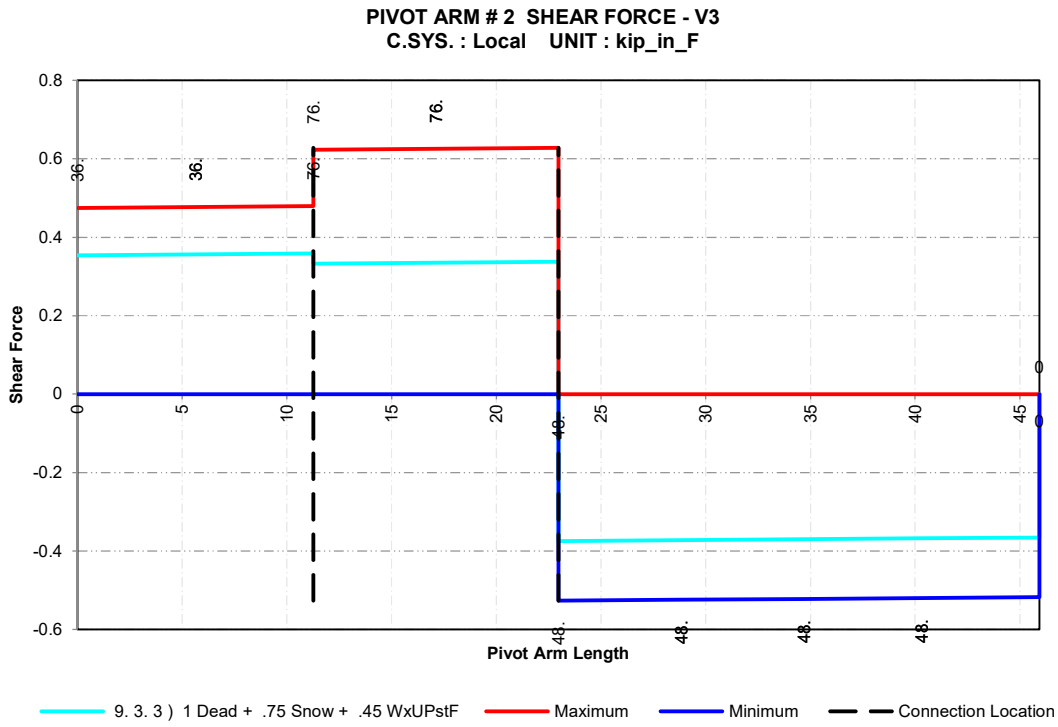
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*



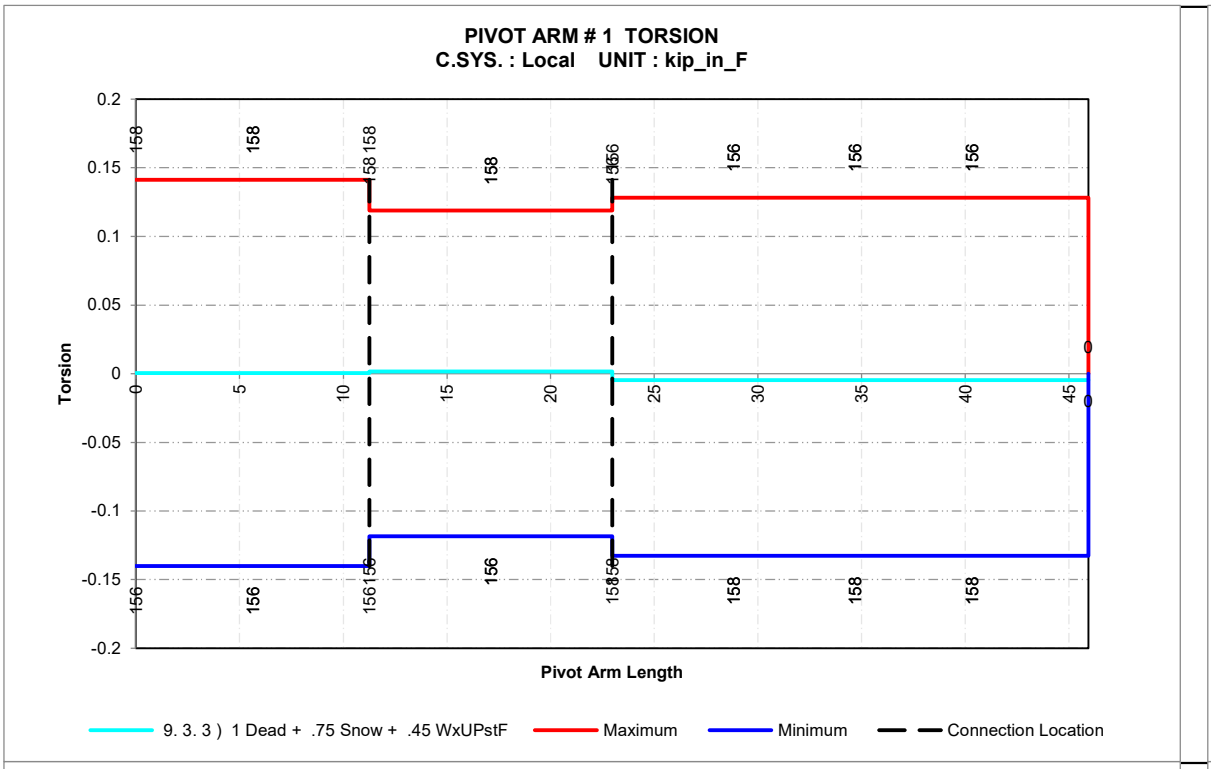


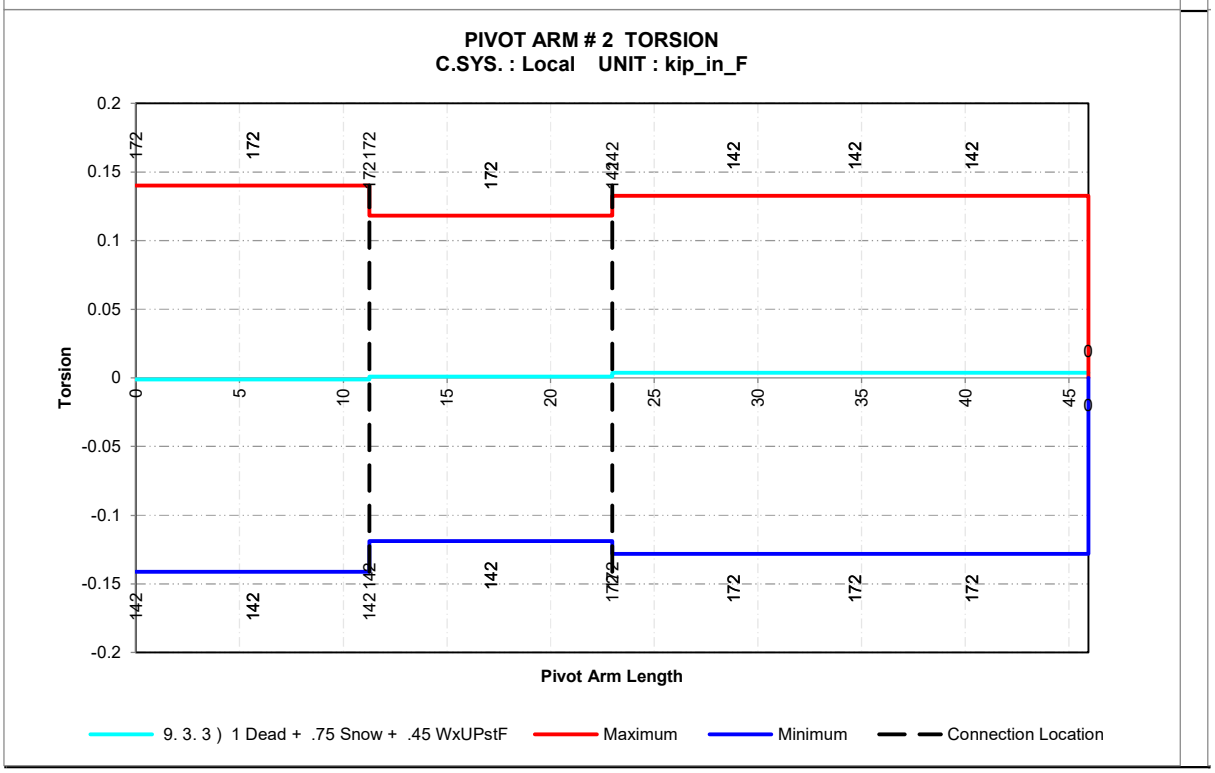
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*



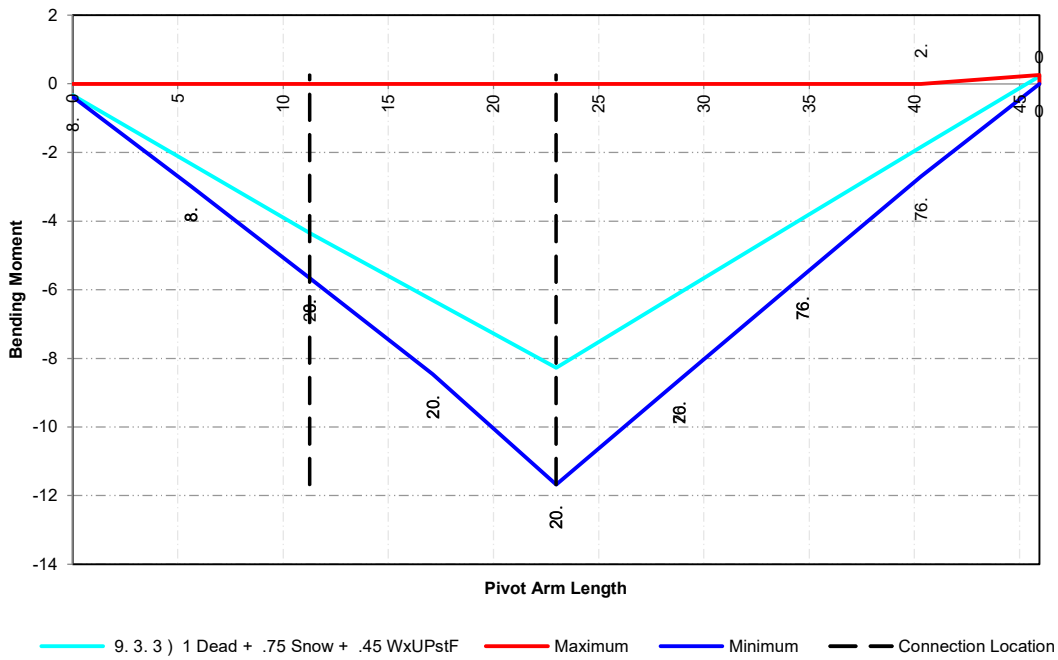


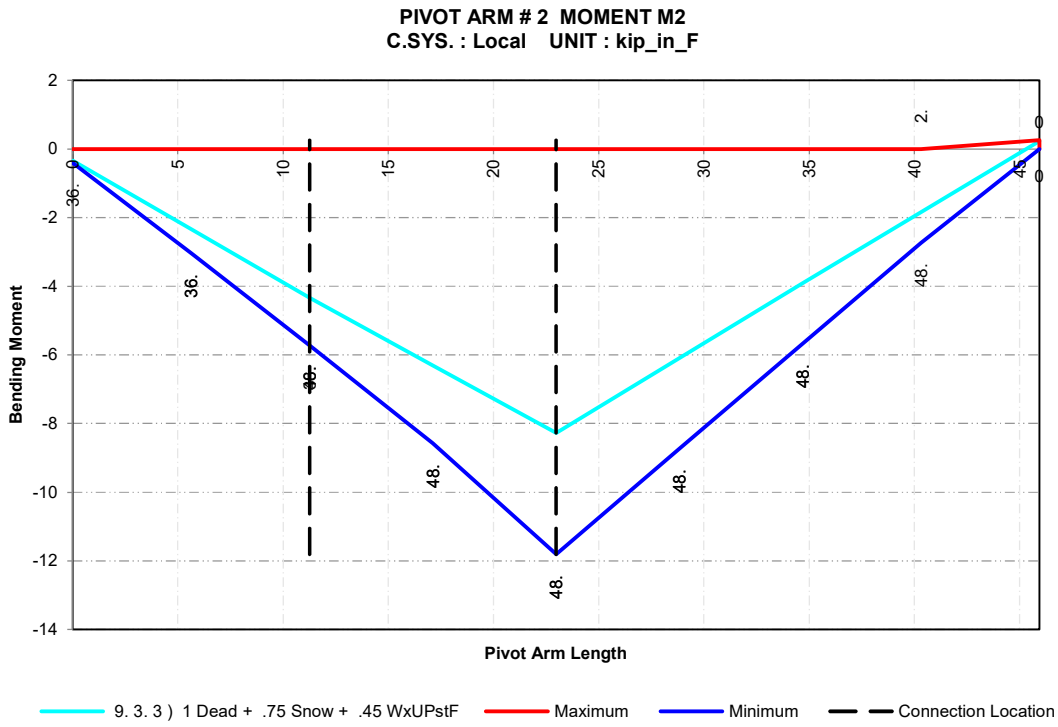
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*



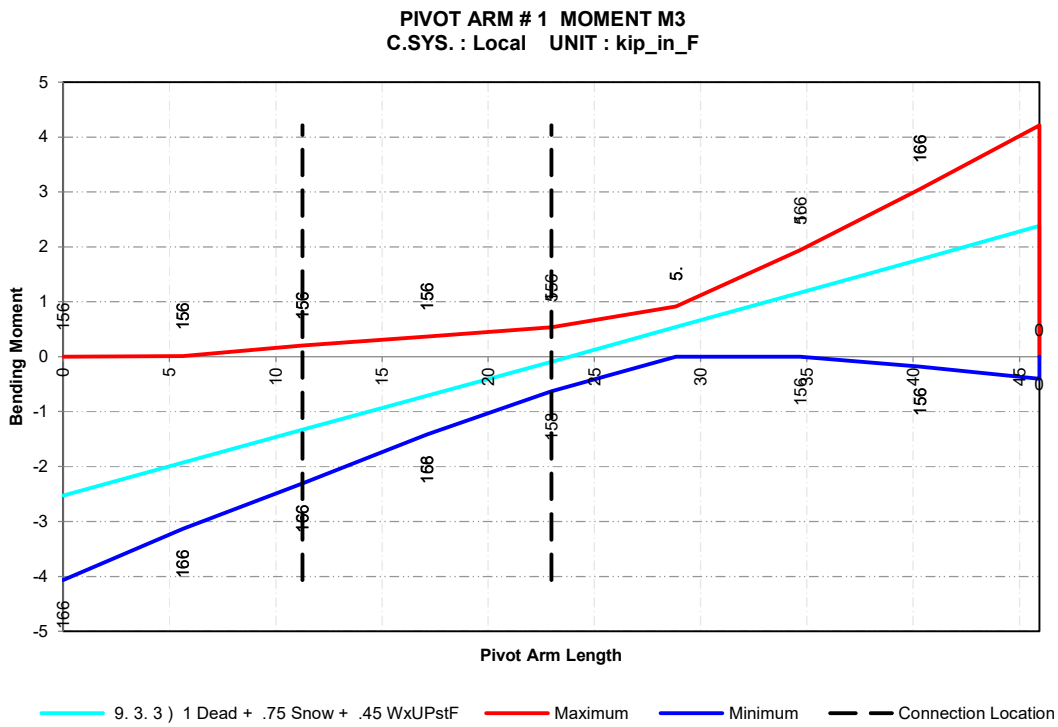


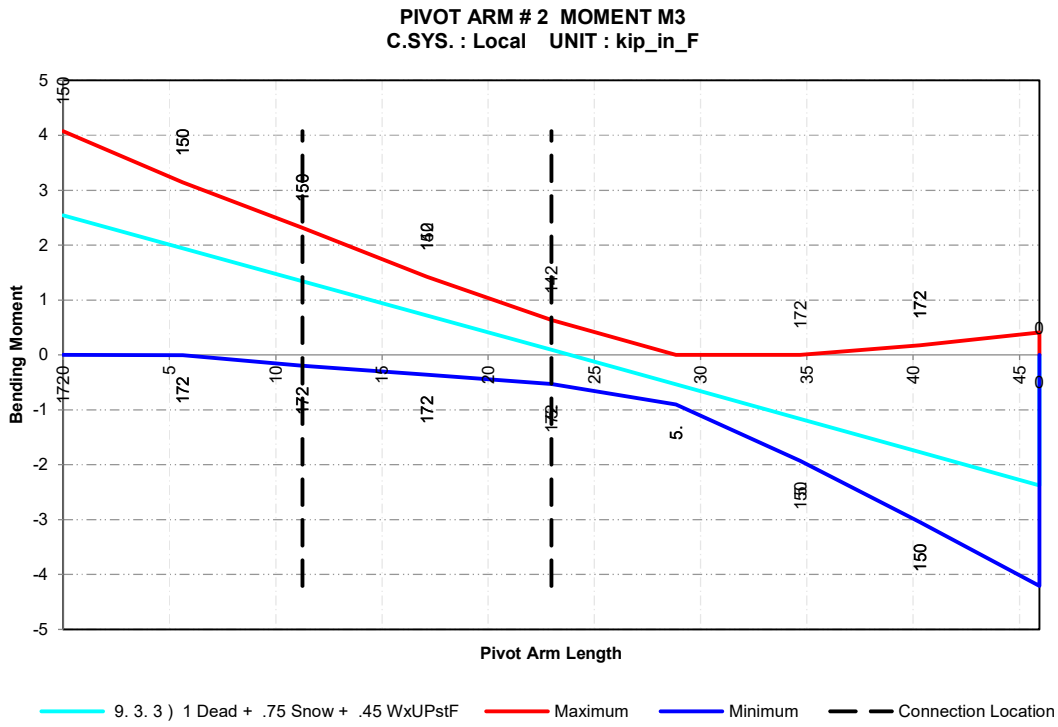
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*



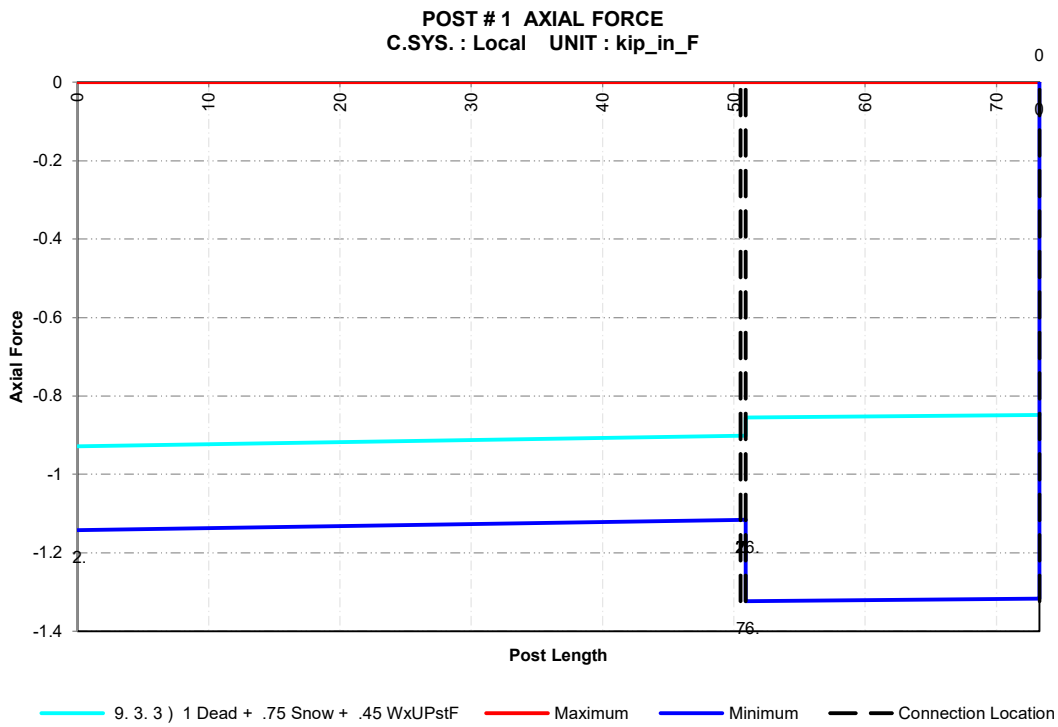


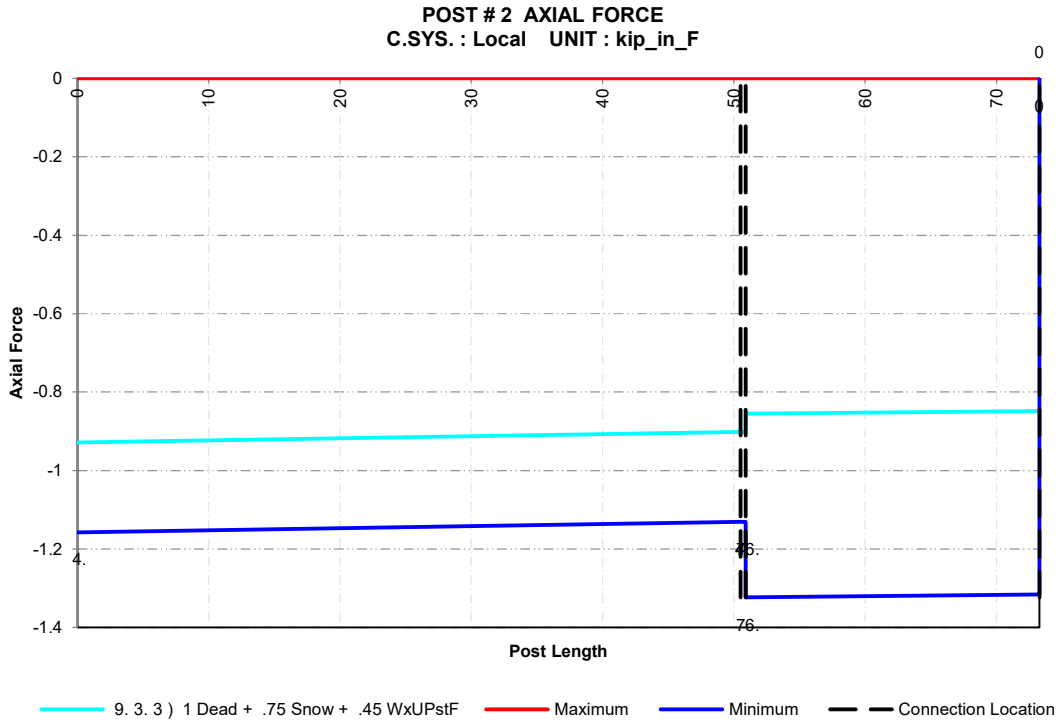
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*



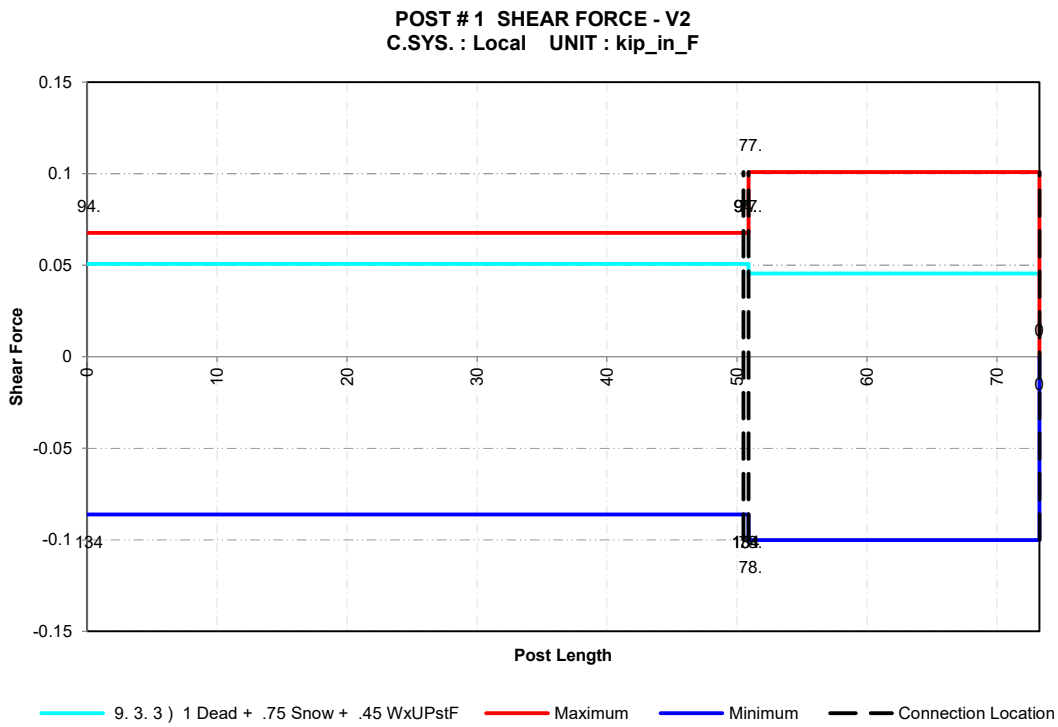


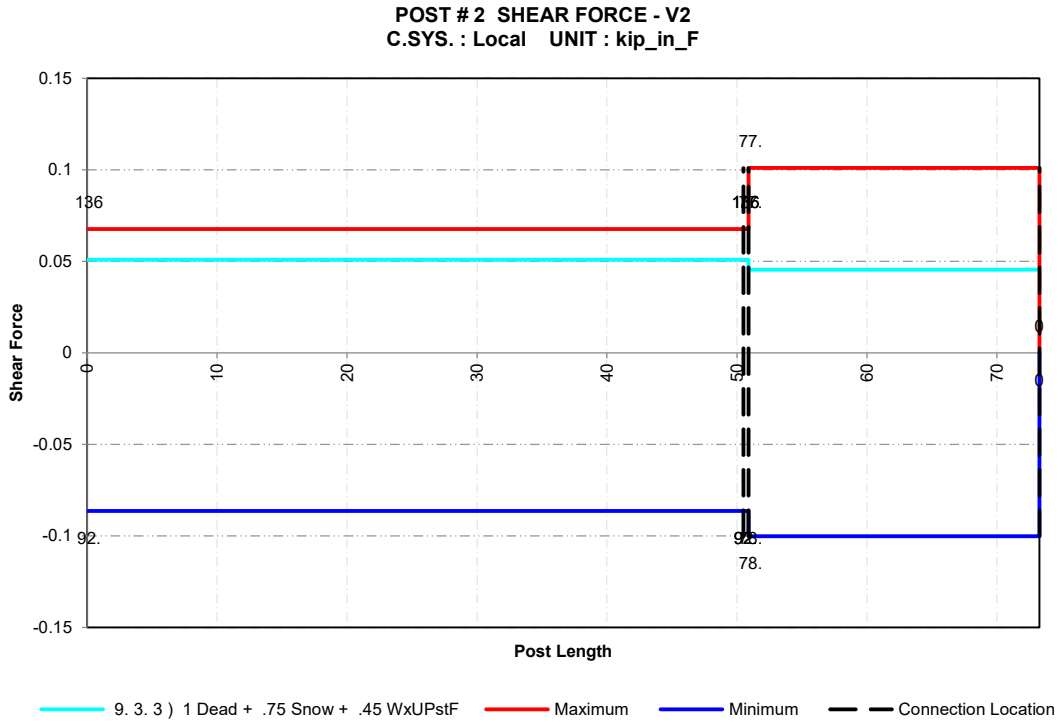
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*





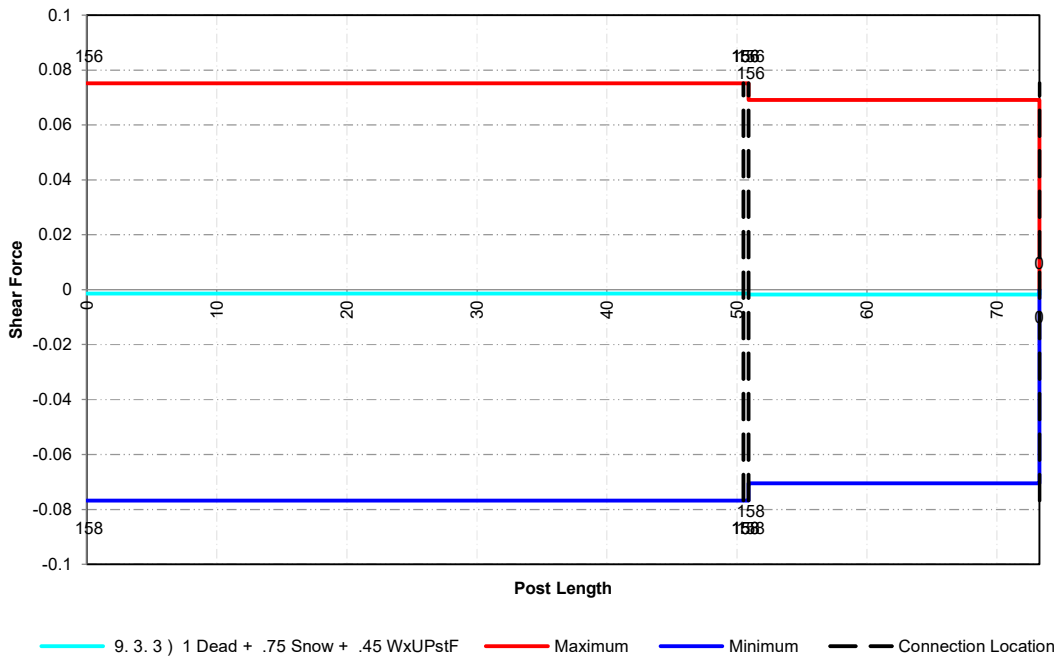
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

POST # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F



POST # 2 SHEAR FORCE - V3
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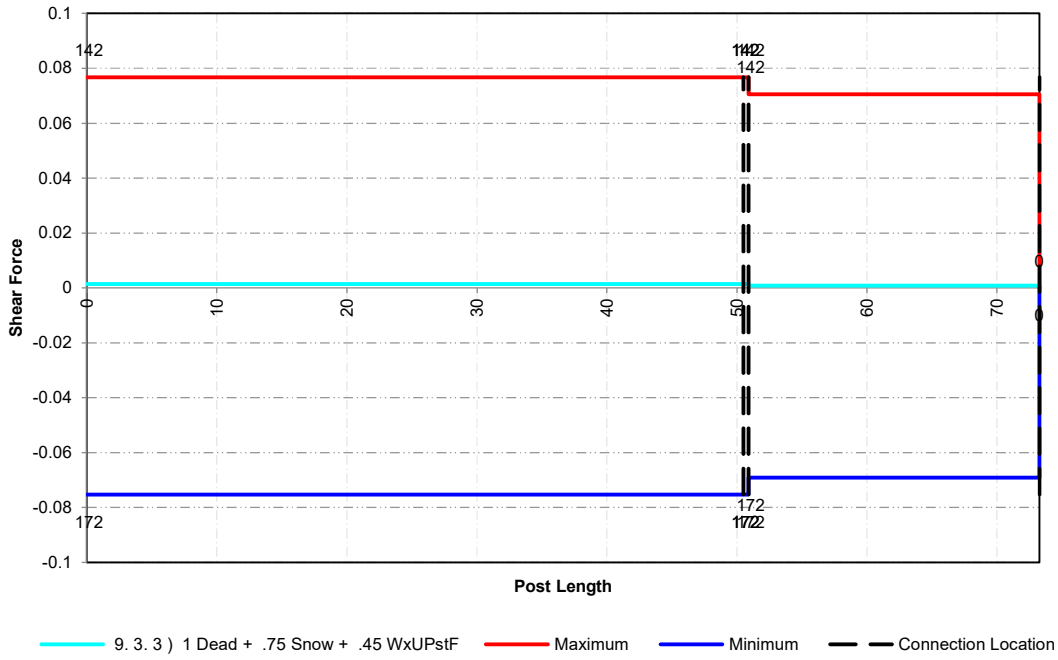
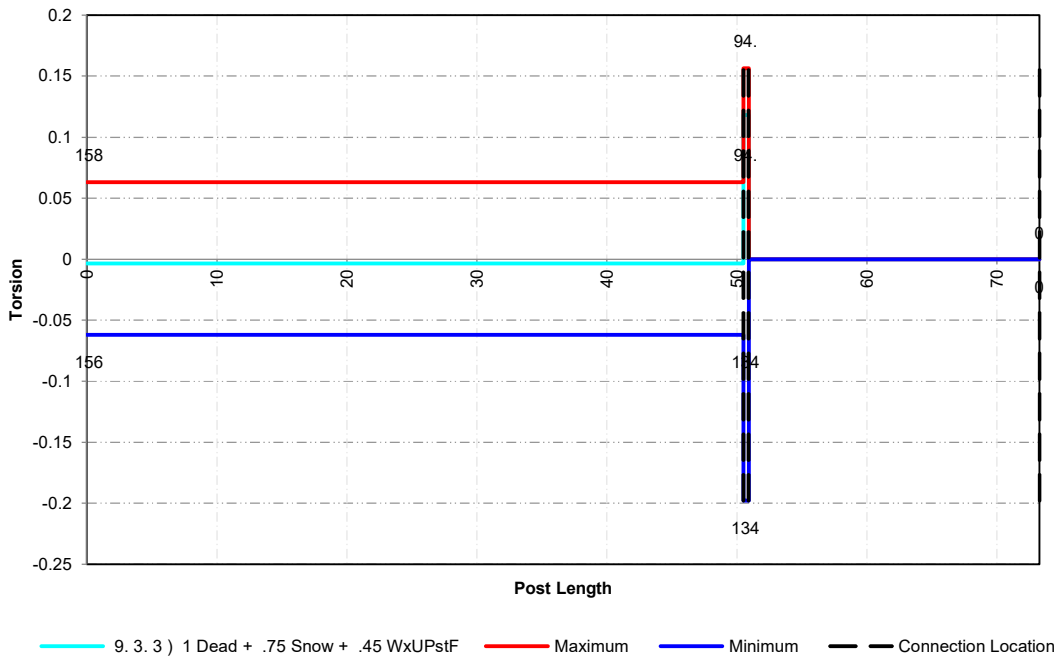
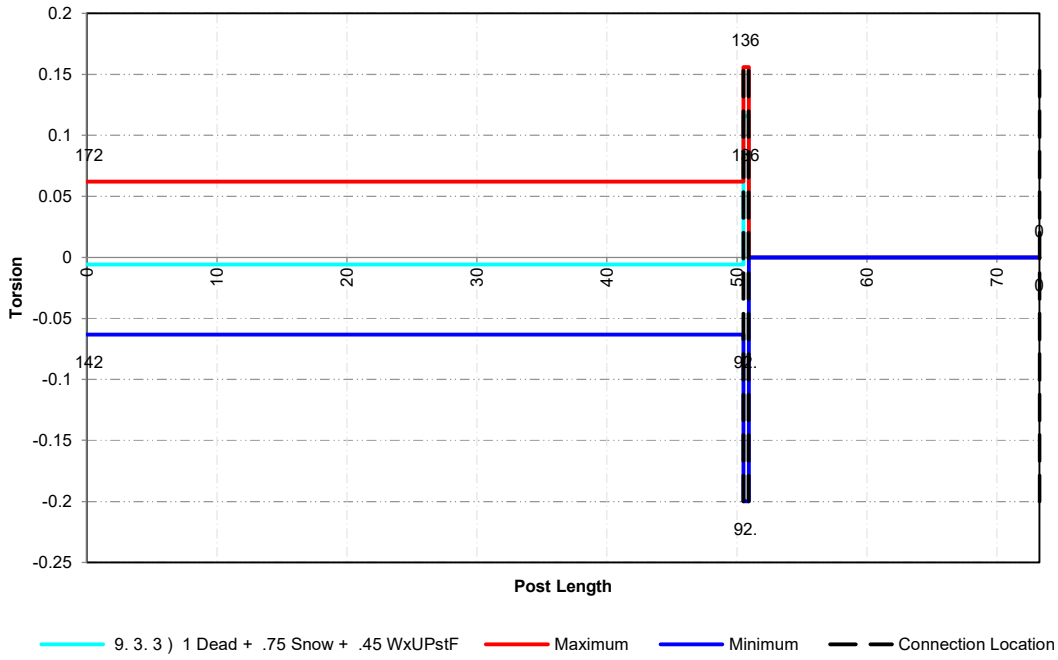


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

POST # 1 TORSION
C.SYS. : Local UNIT : kip_in_F

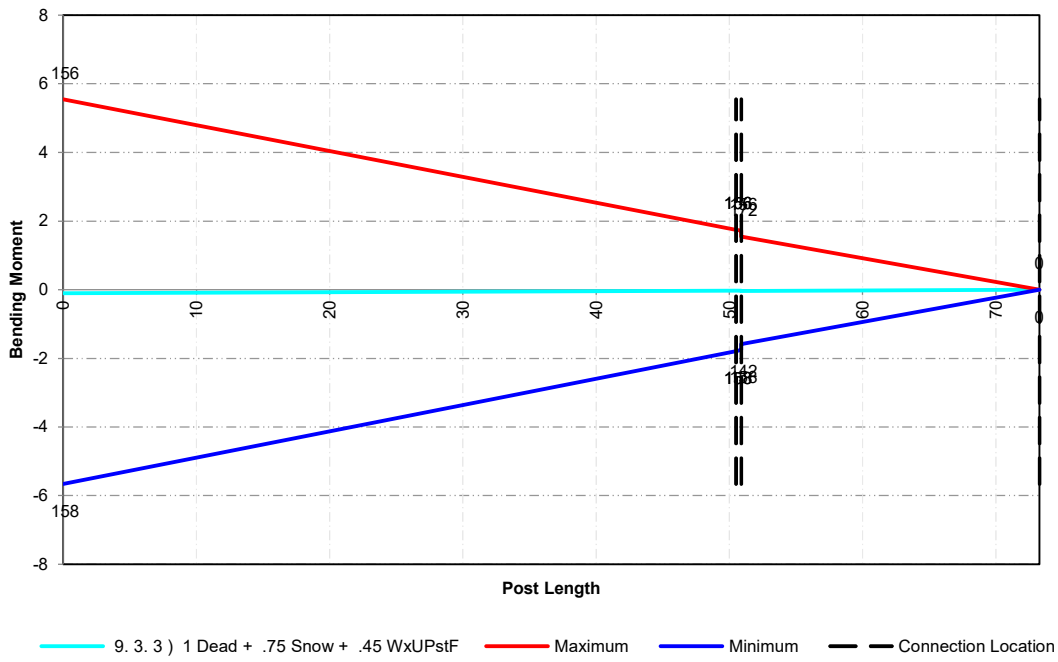


POST # 2 TORSION
C.SYS. : Local UNIT : kip_in_F

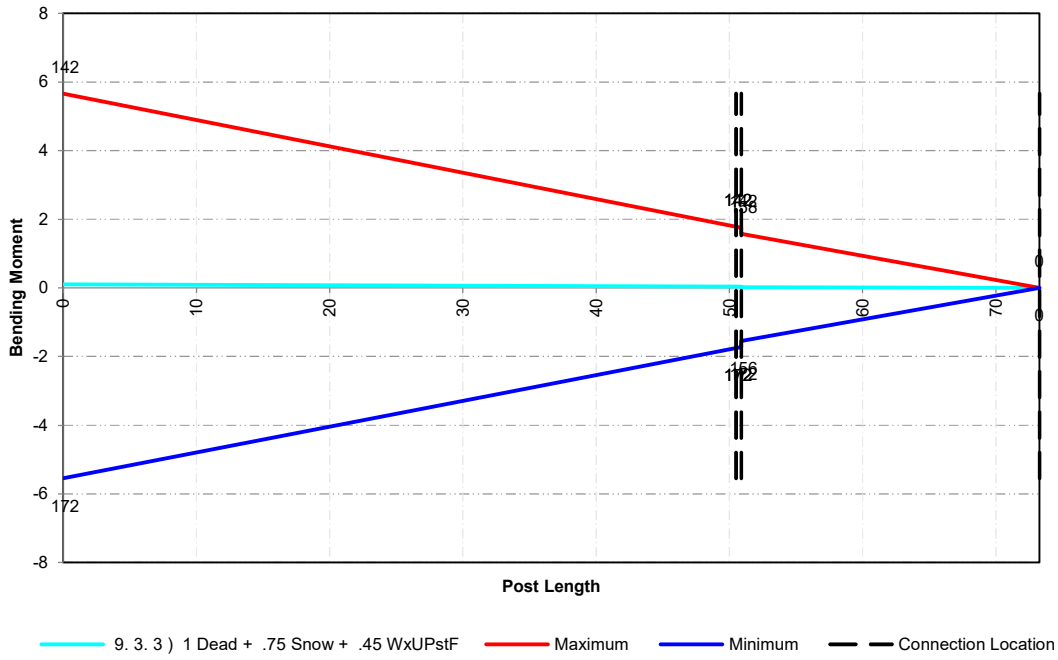


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

POST # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

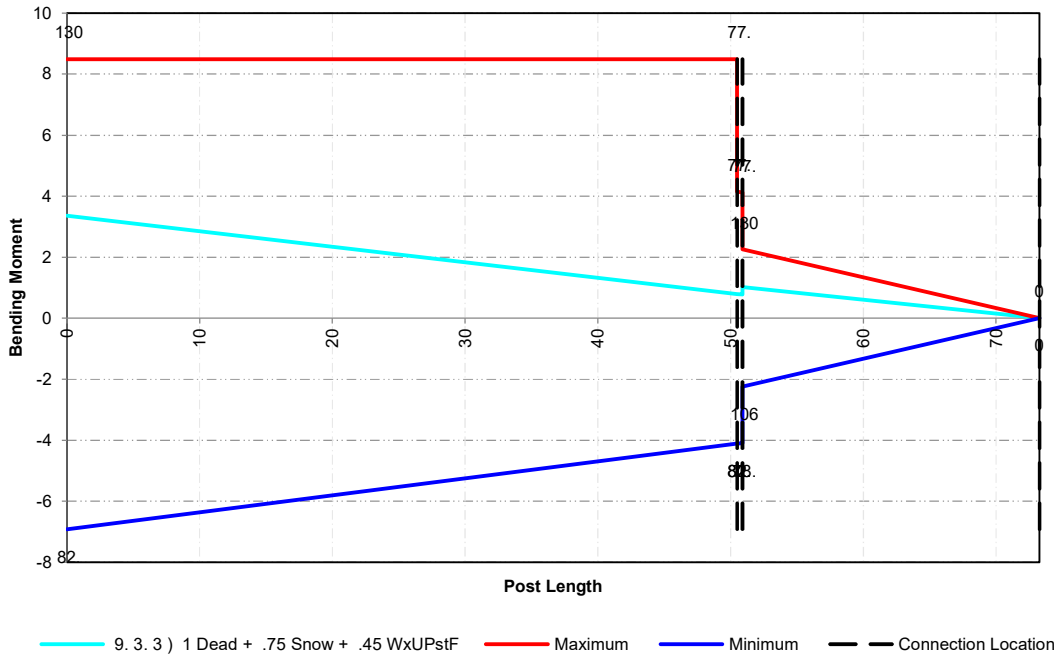


POST # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

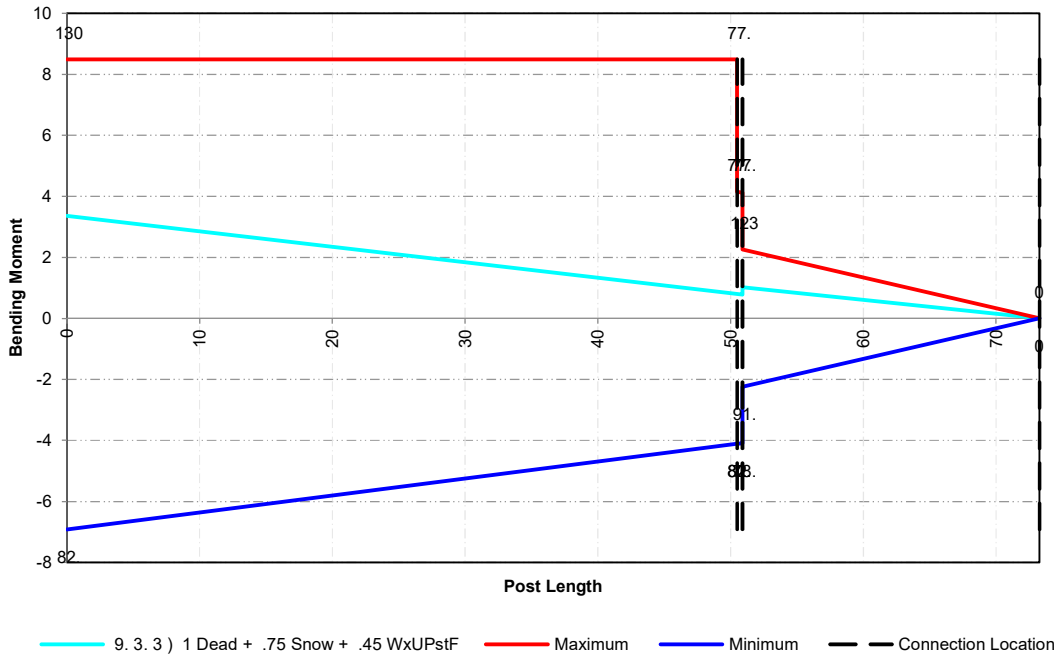


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *30 degree*

POST # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



POST # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

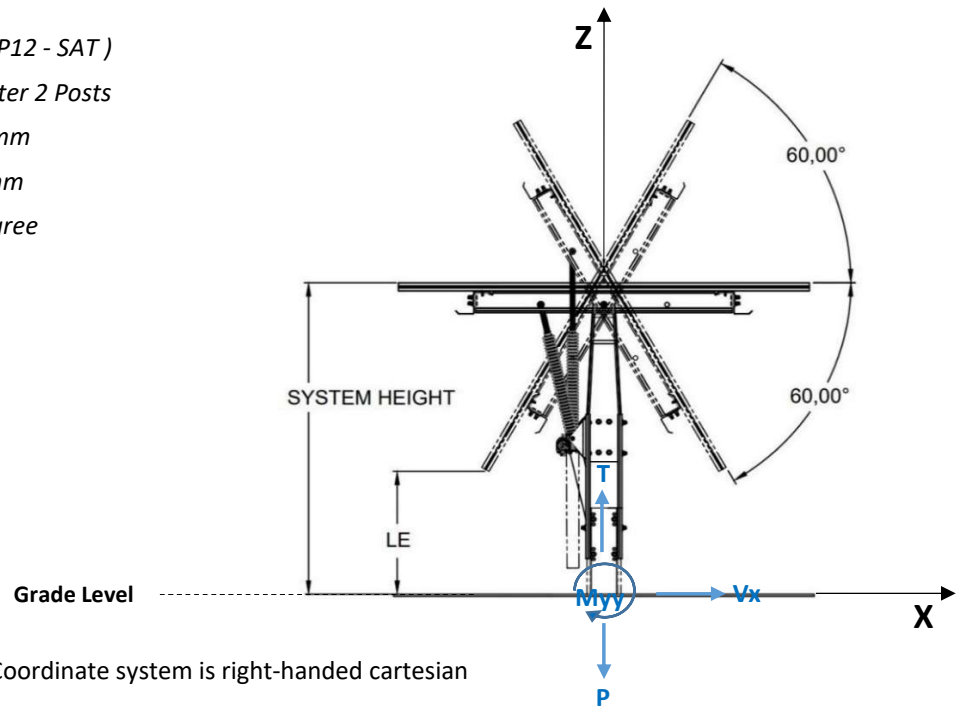
TABLE : *X20 (1P12 - SAT)*

CLASS : *Perimeter 2 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *-30 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.64	0.50	0.00	0.25	≈ 0	0.00	0.25
	T	n/a	0.00	n/a	-0.20	≈ 0	n/a	-0.20
	V_x	0.00	0 , 0	0.00	± 0.14	± 0.09	0.00	-0.14 , 0.11
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	-0.01	-0.21 , 0.2	0.00	± 1.2	± 0.57	0.00	-0.88 , 1.2
	M_{xx}	-0.01	-0.01 , 0	0.00	± 0.01	± 0.65	0.00	± 0.01
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
2ND	**P**	0.64	0.52	0.00	0.25	≈ 0	0.00	0.25
	T	n/a	0.00	n/a	-0.20	≈ 0	n/a	-0.20
	V_x	0.00	0 , 0	0.00	± 0.14	± 0.09	0.00	-0.14 , 0.11
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	-0.01	-0.21 , 0.2	0.00	± 1.2	± 0.57	0.00	-0.88 , 1.2
	M_{xx}	0.01	0 , 0.01	0.00	± 0	± 0.65	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

Reaction Loads & Member Sizing Summary

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X20 (1P12 - SAT)*

LENGTH : *2279 mm*

CLASS : *Perimeter 2 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *-30 degree*

CHORD LENGTH : *13784 mm*

POST SPAN : *8340 mm*

CHORD CONTILEVER : *2722 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	1.95	4	20	45
Splice / Z	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		3.1	note * : standard baseline section		
Pivot Arm - Mid / Ω	N/A	N/A		N/A	N/A		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O	GR_50	88.9	n/a	4.5	n/a	n/a	n/a

Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

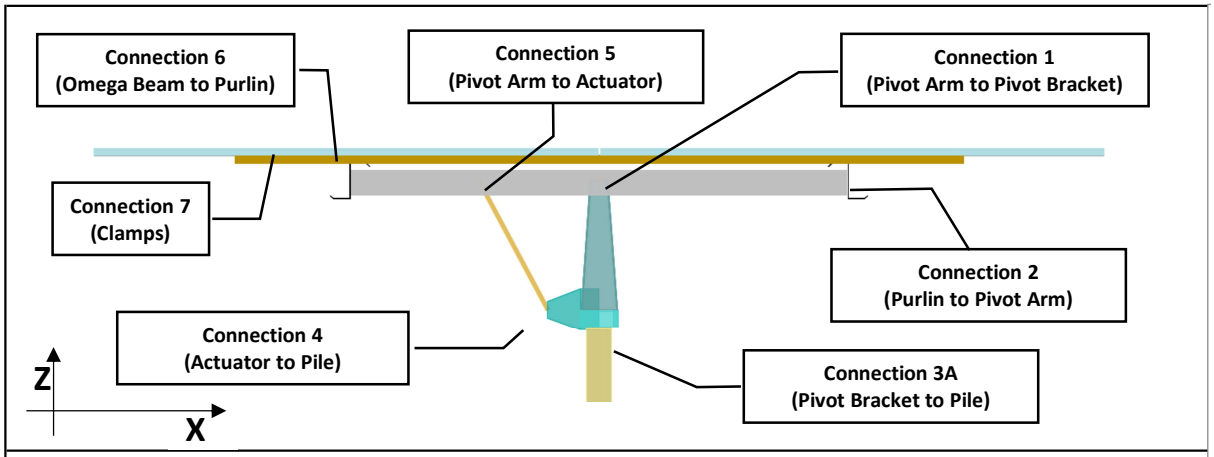
Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.64	0.50	0.00	0.25	≈ 0	0.00	0.25
	T	n/a	0.00	n/a	-0.20	≈ 0	n/a	-0.20
	V_x	0.00	0 , 0	0.00	± 0.14	± 0.09	0.00	-0.14 , 0.11
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	-0.01	-0.21 , 0.2	0.00	± 1.2	± 0.57	0.00	-0.88 , 1.2
	M_{xx}	-0.01	-0.01 , 0	0.00	± 0.01	± 0.65	0.00	± 0.01
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
2ND	**P**	0.64	0.52	0.00	0.25	≈ 0	0.00	0.25
	T	n/a	0.00	n/a	-0.20	≈ 0	n/a	-0.20
	V_x	0.00	0 , 0	0.00	± 0.14	± 0.09	0.00	-0.14 , 0.11
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	-0.01	-0.21 , 0.2	0.00	± 1.2	± 0.57	0.00	-0.88 , 1.2
	M_{xx}	0.01	0 , 0.01	0.00	± 0	± 0.65	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

Connection Loads

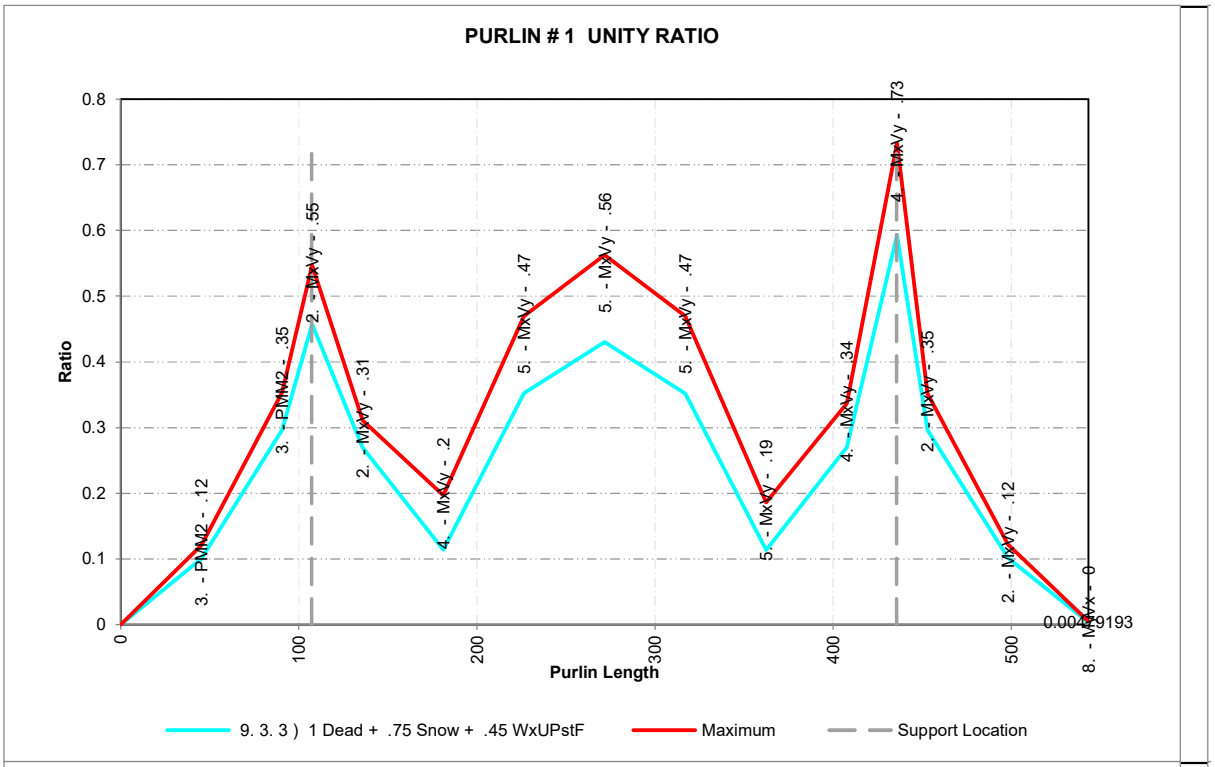
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

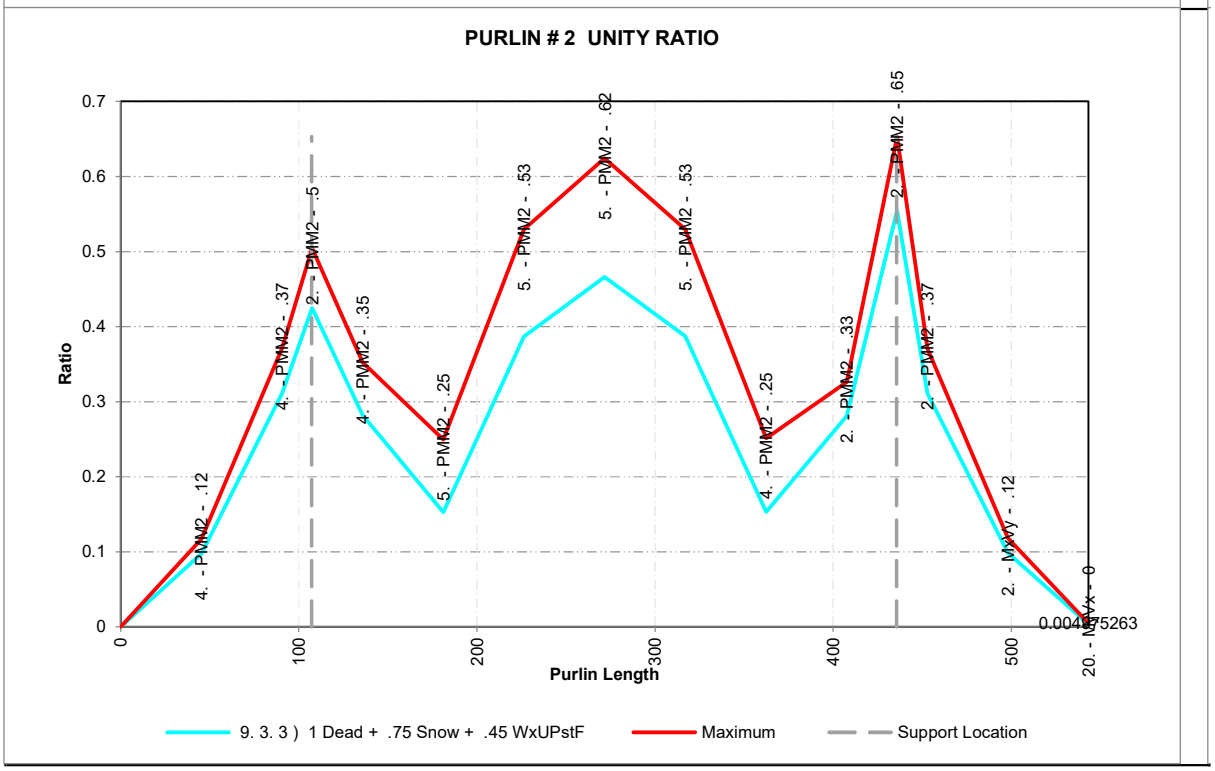


Note: coordinate system is right-handed cartesian

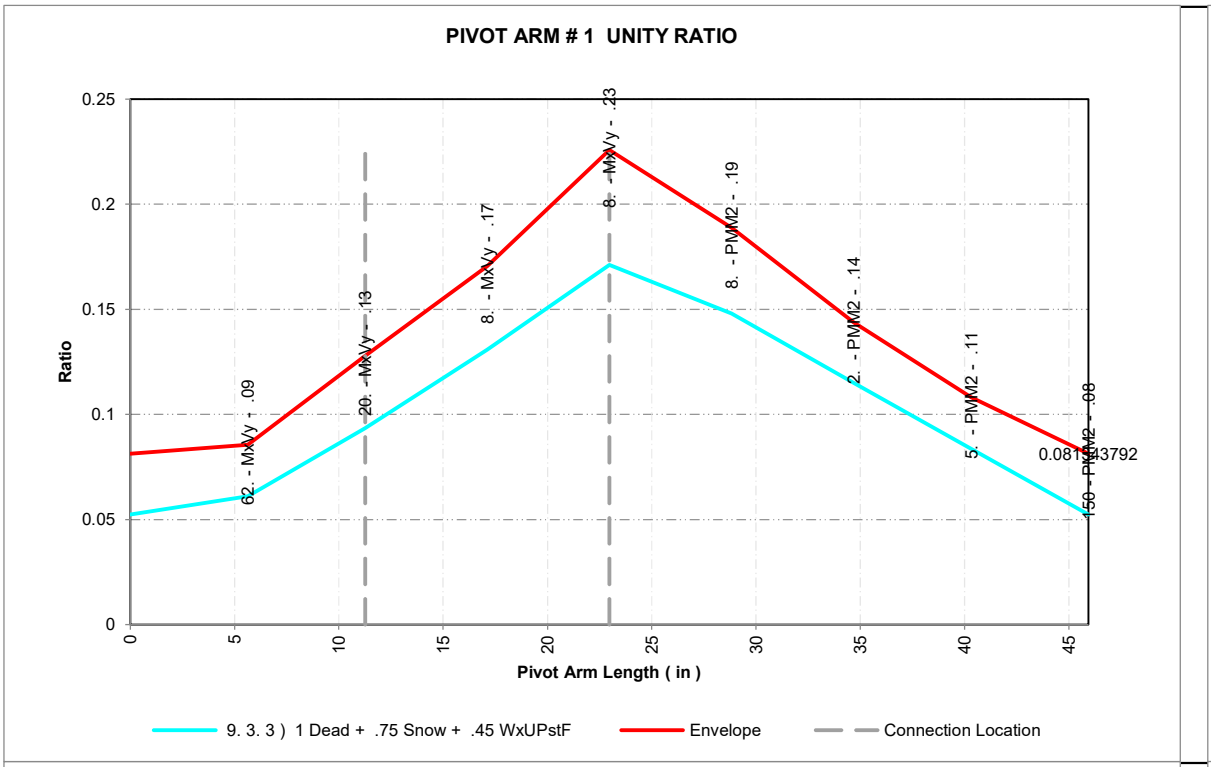
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-1.21	0.10	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
-0.61	0.01	0.05	0.00	0.00	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 2						
0.32	0.48	-0.15	0.00	-0.27	0.02	4. 2. 3) 1 Dead + 1 S2_lhhh
0.29	0.52	-0.13	0.00	-0.23	0.01	48. 3. 66) 1 Dead + .75 S2_lhhh + .45 WxDNst+T
Connection : 3						
-0.26	-0.07	0.00	0.00	0.00	-0.41	117. 5. 3) .6 Dead + .6 WxUPstF
-1.16	0.00	0.00	0.00	0.01	0.03	4. 2. 3) 1 Dead + 1 S2_lhhh
-0.53	0.09	0.00	0.00	0.01	0.54	115. 5. 1) .6 Dead + .6 WxDNstF
-0.38	0.00	0.00	0.00	0.00	-0.71	130. 5. 16) .6 Dead + .6 WxOTal
-0.63	0.00	0.08	-0.02	0.46	0.02	142. 9. 2) 1 Dead + .7 Quake_y
-0.63	0.00	0.08	-0.02	0.46	0.02	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
0.30	*	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
Connection : 5		** Note : the load is axial in actuator direction*				
0.30	*	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.02						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.02						0.6 WLup

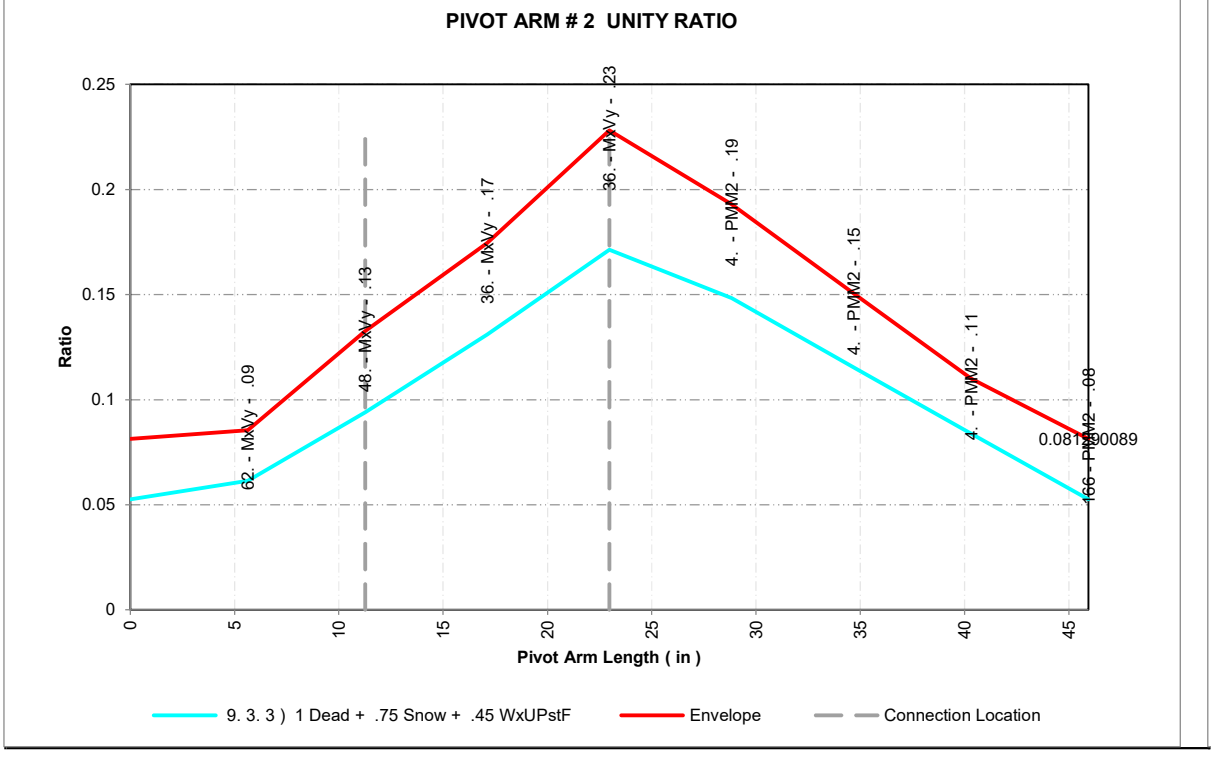
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*





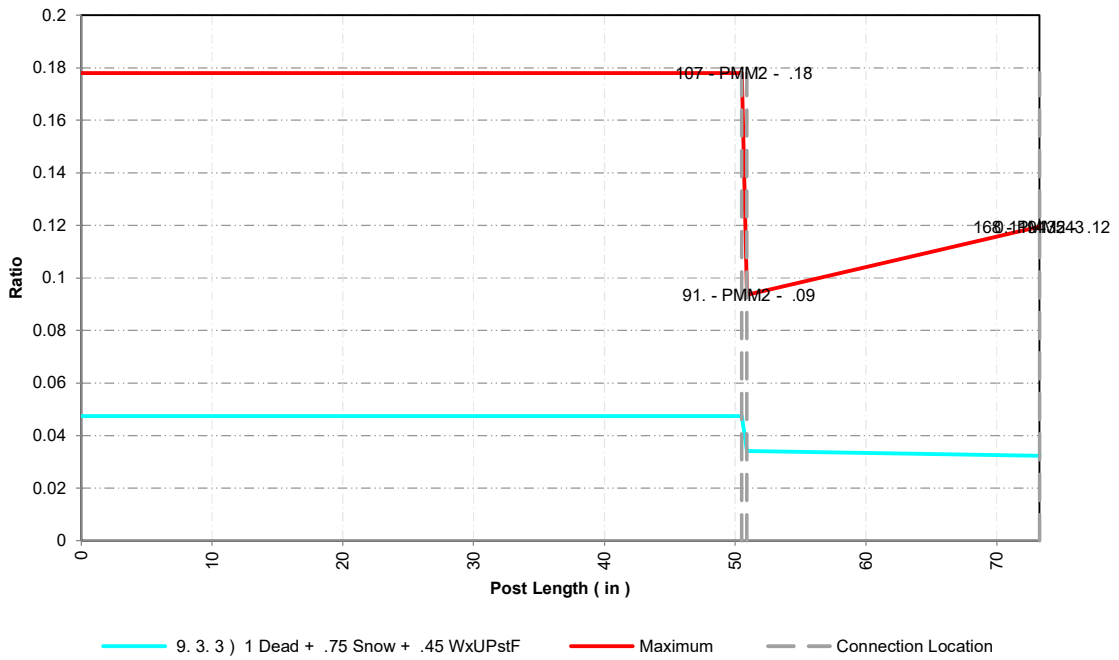
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*



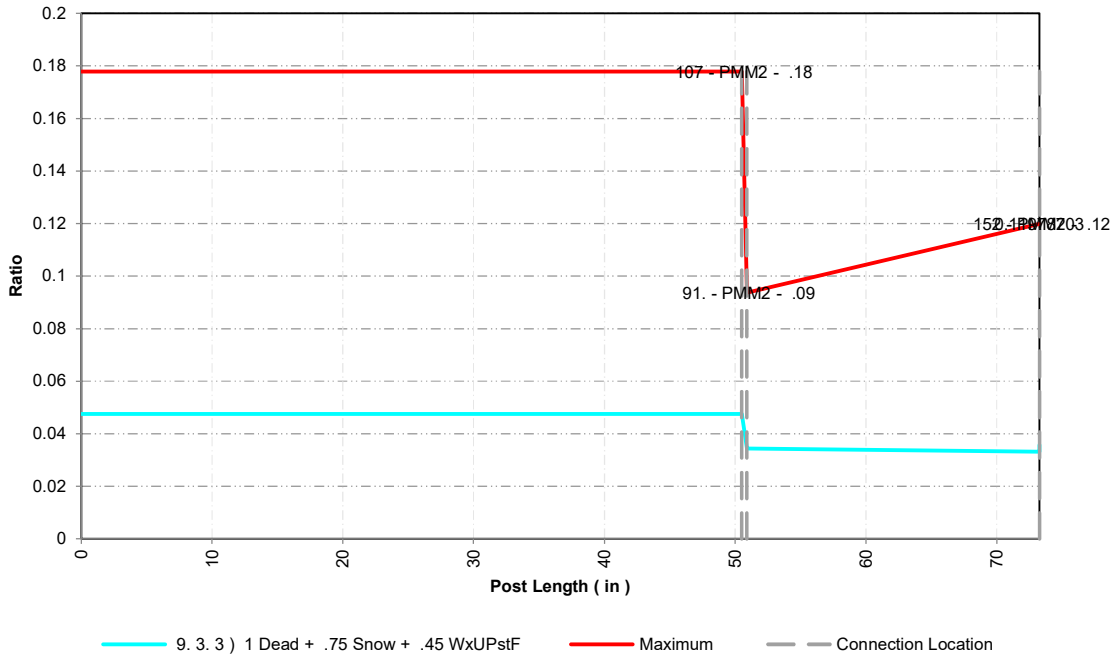


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

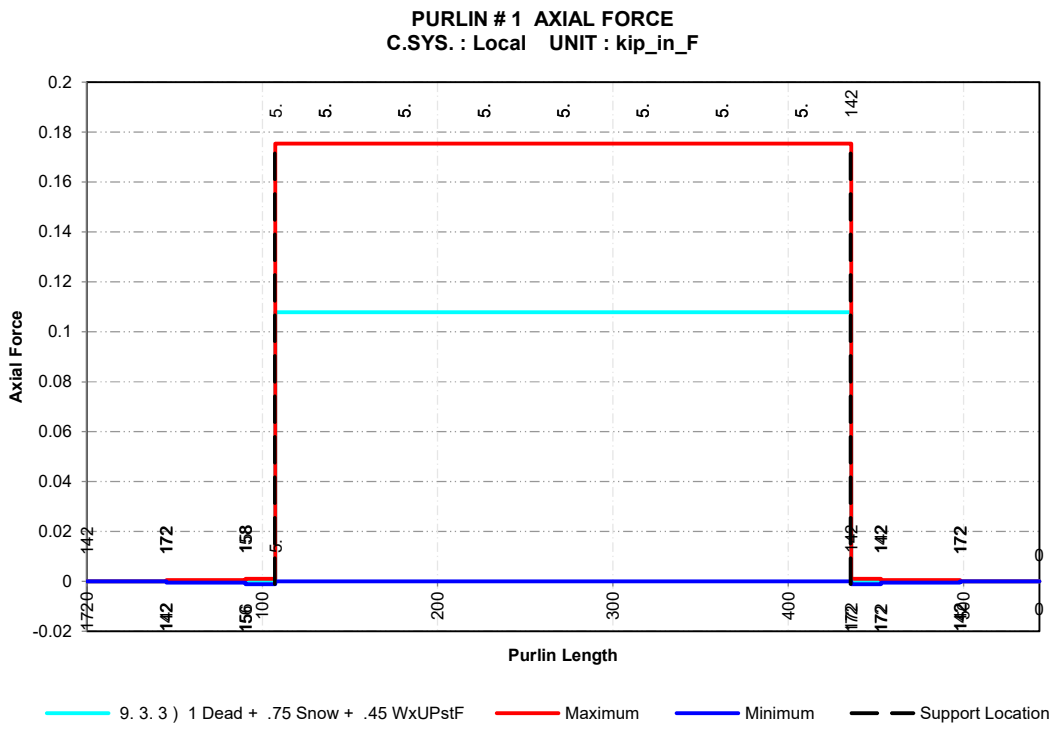
POST # 1 UNITY RATIO

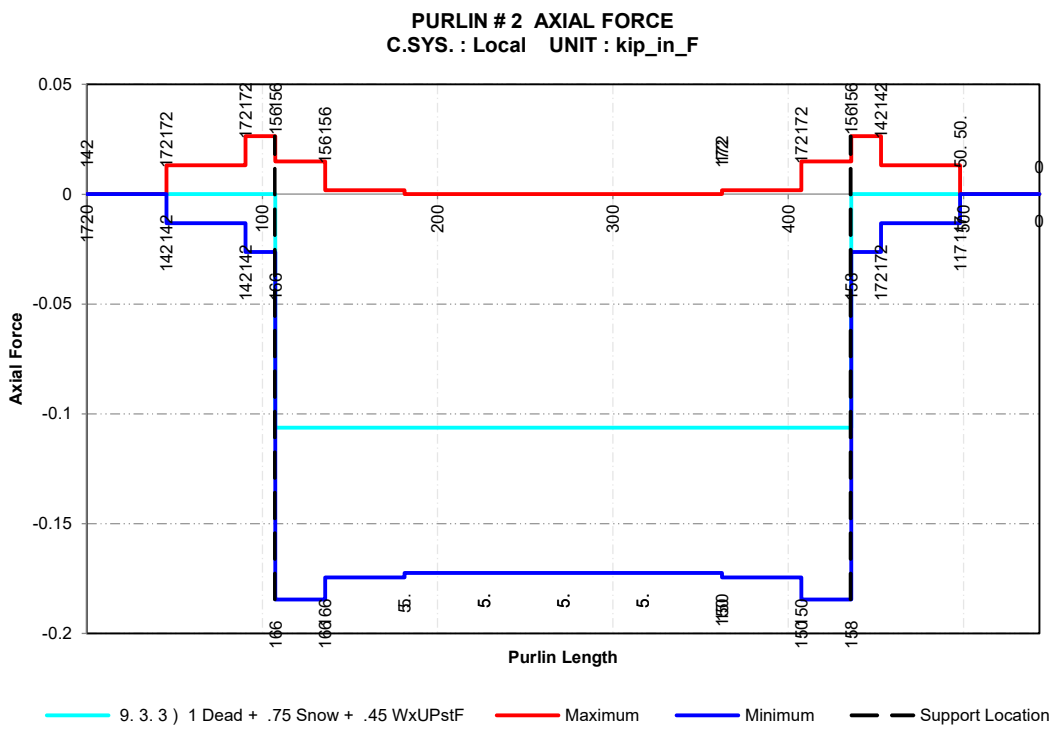


POST # 2 UNITY RATIO



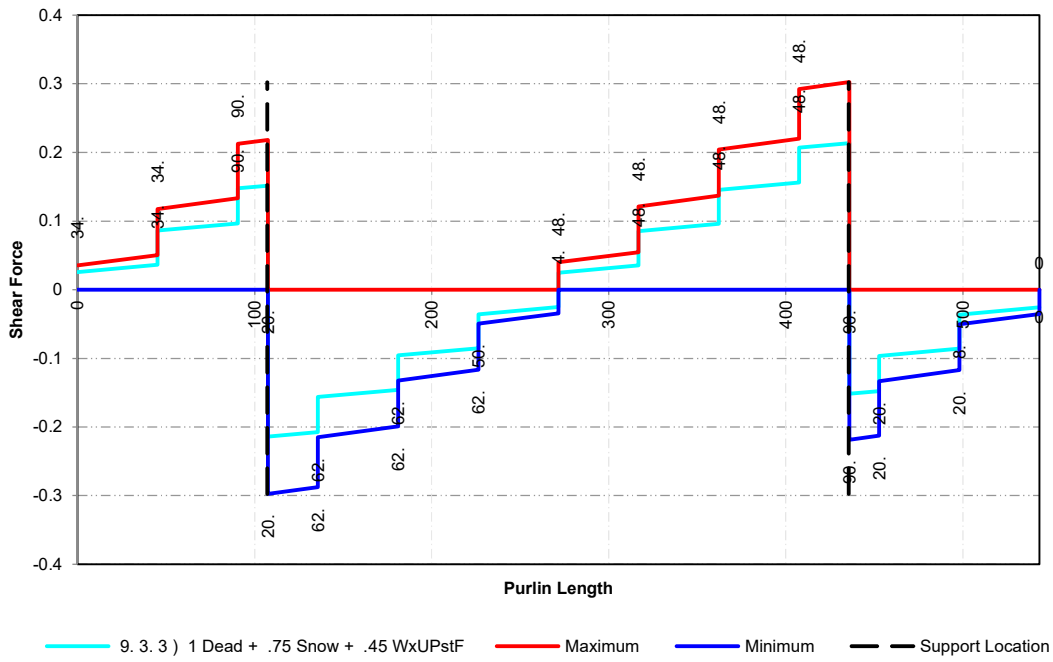
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*



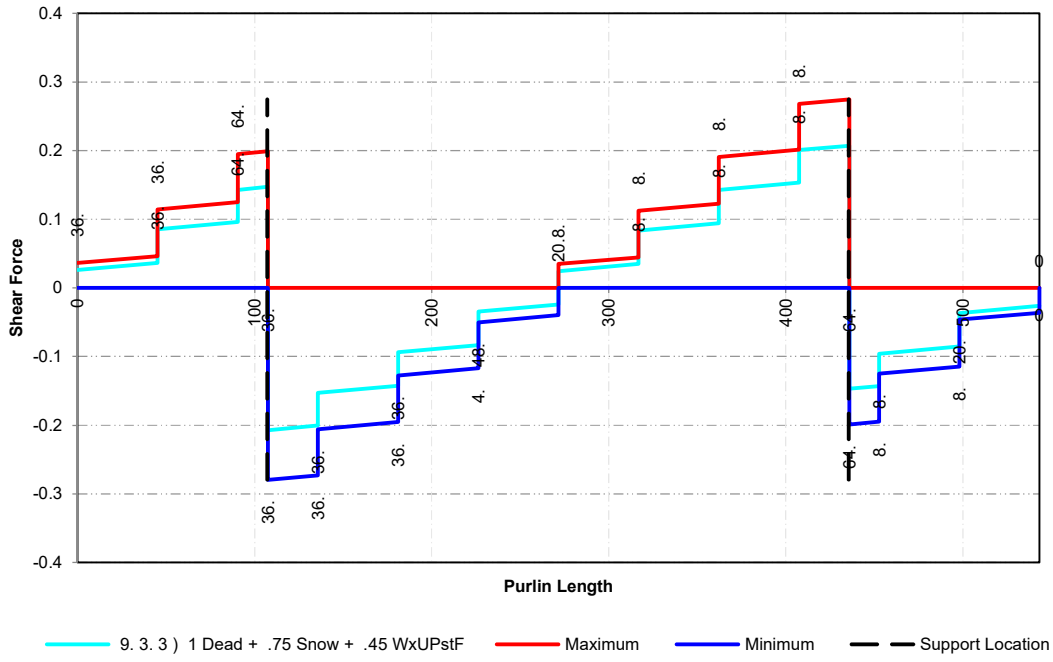


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

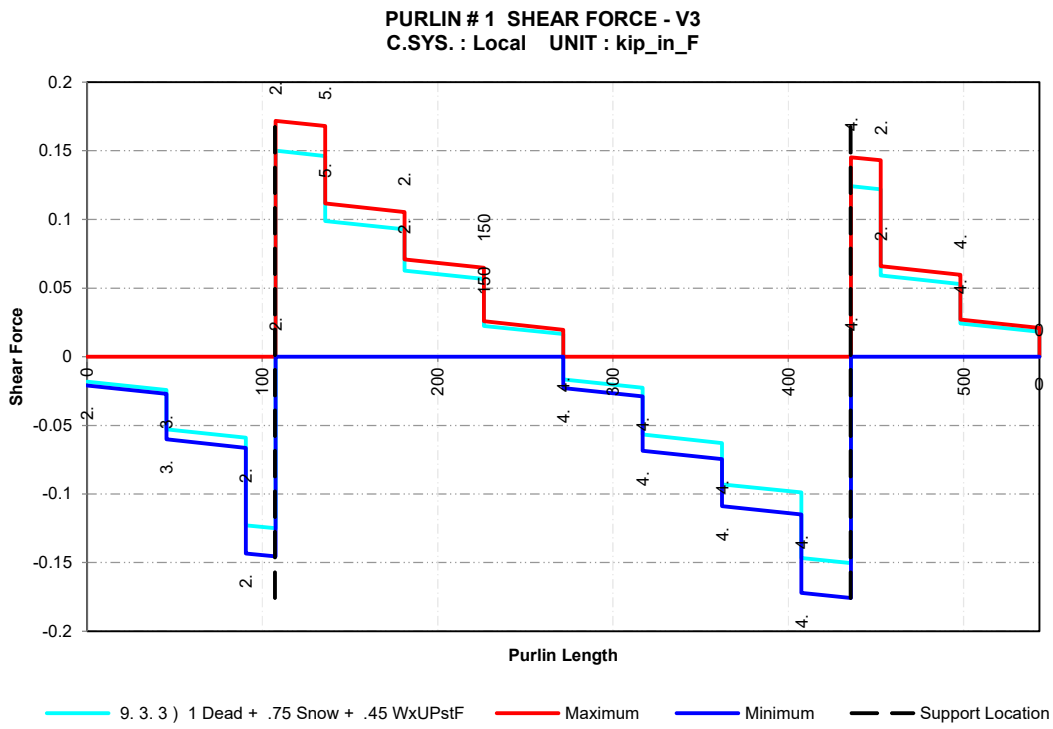
PURLIN # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F

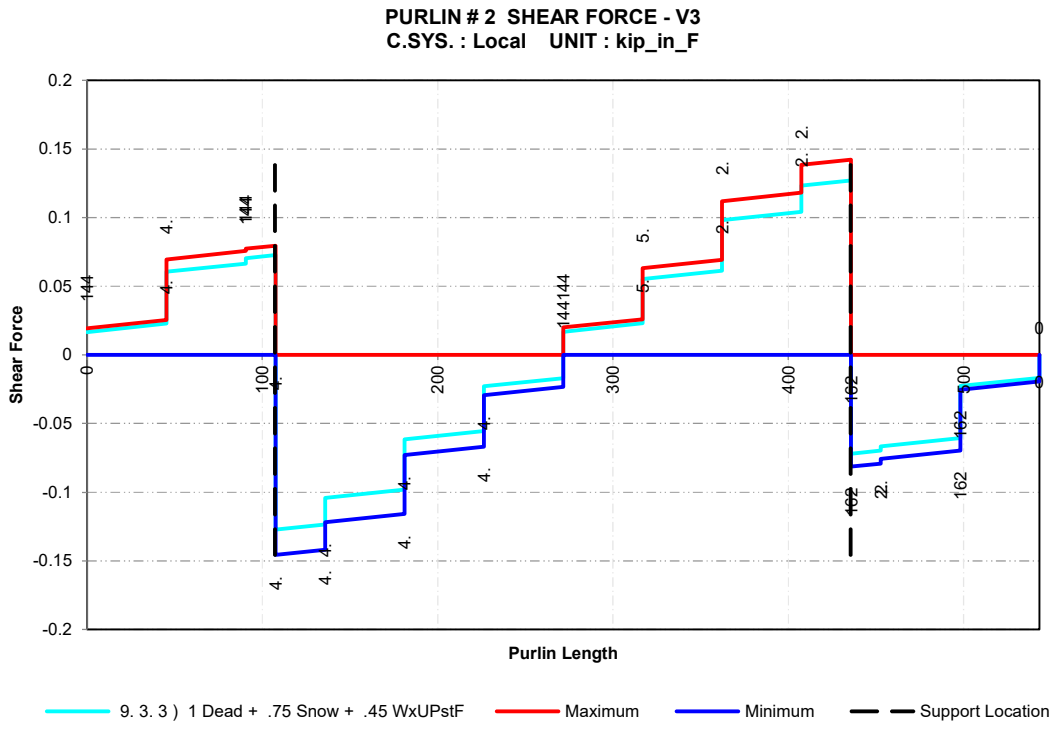


PURLIN # 2 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



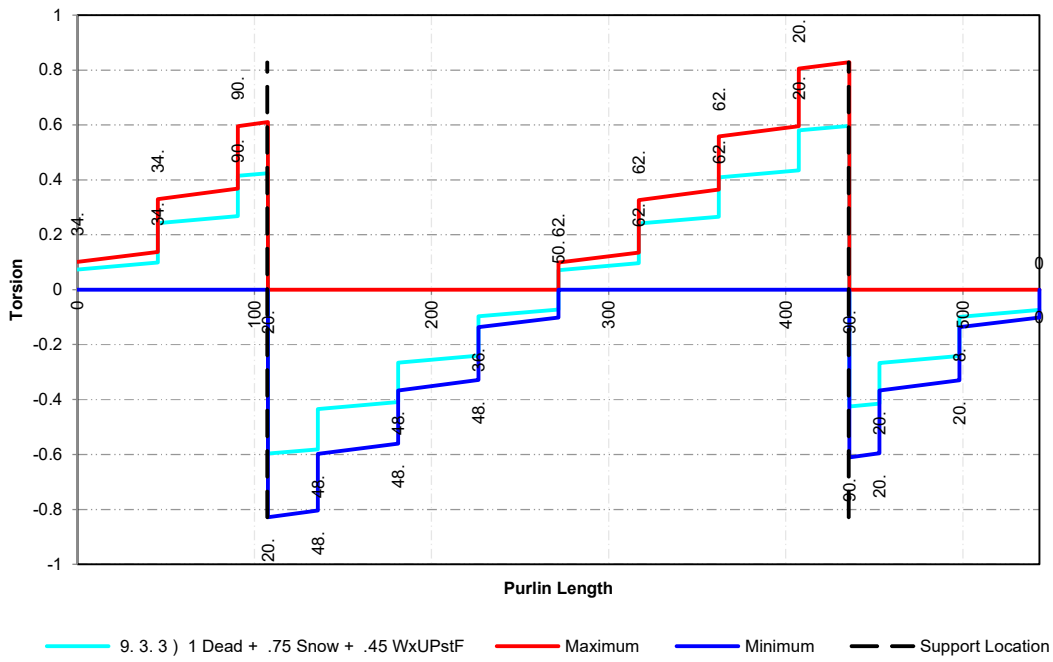
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*



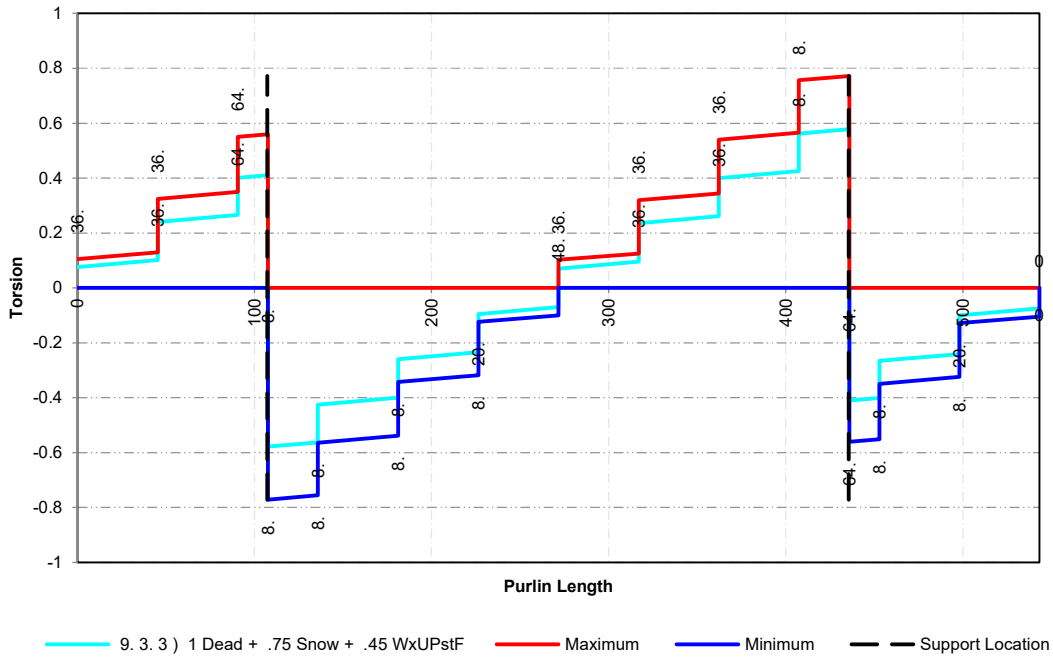


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

PURLIN # 1 TORSION
C.SYS. : Local UNIT : kip_in_F

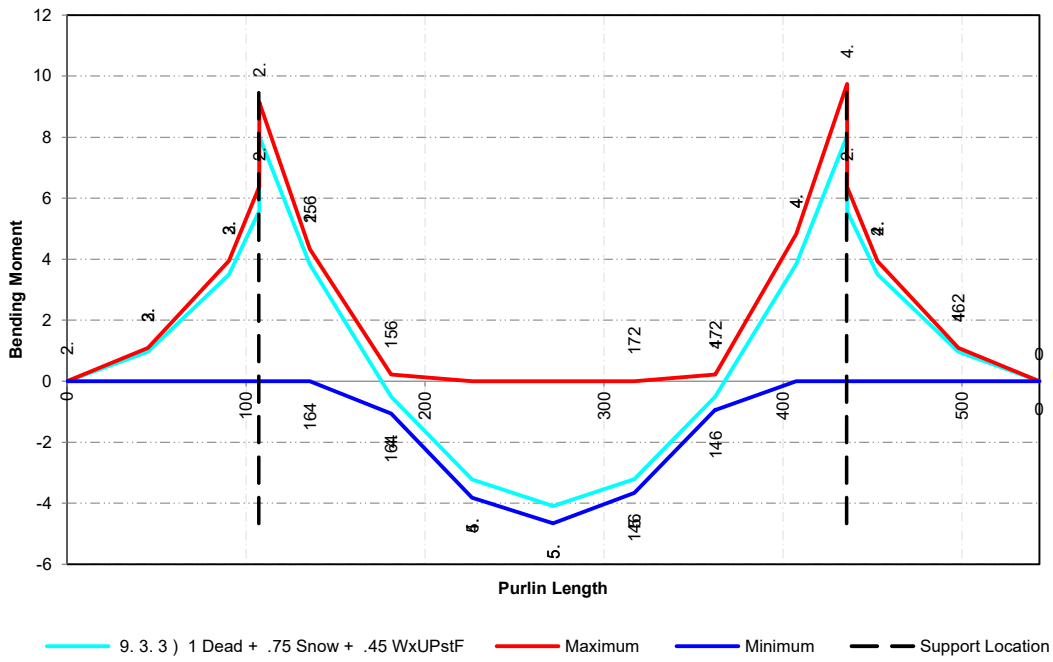


PURLIN # 2 TORSION
C.SYS. : Local UNIT : kip_in_F

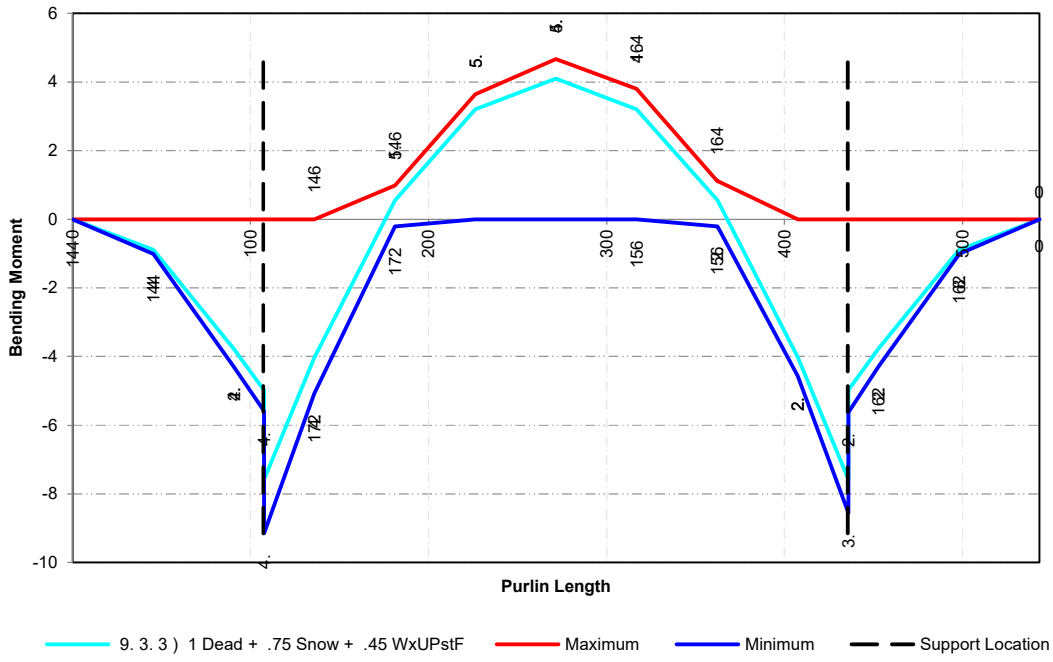


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

PURLIN # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

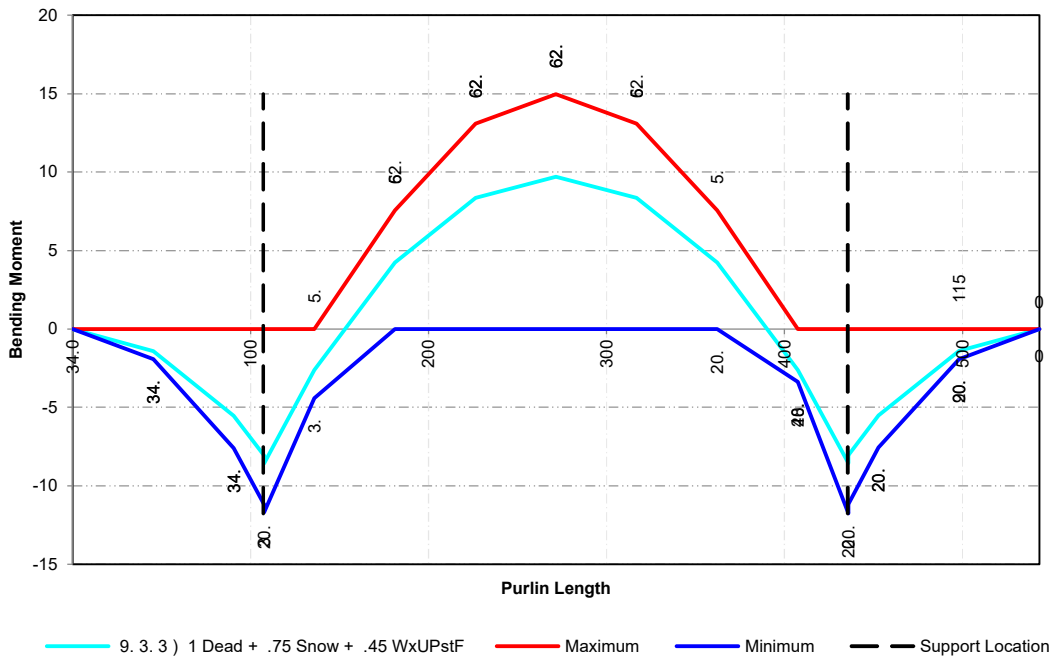


PURLIN # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

PURLIN # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



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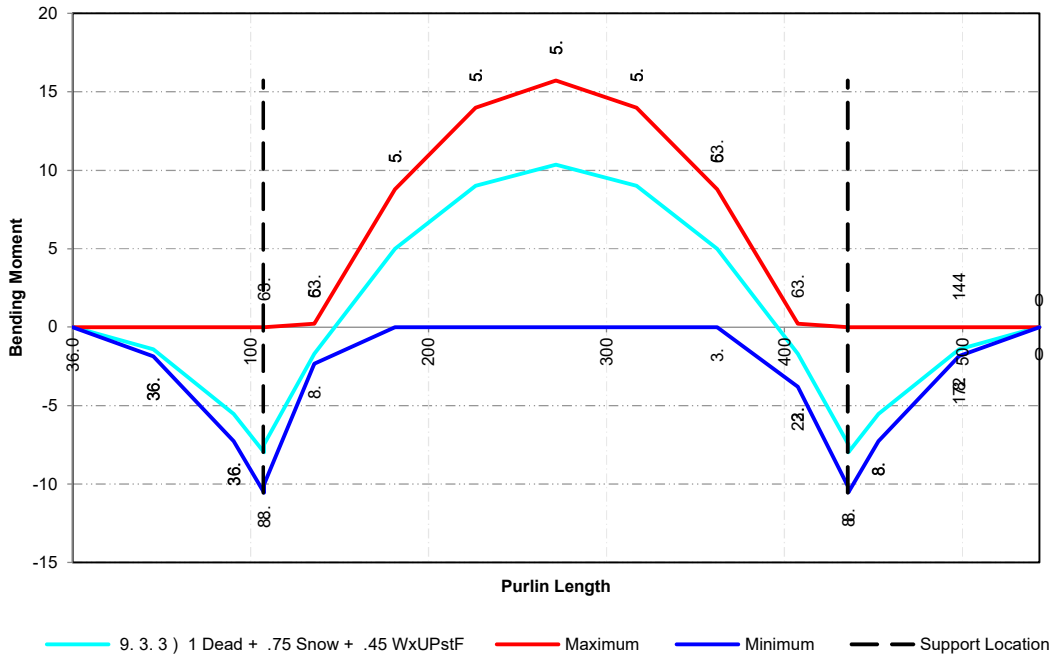
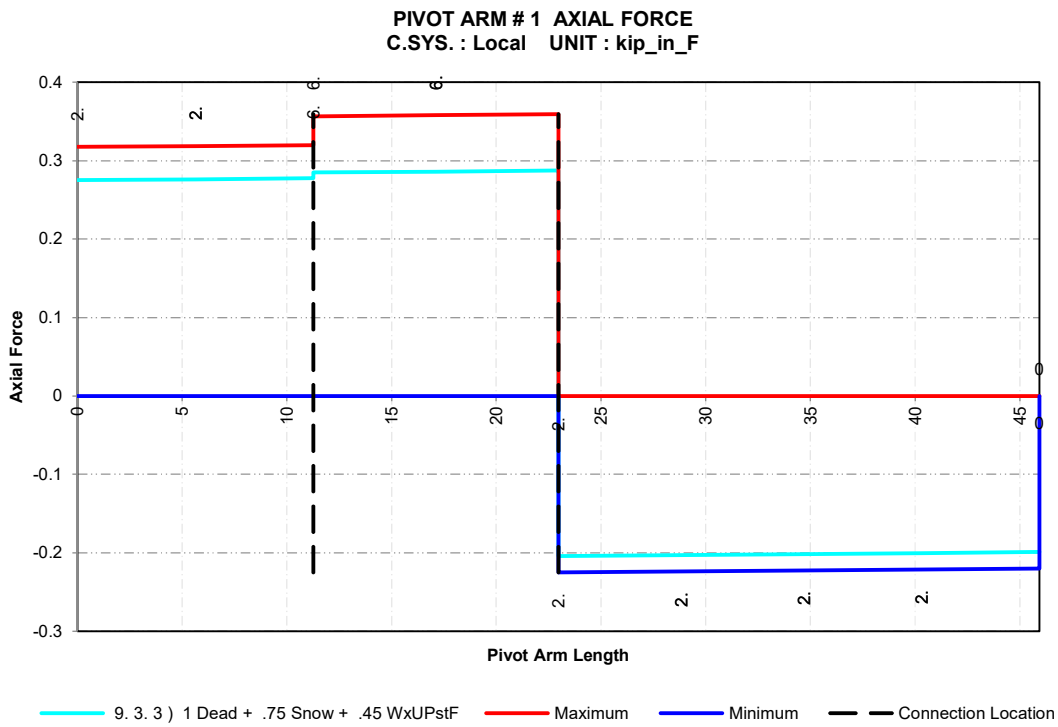
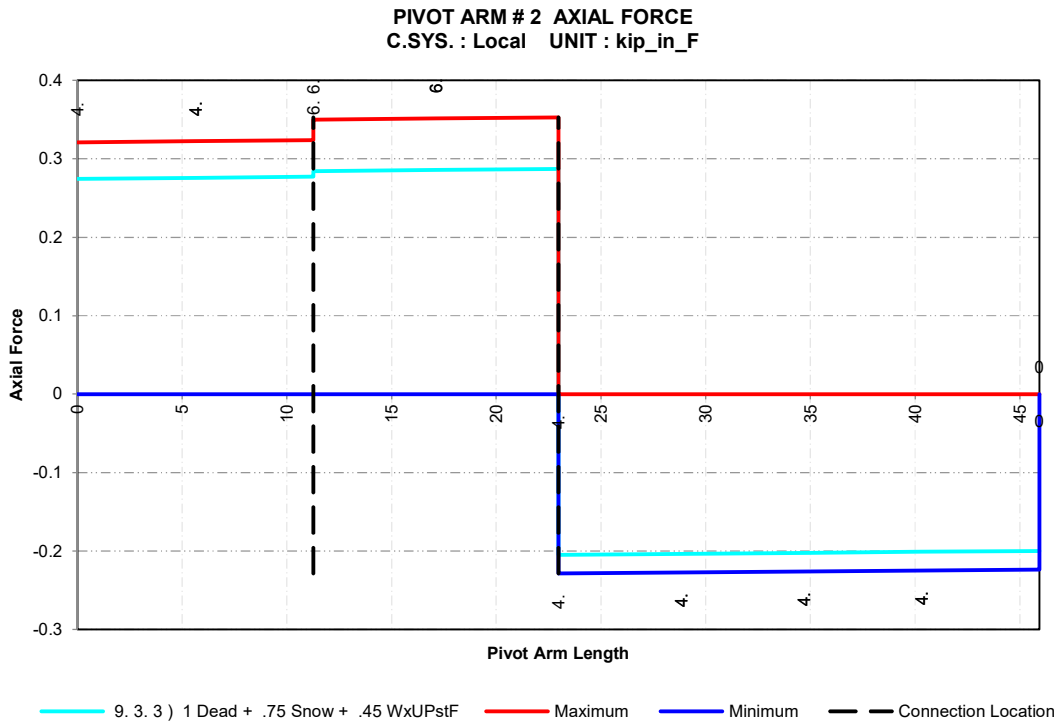
C.SYS. : Local UNIT : kip_in_F

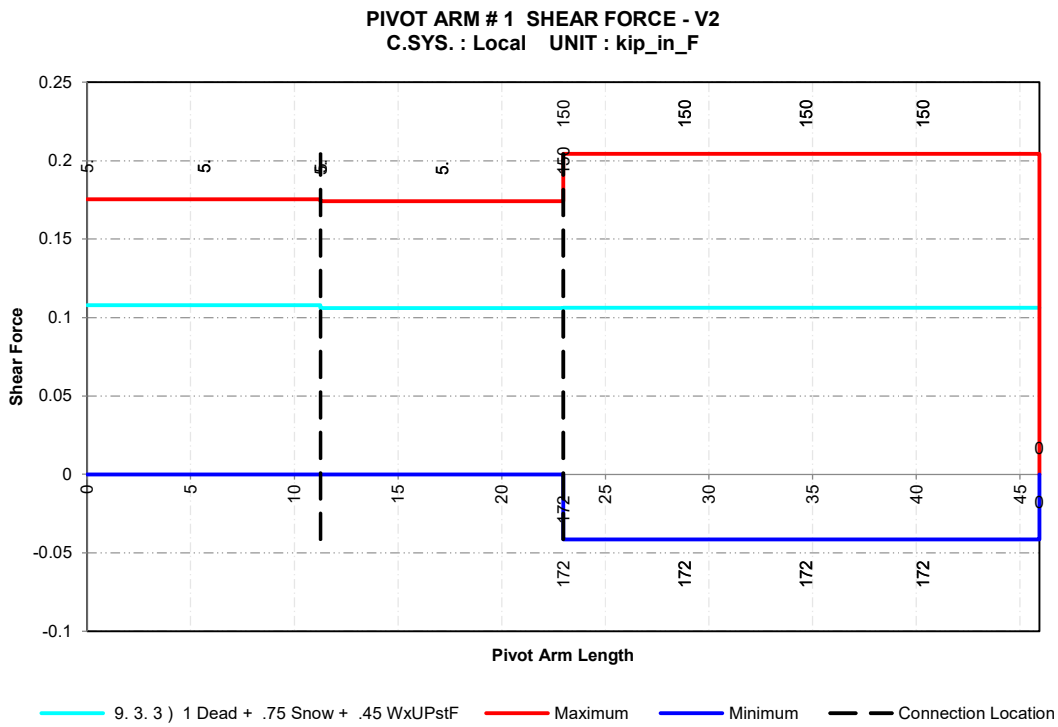


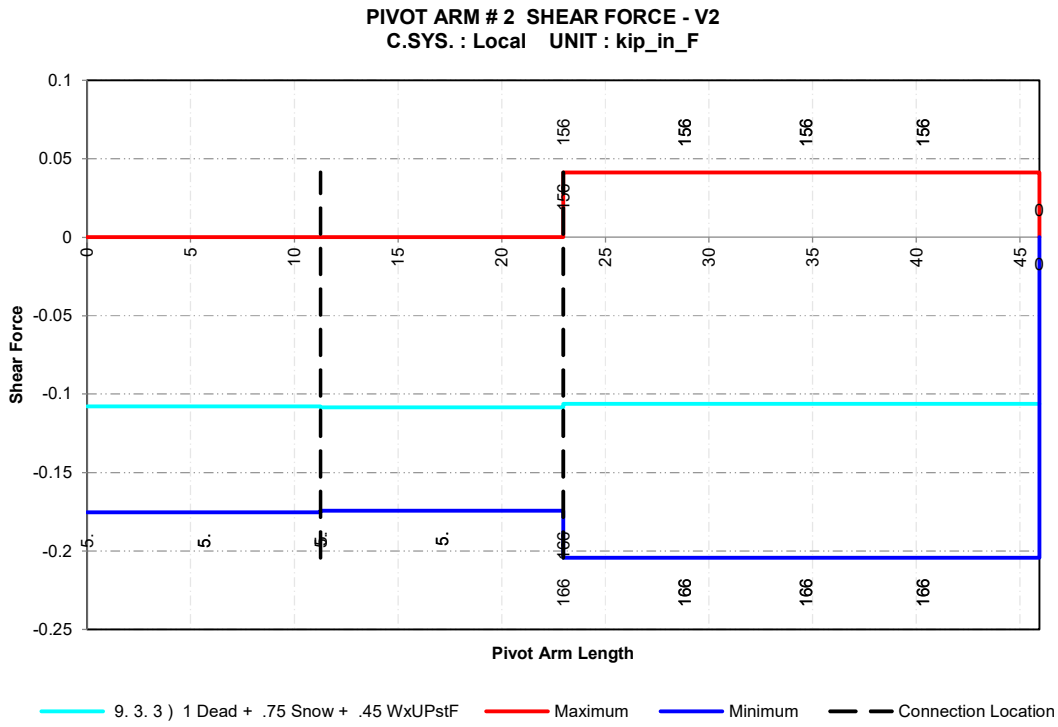
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*



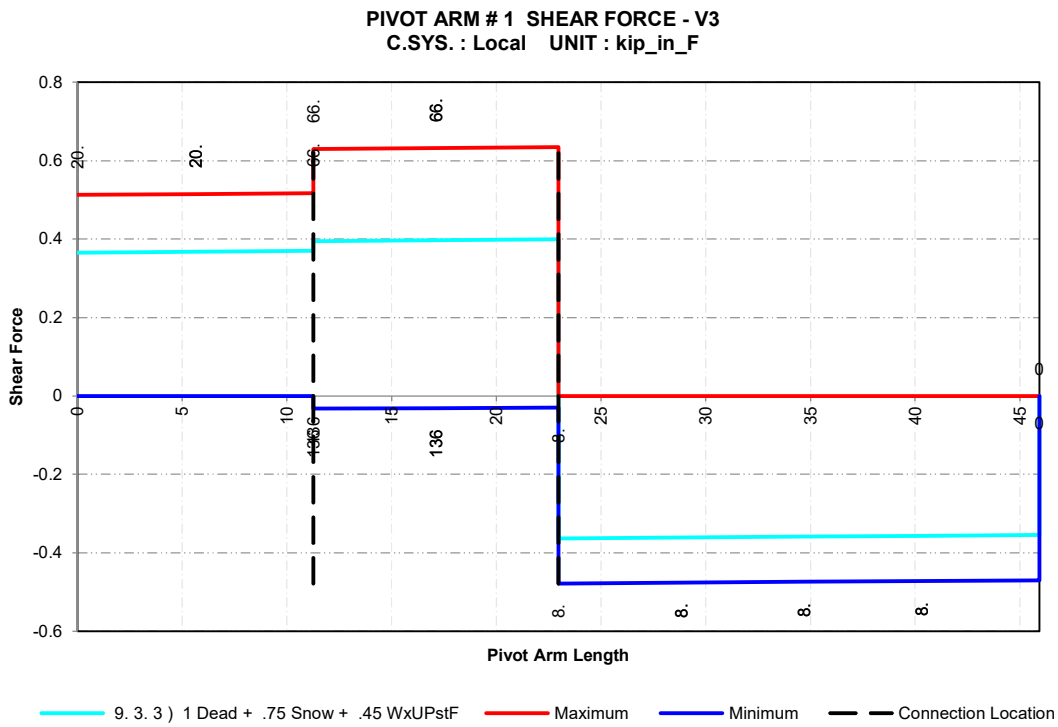


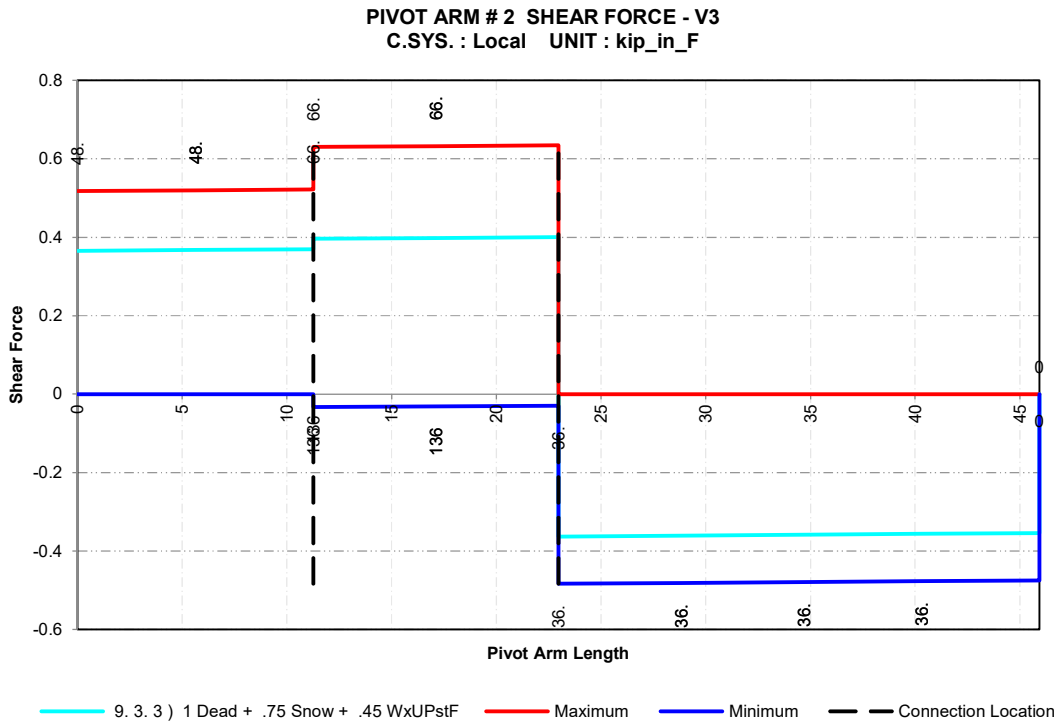
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*





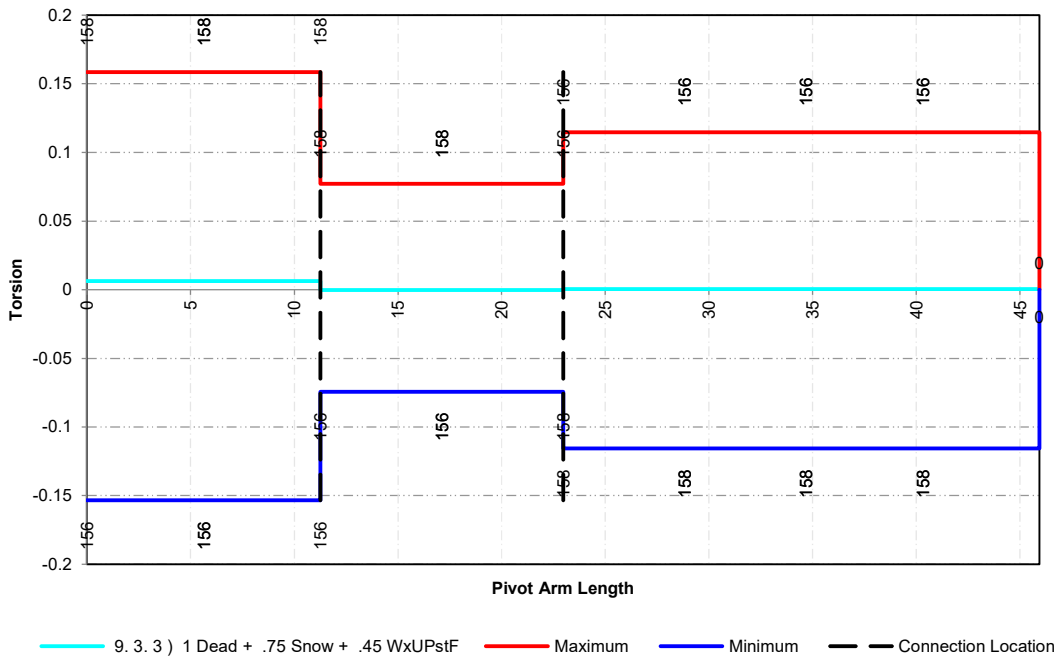
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*



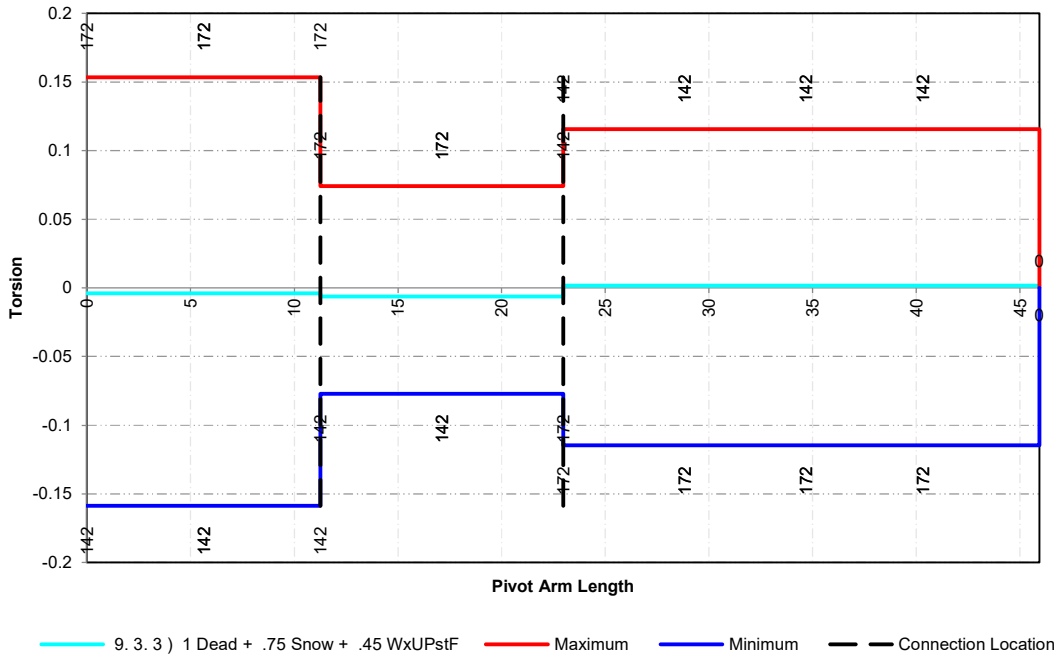


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

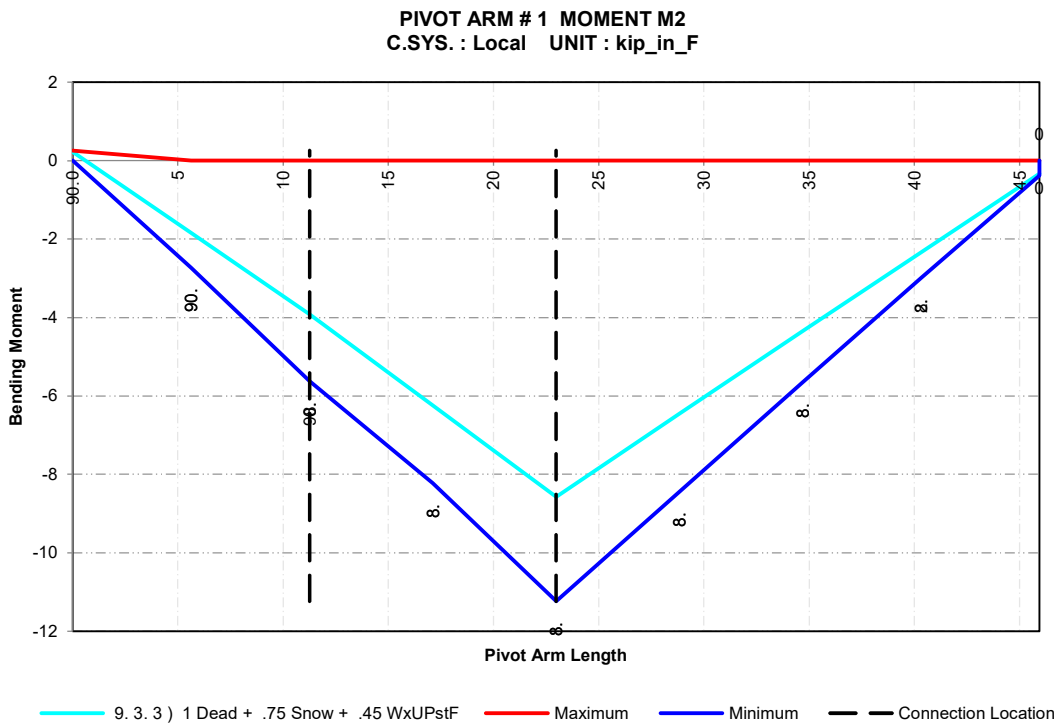
PIVOT ARM # 1 TORSION
C.SYS. : Local UNIT : kip_in_F

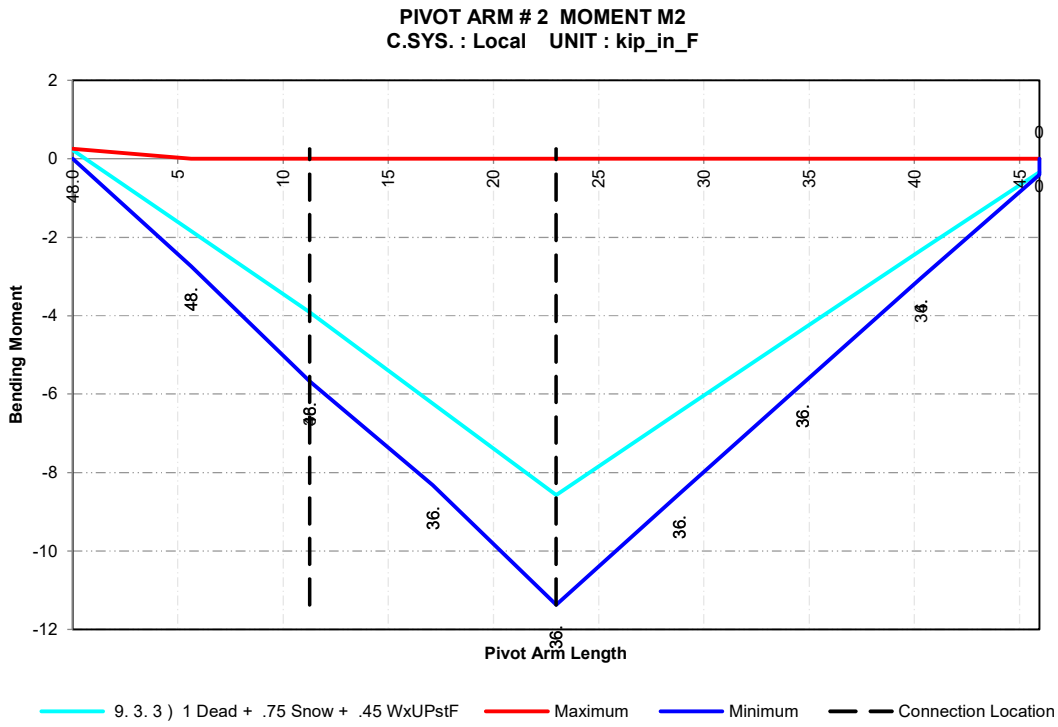


PIVOT ARM # 2 TORSION
C.SYS. : Local UNIT : kip_in_F



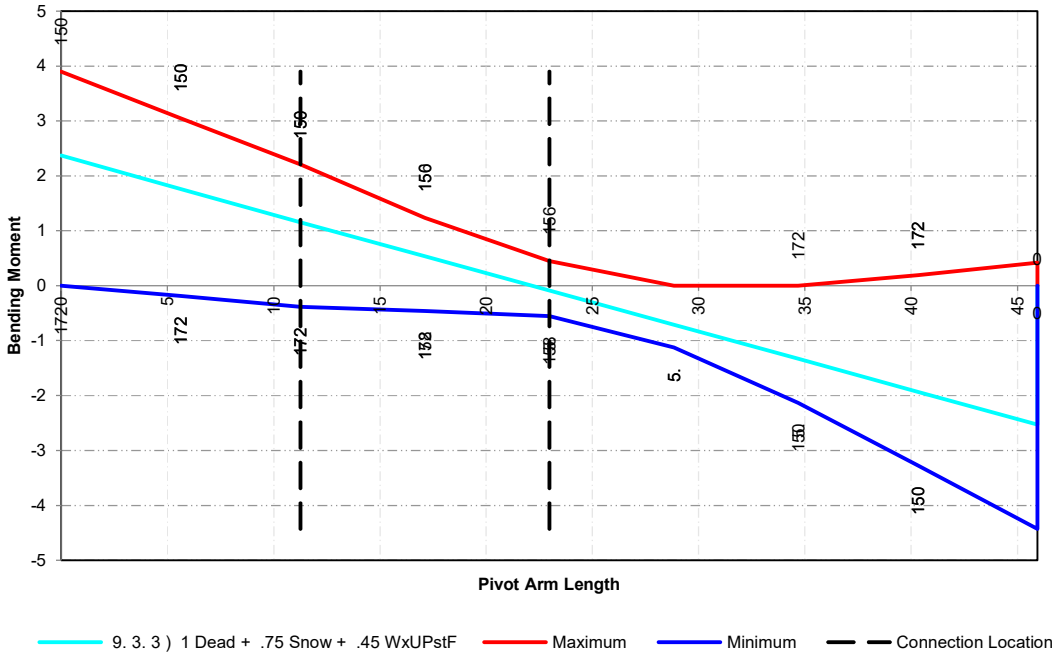
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*



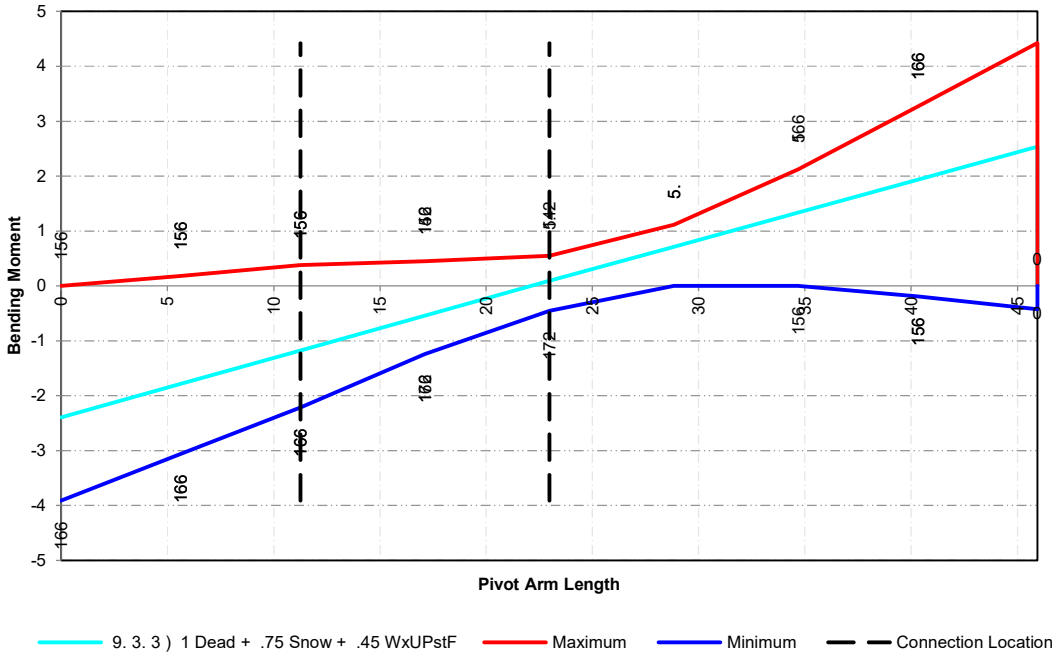


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

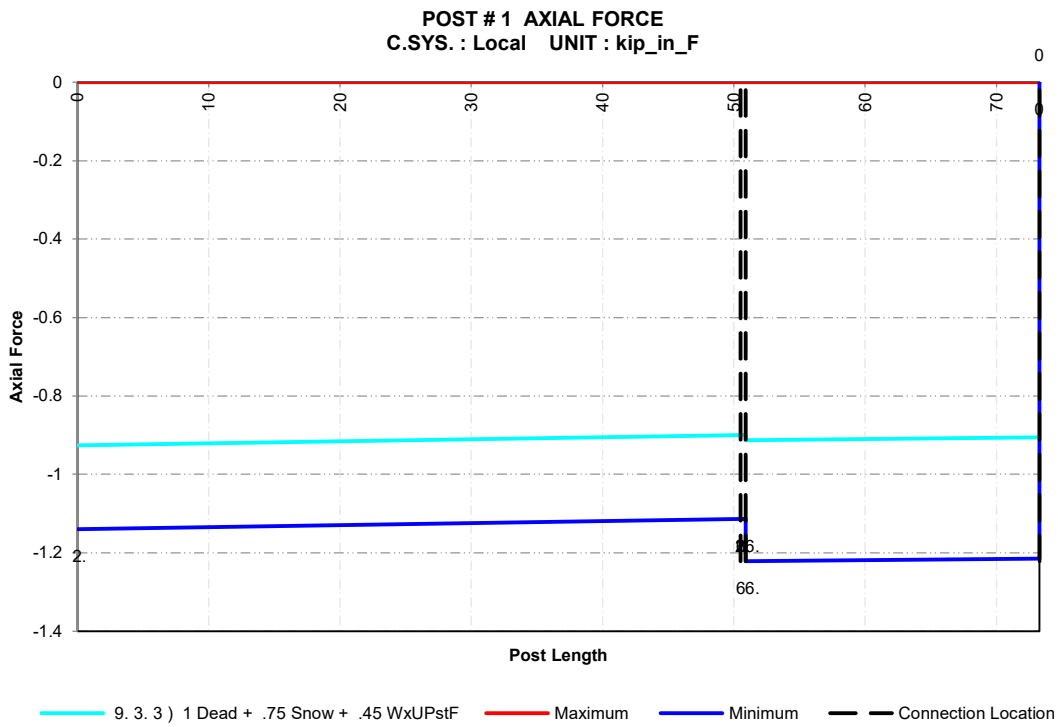
PIVOT ARM # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

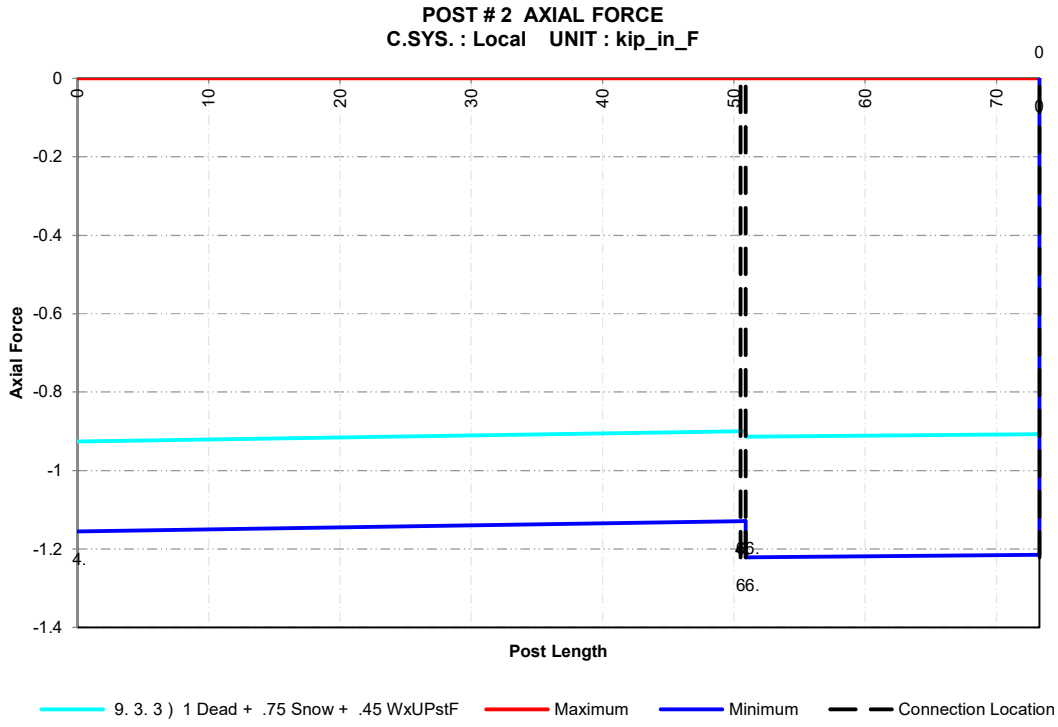


PIVOT ARM # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

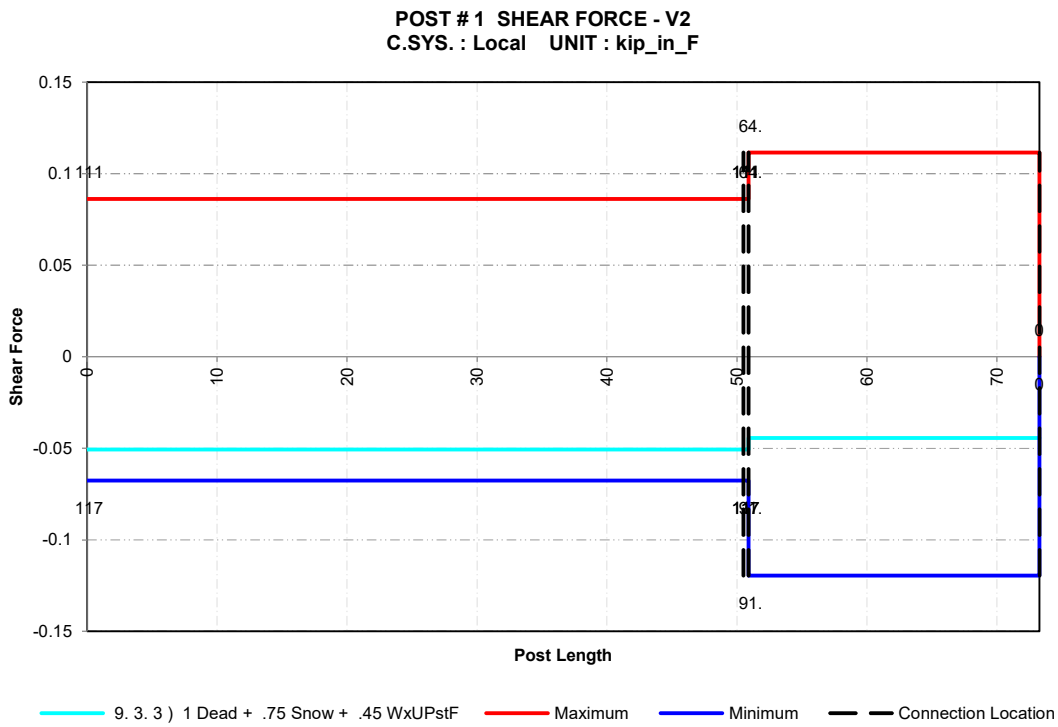


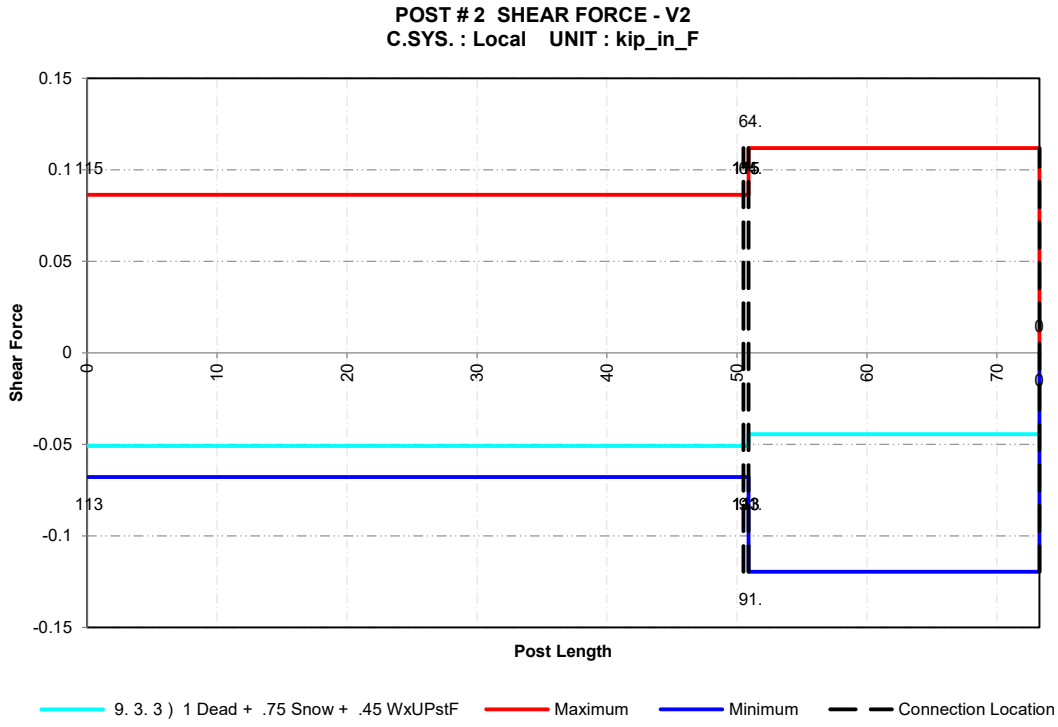
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*





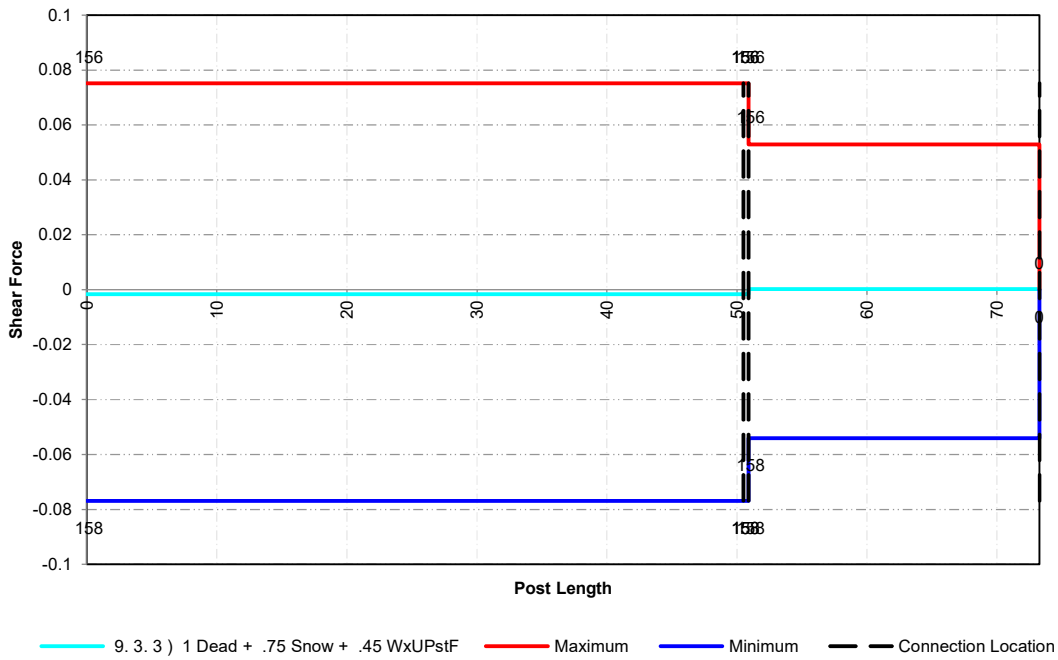
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*



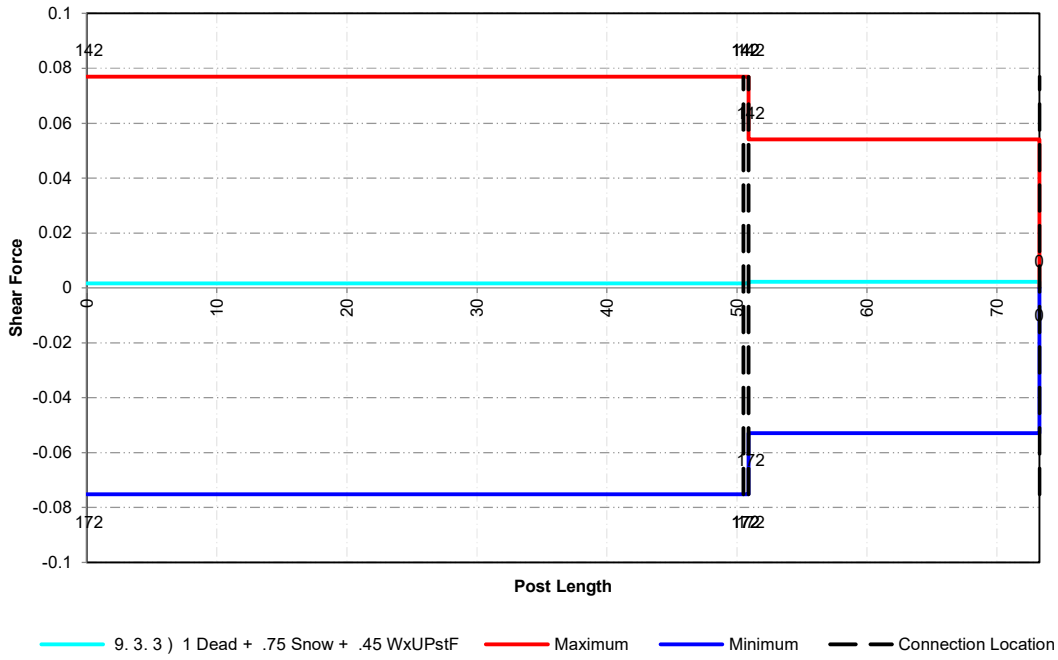


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

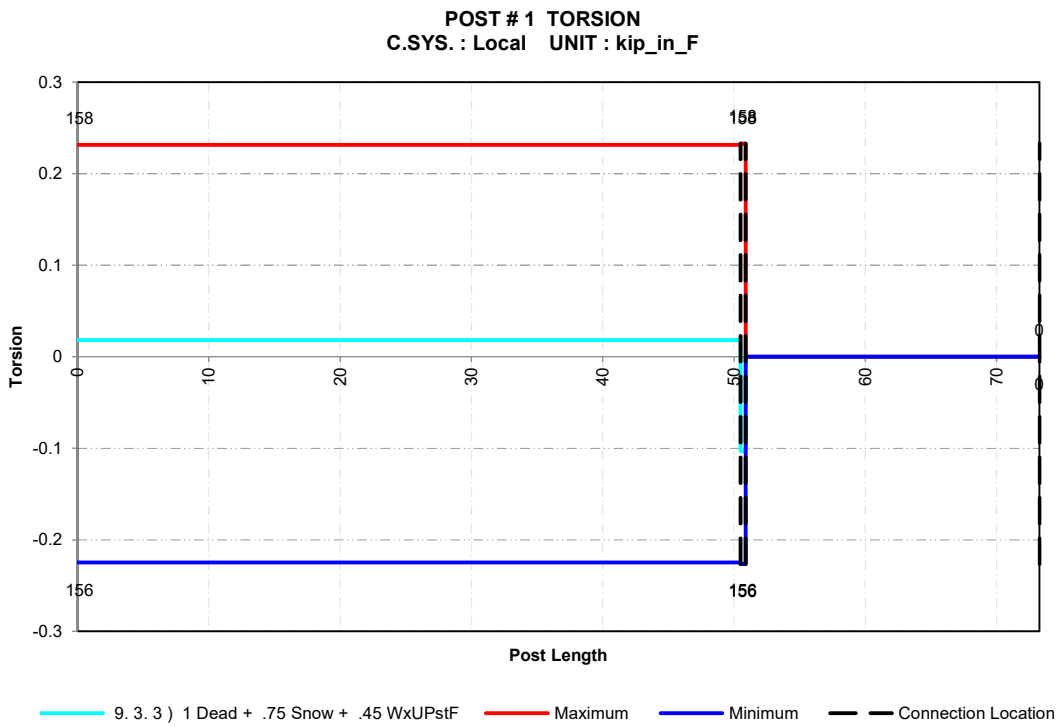
POST # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

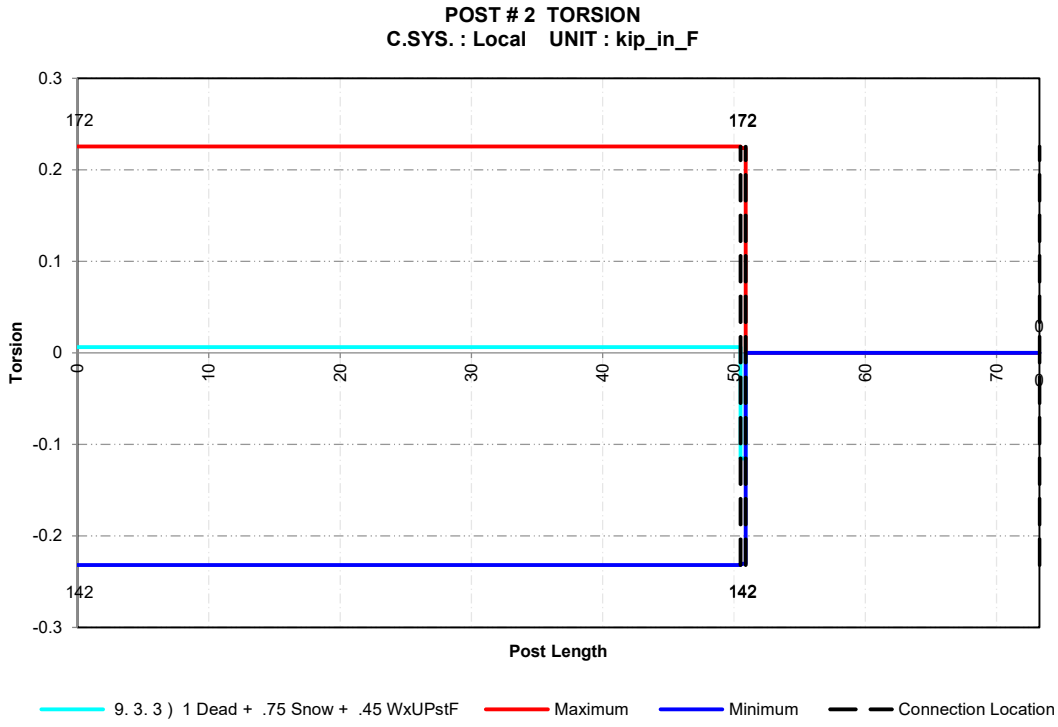


POST # 2 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F



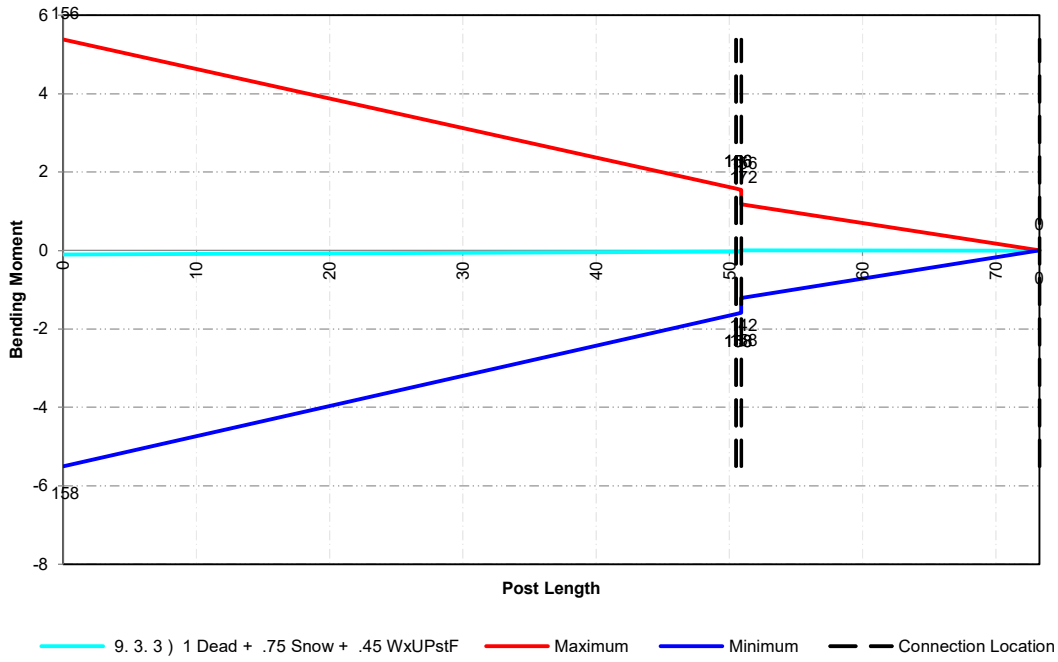
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*



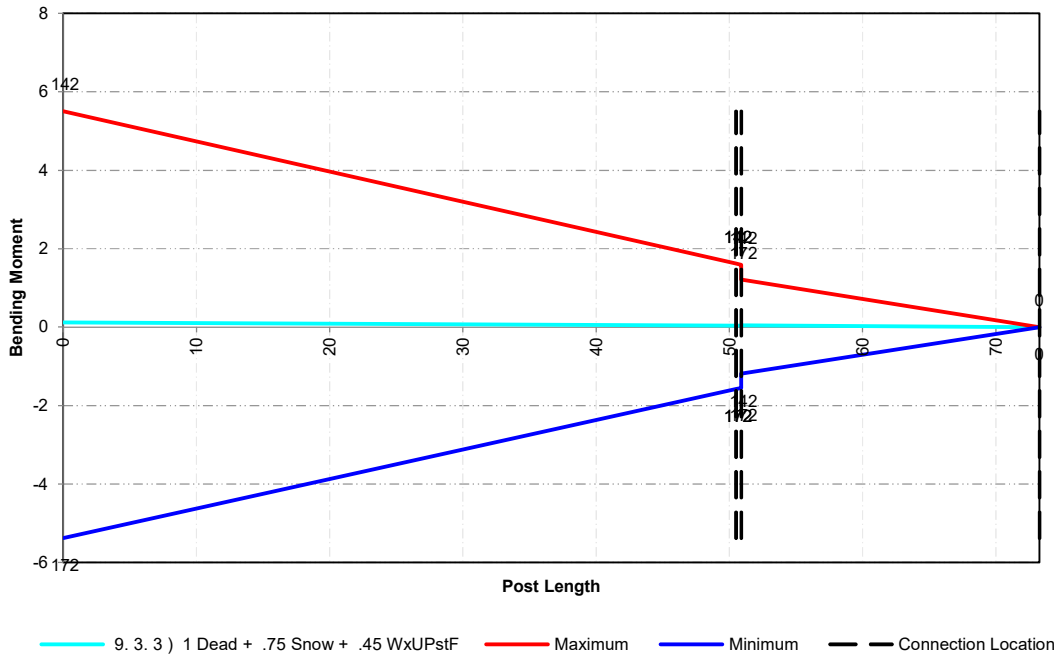


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

POST # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

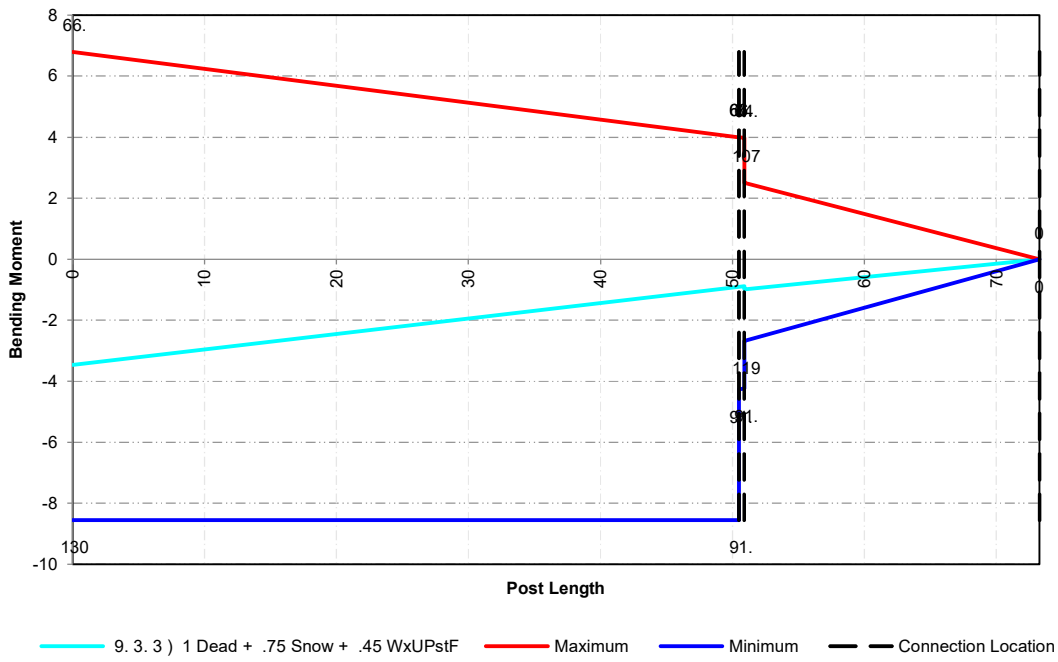


POST # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

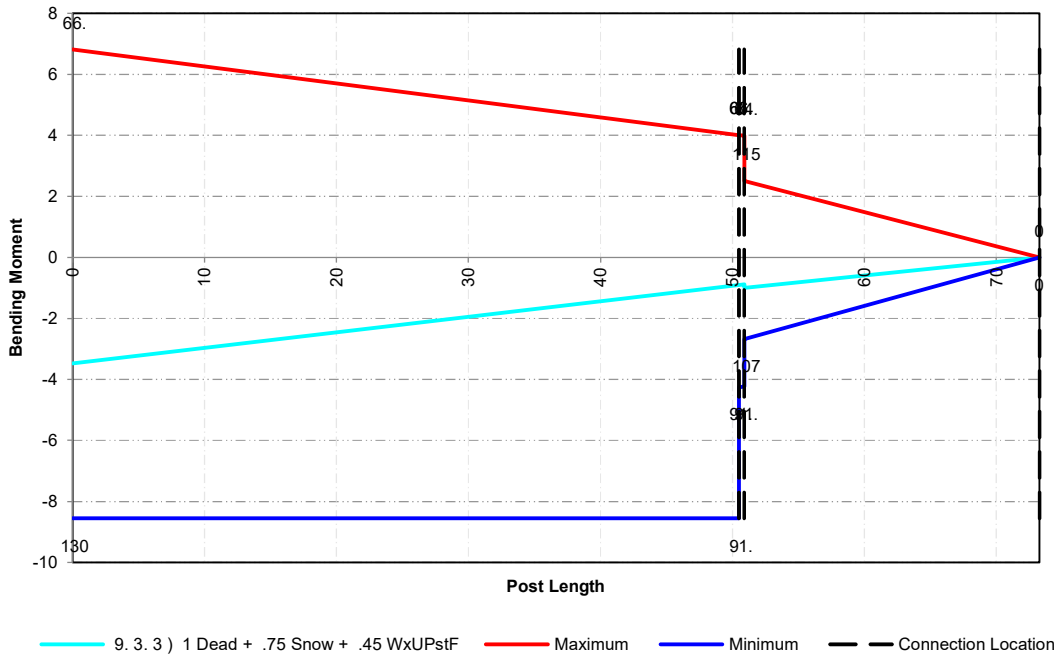


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-30 degree*

POST # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



POST # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

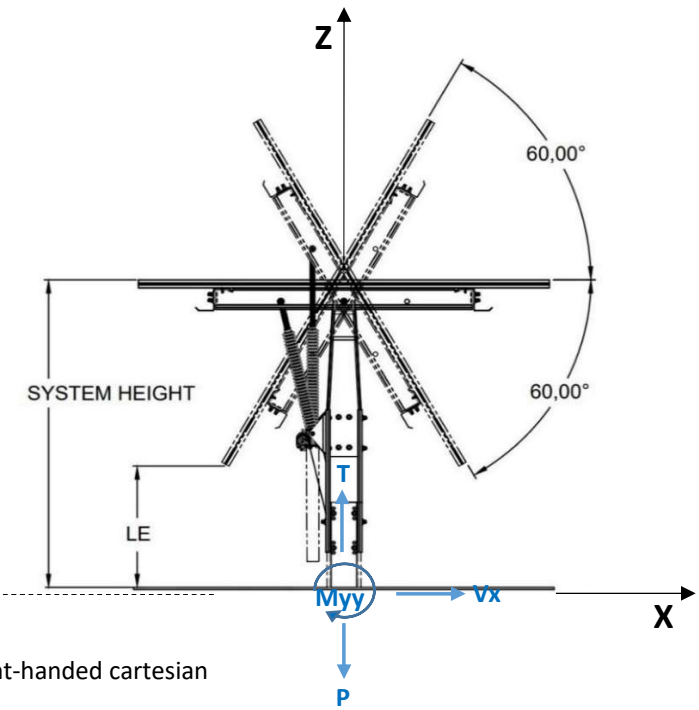
TABLE : *X20 (1P12 - SAT)*

CLASS : *Perimeter 2 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *-60 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.64	0.07	0.00	0.07	≈ 0	0.00	0.07
	T	n/a	0.00	n/a	-0.06	≈ 0	n/a	-0.06
	V_x	0.00	0 , 0	0.00	± 0.12	± 0.09	0.00	-0.12 , 0.11
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	-0.03	-0.02 , 0.02	0.00	± 0.8	± 0.57	0.00	-0.75 , 0.8
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.61	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
2ND	**P**	0.64	0.07	0.00	0.07	≈ 0	0.00	0.07
	T	n/a	0.00	n/a	-0.06	≈ 0	n/a	-0.06
	V_x	0.00	0 , 0	0.00	± 0.12	± 0.09	0.00	-0.12 , 0.11
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	-0.03	-0.02 , 0.02	0.00	± 0.8	± 0.57	0.00	-0.75 , 0.8
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.61	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

Reaction Loads & Member Sizing Summary

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X20 (1P12 - SAT)*

LENGTH : *2279 mm*

CLASS : *Perimeter 2 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *-60 degree*

CHORD LENGTH : *13784 mm*

POST SPAN : *8340 mm*

CHORD CONTILEVER : *2722 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	1.95	4	20	45
Splice / Z	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		3.1	note * : standard baseline section		
Pivot Arm - Mid / Ω	N/A	N/A		N/A	N/A		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O	GR_50	88.9	n/a	4.5	n/a	n/a	n/a

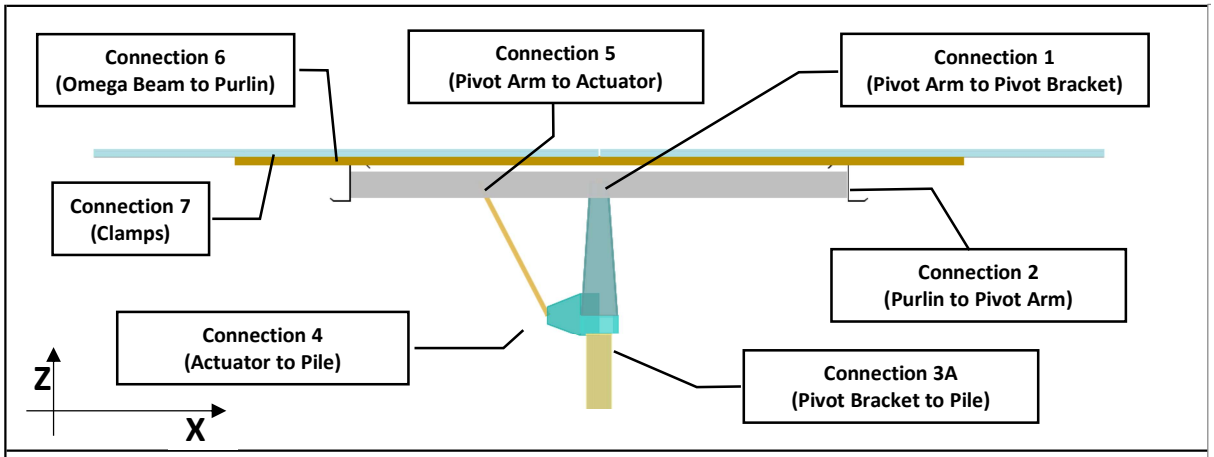
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.64	0.07	0.00	0.07	≈ 0	0.00	0.07
	T	n/a	0.00	n/a	-0.06	≈ 0	n/a	-0.06
	V_x	0.00	0 , 0	0.00	± 0.12	± 0.09	0.00	-0.12 , 0.11
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	-0.03	-0.02 , 0.02	0.00	± 0.8	± 0.57	0.00	-0.75 , 0.8
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.61	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
2ND	**P**	0.64	0.07	0.00	0.07	≈ 0	0.00	0.07
	T	n/a	0.00	n/a	-0.06	≈ 0	n/a	-0.06
	V_x	0.00	0 , 0	0.00	± 0.12	± 0.09	0.00	-0.12 , 0.11
	V_y	0.00	0 , 0	0.00	± 0	± 0.11	0.00	± 0
	M_{yy}	-0.03	-0.02 , 0.02	0.00	± 0.8	± 0.57	0.00	-0.75 , 0.8
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.61	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-60 degree*

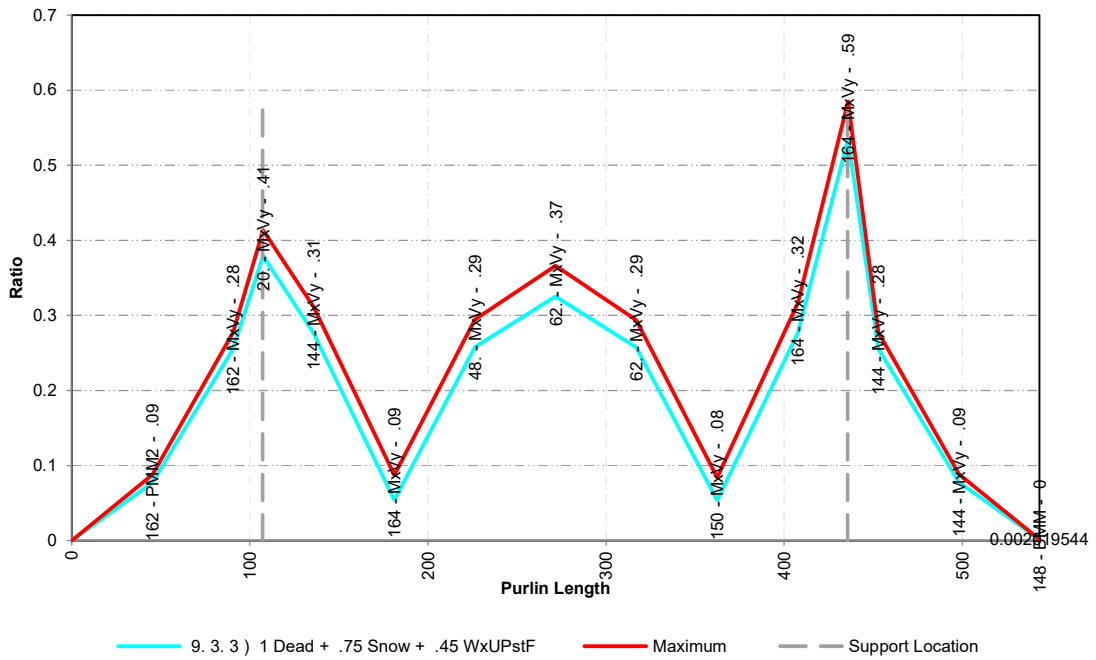


Note: coordinate system is right-handed cartesian

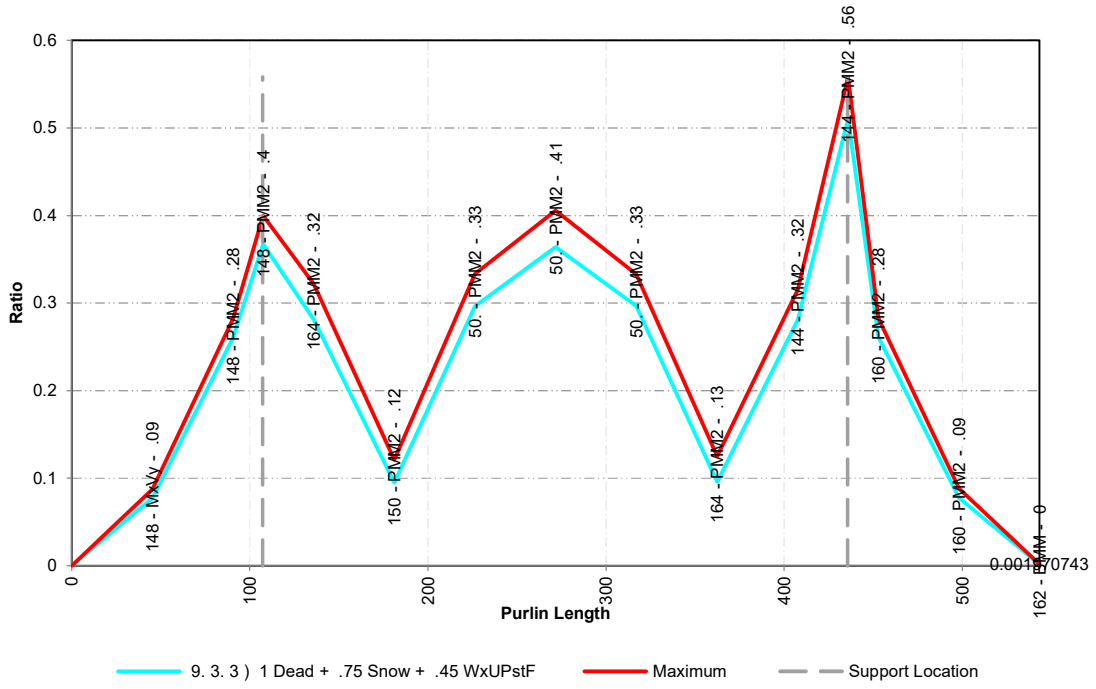
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-0.84	0.02	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
-0.65	0.00	0.04	0.00	0.00	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 2						
0.30	0.14	0.13	0.00	0.24	0.03	159. 13. 1) 1 Dead + .75 Snow + -.525 Quake_x
0.29	0.20	-0.13	0.00	-0.24	0.02	48. 3. 66) 1 Dead + .75 S2_lhhh + .45 WxDNst+T
Connection : 3						
-0.34	-0.07	0.00	0.00	0.00	-0.39	117. 5. 3) .6 Dead + .6 WxUPstF
-0.72	0.06	0.00	0.00	0.00	0.32	48. 3. 66) 1 Dead + .75 S2_lhhh + .45 WxDNst+T
-0.42	0.07	0.00	0.00	0.00	0.47	115. 5. 1) .6 Dead + .6 WxDNstF
-0.68	0.07	0.00	0.00	0.00	0.48	92. 4. 1) 1 Dead + .6 WxDNstF
-0.63	0.00	0.08	-0.02	0.43	0.03	142. 9. 2) 1 Dead + .7 Quake_y
-0.63	0.00	0.08	-0.02	0.43	0.03	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
0.20	*	0.00	0.00	0.00	0.00	96. 4. 5) 1 Dead + .6 WxDNstH
Connection : 5		** Note : the load is axial in actuator direction*				
0.20	*	0.00	0.00	0.00	0.00	96. 4. 5) 1 Dead + .6 WxDNstH
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.01						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.01						0.6 WLup

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-60 degree*

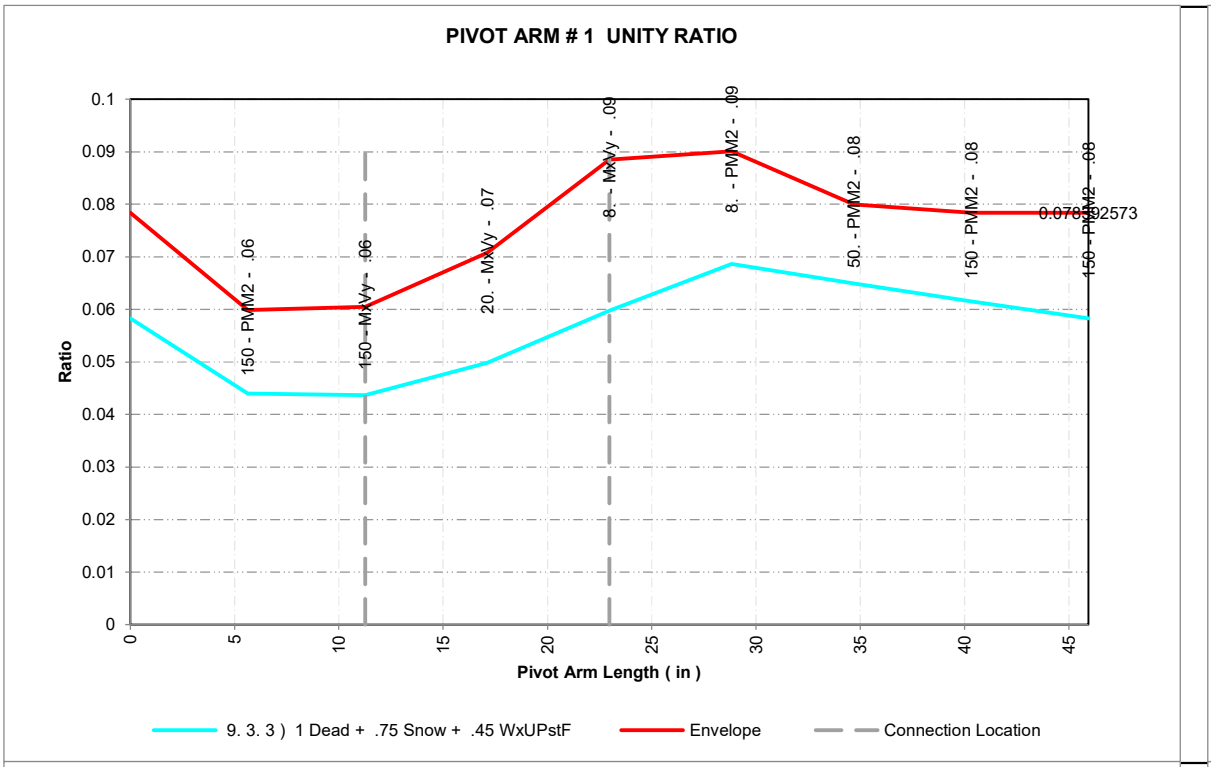
PURLIN # 1 UNITY RATIO

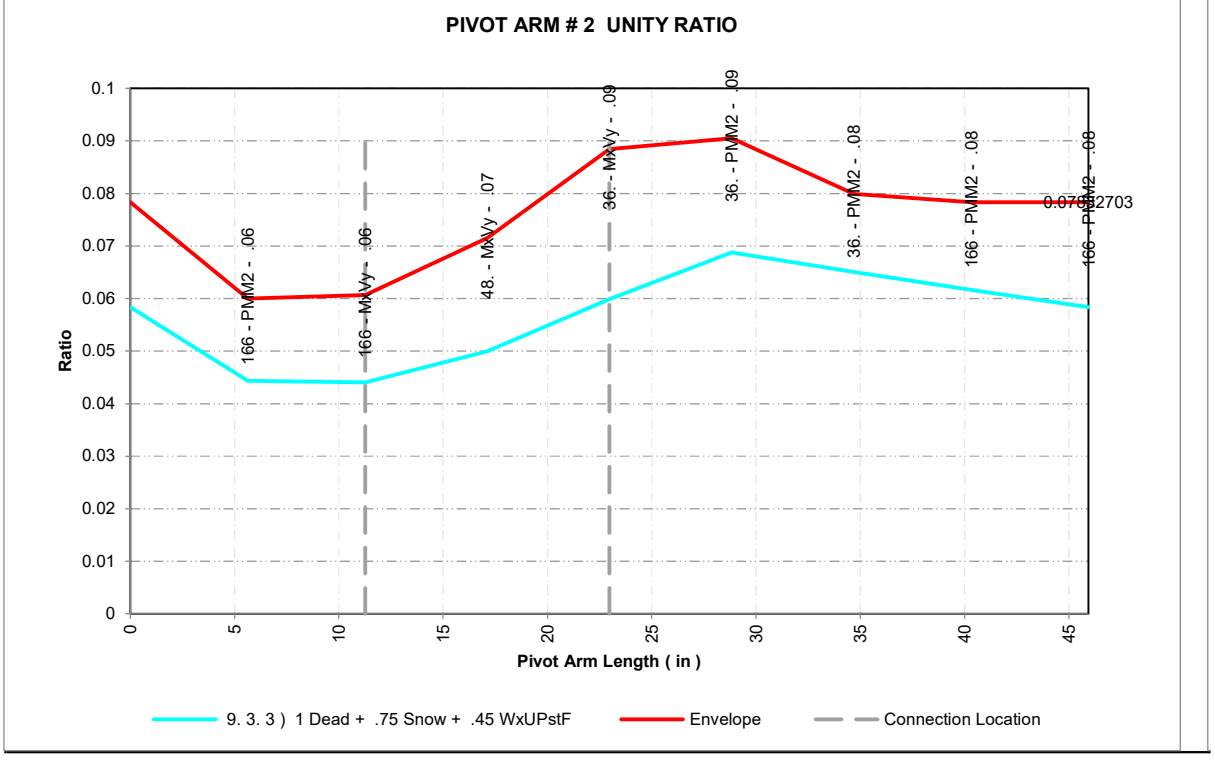


PURLIN # 2 UNITY RATIO



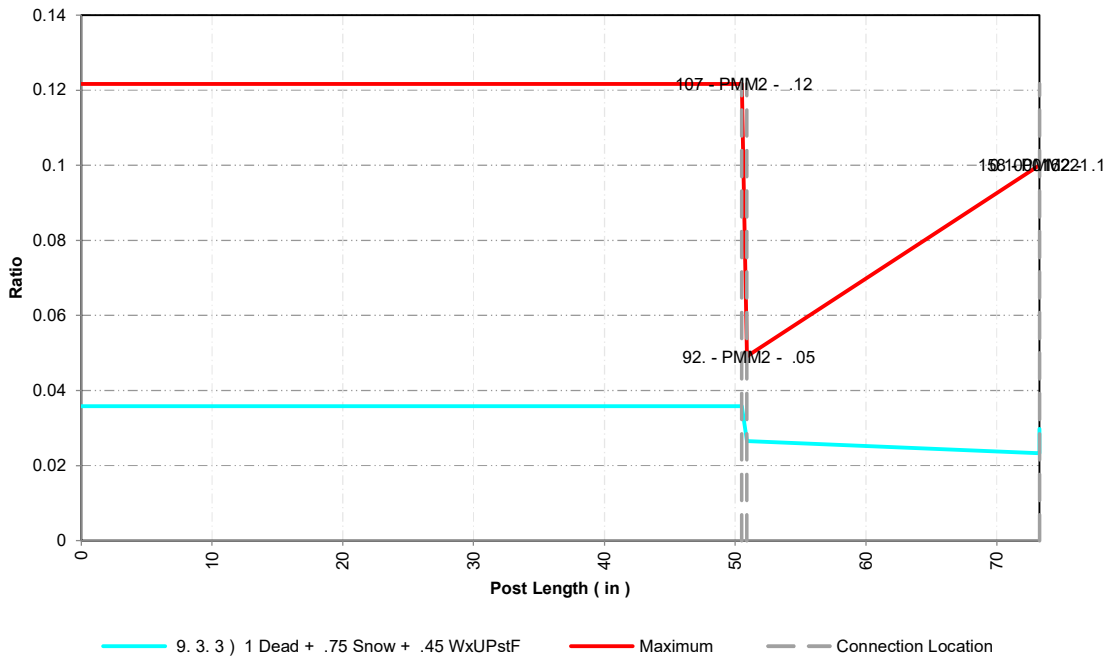
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-60 degree*



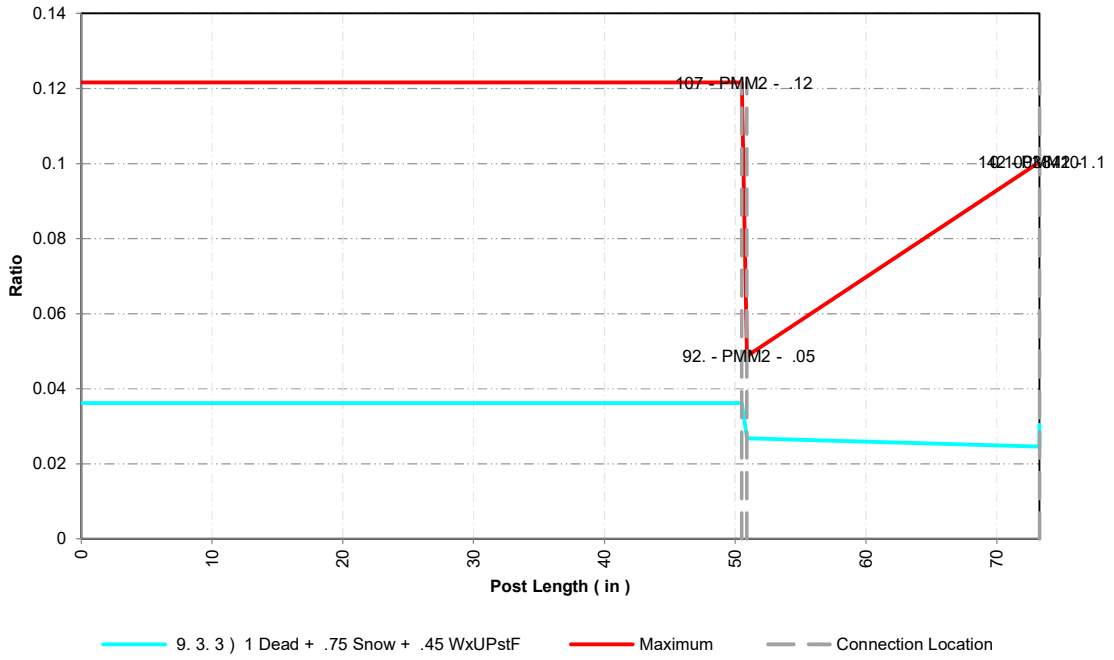


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X20 (1P12 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Perimeter 2 Posts*	**TILT :** *-60 degree*

POST # 1 UNITY RATIO



POST # 2 UNITY RATIO



PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

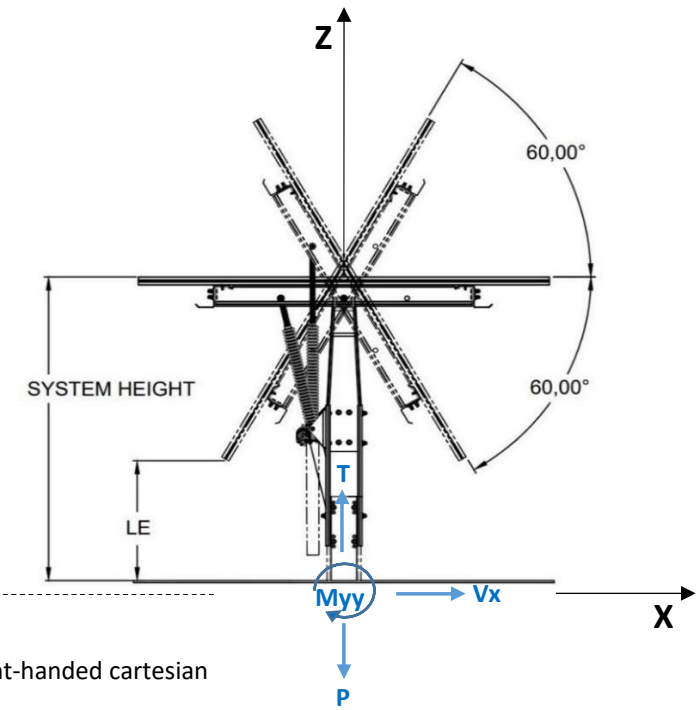
TABLE : *X25 (1P24 - SAT)*

CLASS : *Central 3 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *-3 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.77	0.97	0.00	2.01	≈ 0	0.44	0.96
	T	n/a	0.00	n/a	-2.34	≈ 0	n/a	-1.29
	V_x	0.00	0 , 0	0.00	± 0.12	± 0.09	-0.02	-0.05 , 0.07
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.01	-0.45 , 0.47	0.00	± 4.71	± 0.55	-0.14	-1.37 , 2.6
	M_{xx}	0.00	-0.01 , 0.01	0.00	± 0	± 0.57	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.02	1.37	0.00	2.60	≈ 0	0.57	1.24
	T	n/a	0.00	n/a	-3.03	≈ 0	n/a	-1.68
	V_x	0.00	-0.01 , 0	0.00	± 0.16	± 0.1	-0.03	-0.06 , 0.09
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	-0.02	-0.6 , 0.56	0.00	± 5.39	± 0.62	-0.18	-1.72 , 2.98
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.73	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X25 (1P24 - SAT)*

LENGTH : *2279 mm*

CLASS : *Central 3 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *-3 degree*

CHORD LENGTH : *27758 mm*

POST SPAN : *10230 mm*

CHORD CONTILEVER : *3649 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	2.15	4	20	45
Splice / Z	GR_70	142.7	69	4.2	4	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		2.3	note * : standard baseline section		
Pivot Arm - Mid / Ω	GR_70	see note *		2.7	note * : standard baseline section		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O - ext (int)	GR_50	88.9	n/a	4.5 (4.5)	n/a	n/a	n/a

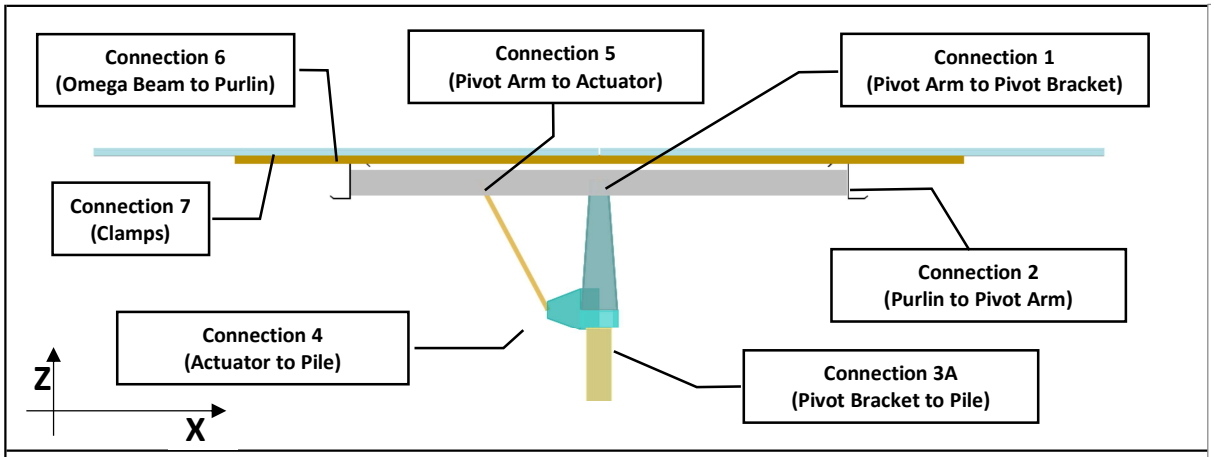
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.77	0.97	0.00	2.01	≈ 0	0.44	0.96
	T	n/a	0.00	n/a	-2.34	≈ 0	n/a	-1.29
	V_x	0.00	0 , 0	0.00	± 0.12	± 0.09	-0.02	-0.05 , 0.07
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.01	-0.45 , 0.47	0.00	± 4.71	± 0.55	-0.14	-1.37 , 2.6
	M_{xx}	0.00	-0.01 , 0.01	0.00	± 0	± 0.57	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.02	1.37	0.00	2.60	≈ 0	0.57	1.24
	T	n/a	0.00	n/a	-3.03	≈ 0	n/a	-1.68
	V_x	0.00	-0.01 , 0	0.00	± 0.16	± 0.1	-0.03	-0.06 , 0.09
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	-0.02	-0.6 , 0.56	0.00	± 5.39	± 0.62	-0.18	-1.72 , 2.98
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.73	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

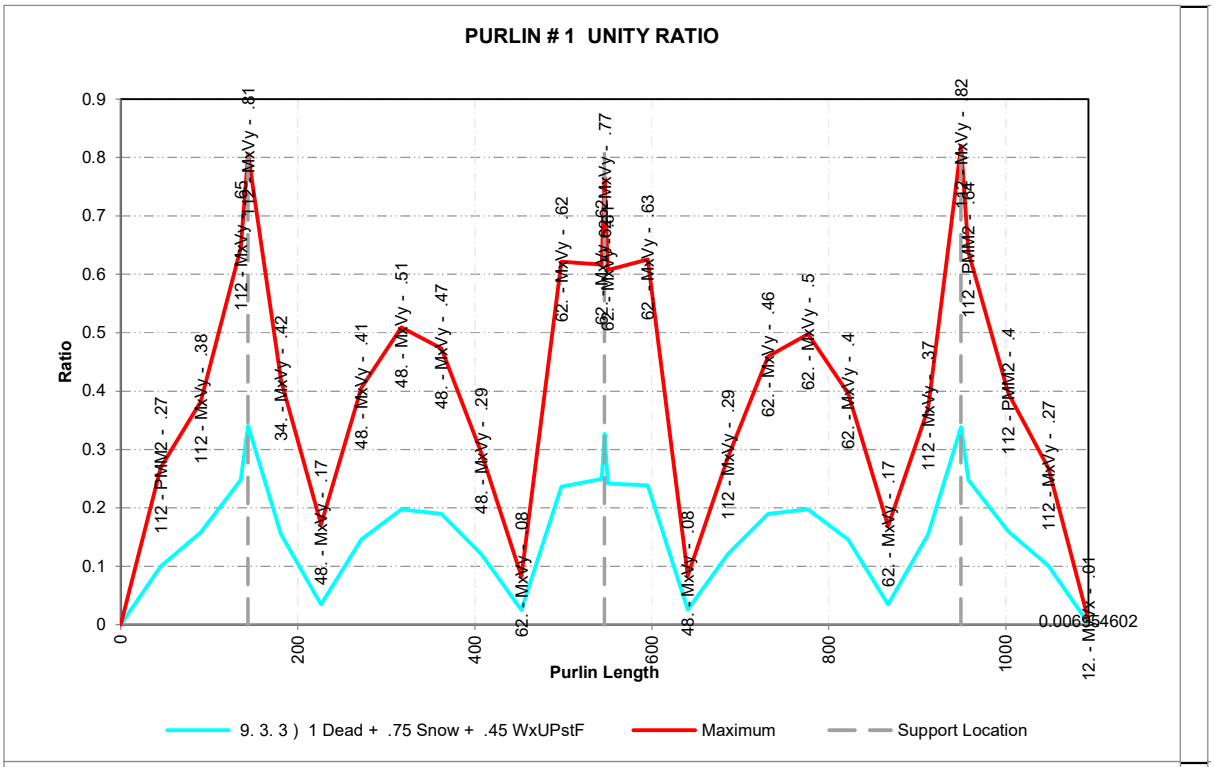
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

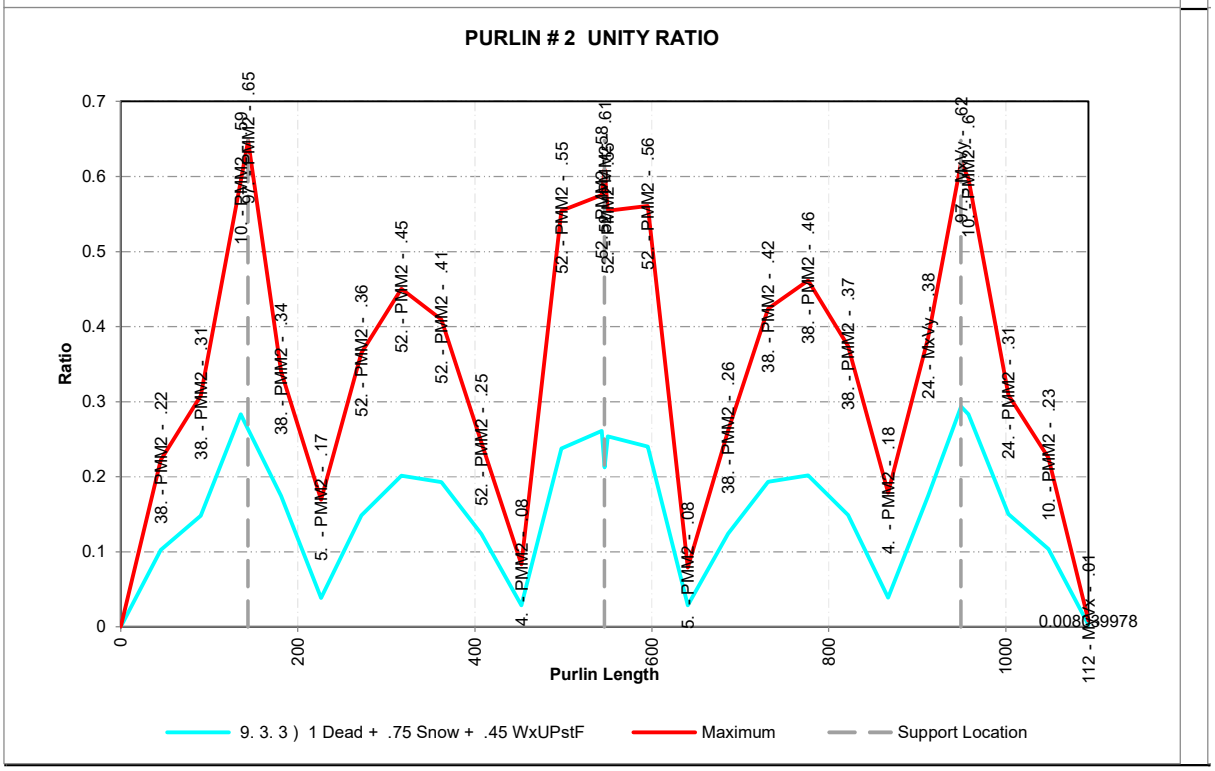


Note: coordinate system is right-handed cartesian

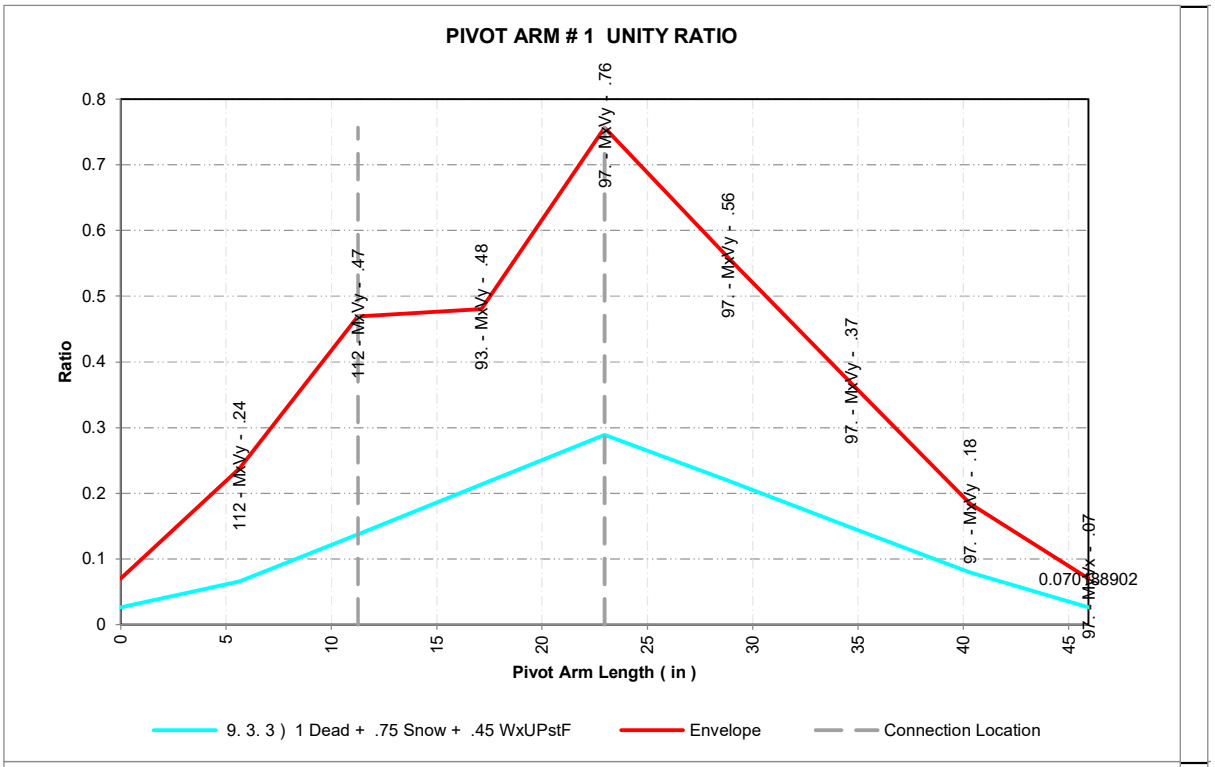
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-3.88	0.56	0.00	0.00	0.00	0.00	97. 4. 6) 1 Dead + .6 WxDNalH
-0.98	0.00	-0.07	0.00	0.00	0.00	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 2						
2.57	1.00	0.00	0.00	0.04	0.23	52. 3. 74) 1 Dead + .75 S3_lhhl + .45 WxDNstH
1.69	1.85	0.00	0.00	0.00	0.12	112. 4. 21) 1 Dead + .6 WxDNal+T
Connection : 3						
1.21	-0.09	0.00	0.00	0.00	-0.56	118. 5. 4) .6 Dead + .6 WxUPalF
-2.61	0.04	0.00	0.00	0.00	-1.46	62. 3. 89) 1 Dead + .75 S3_lhhl + .45 WxDNst+T
1.21	-0.09	0.00	0.00	0.00	-0.56	118. 5. 4) .6 Dead + .6 WxUPalF
-0.61	0.01	0.00	0.00	0.00	-3.23	130. 5. 16) .6 Dead + .6 WxOTal
-1.02	0.00	-0.08	0.02	-0.51	0.02	158. 12. 2) 1 Dead + -.7 Quake_y
-1.02	0.00	-0.08	0.02	-0.51	0.02	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
-2.41	*	0.00	0.00	0.00	0.00	135. 5. 21) .6 Dead + .6 WxDNal+T
Connection : 5		** Note : the load is axial in actuator direction*				
-2.41	*	0.00	0.00	0.00	0.00	135. 5. 21) .6 Dead + .6 WxDNal+T
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.17						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.17						0.6 WLup

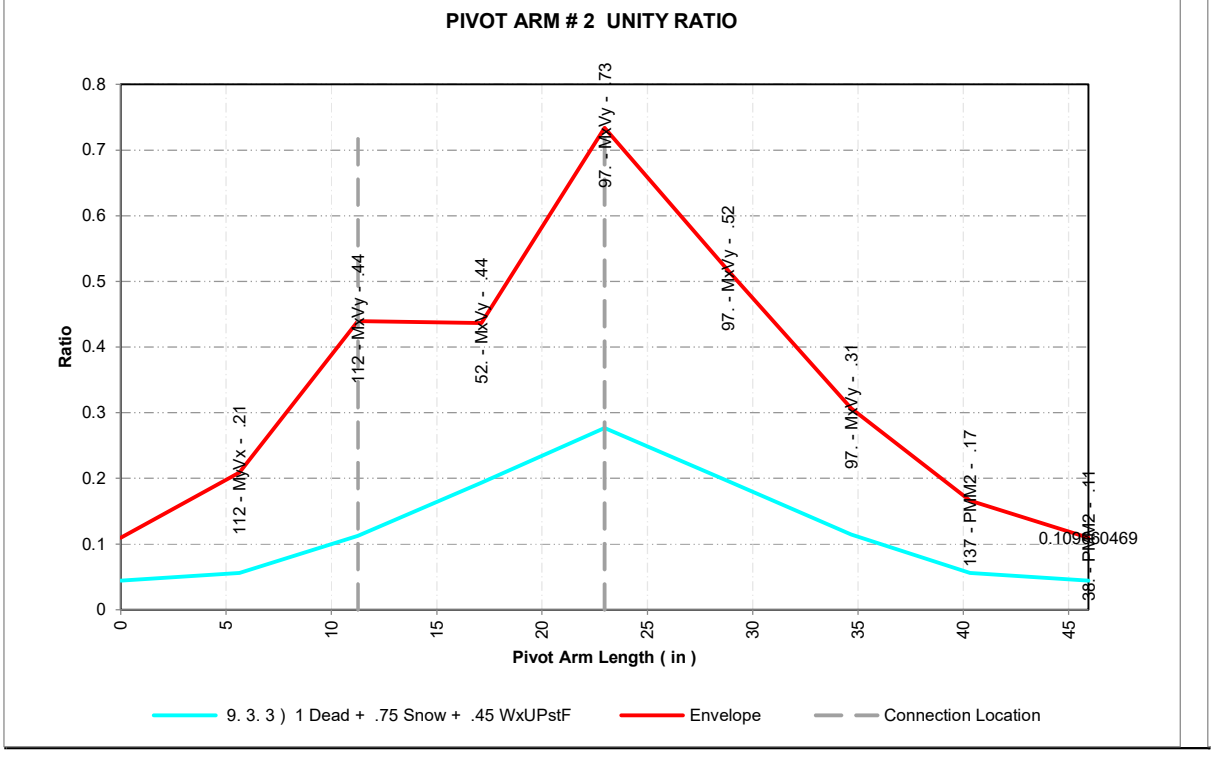
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*





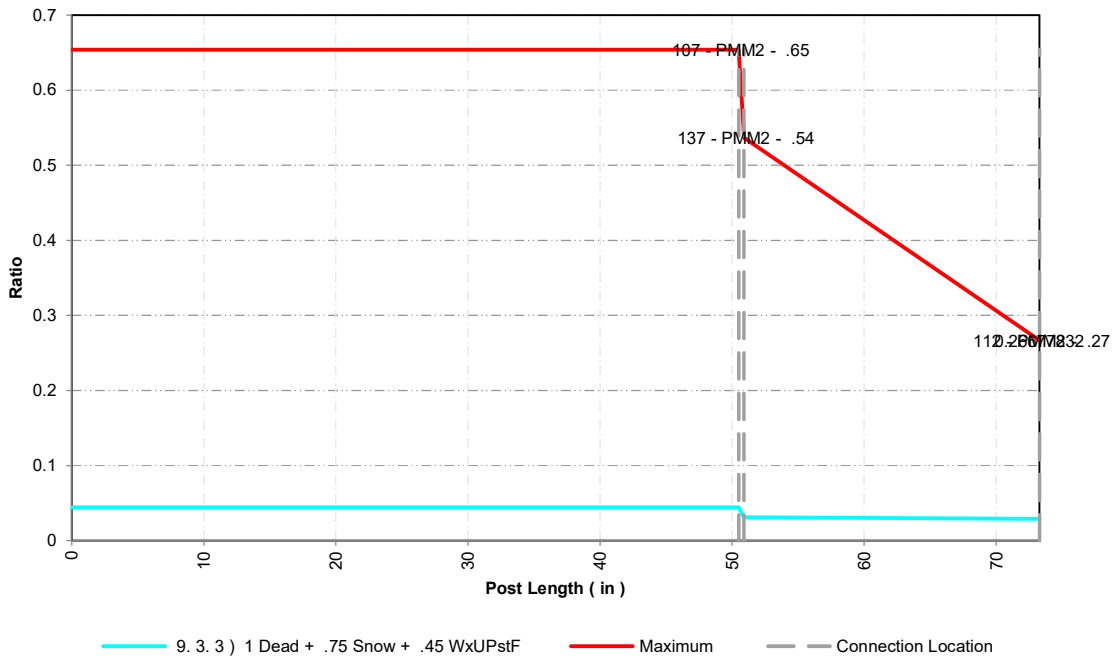
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*



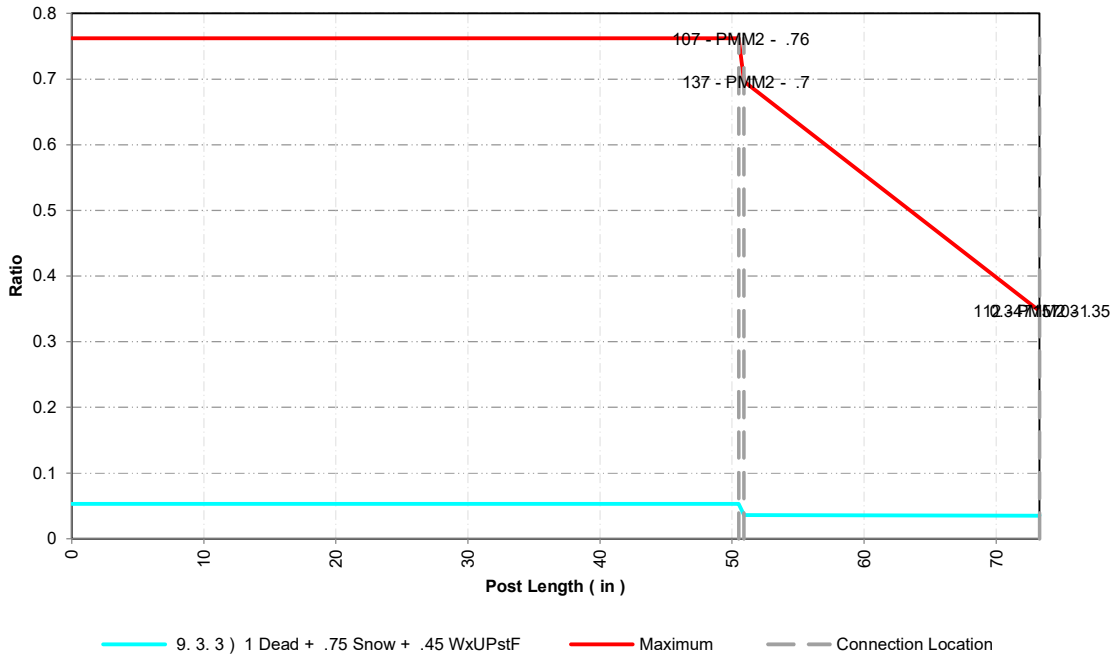


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

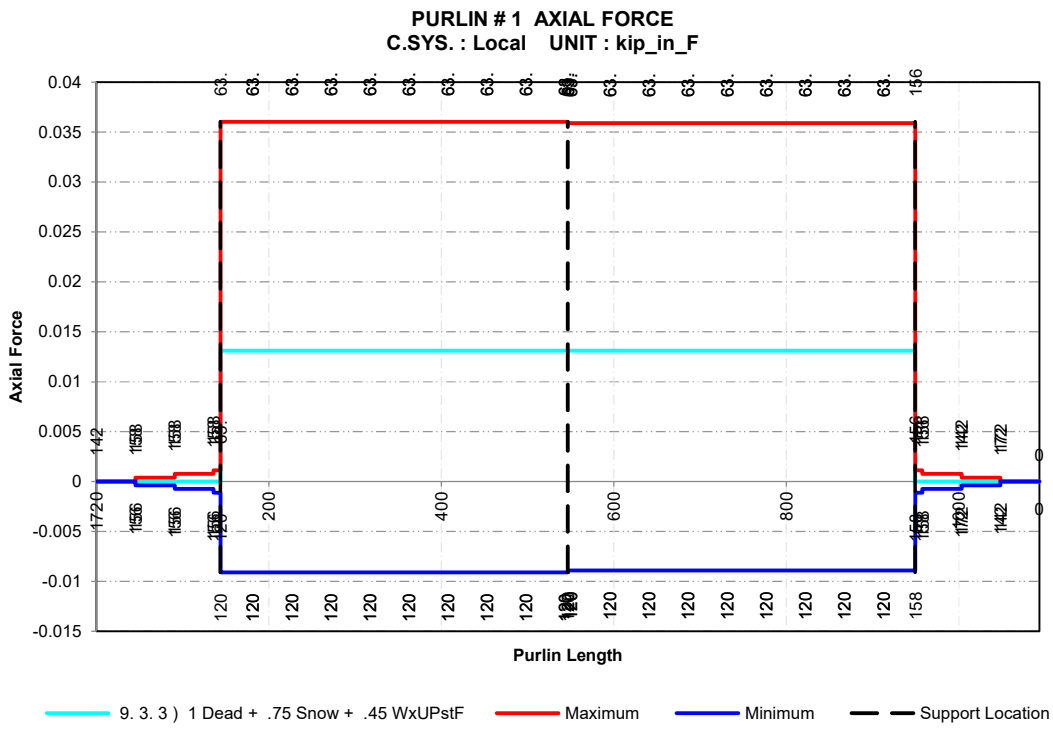
POST # 1 UNITY RATIO

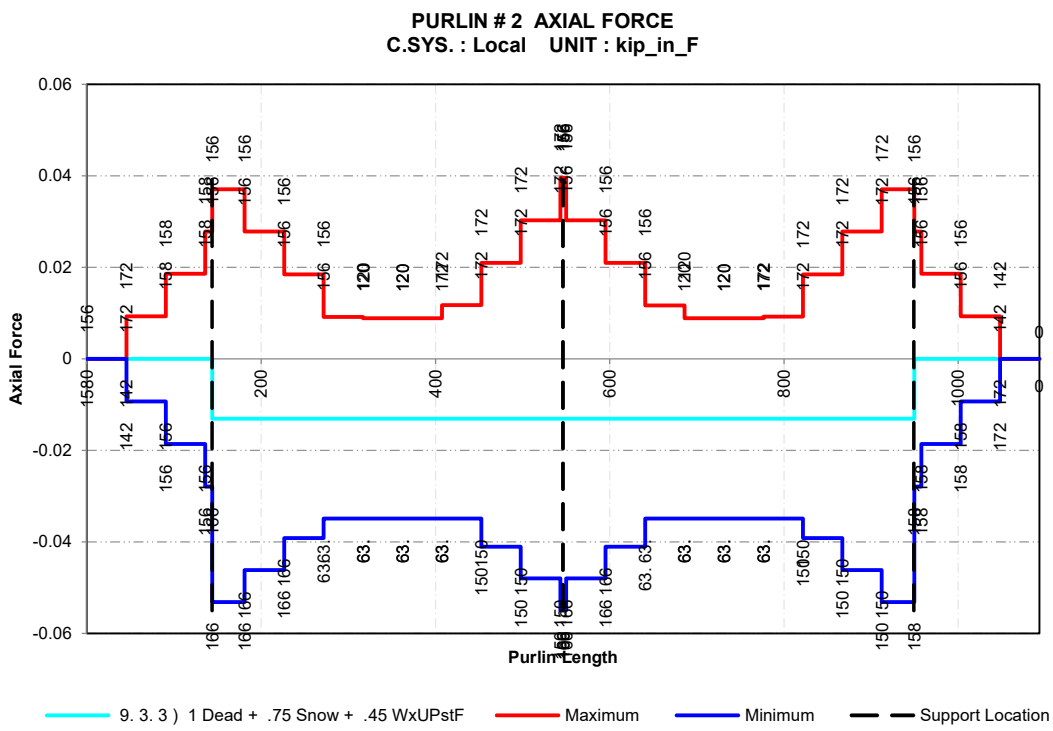


POST # 2 UNITY RATIO

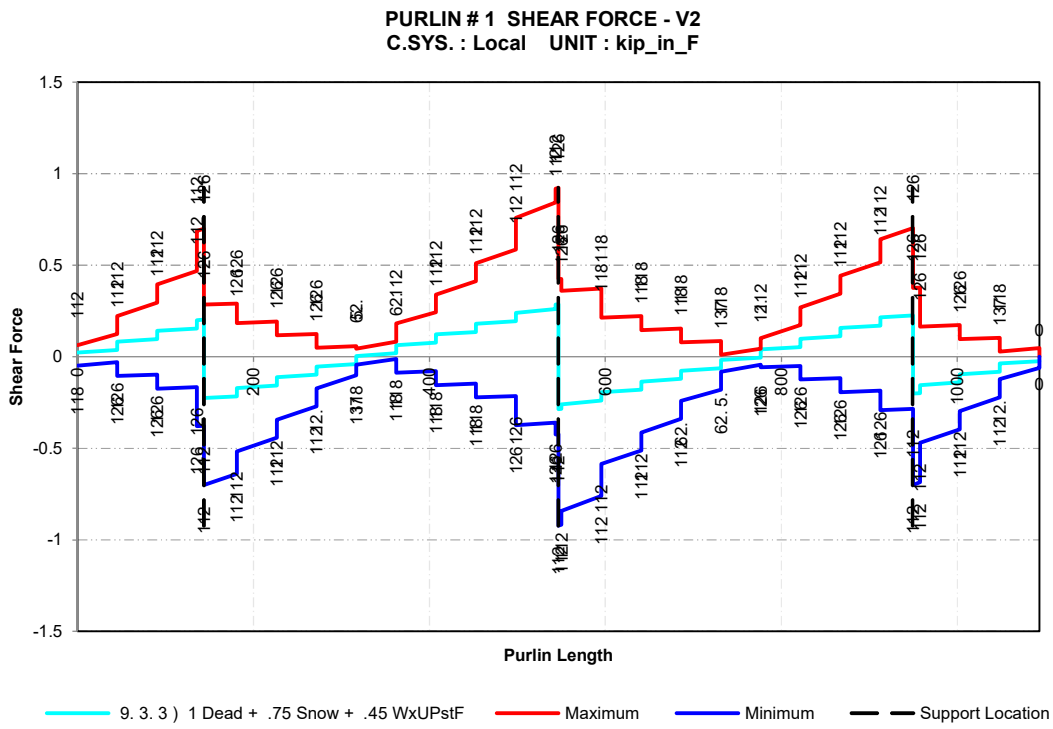


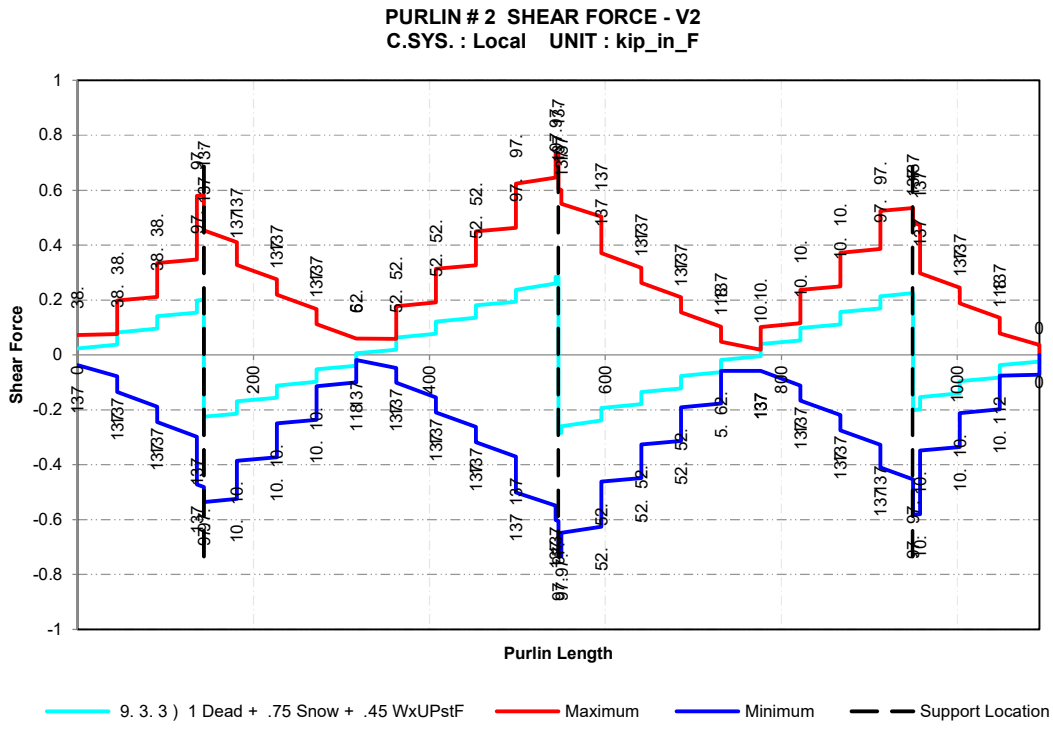
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*





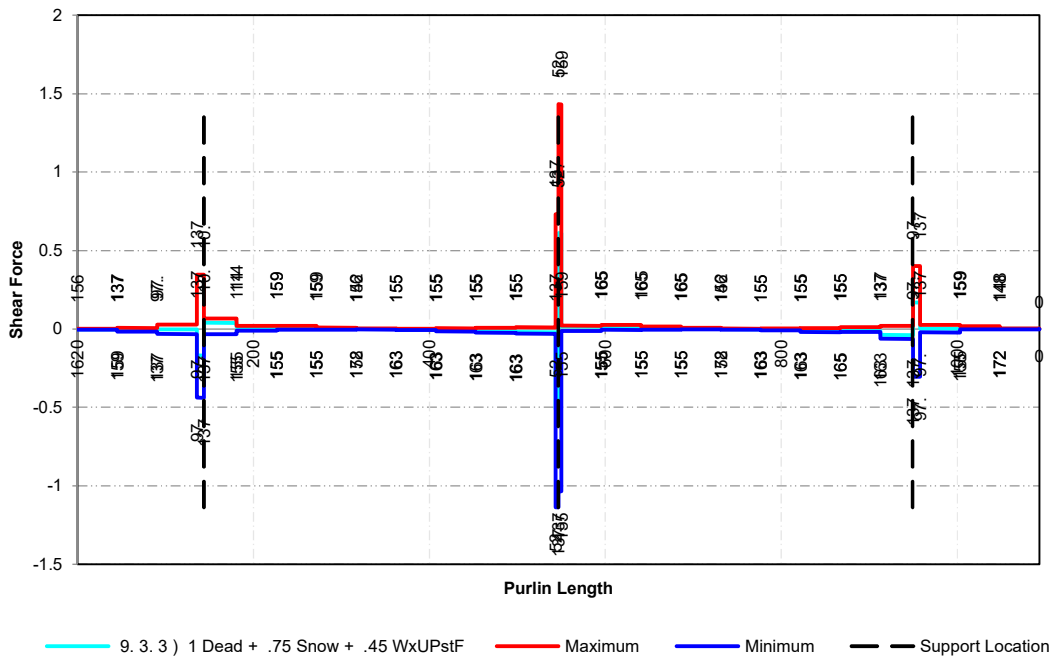
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*



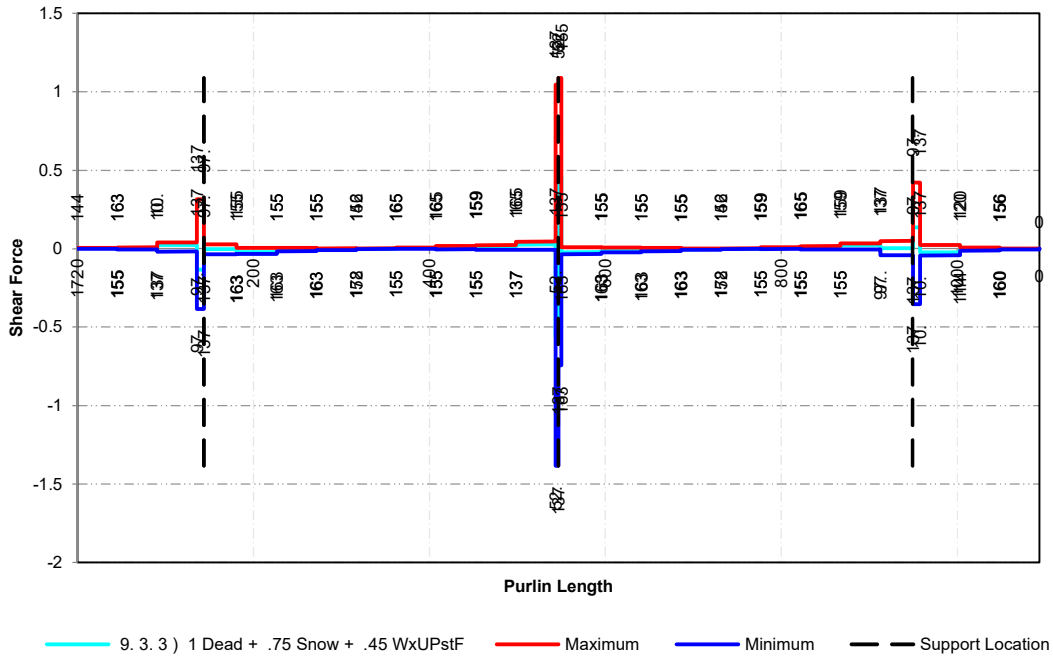


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

PURLIN # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

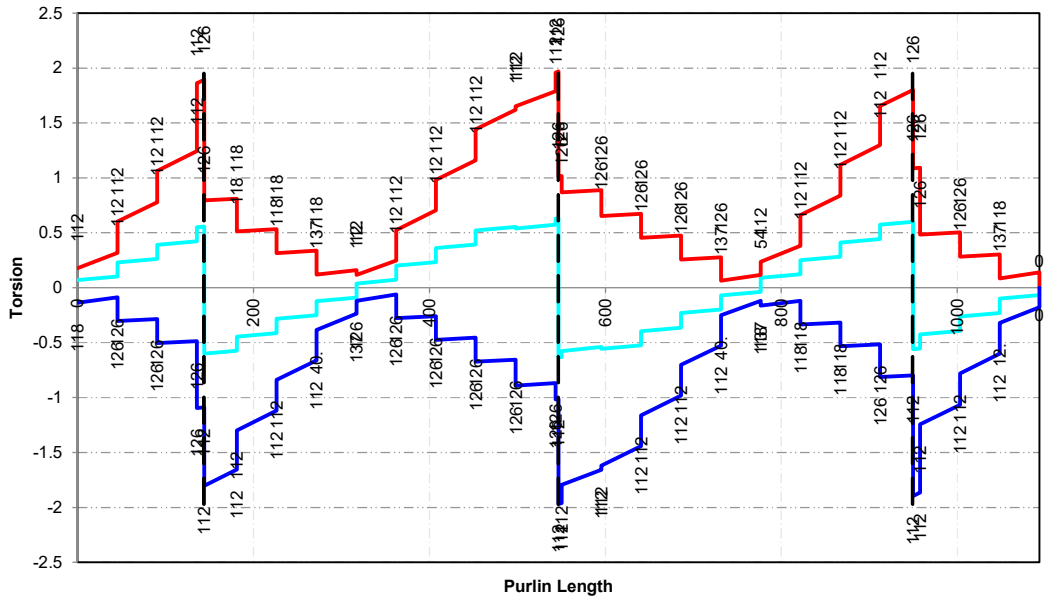


PURLIN # 2 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

PURLIN # 1 TORSION
C.SYS. : Local UNIT : kip_in_F



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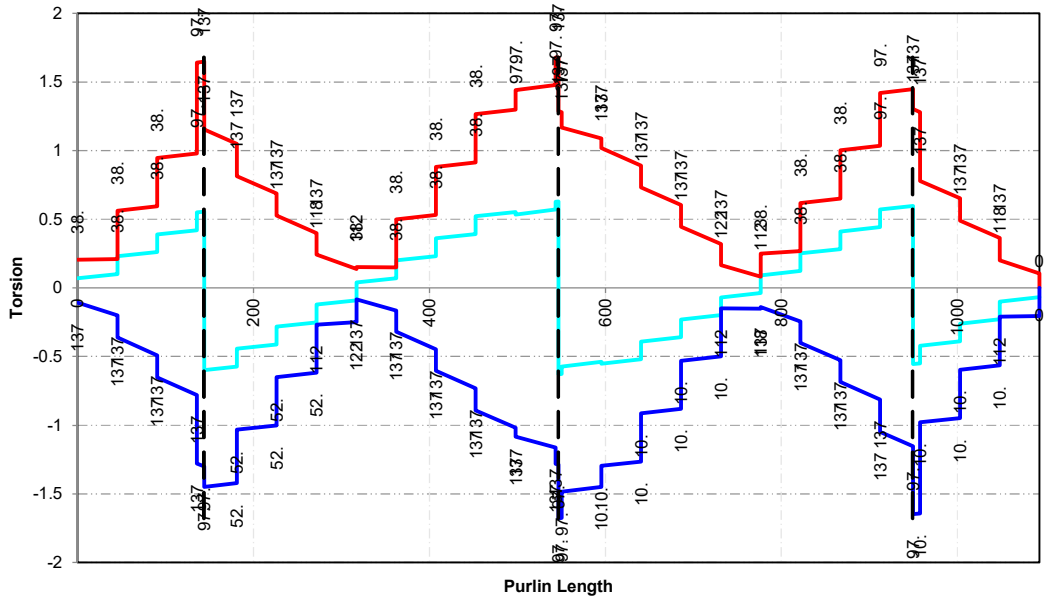
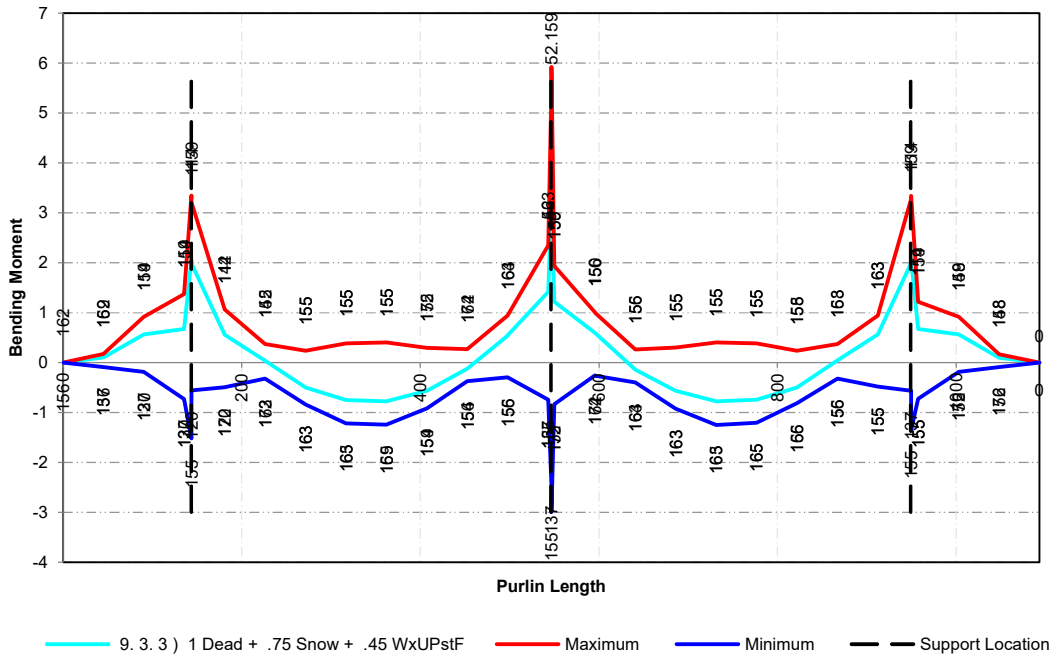


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

PURLIN # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



PURLIN # 2 MOMENT M2
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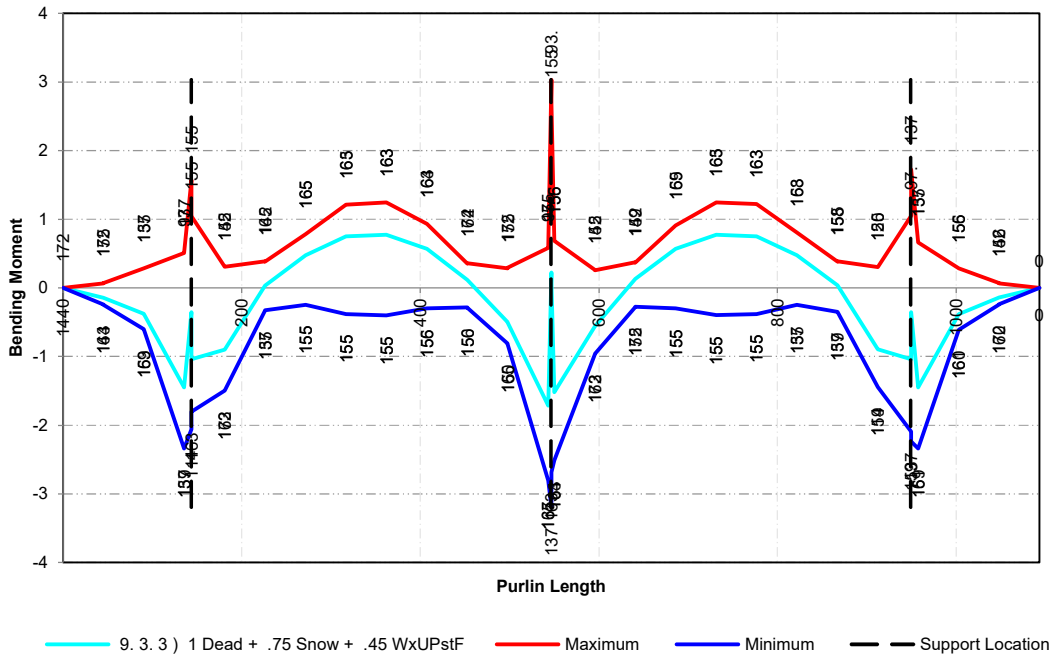
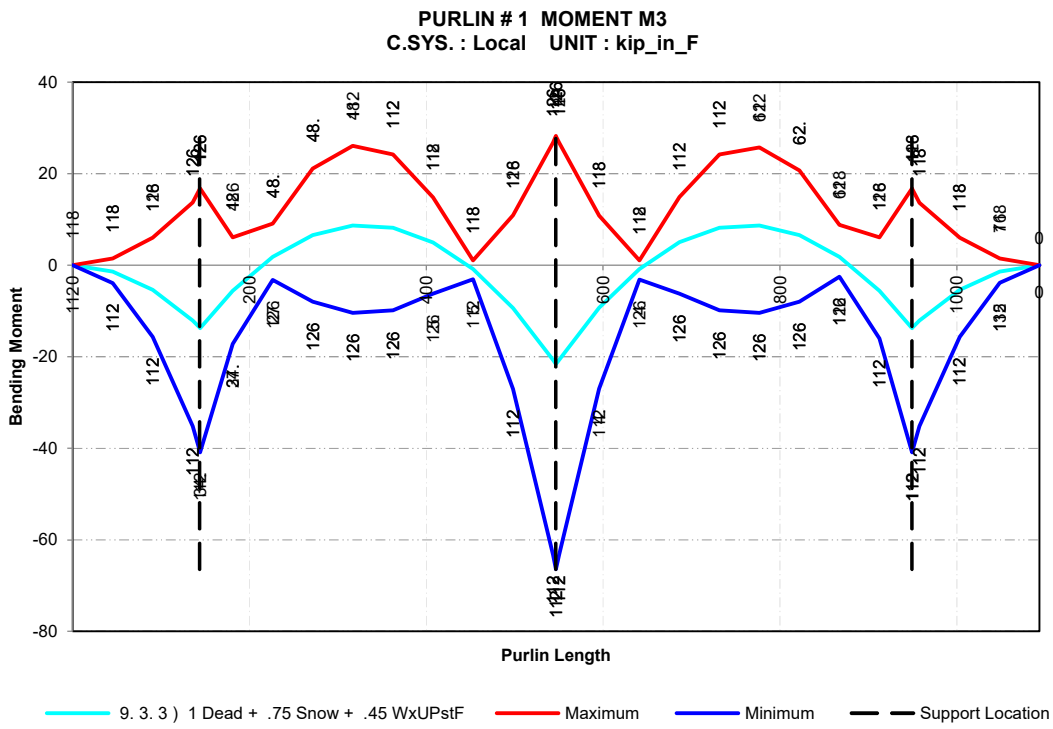
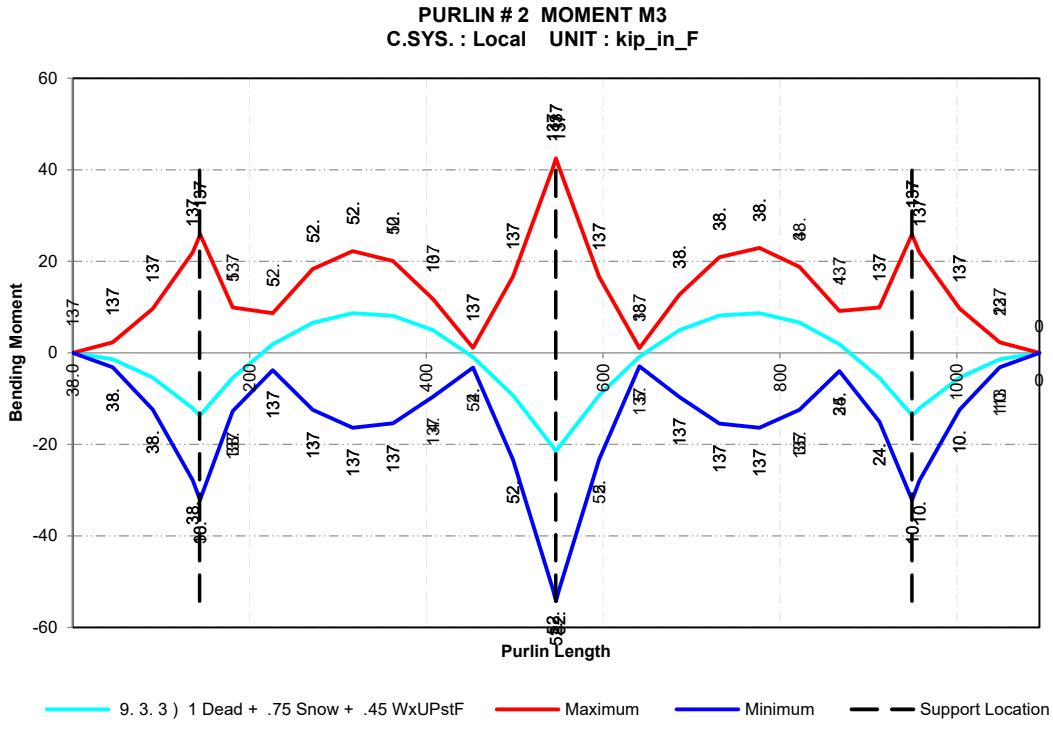
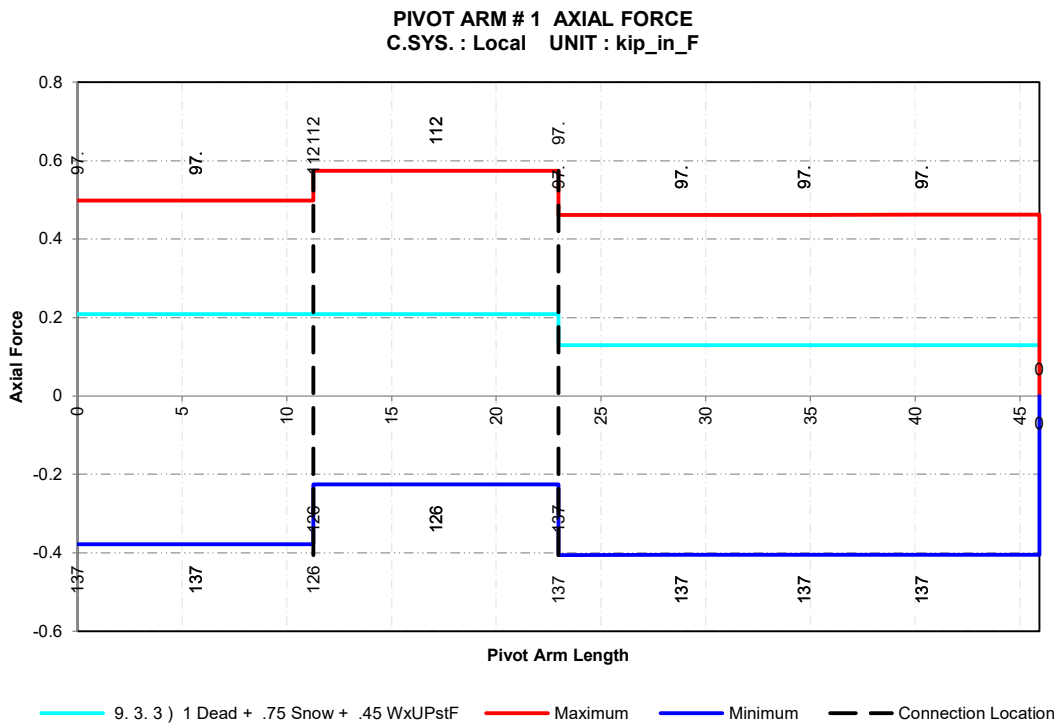


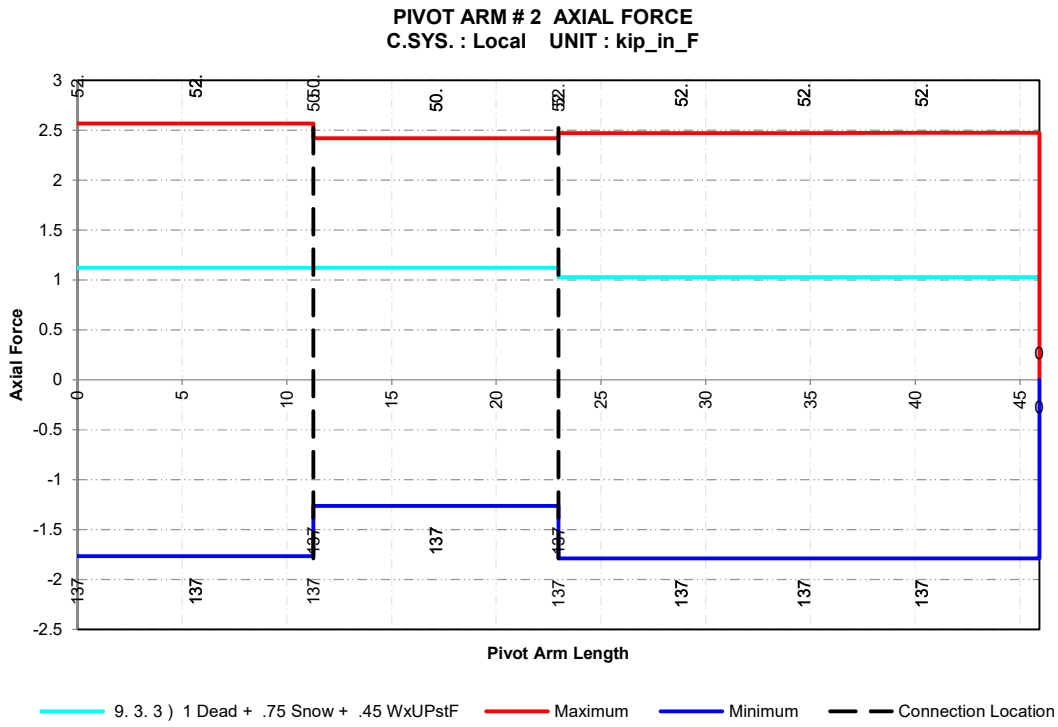
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*



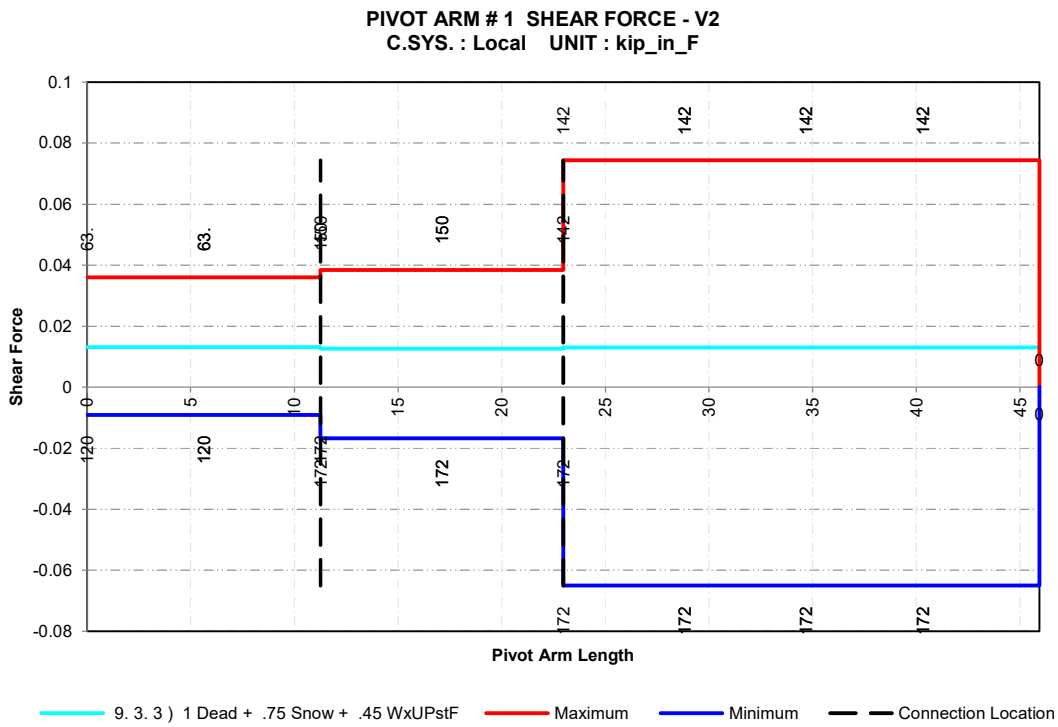


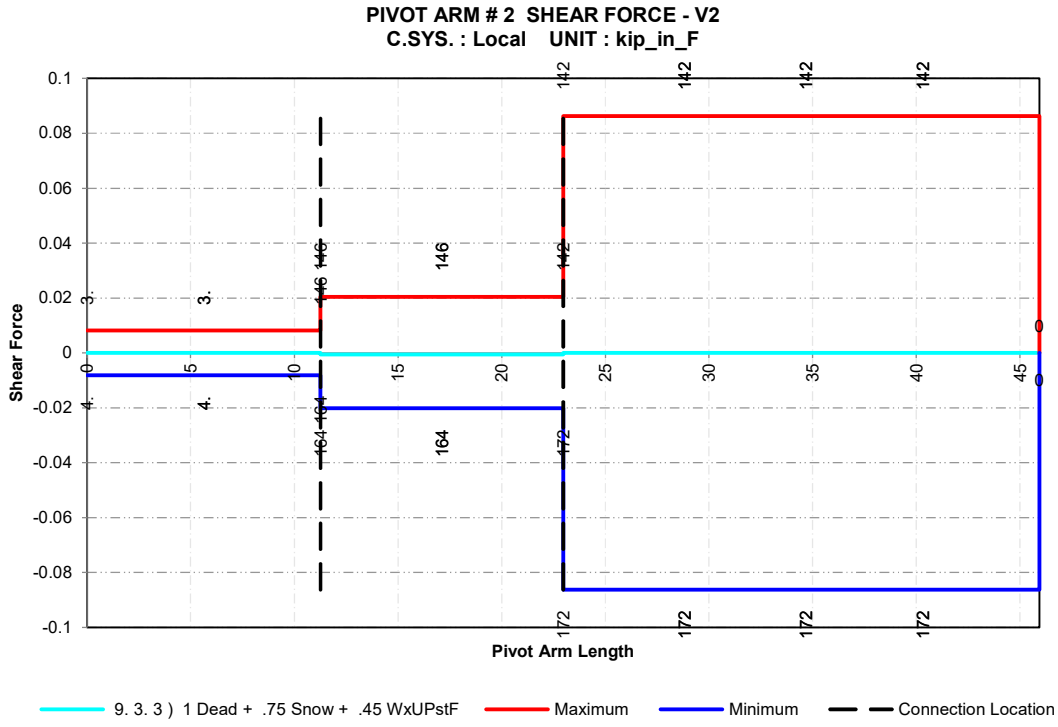
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*





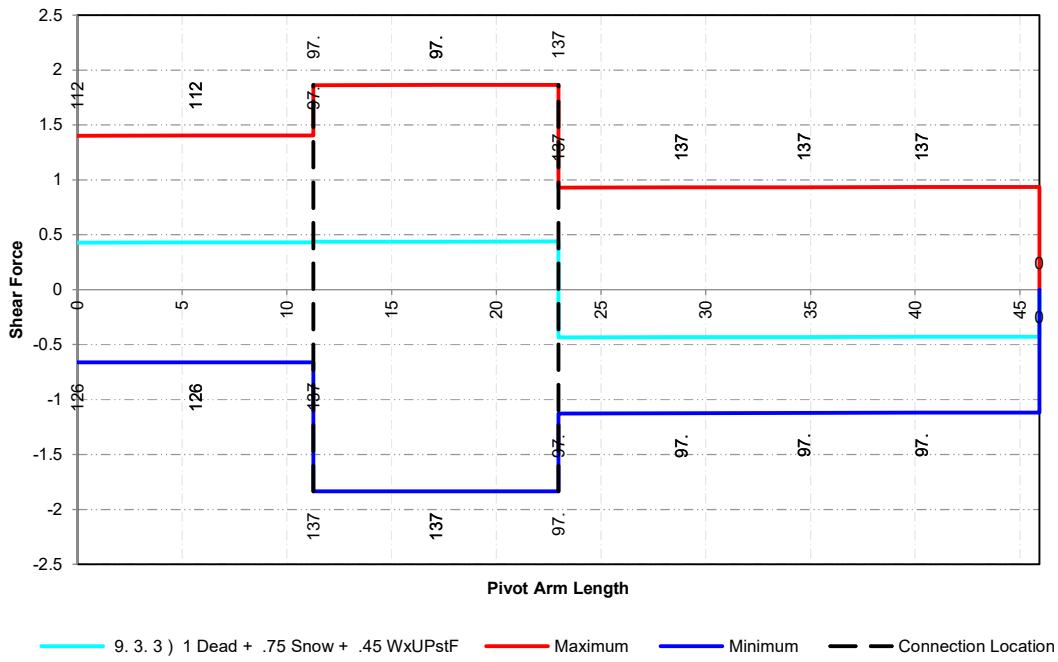
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*



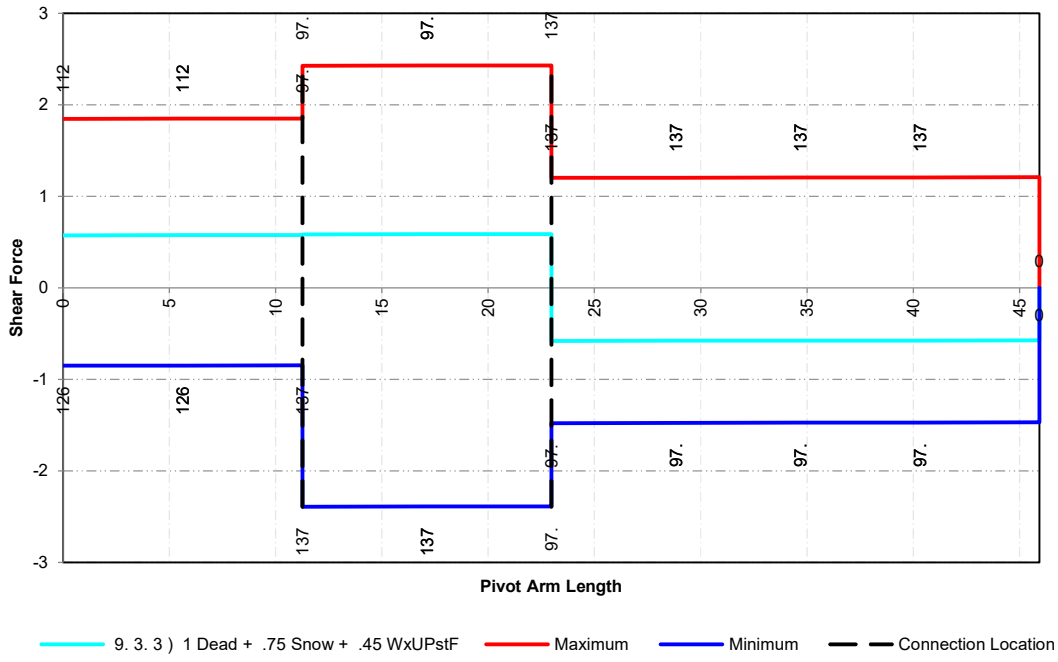


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

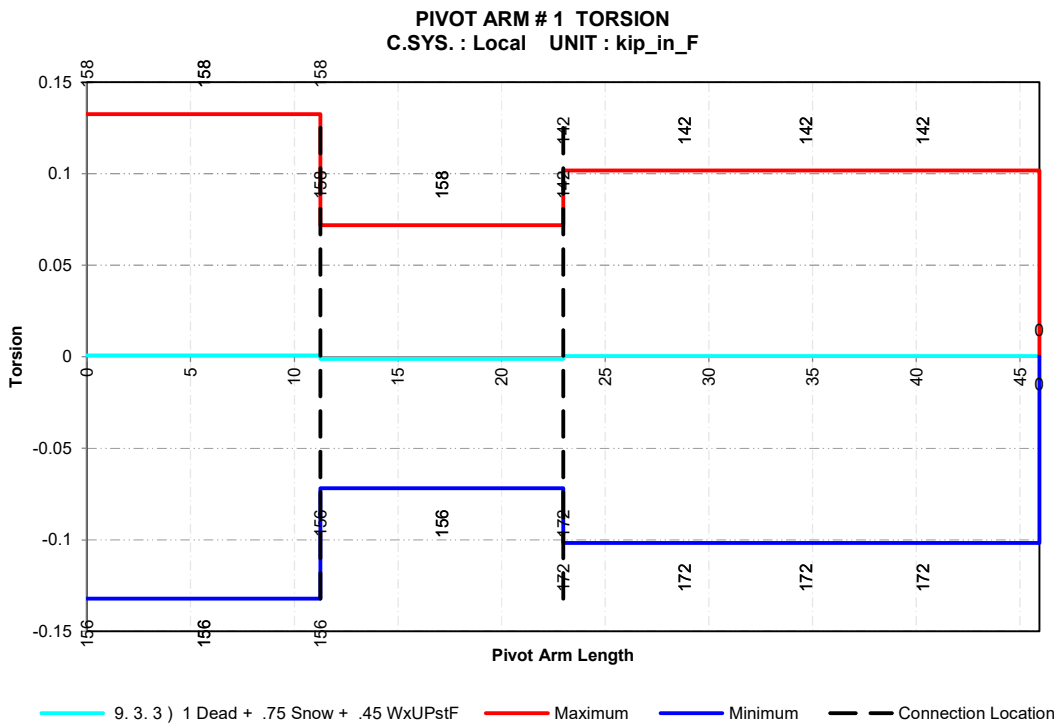
PIVOT ARM # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

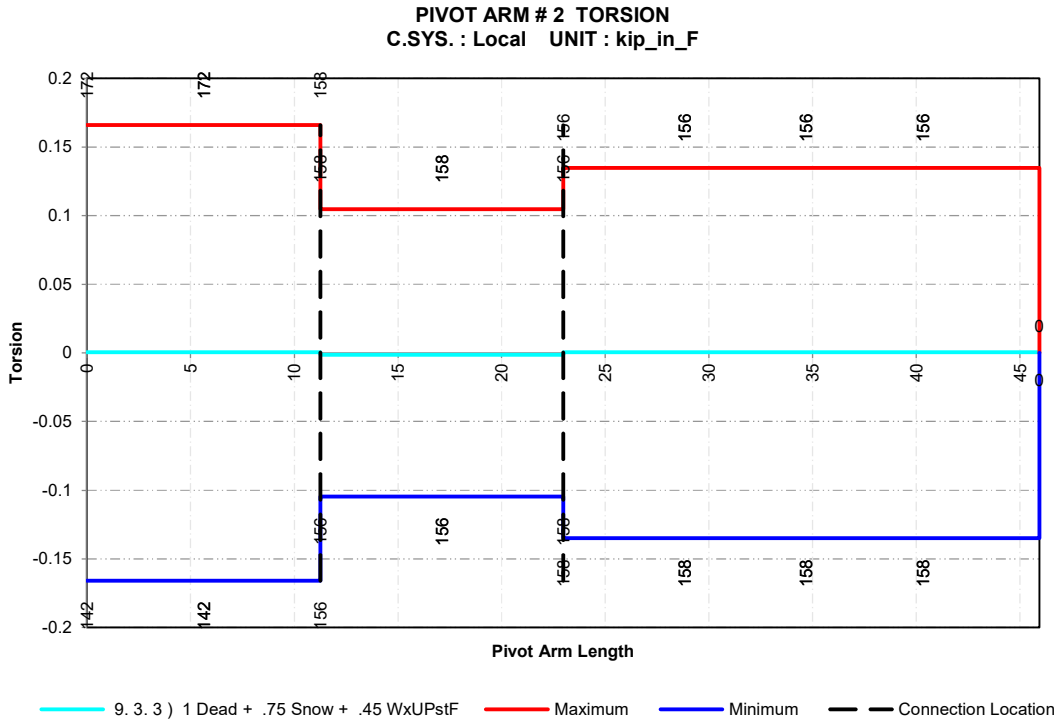


PIVOT ARM # 2 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

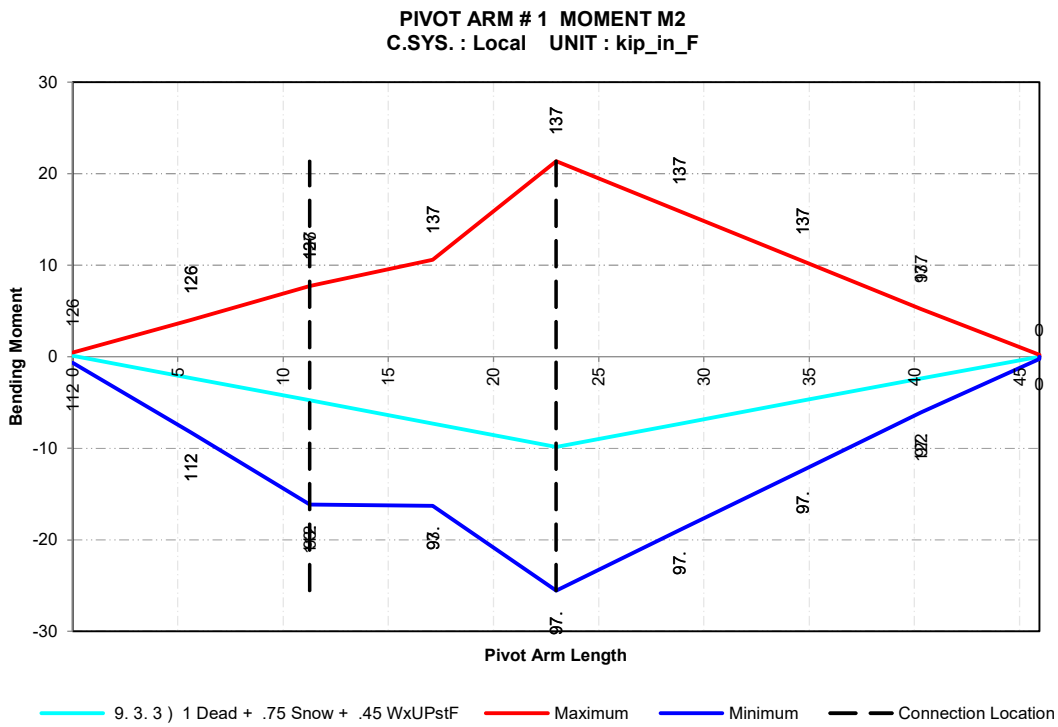


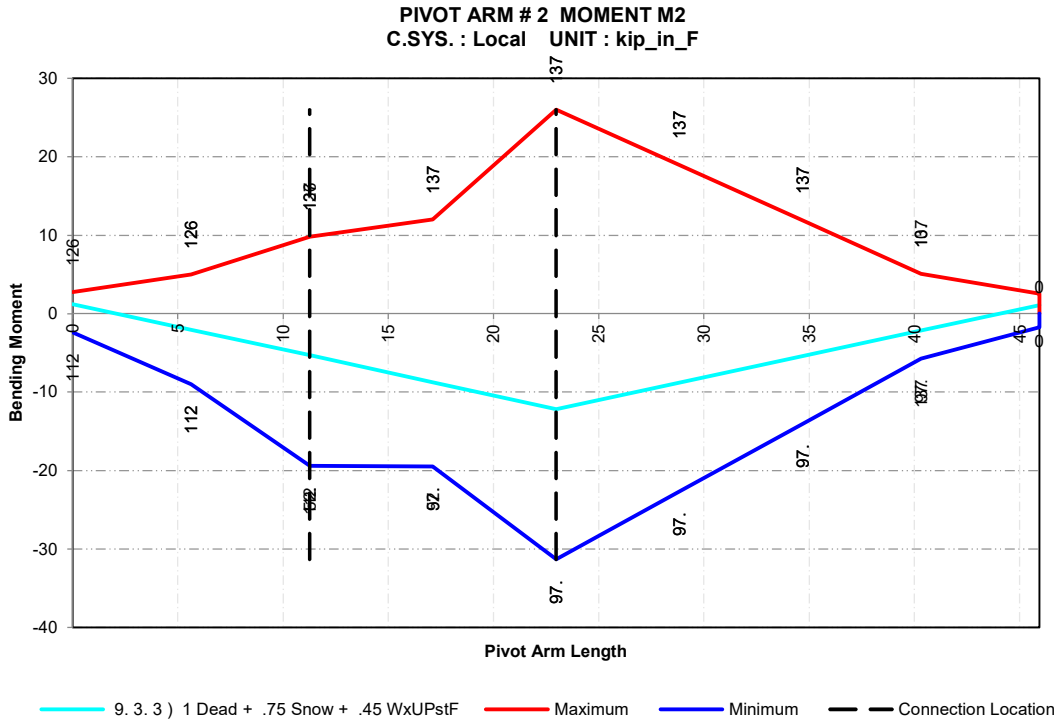
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*



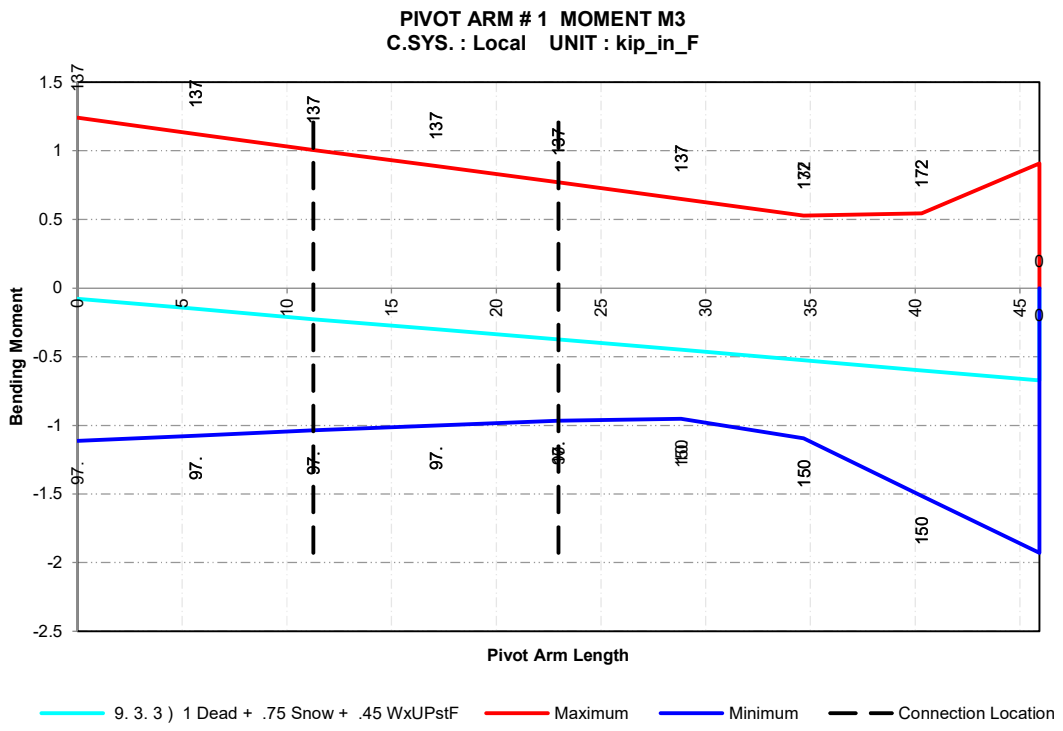


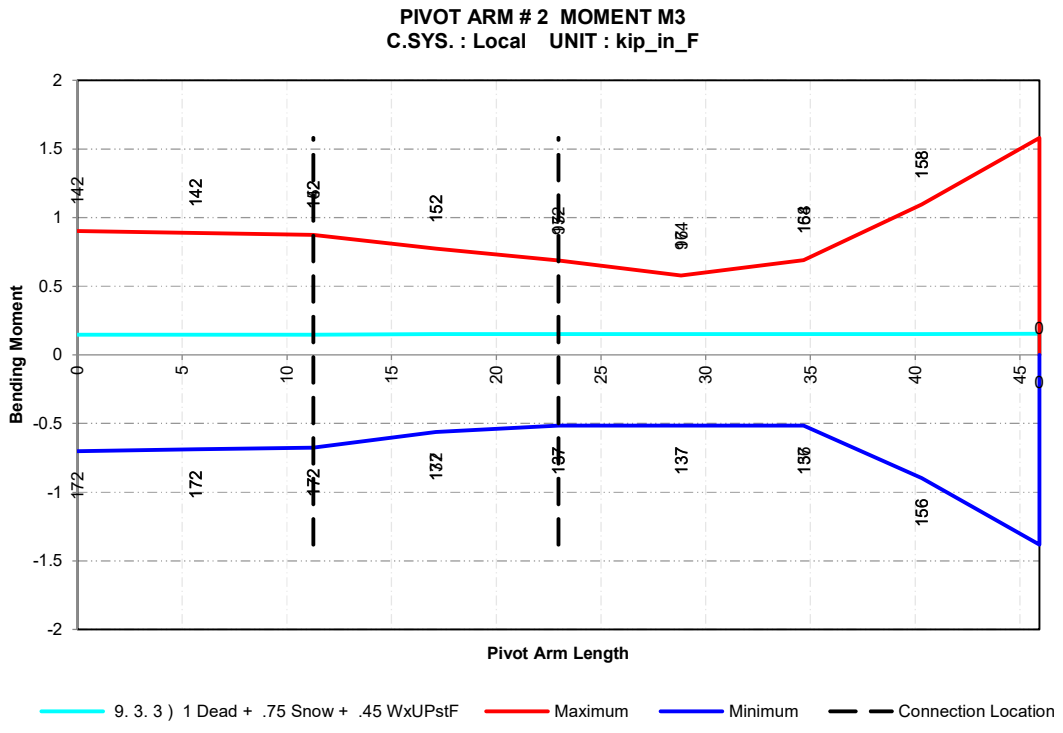
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*





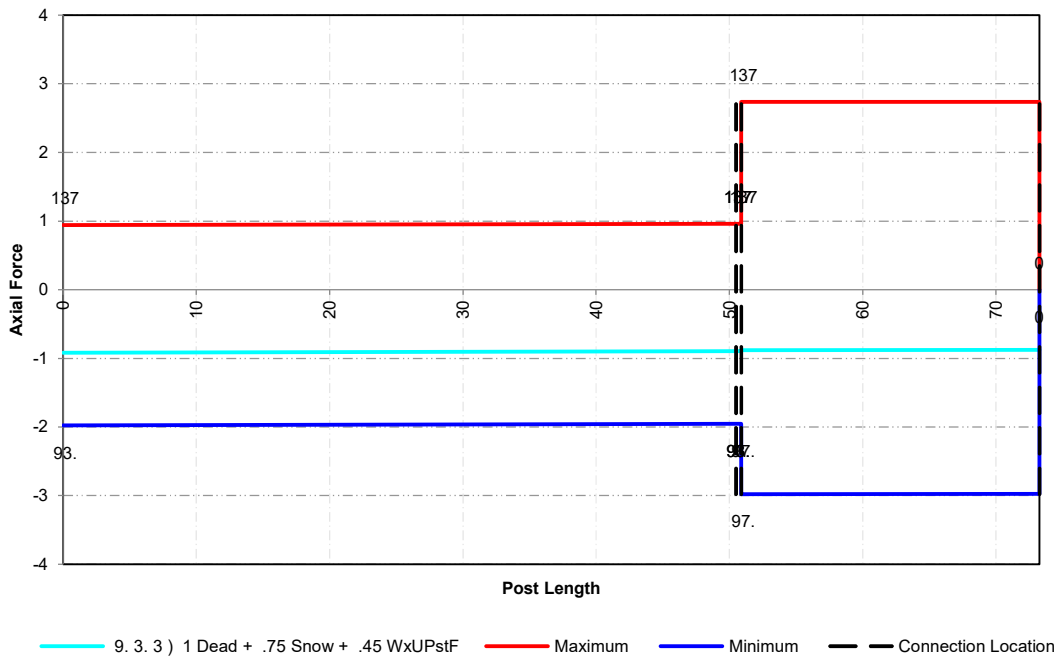
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*



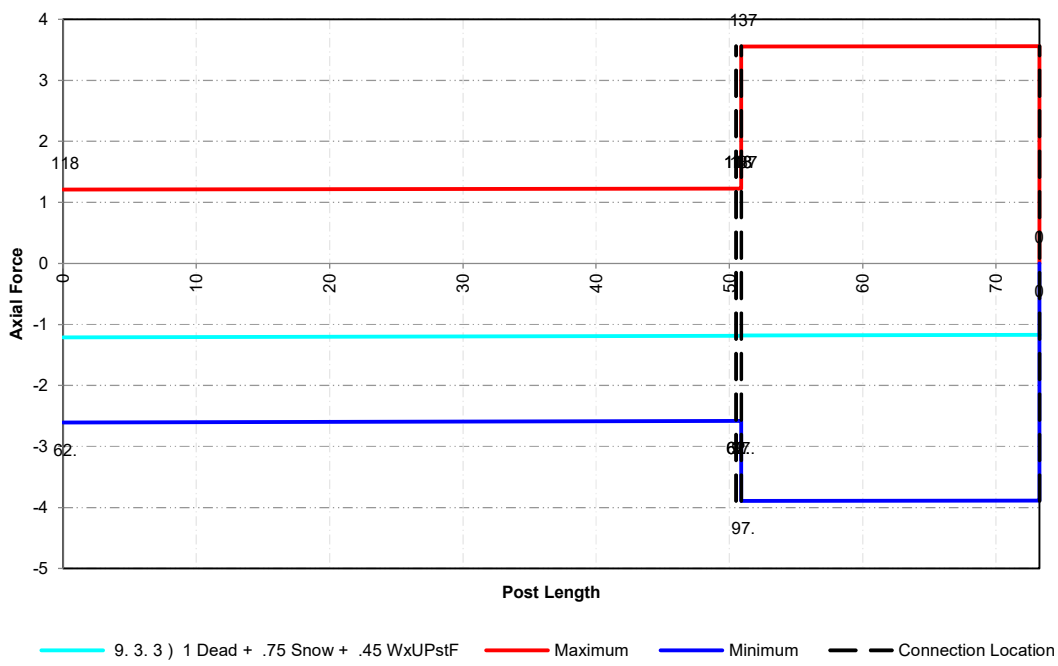


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

POST # 1 AXIAL FORCE
C.SYS. : Local UNIT : kip_in_F

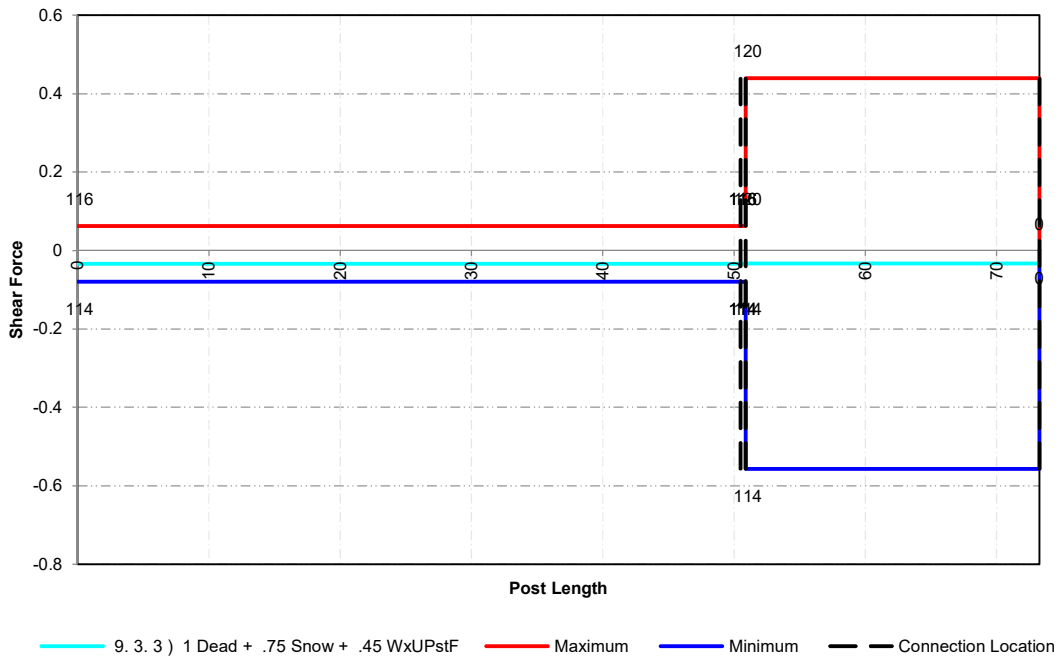


POST # 2 AXIAL FORCE
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

POST # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



POST # 2 SHEAR FORCE - V2
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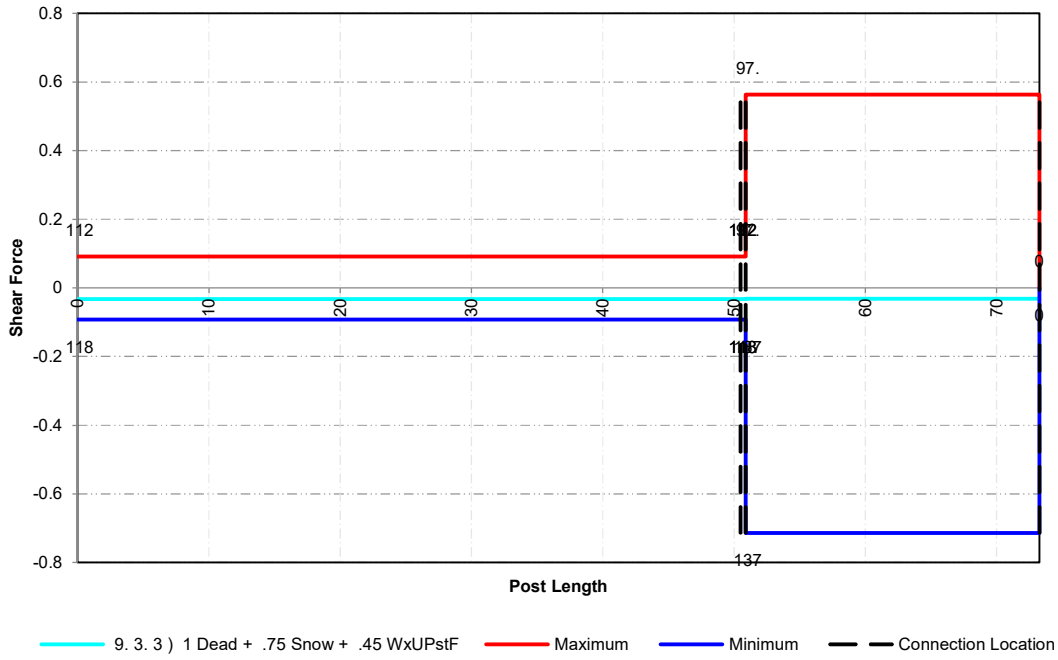
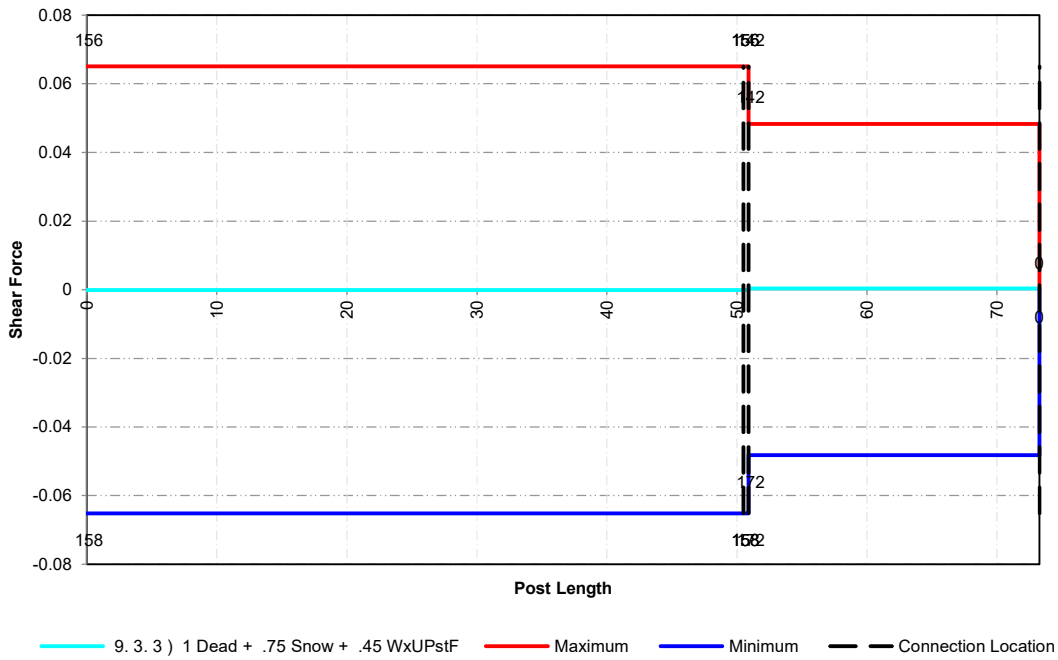
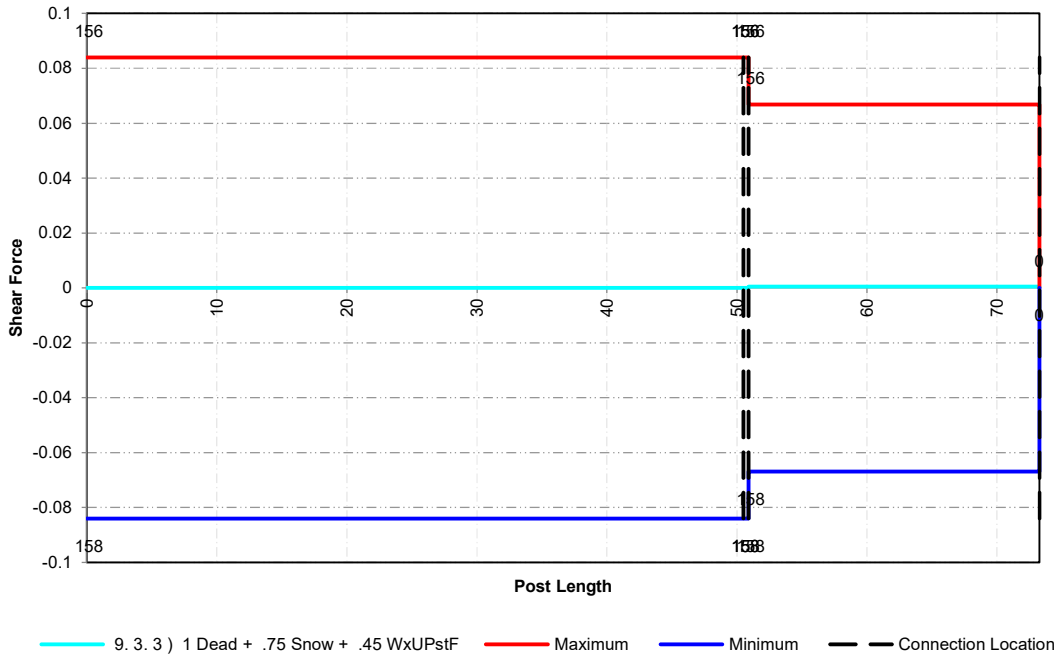


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

POST # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

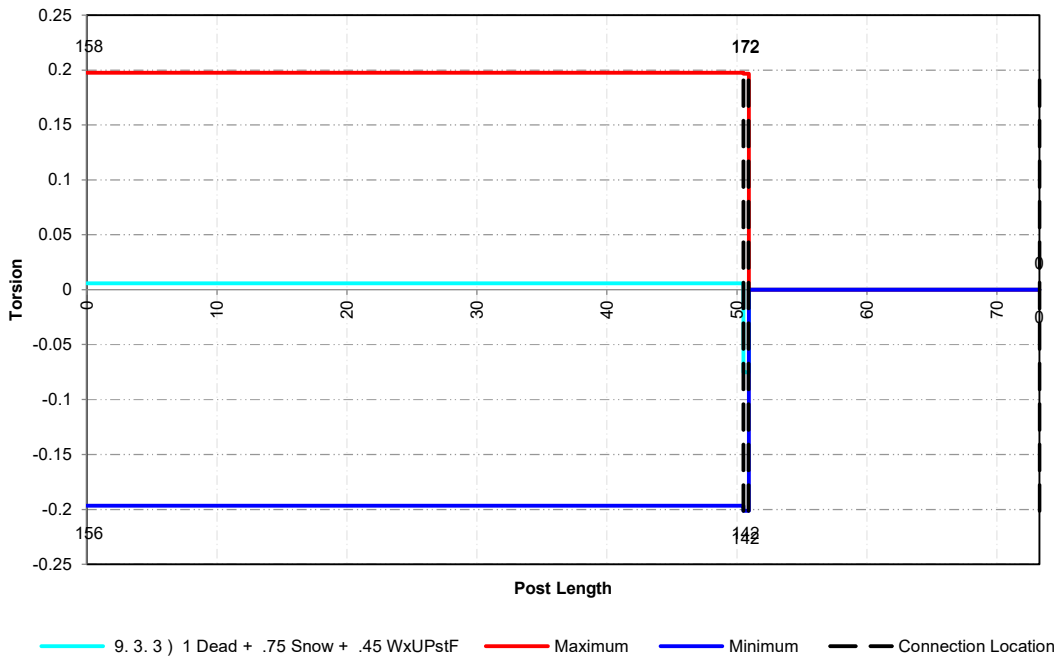


POST # 2 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

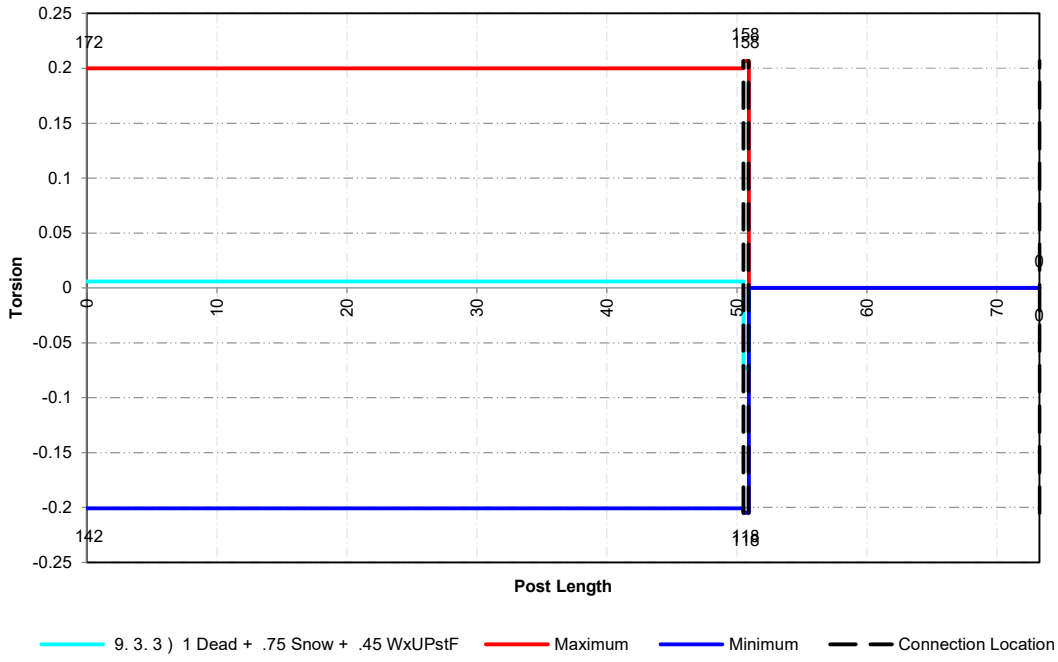


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

POST # 1 TORSION
C.SYS. : Local UNIT : kip_in_F

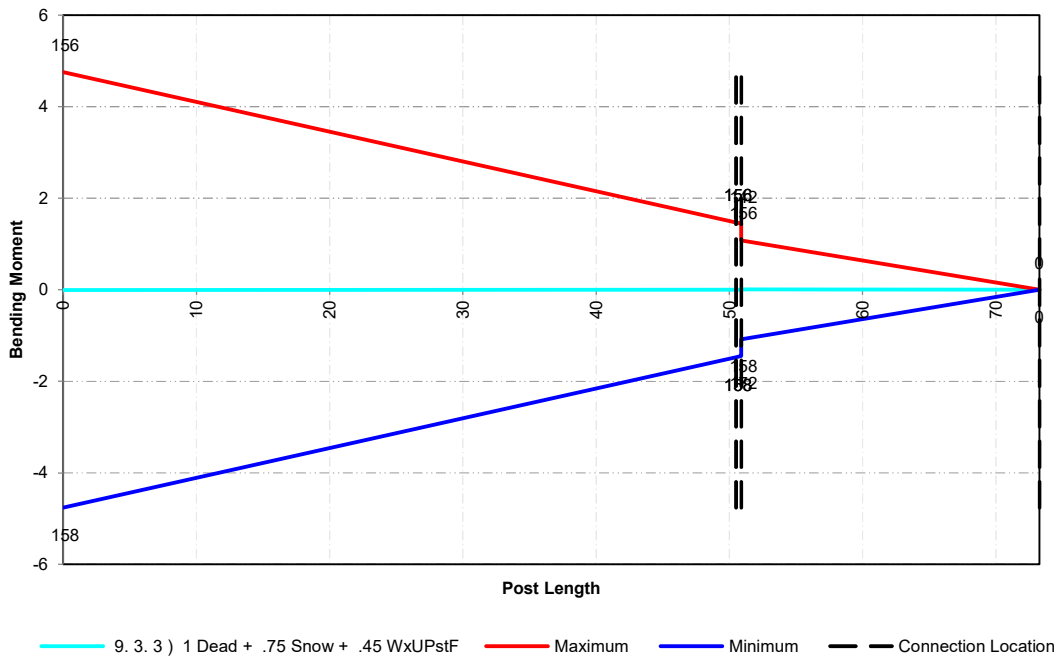


POST # 2 TORSION
C.SYS. : Local UNIT : kip_in_F

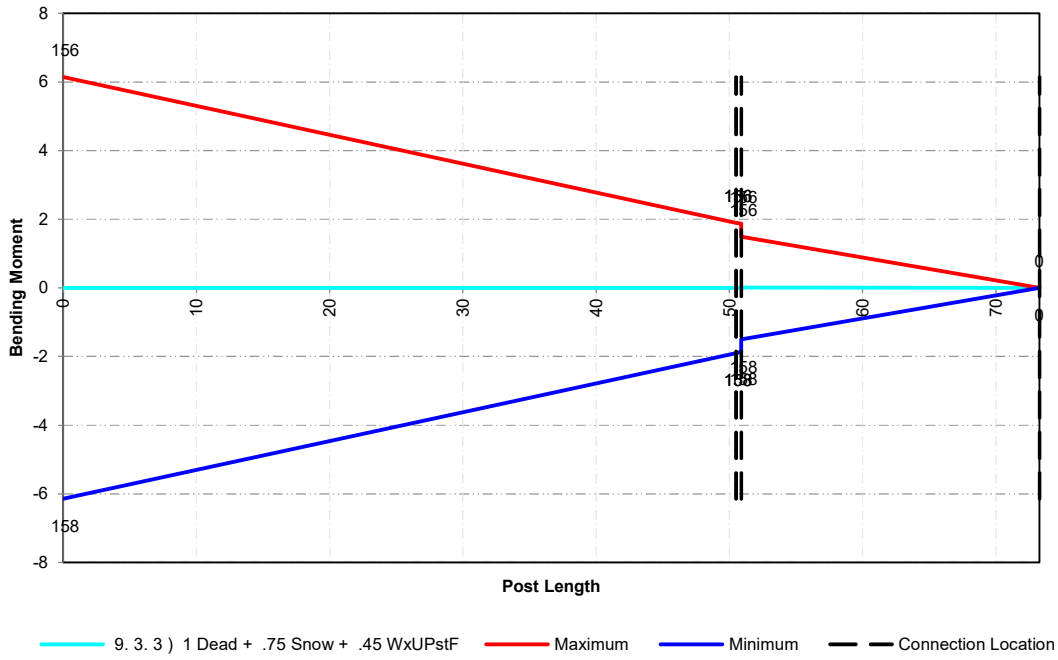


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*

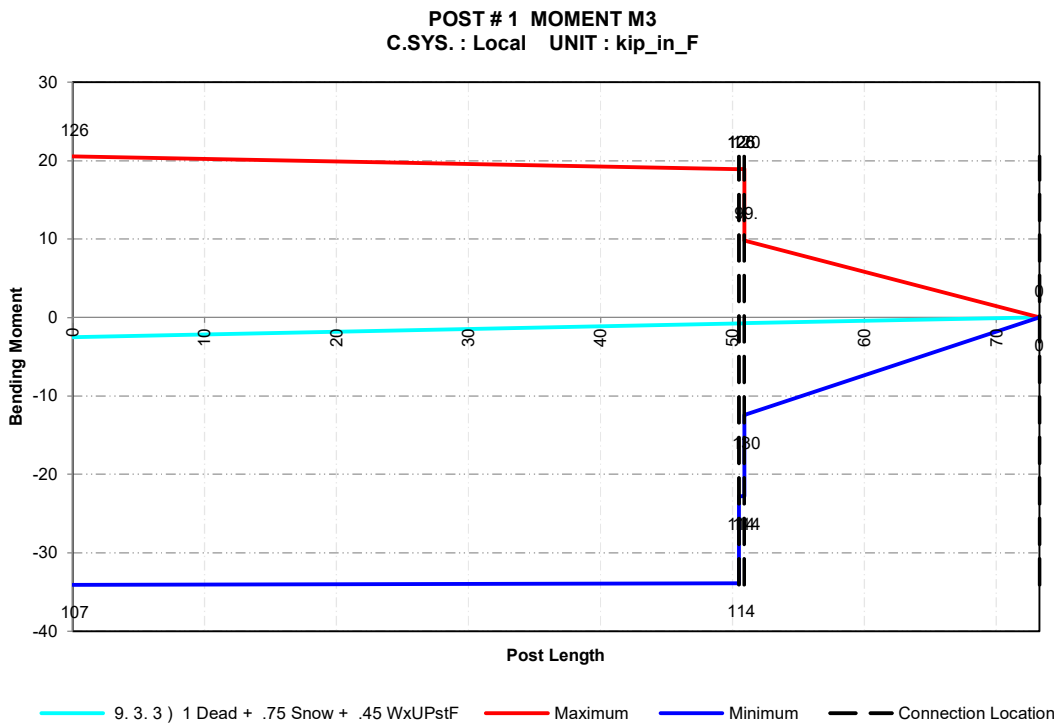
POST # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

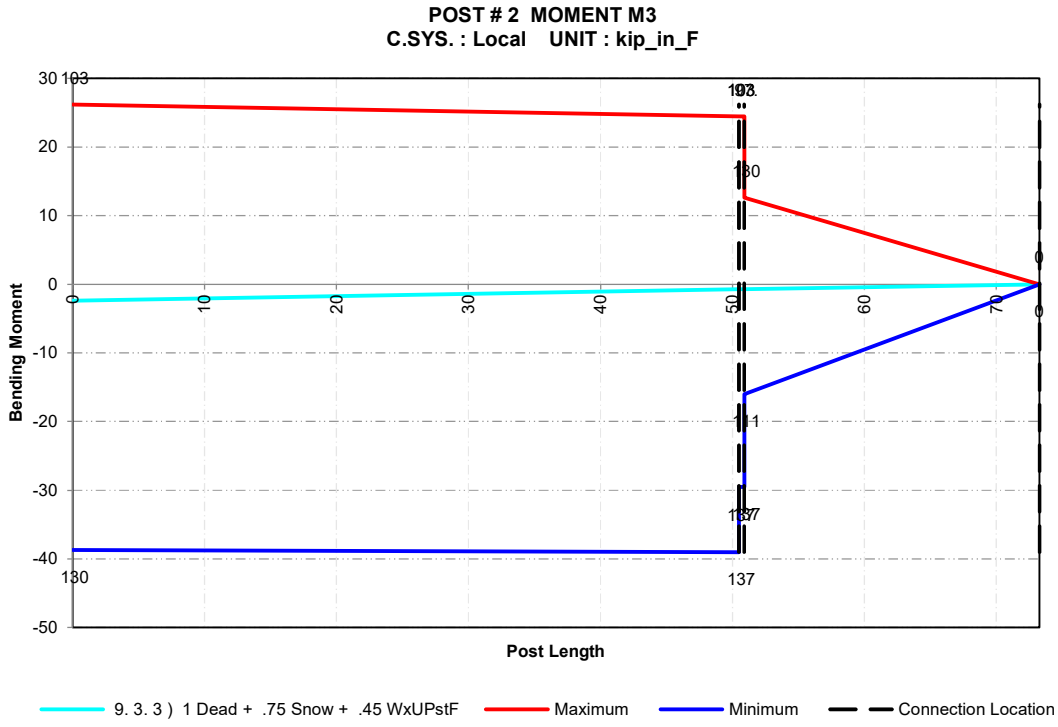


POST # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-3 degree*





PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

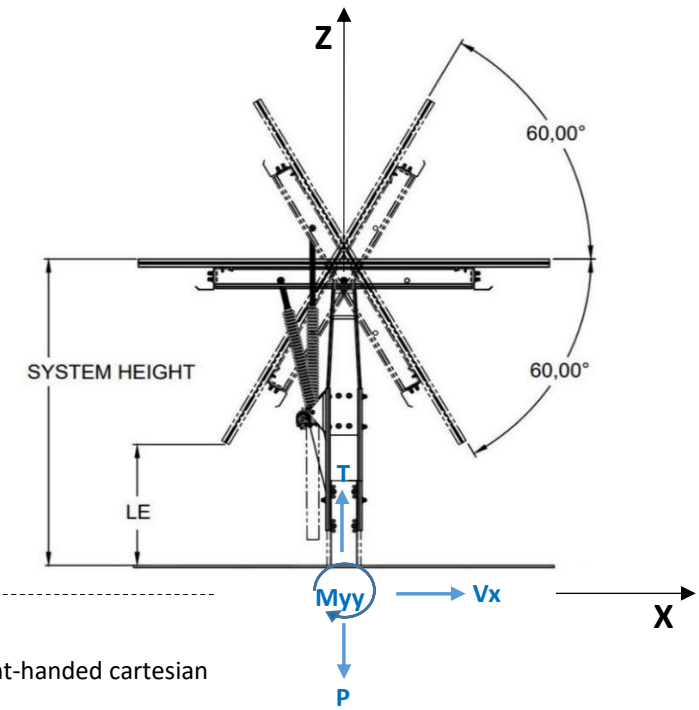
TABLE : *X25 (1P24 - SAT)*

CLASS : *Central 3 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *3 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.77	0.97	0.00	2.01	≈ 0	0.44	0.96
	T	n/a	0.00	n/a	-2.34	≈ 0	n/a	-1.29
	V_x	0.00	0 , 0	0.00	± 0.12	± 0.09	0.02	-0.07 , 0.05
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.00	-0.47 , 0.45	0.00	± 4.71	± 0.55	0.14	-2.6 , 1.37
	M_{xx}	0.00	-0.01 , 0.01	0.00	± 0	± 0.57	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.02	1.37	0.00	2.60	≈ 0	0.57	1.24
	T	n/a	0.00	n/a	-3.03	≈ 0	n/a	-1.68
	V_x	0.00	0 , 0.01	0.00	± 0.16	± 0.1	0.03	-0.09 , 0.06
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	0.03	-0.56 , 0.6	0.00	± 5.39	± 0.62	0.18	-2.98 , 1.72
	M_{xx}	0.00	-0.01 , 0	0.00	± 0	± 0.73	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X25 (1P24 - SAT)*

LENGTH : *2279 mm*

CLASS : *Central 3 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *3 degree*

CHORD LENGTH : *27758 mm*

POST SPAN : *10230 mm*

CHORD CONTILEVER : *3649 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	2.15	4	20	45
Splice / Z	GR_70	142.7	69	4.2	4	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		2.3	note * : standard baseline section		
Pivot Arm - Mid / Ω	GR_70	see note *		2.7	note * : standard baseline section		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O - ext (int)	GR_50	88.9	n/a	4.5 (4.5)	n/a	n/a	n/a

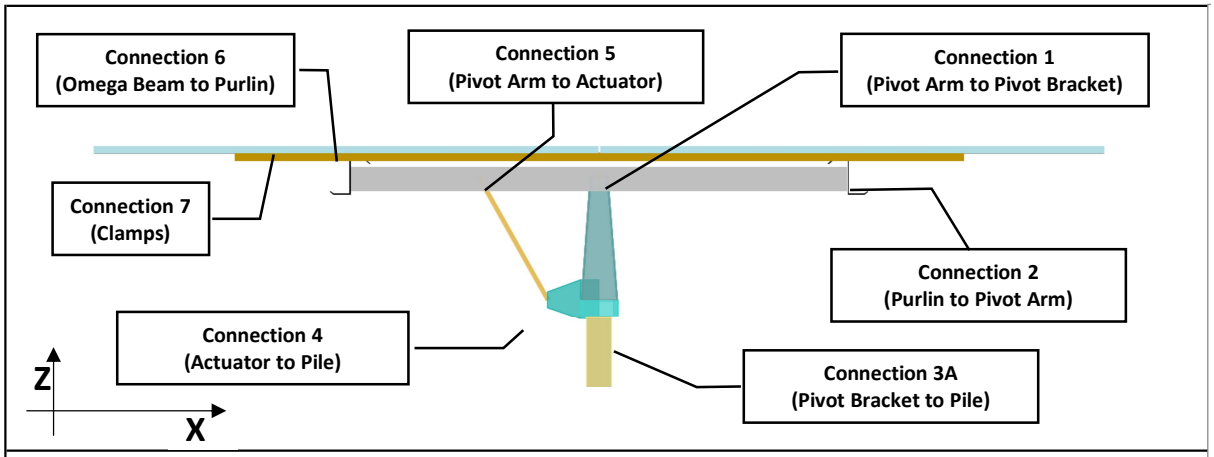
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.77	0.97	0.00	2.01	≈ 0	0.44	0.96
	T	n/a	0.00	n/a	-2.34	≈ 0	n/a	-1.29
	V_x	0.00	0 , 0	0.00	± 0.12	± 0.09	0.02	-0.07 , 0.05
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.00	-0.47 , 0.45	0.00	± 4.71	± 0.55	0.14	-2.6 , 1.37
	M_{xx}	0.00	-0.01 , 0.01	0.00	± 0	± 0.57	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.02	1.37	0.00	2.60	≈ 0	0.57	1.24
	T	n/a	0.00	n/a	-3.03	≈ 0	n/a	-1.68
	V_x	0.00	0 , 0.01	0.00	± 0.16	± 0.1	0.03	-0.09 , 0.06
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	0.03	-0.56 , 0.6	0.00	± 5.39	± 0.62	0.18	-2.98 , 1.72
	M_{xx}	0.00	-0.01 , 0	0.00	± 0	± 0.73	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*

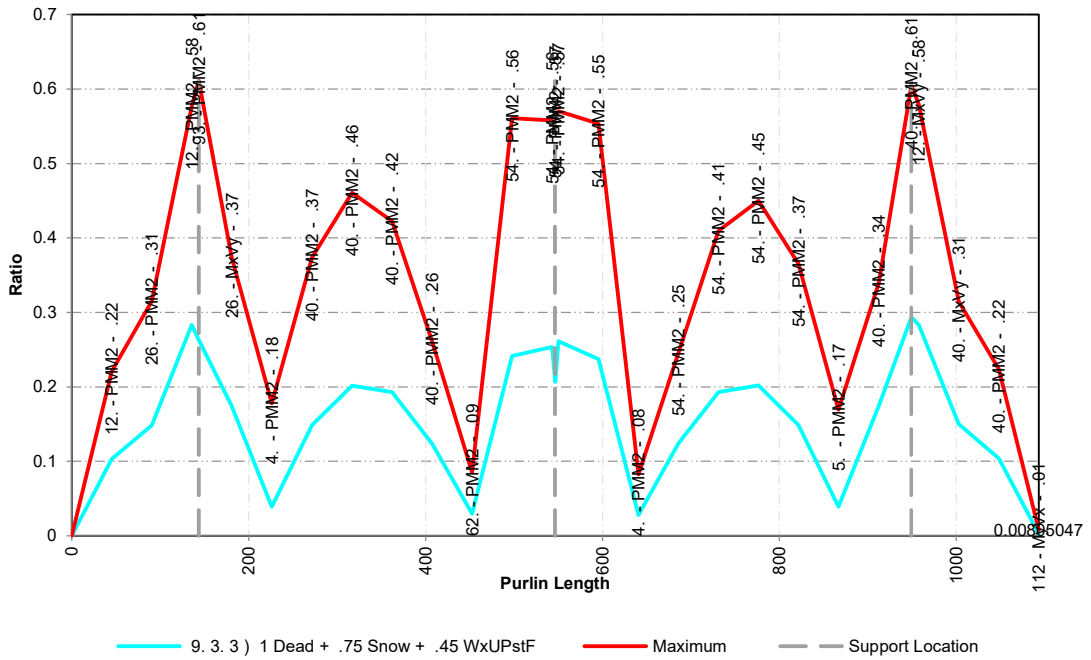


Note: coordinate system is right-handed cartesian

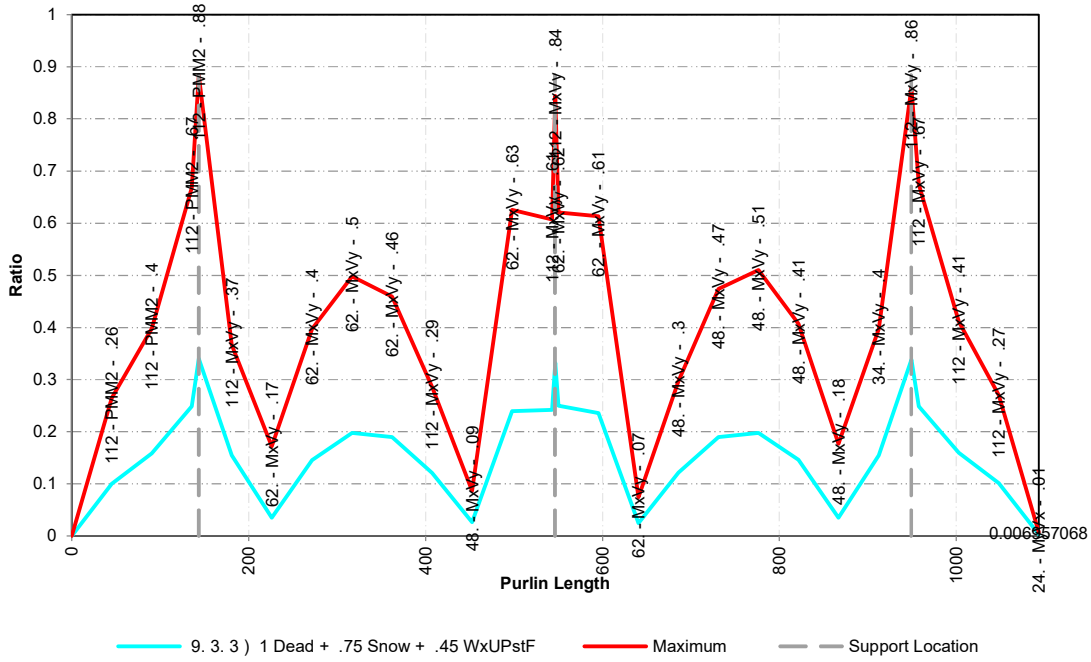
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-4.93	0.52	0.00	0.00	0.00	0.00	112. 4. 21) 1 Dead + .6 WxDNal+T
-0.97	0.00	-0.07	0.00	0.00	0.00	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 2						
3.03	-1.85	0.00	0.00	0.06	0.25	112. 4. 21) 1 Dead + .6 WxDNal+T
3.03	-1.85	0.00	0.00	0.06	0.25	112. 4. 21) 1 Dead + .6 WxDNal+T
Connection : 3						
1.21	0.09	0.00	0.00	0.00	2.82	137. 5. 23) .6 Dead + .6 WxUPal+T
-2.61	-0.04	0.00	0.00	0.00	-0.25	50. 3. 70) 1 Dead + .75 S3_lhhl + .45 WxDNstF
1.21	0.09	0.00	0.00	0.00	0.56	118. 5. 4) .6 Dead + .6 WxUPalF
-0.61	-0.01	0.00	0.00	0.00	3.22	130. 5. 16) .6 Dead + .6 WxOTal
-1.02	0.00	-0.08	0.01	-0.51	-0.03	158. 12. 2) 1 Dead + -.7 Quake_y
-1.02	0.00	-0.08	0.01	-0.51	-0.03	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
2.47	*	0.00	0.00	0.00	0.00	135. 5. 21) .6 Dead + .6 WxDNal+T
Connection : 5		** Note : the load is axial in actuator direction*				
2.47	*	0.00	0.00	0.00	0.00	135. 5. 21) .6 Dead + .6 WxDNal+T
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.17						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.17						0.6 WLup

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*

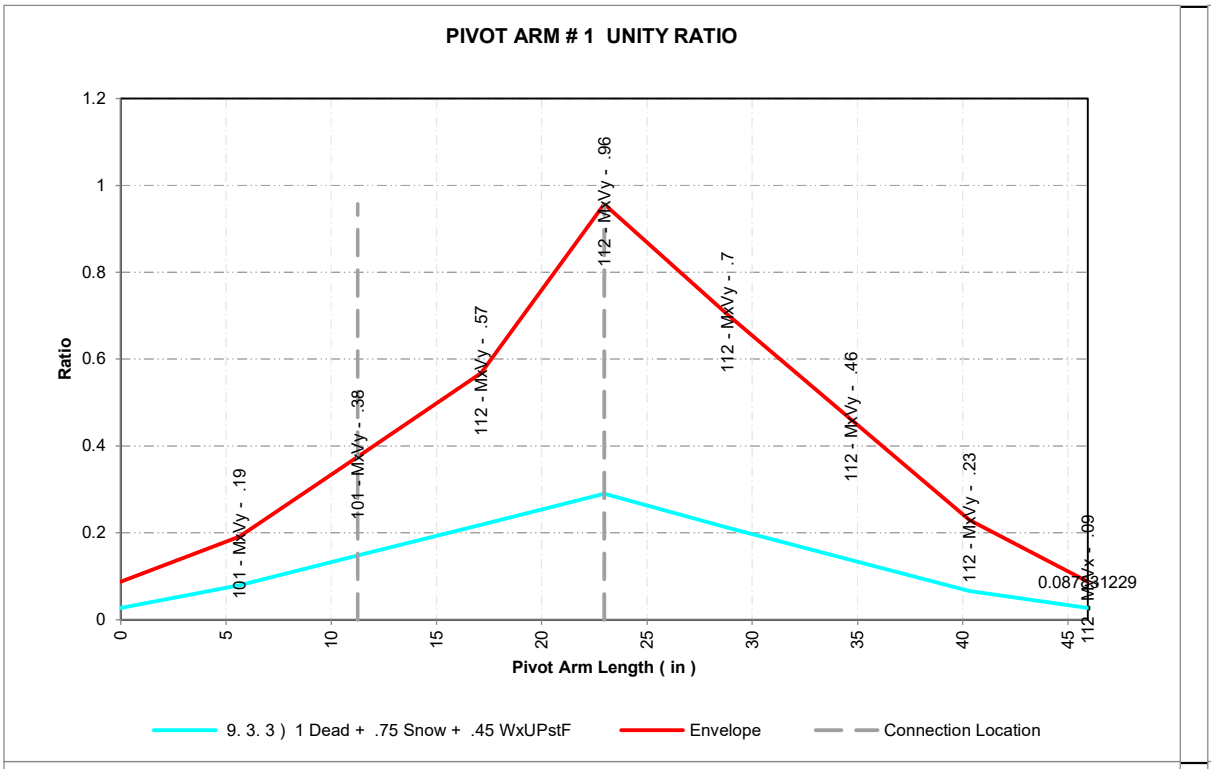
PURLIN # 1 UNITY RATIO

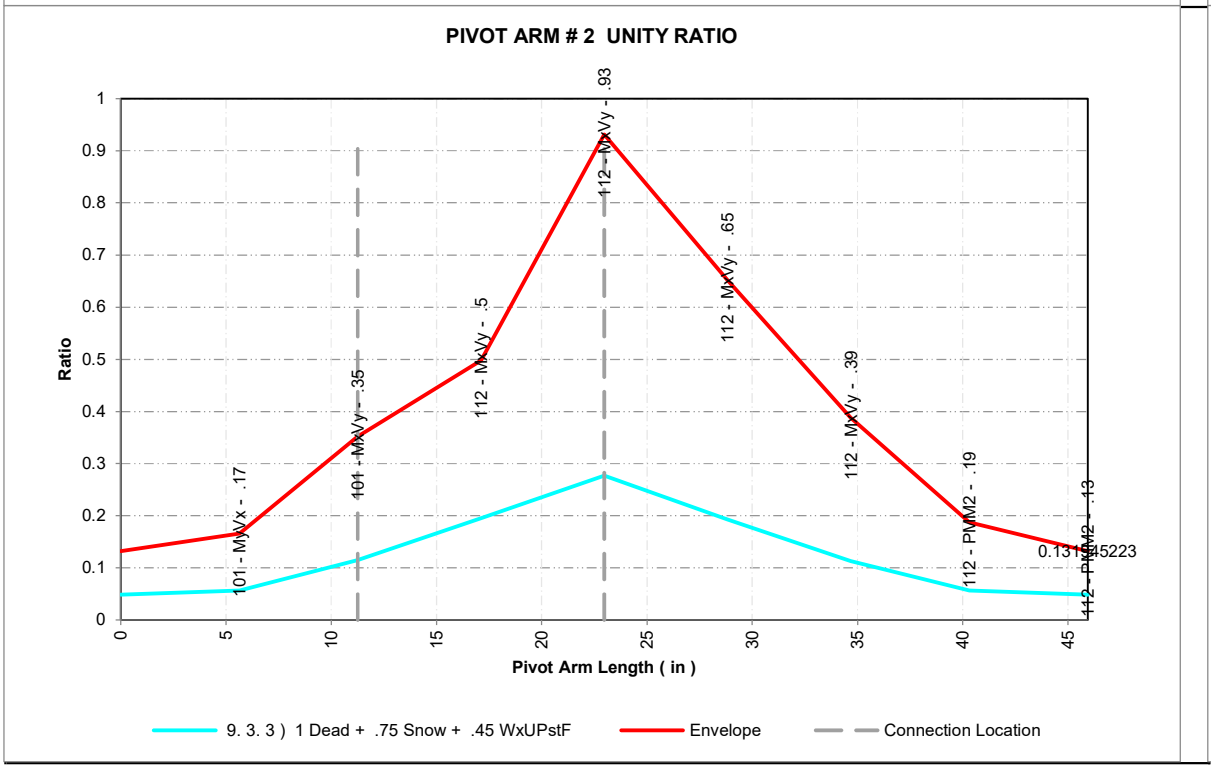


PURLIN # 2 UNITY RATIO



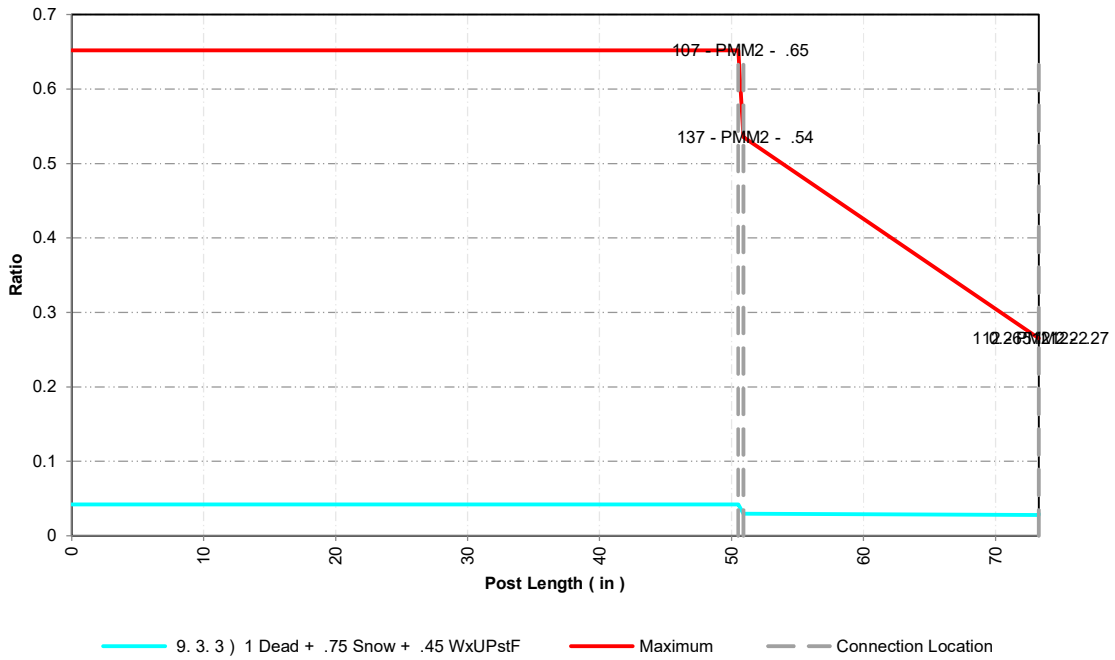
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



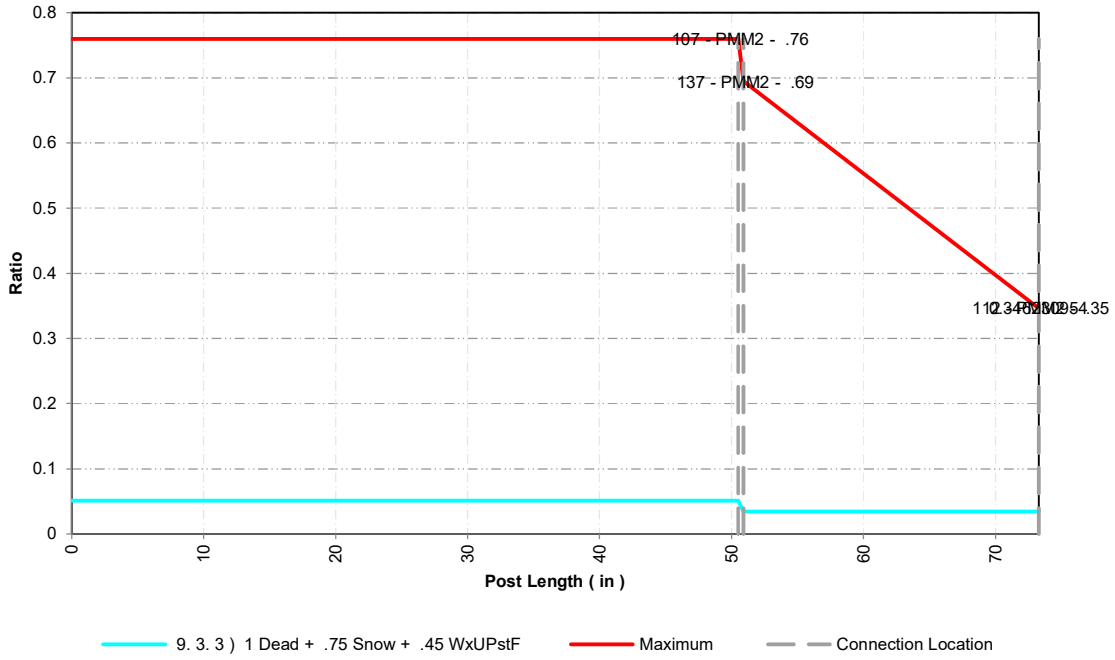


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*

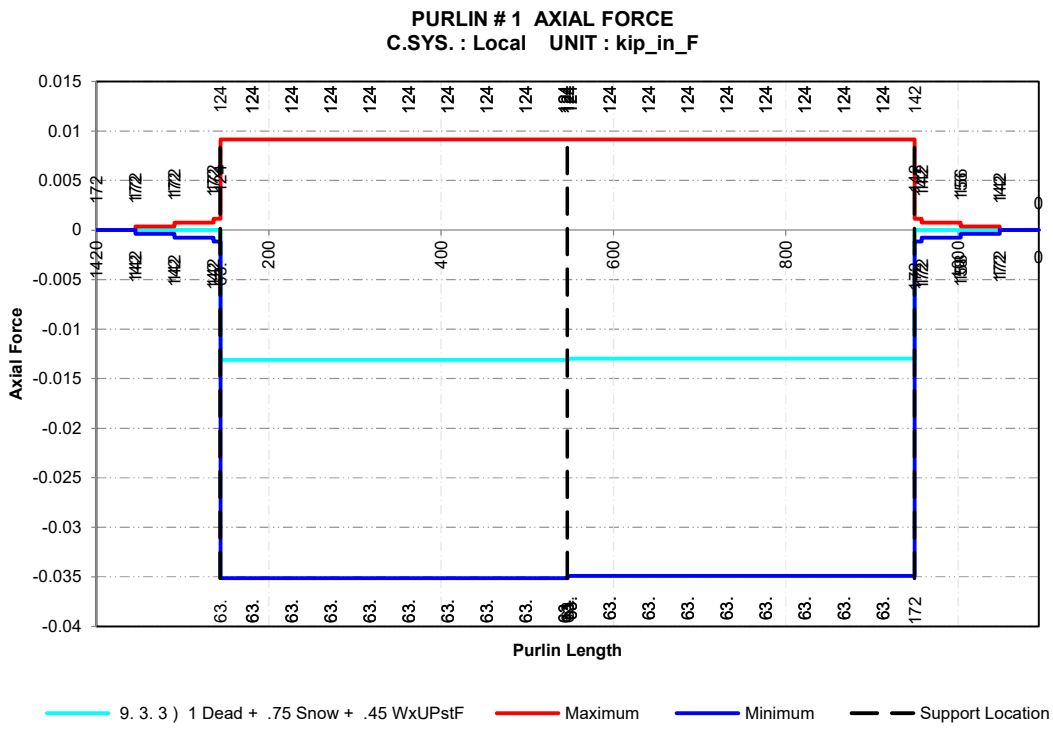
POST # 1 UNITY RATIO

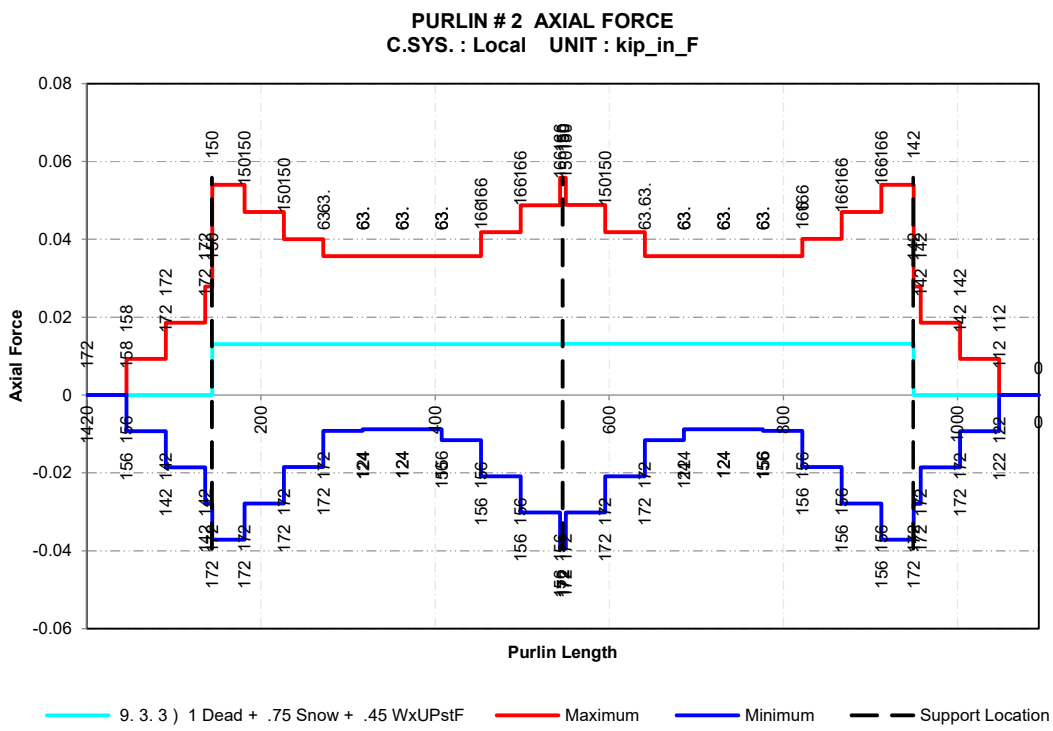


POST # 2 UNITY RATIO



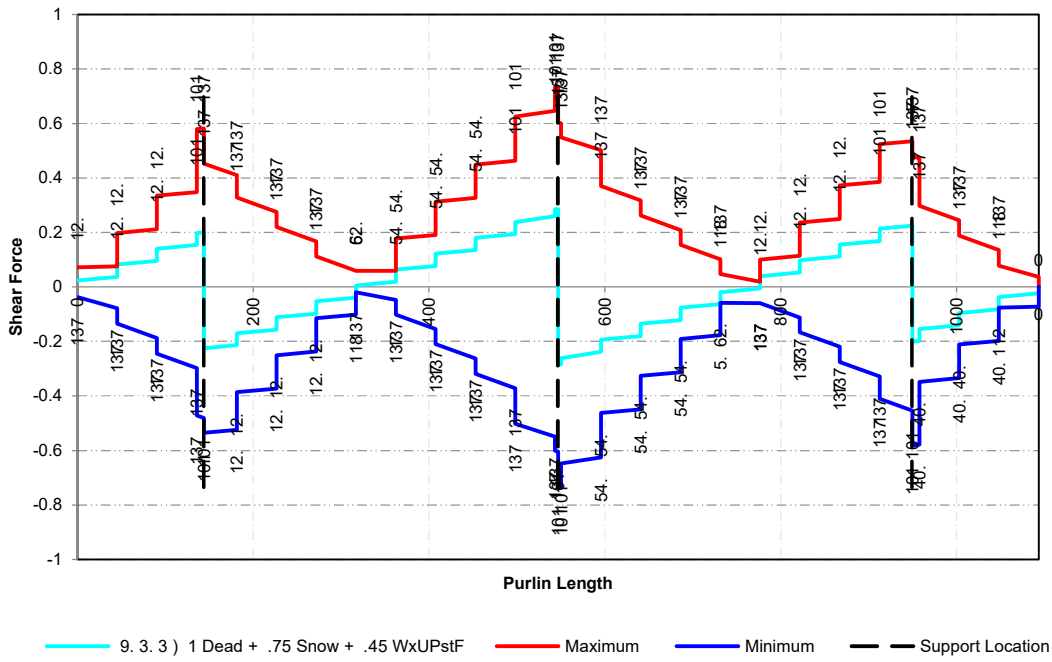
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*

PURLIN # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



PURLIN # 2 SHEAR FORCE - V2
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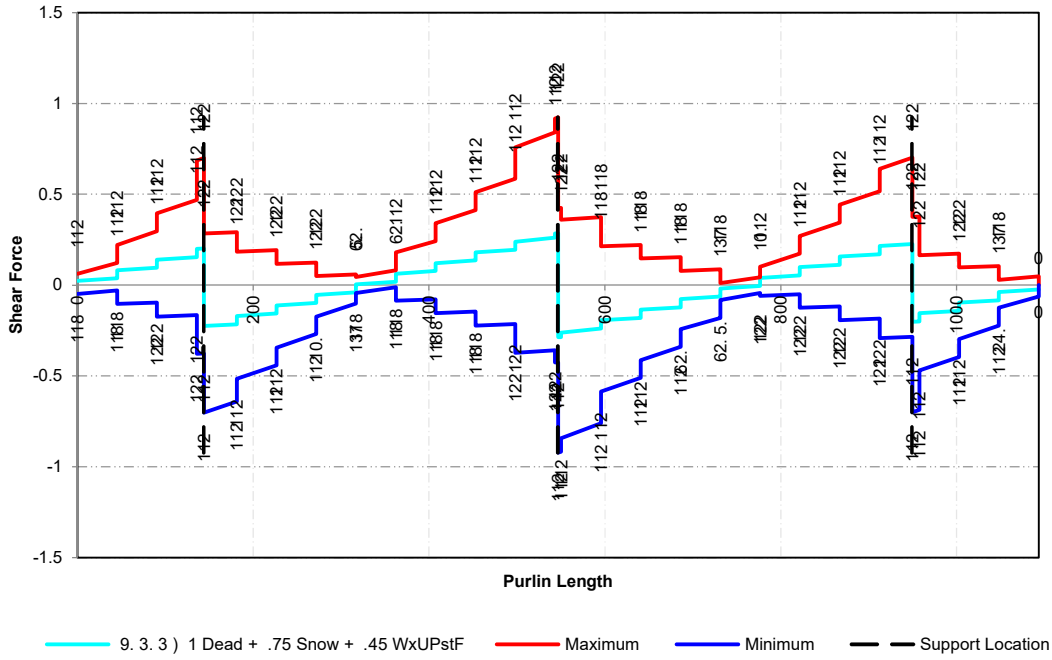
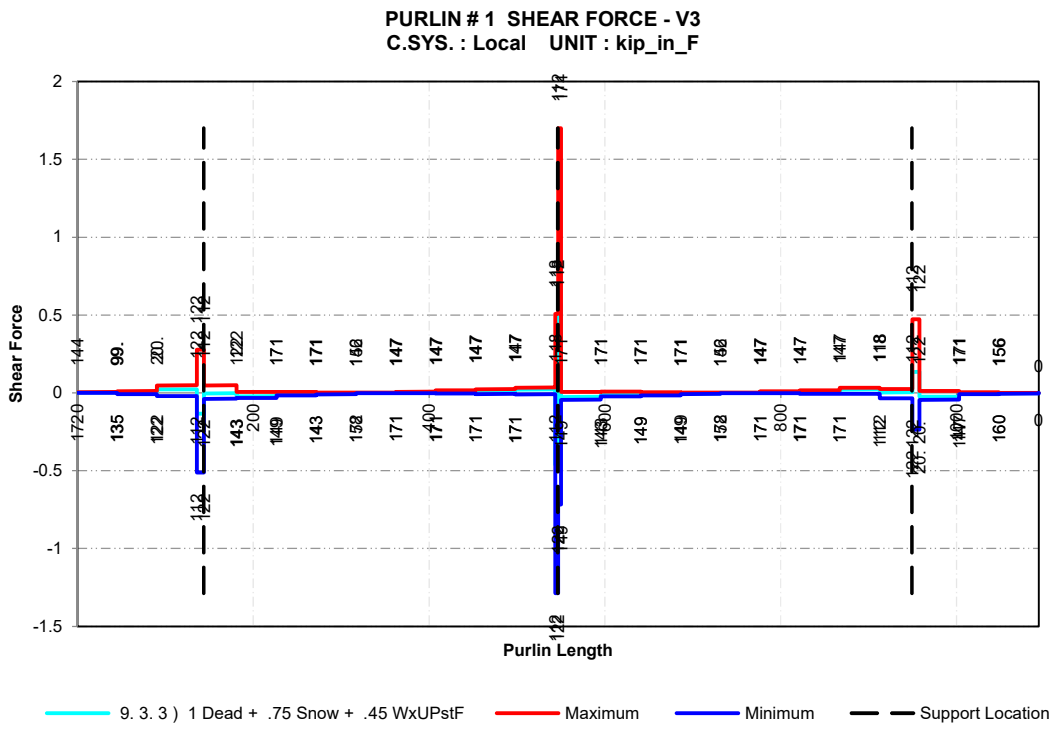
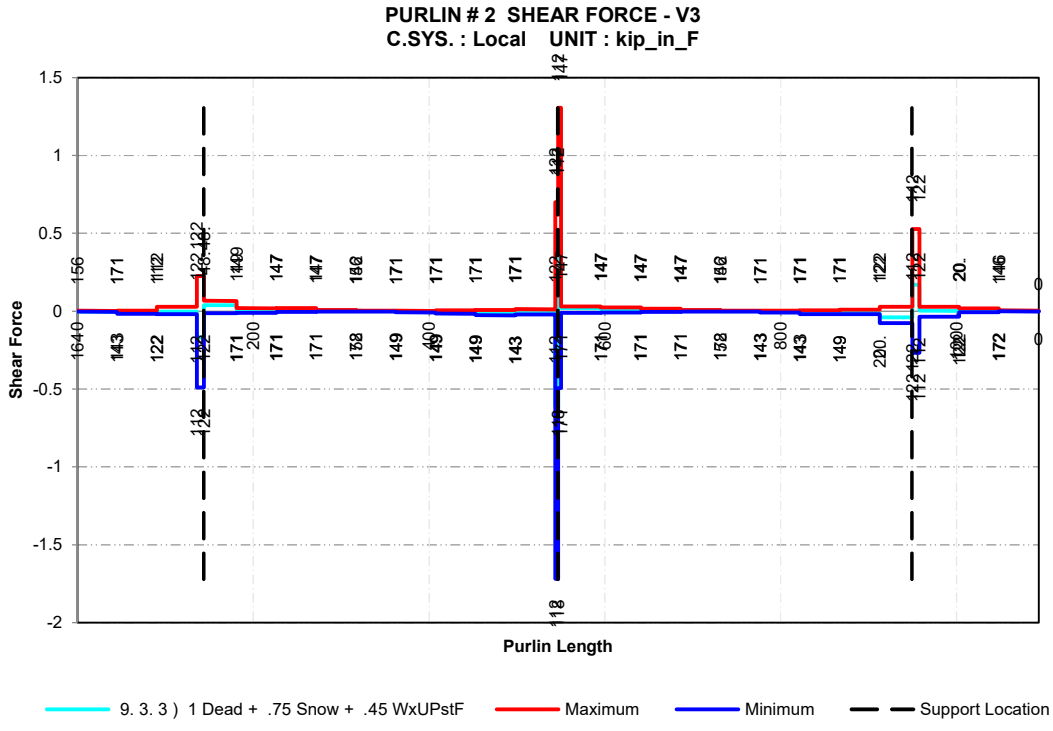


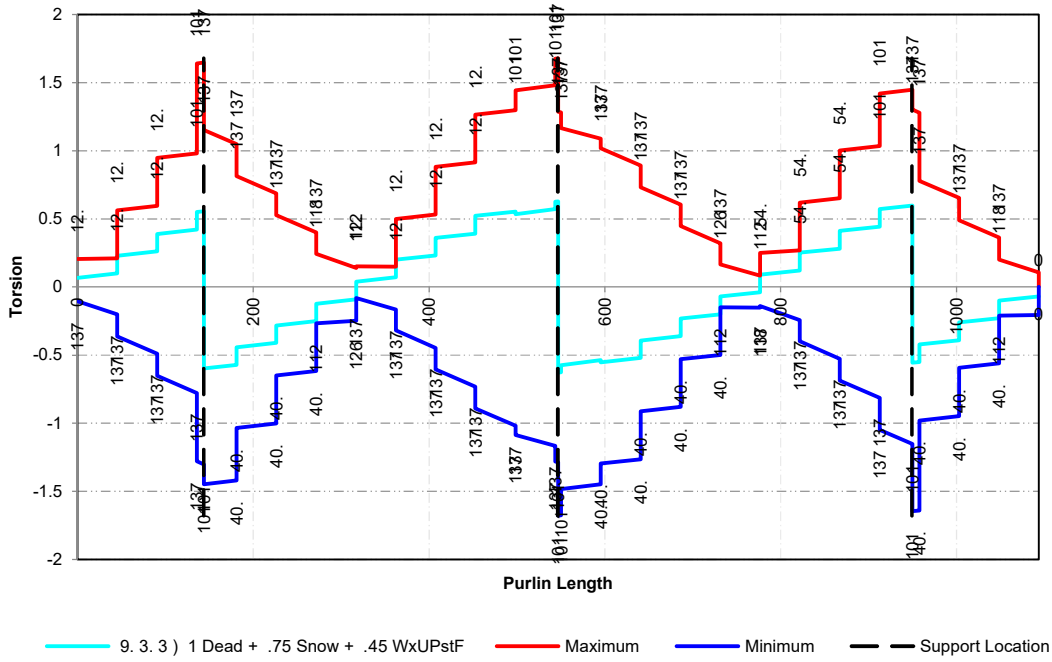
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*

PURLIN # 1 TORSION
C.SYS. : Local UNIT : kip_in_F



PURLIN # 2 TORSION
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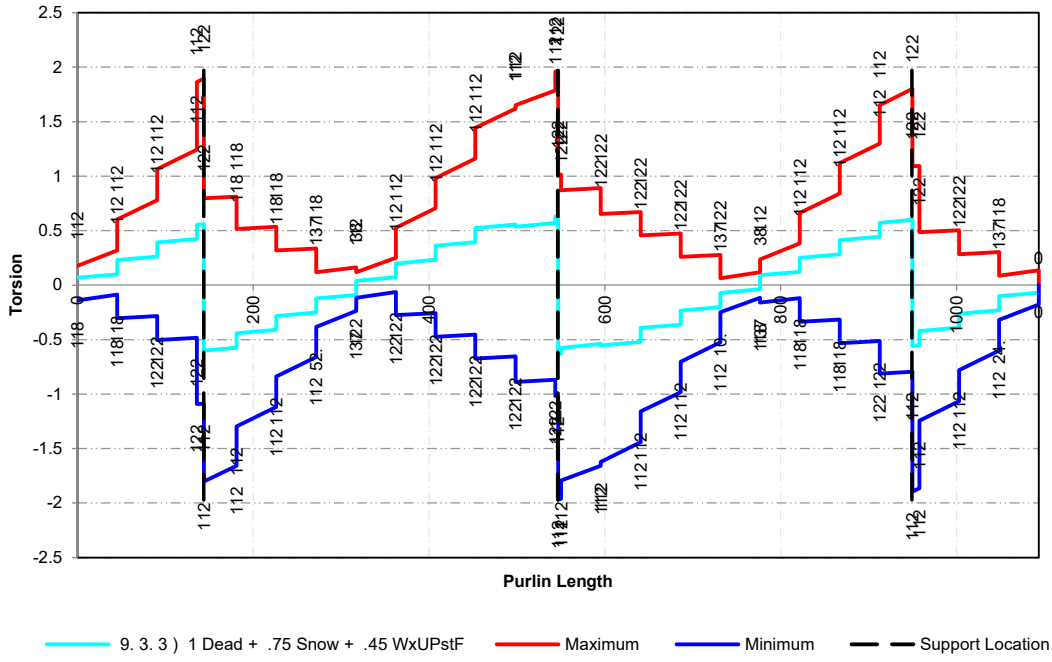
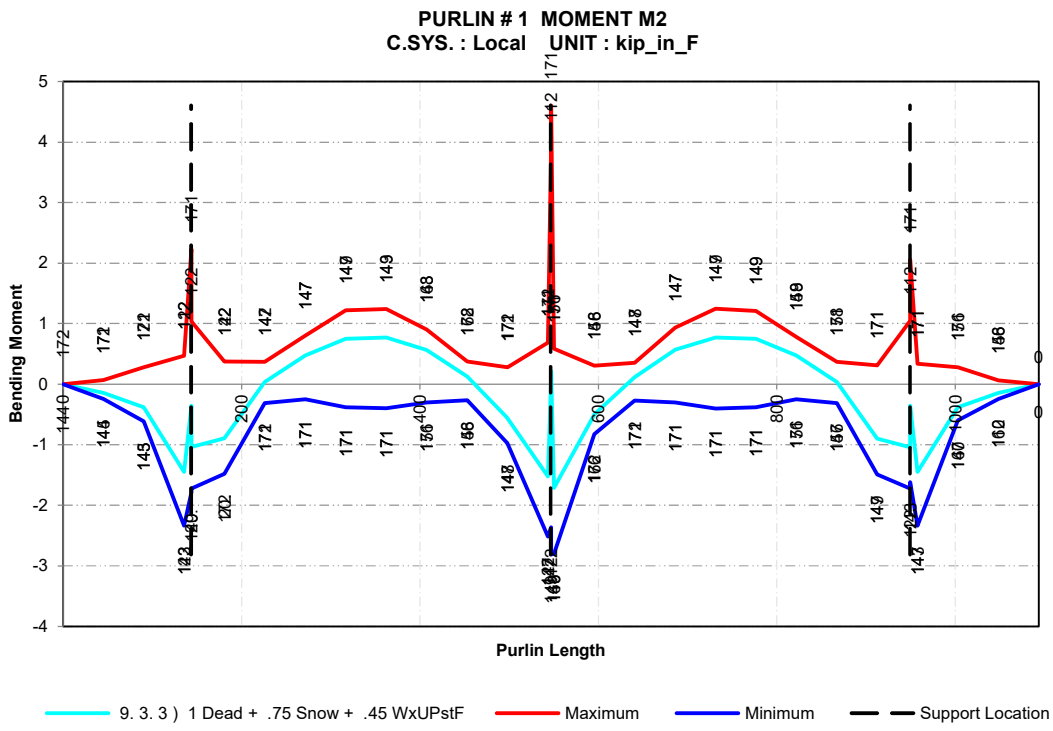
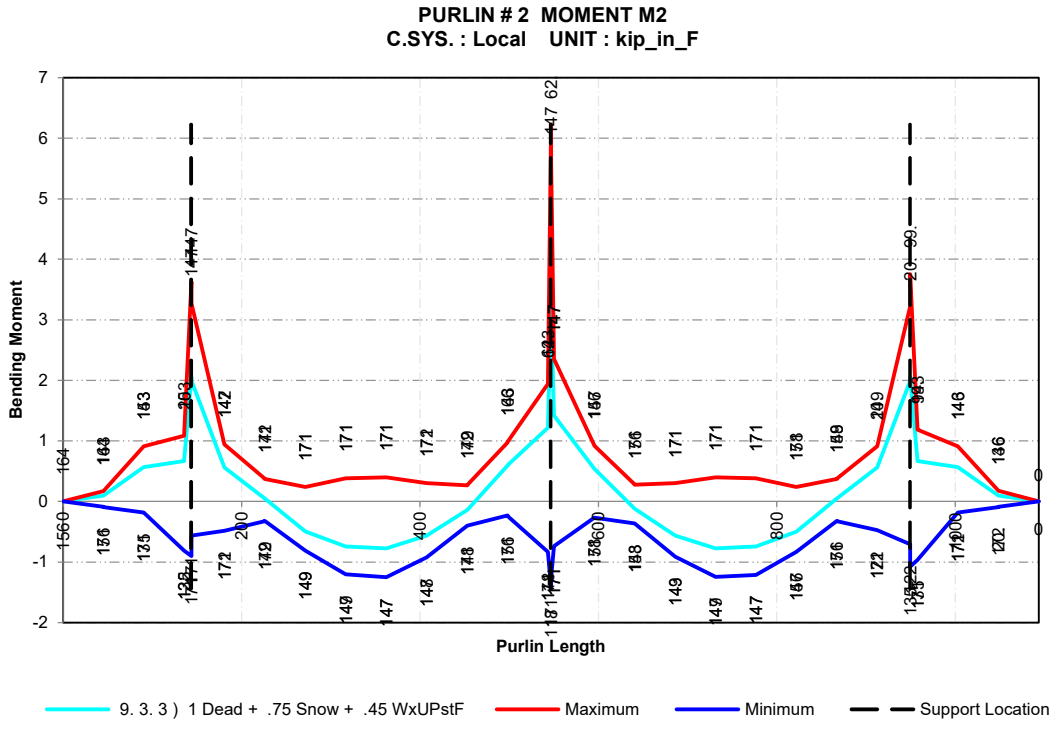
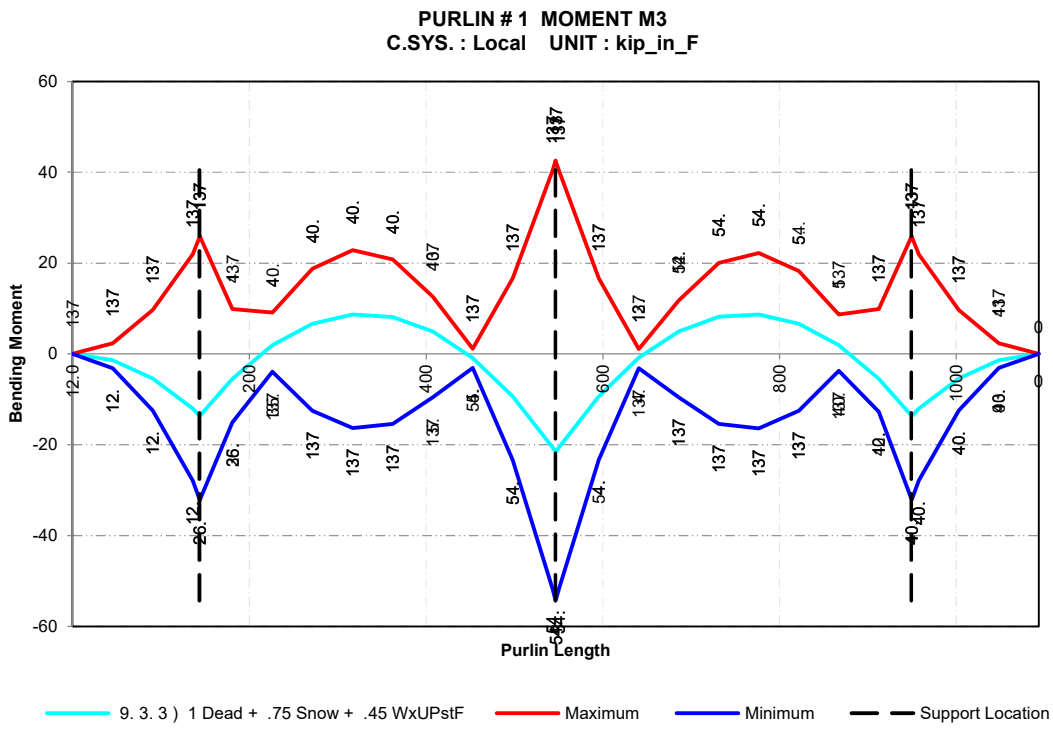


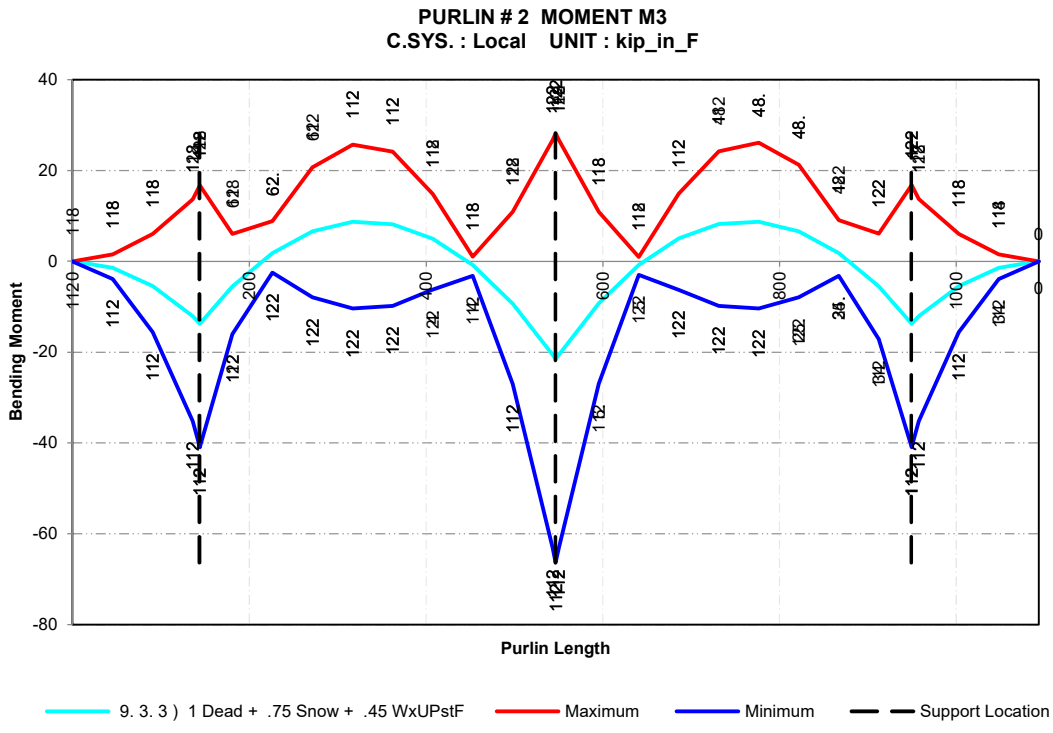
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



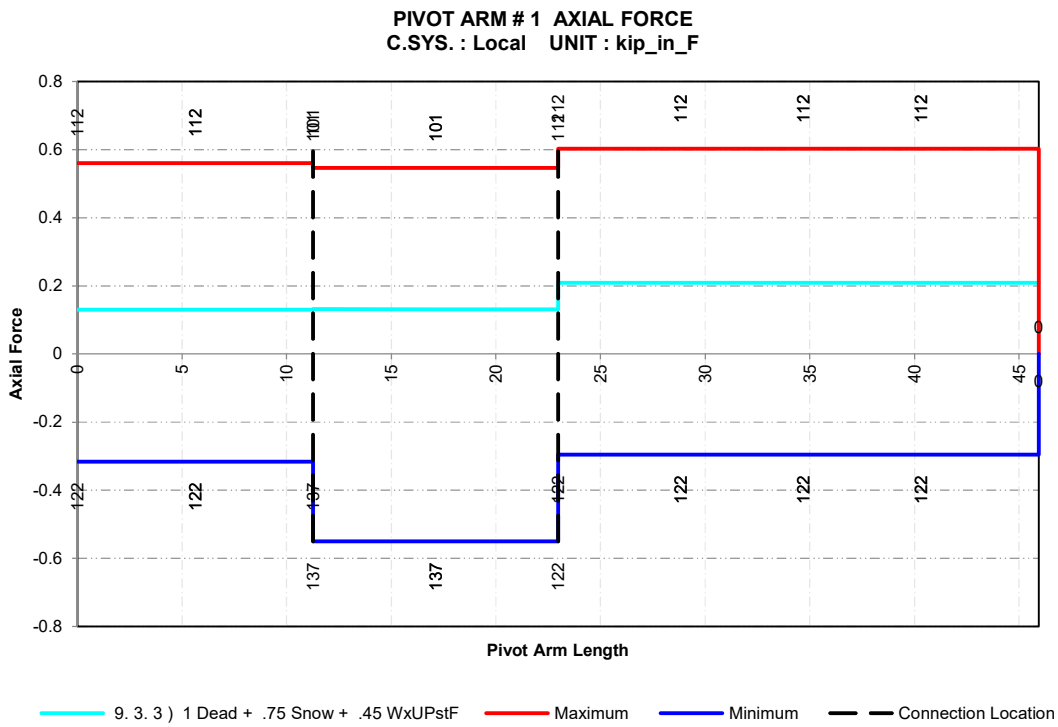


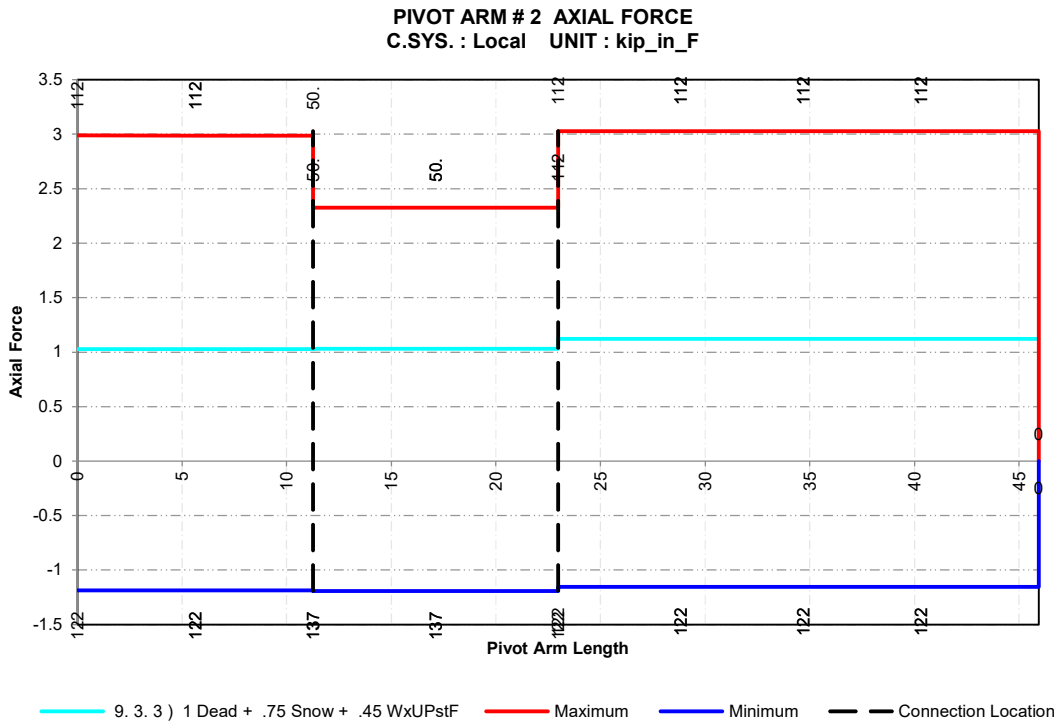
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



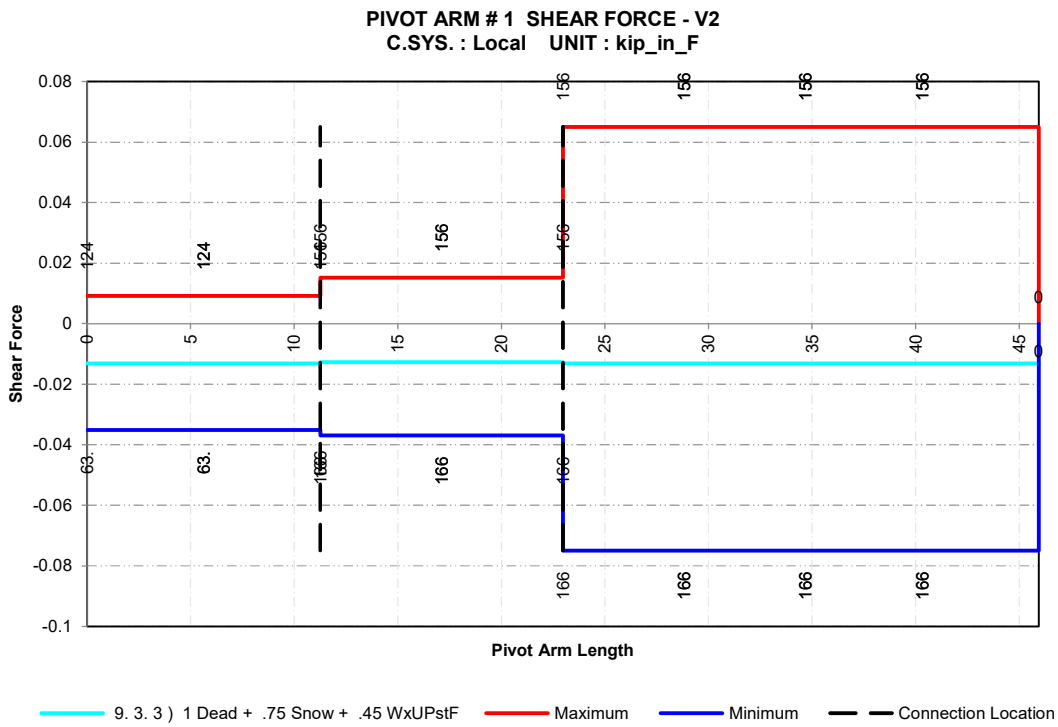


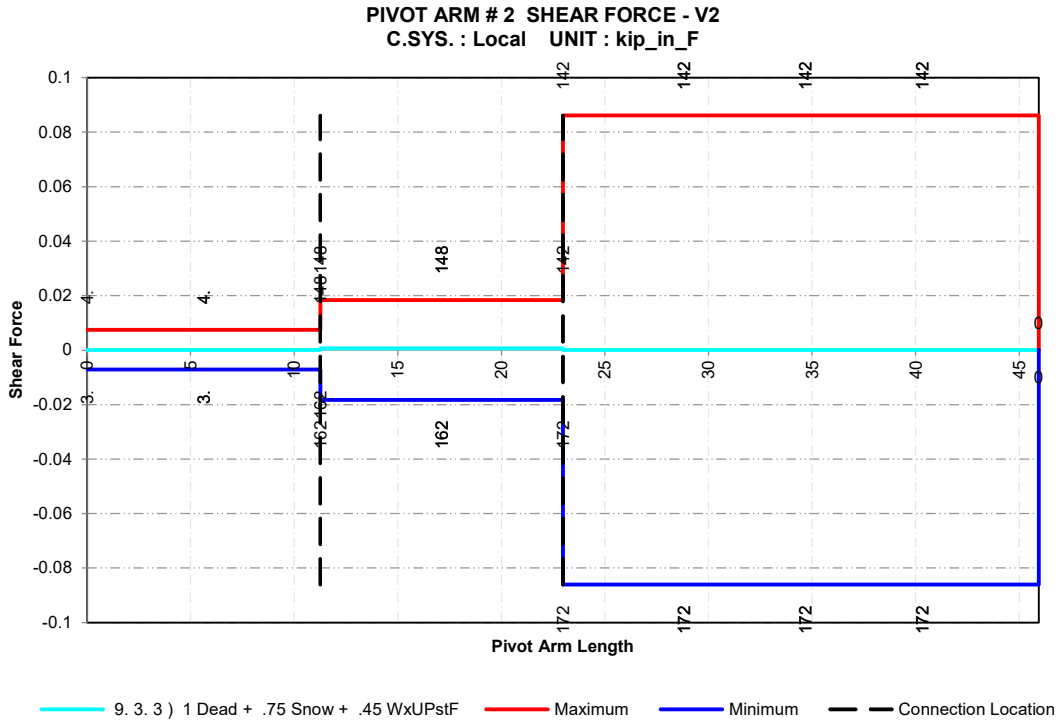
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*





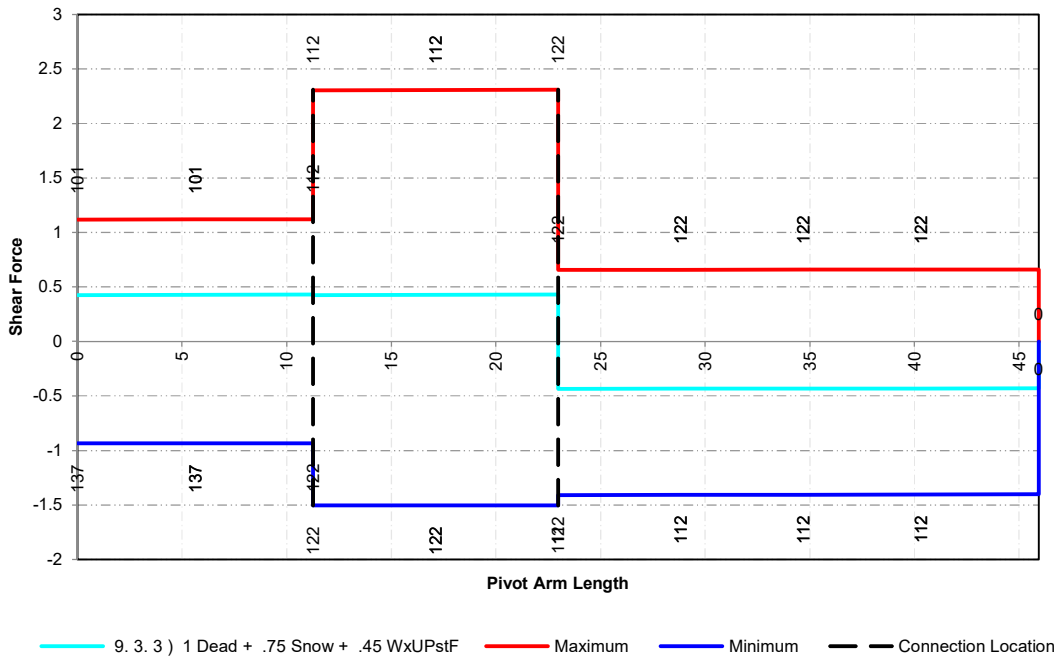
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



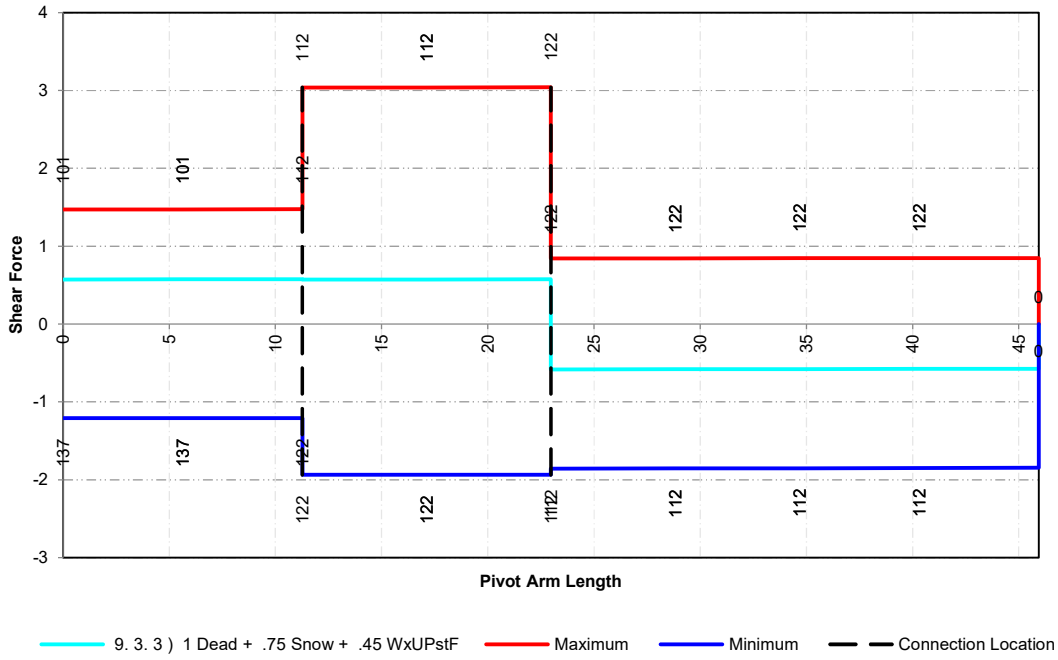


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*

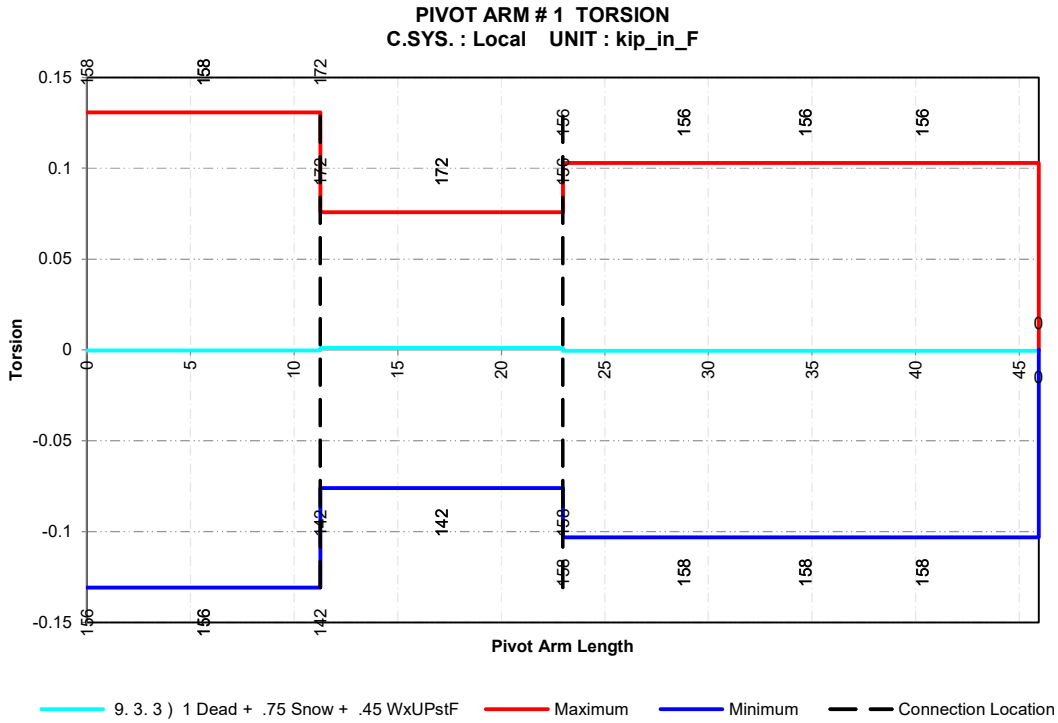
PIVOT ARM # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

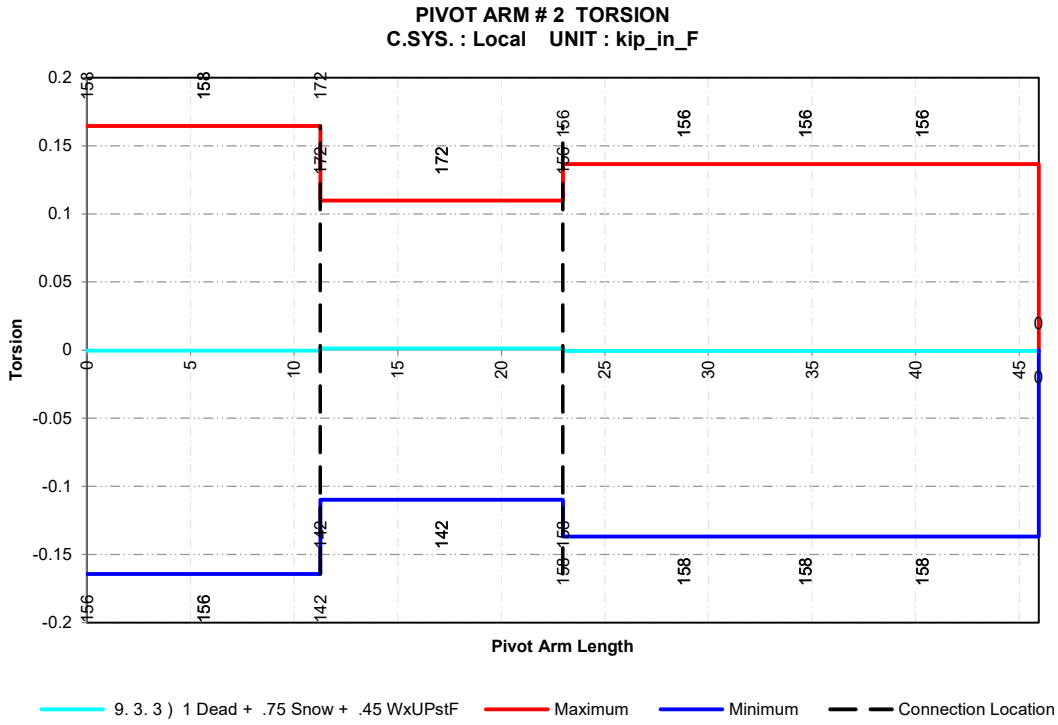


PIVOT ARM # 2 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

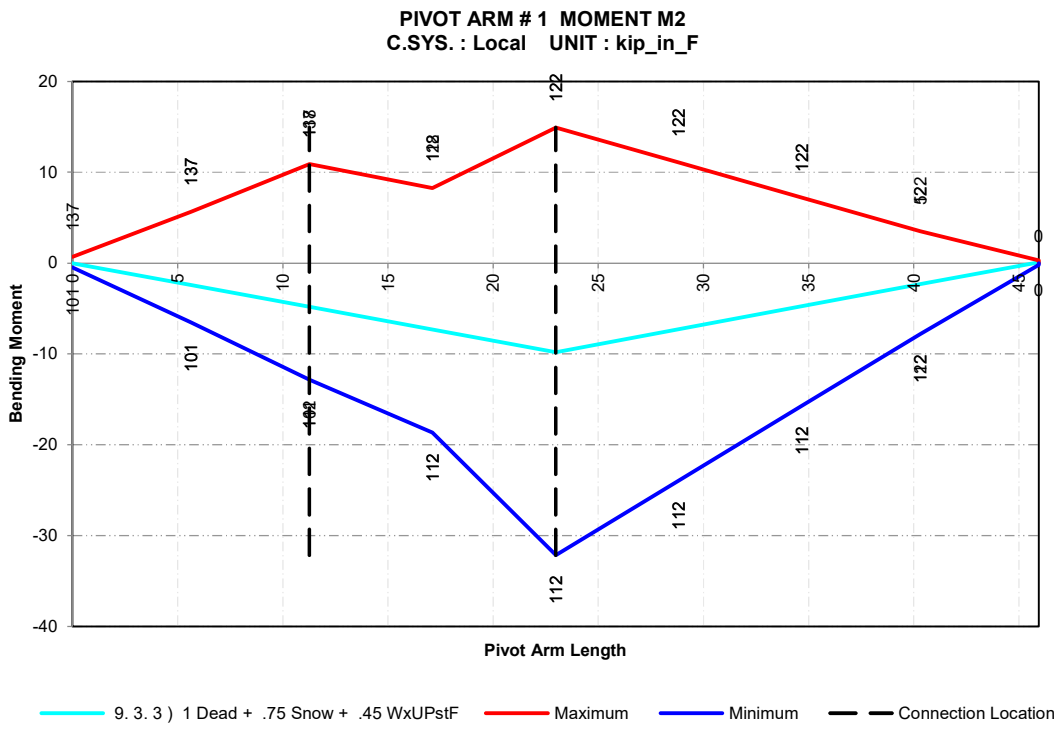


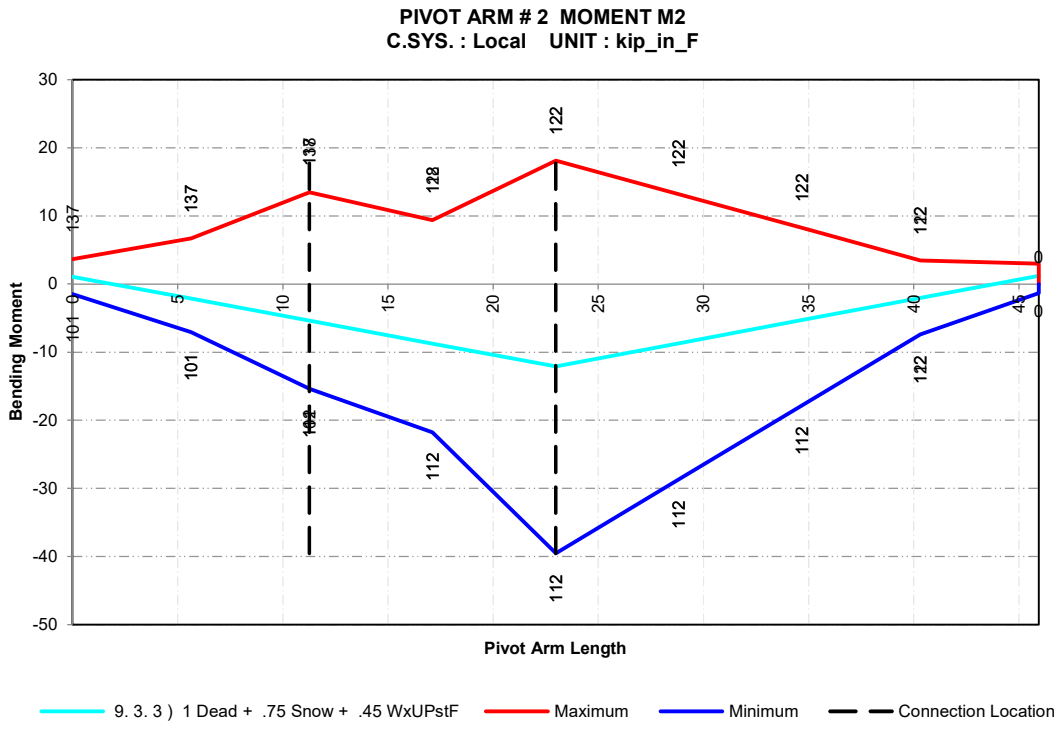
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



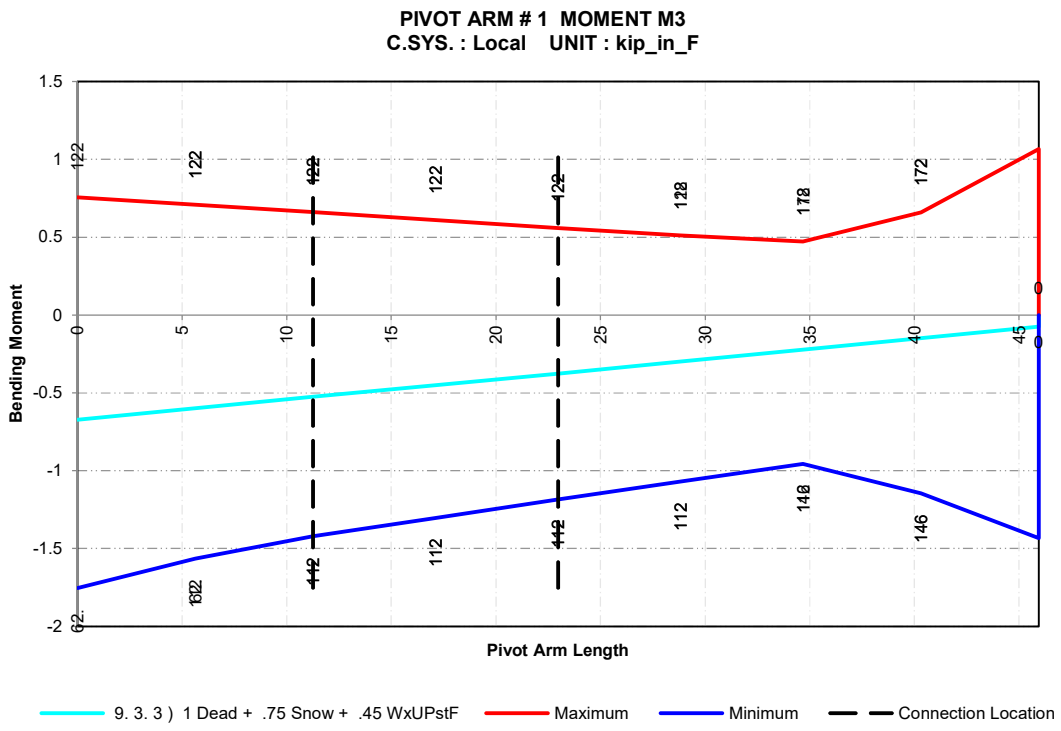


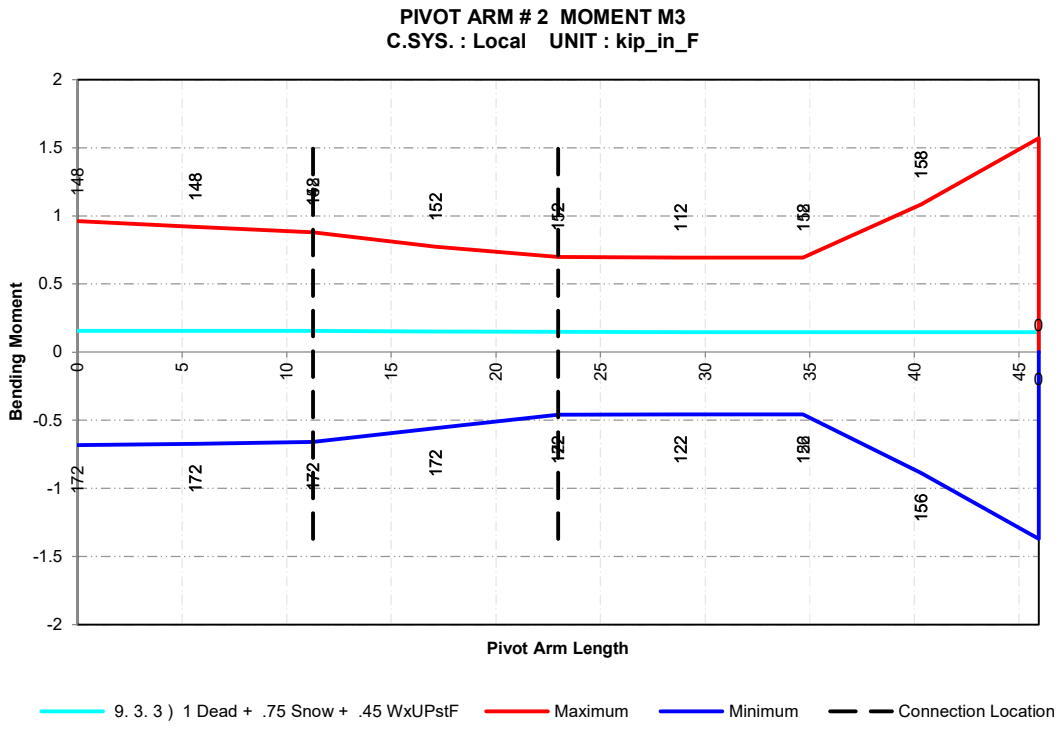
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



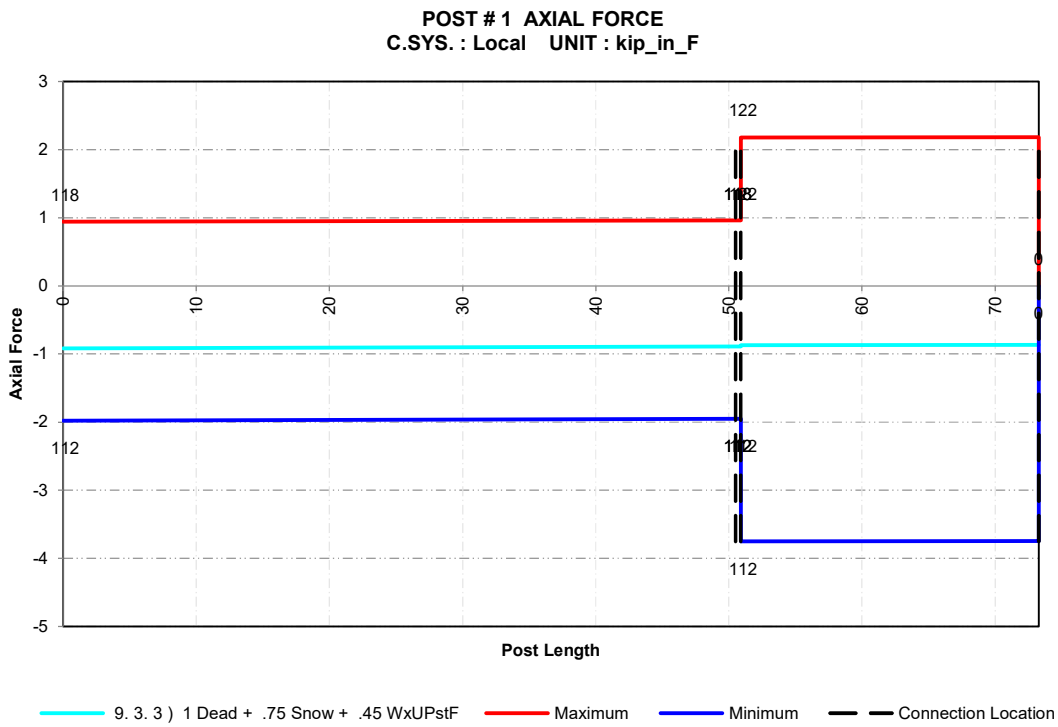


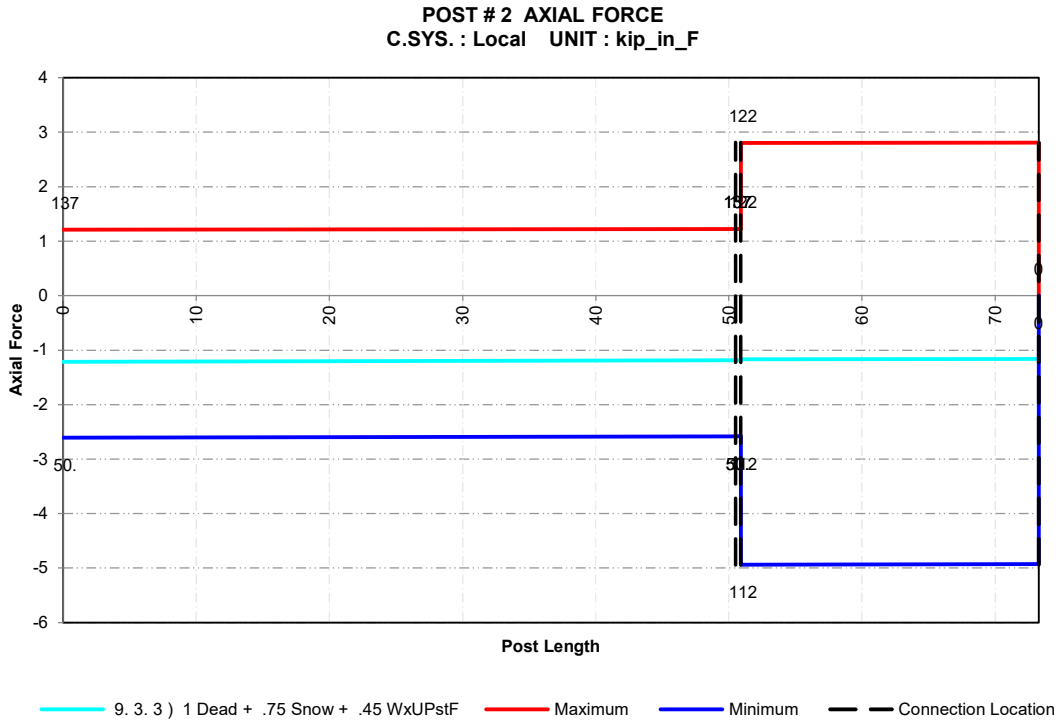
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



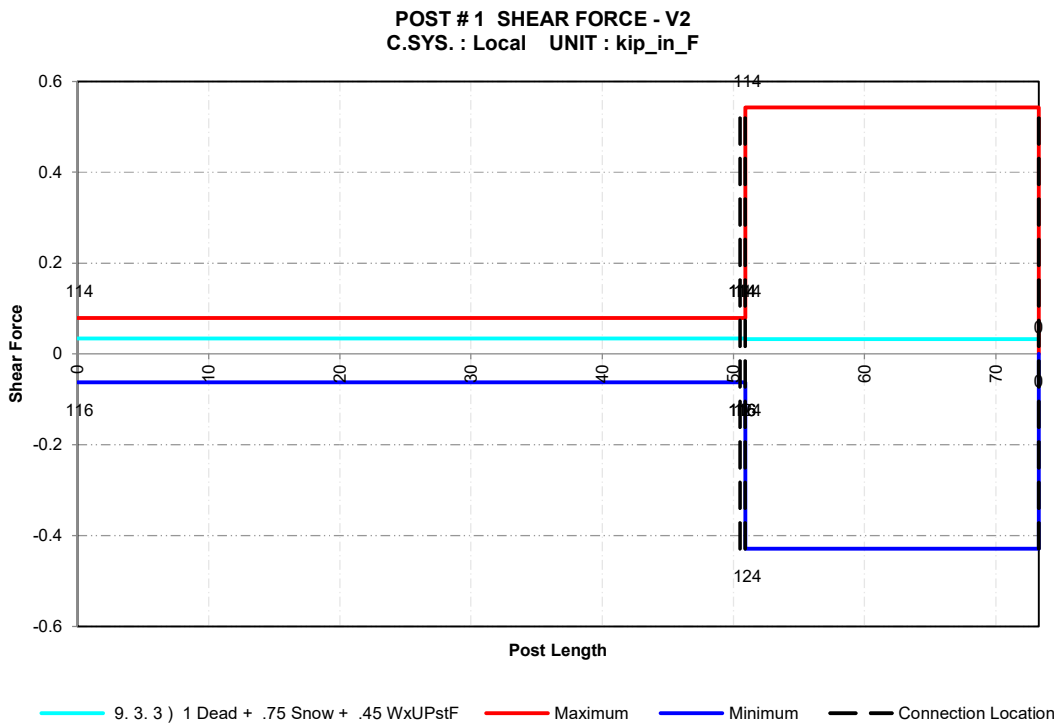


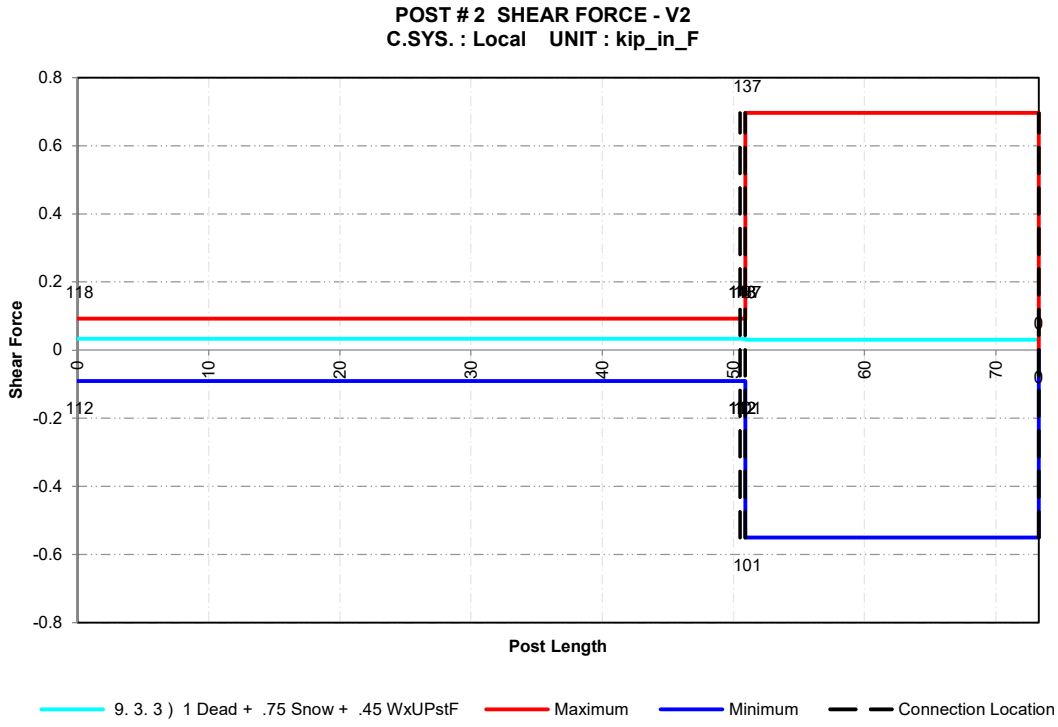
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



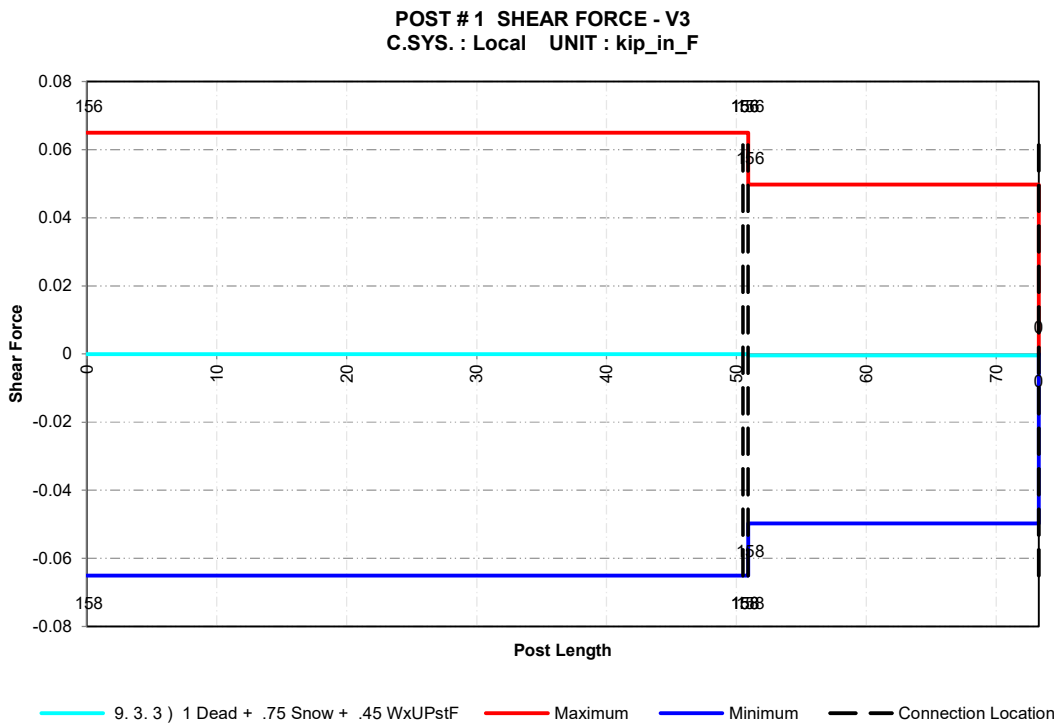


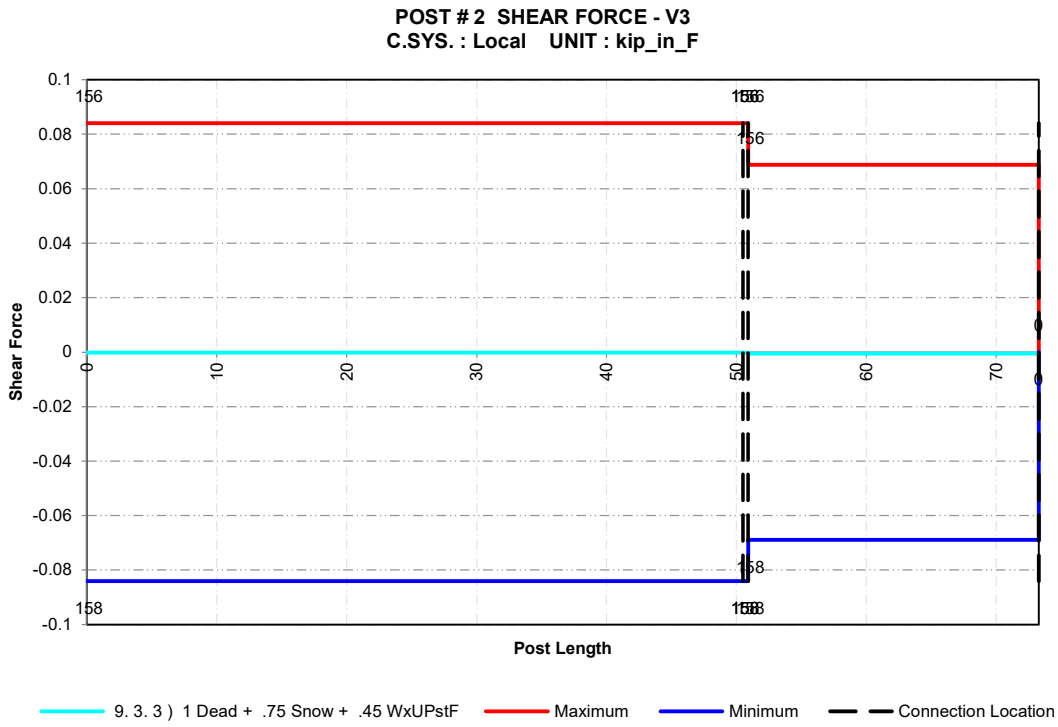
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*





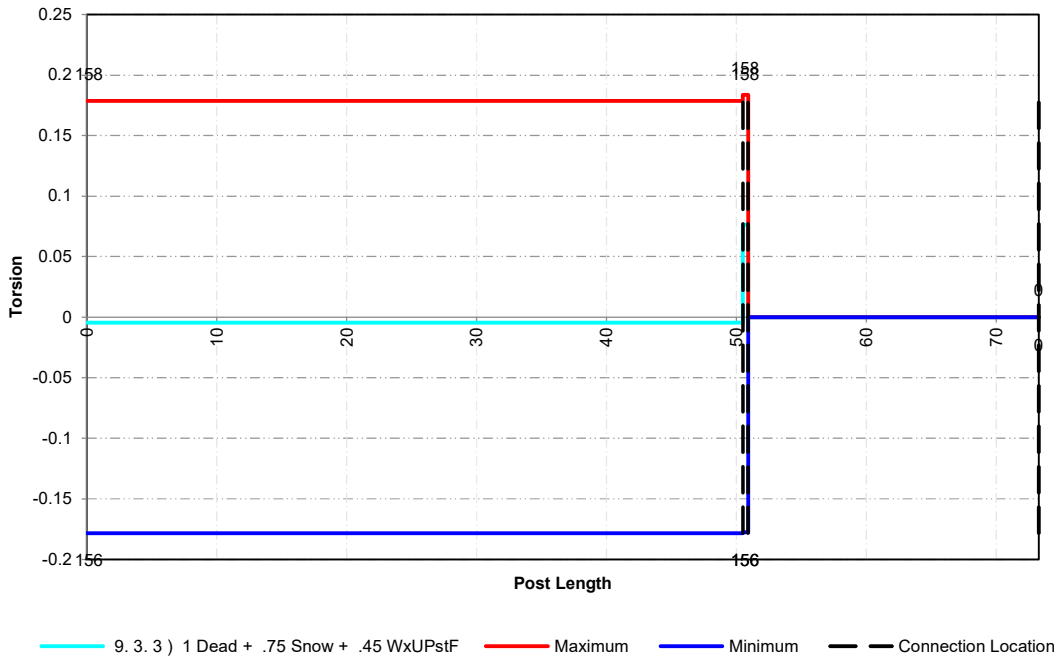
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*



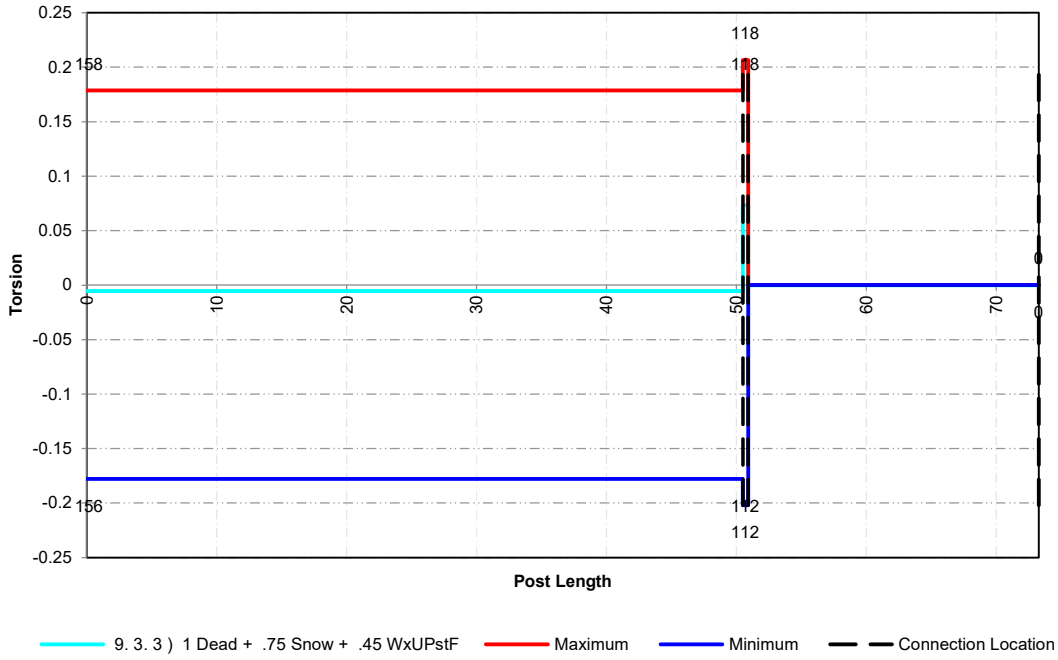


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*

POST # 1 TORSION
C.SYS. : Local UNIT : kip_in_F

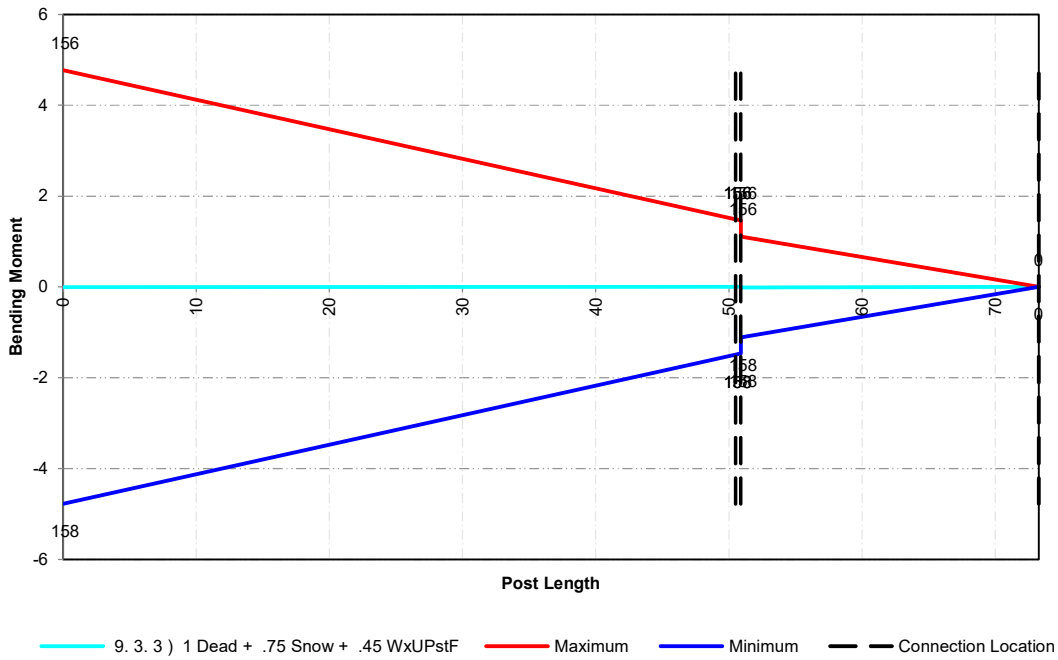


POST # 2 TORSION
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*

POST # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



POST # 2 MOMENT M2
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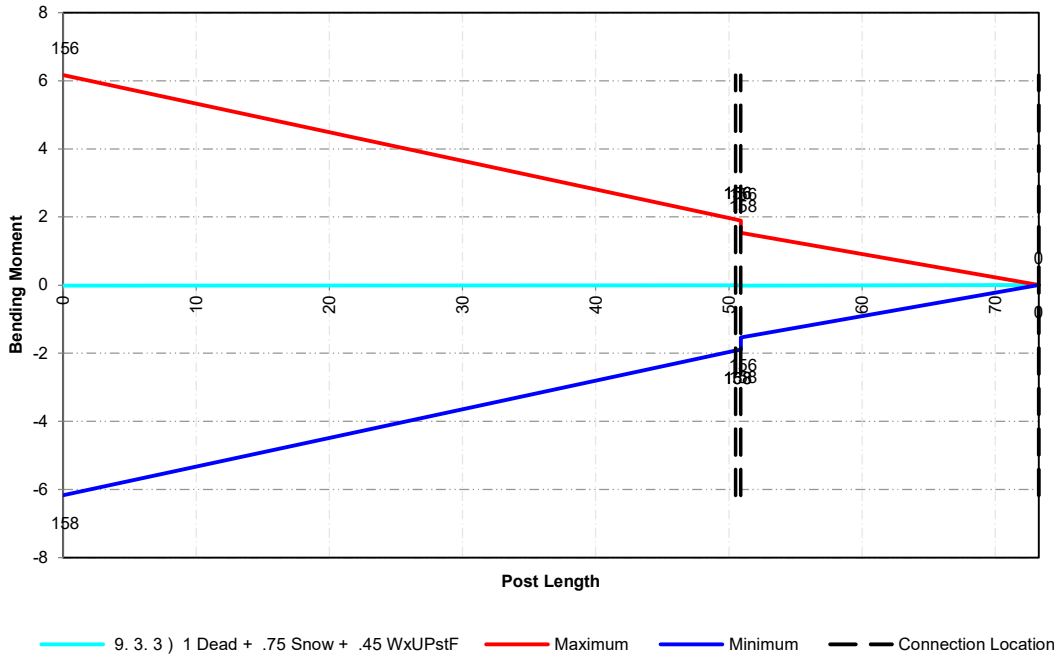
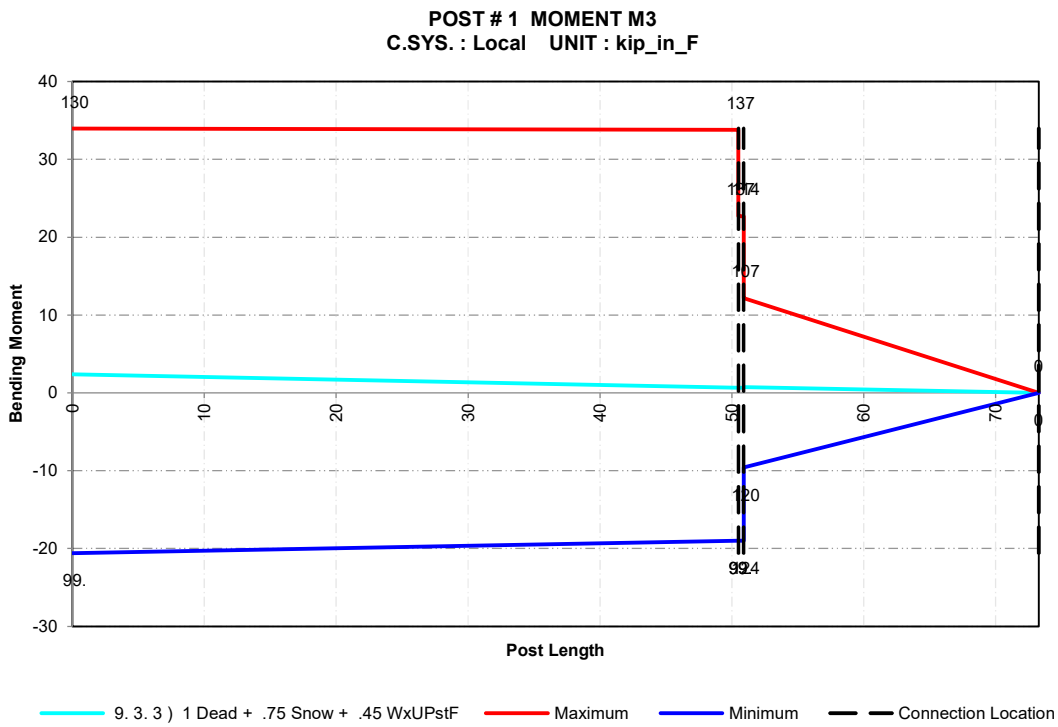
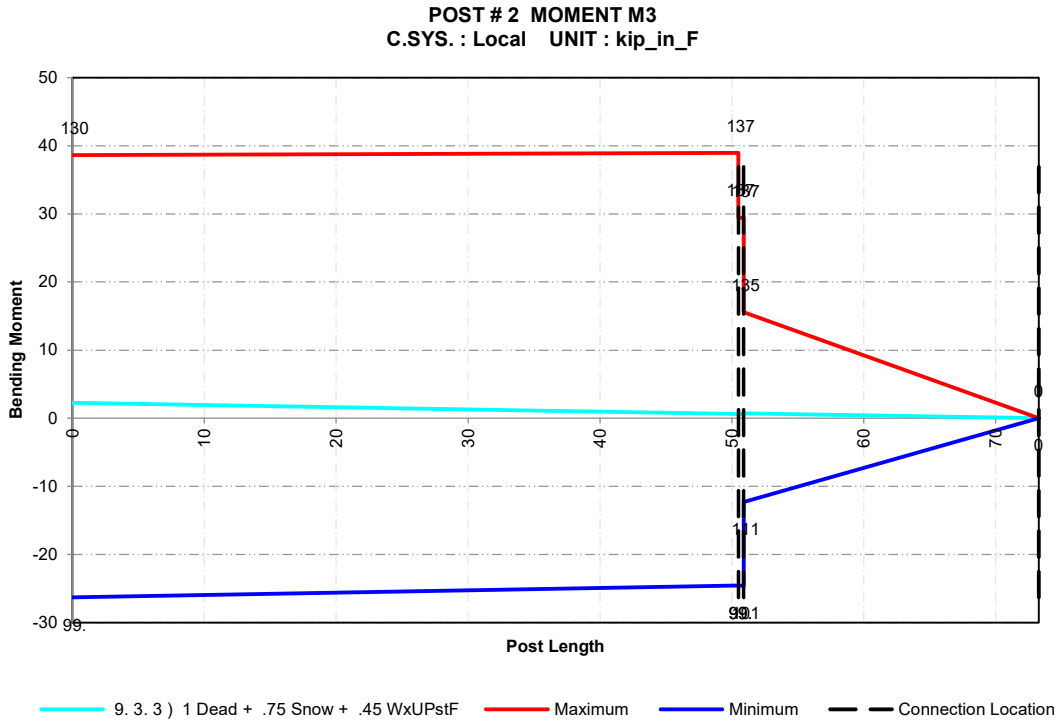


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *3 degree*





PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

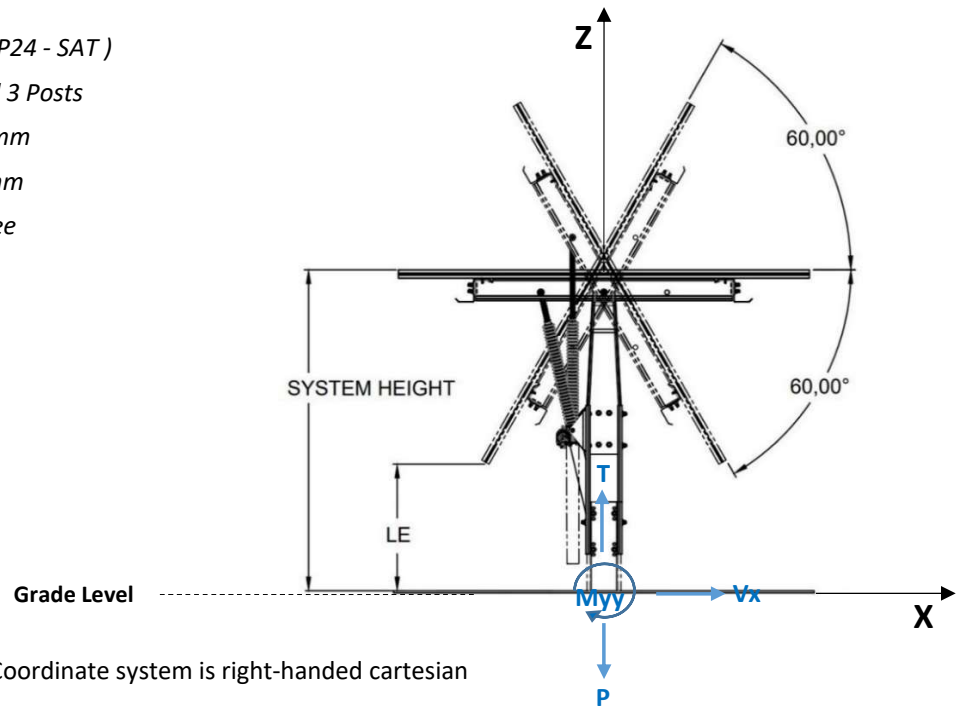
TABLE : *X25 (1P24 - SAT)*

CLASS : *Central 3 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *0 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.77	0.97	1.25	1.64	≈ 0	0.36	0.59
	T	n/a	0.00	n/a	-1.88	≈ 0	n/a	-0.83
	V_x	0.00	0 , 0	0.00	± 0	± 0.09	0.00	0 , 0
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.00	-0.46 , 0.46	0.00	± 3.46	± 0.55	0.00	-1.11 , 1.91
	M_{xx}	0.00	-0.01 , 0.01	0.00	± 0	± 0.57	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.02	1.37	1.62	2.12	≈ 0	0.46	0.76
	T	n/a	0.00	n/a	-2.44	≈ 0	n/a	-1.07
	V_x	0.00	0 , 0	0.00	± 0.01	± 0.1	0.00	0 , 0
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	0.00	-0.58 , 0.58	0.00	± 3.95	± 0.62	0.00	-1.66 , 1.87
	M_{xx}	0.00	-0.01 , 0	0.00	± 0	± 0.73	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X25 (1P24 - SAT)*

LENGTH : *2279 mm*

CLASS : *Central 3 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *0 degree*

CHORD LENGTH : *27758 mm*

POST SPAN : *10230 mm*

CHORD CONTILEVER : *3649 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	2.15	4	20	45
Splice / Z	GR_70	142.7	69	4.2	4	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		2.3	note * : standard baseline section		
Pivot Arm - Mid / Ω	GR_70	see note *		2.7	note * : standard baseline section		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O - ext (int)	GR_50	88.9	n/a	4.5 (4.5)	n/a	n/a	n/a

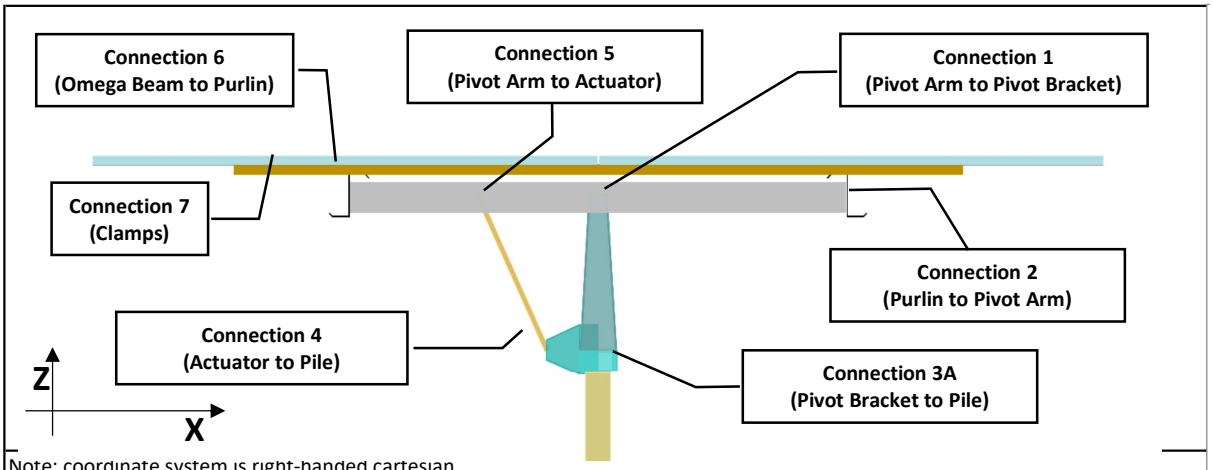
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	P	0.77	0.97	1.25	1.64	≈ 0	0.36	0.59
	T	n/a	0.00	n/a	-1.88	≈ 0	n/a	-0.83
	V_x	0.00	0 , 0	0.00	± 0	± 0.09	0.00	0 , 0
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.00	-0.46 , 0.46	0.00	± 3.46	± 0.55	0.00	-1.11 , 1.91
	M_{xx}	0.00	-0.01 , 0.01	0.00	± 0	± 0.57	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	P	1.02	1.37	1.62	2.12	≈ 0	0.46	0.76
	T	n/a	0.00	n/a	-2.44	≈ 0	n/a	-1.07
	V_x	0.00	0 , 0	0.00	± 0.01	± 0.1	0.00	0 , 0
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	0.00	-0.58 , 0.58	0.00	± 3.95	± 0.62	0.00	-1.66 , 1.87
	M_{xx}	0.00	-0.01 , 0	0.00	± 0	± 0.73	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *0 degree*

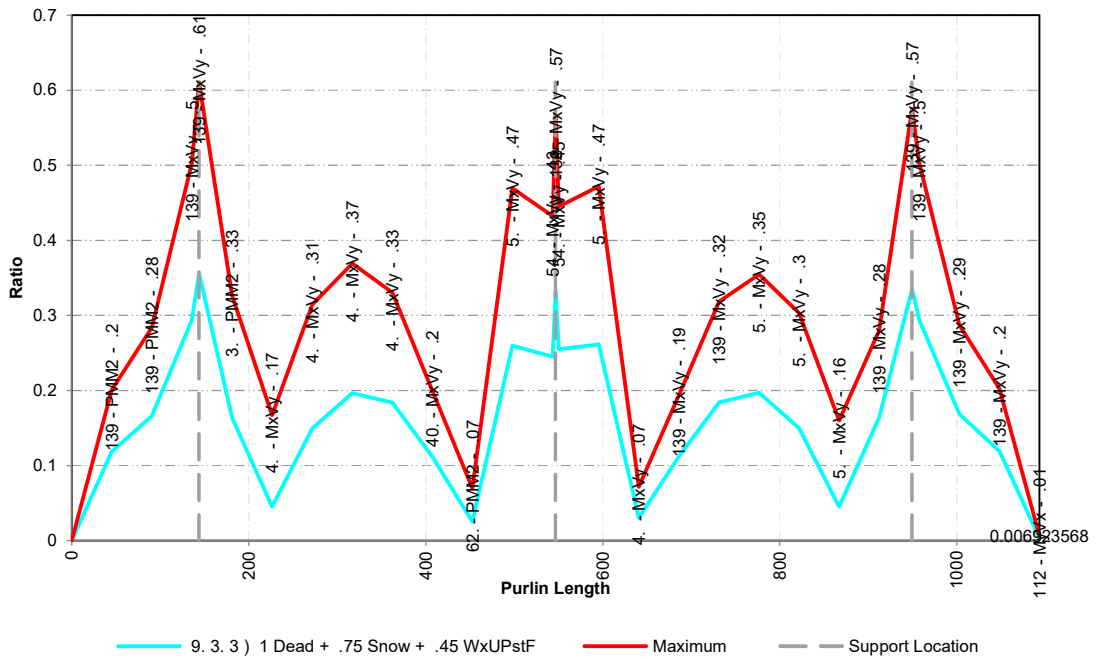


Note: coordinate system is right-handed cartesian

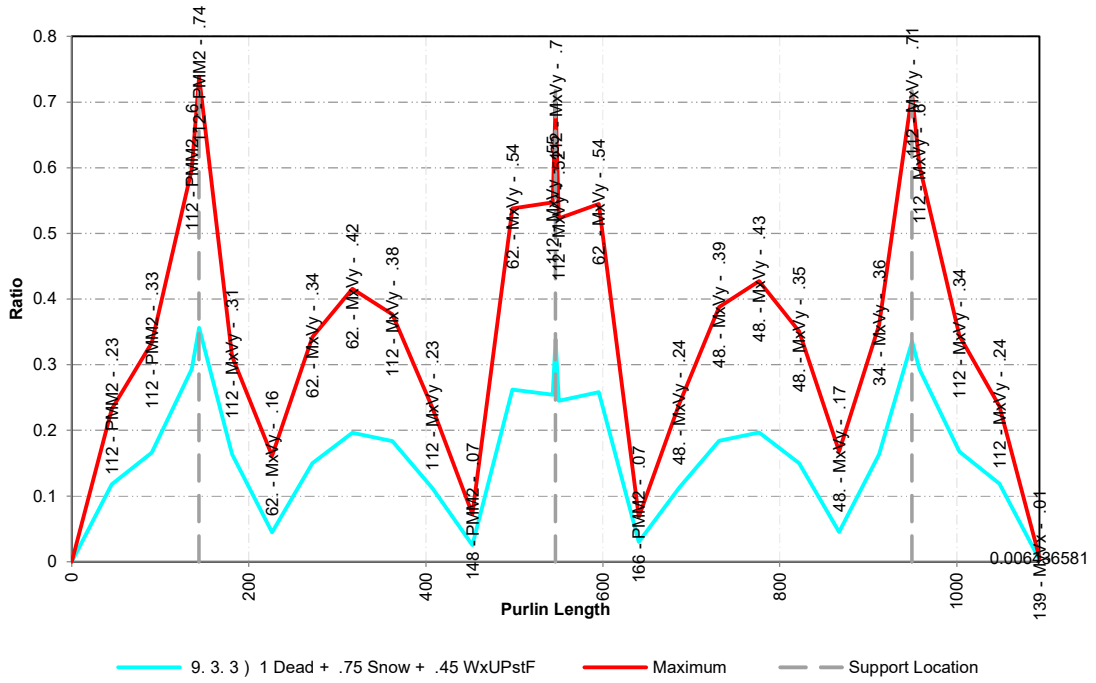
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-4.13	0.49	0.00	0.00	0.00	0.00	112. 4. 21) 1 Dead + .6 WxDNal+T
-0.98	0.00	-0.07	0.00	0.00	0.00	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 2						
2.60	0.65	0.00	0.00	0.05	0.26	112. 4. 21) 1 Dead + .6 WxDNal+T
2.60	-1.58	0.00	0.00	0.05	0.21	112. 4. 21) 1 Dead + .6 WxDNal+T
Connection : 3						
0.85	-0.01	0.00	0.00	0.00	1.80	137. 5. 23) .6 Dead + .6 WxUPal+T
-2.48	0.00	0.00	0.00	0.00	-0.01	139. 7. 1) 1 Dead + .7 Ice_dead + .7 Ice_wDN
-1.02	-0.07	0.00	0.00	0.00	-0.44	157. 12. 1) 1 Dead + -.7 Quake_x
-1.02	0.00	0.00	0.00	0.00	-2.38	107. 4. 16) 1 Dead + .6 WxOTal
-1.02	0.00	-0.08	0.02	-0.51	0.00	158. 12. 2) 1 Dead + -.7 Quake_y
-1.02	0.00	-0.08	0.02	-0.51	0.00	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
1.95	*	0.00	0.00	0.00	0.00	137. 5. 23) .6 Dead + .6 WxUPal+T
Connection : 5		** Note : the load is axial in actuator direction*				
1.95	*	0.00	0.00	0.00	0.00	137. 5. 23) .6 Dead + .6 WxUPal+T
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.13						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.13						0.6 WLup

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *0 degree*

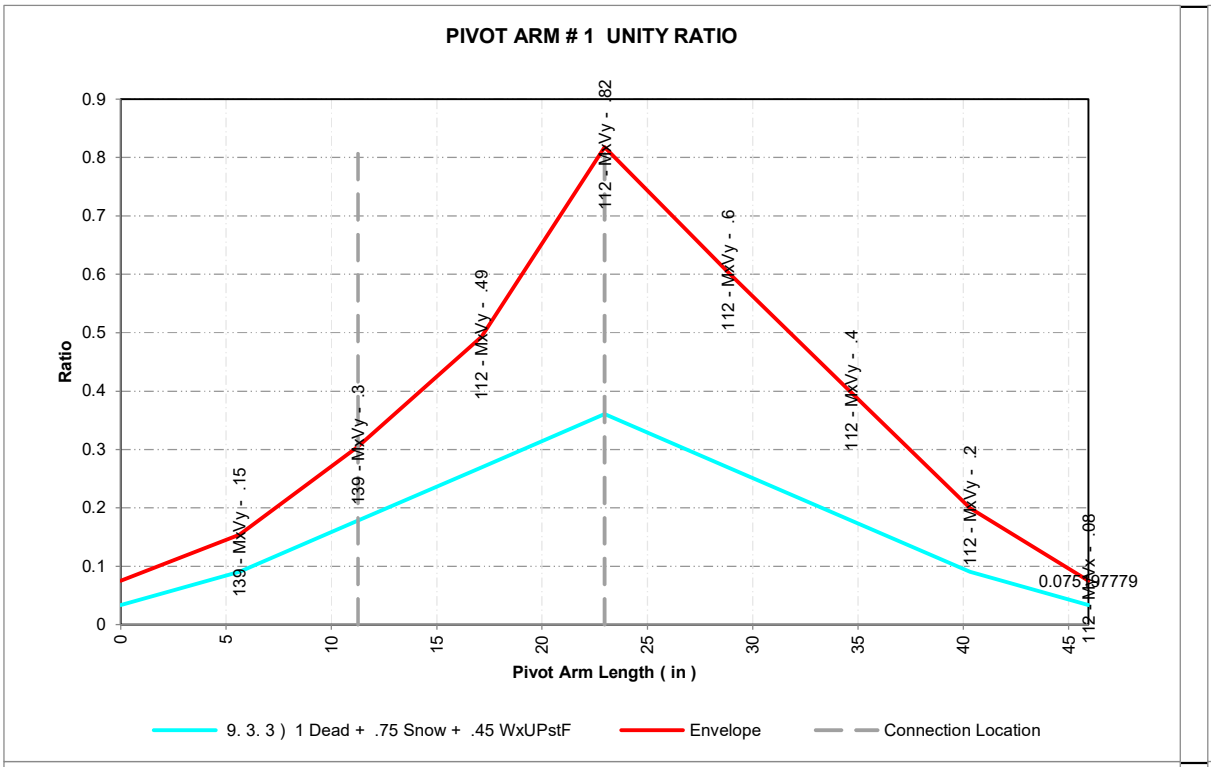
PURLIN # 1 UNITY RATIO

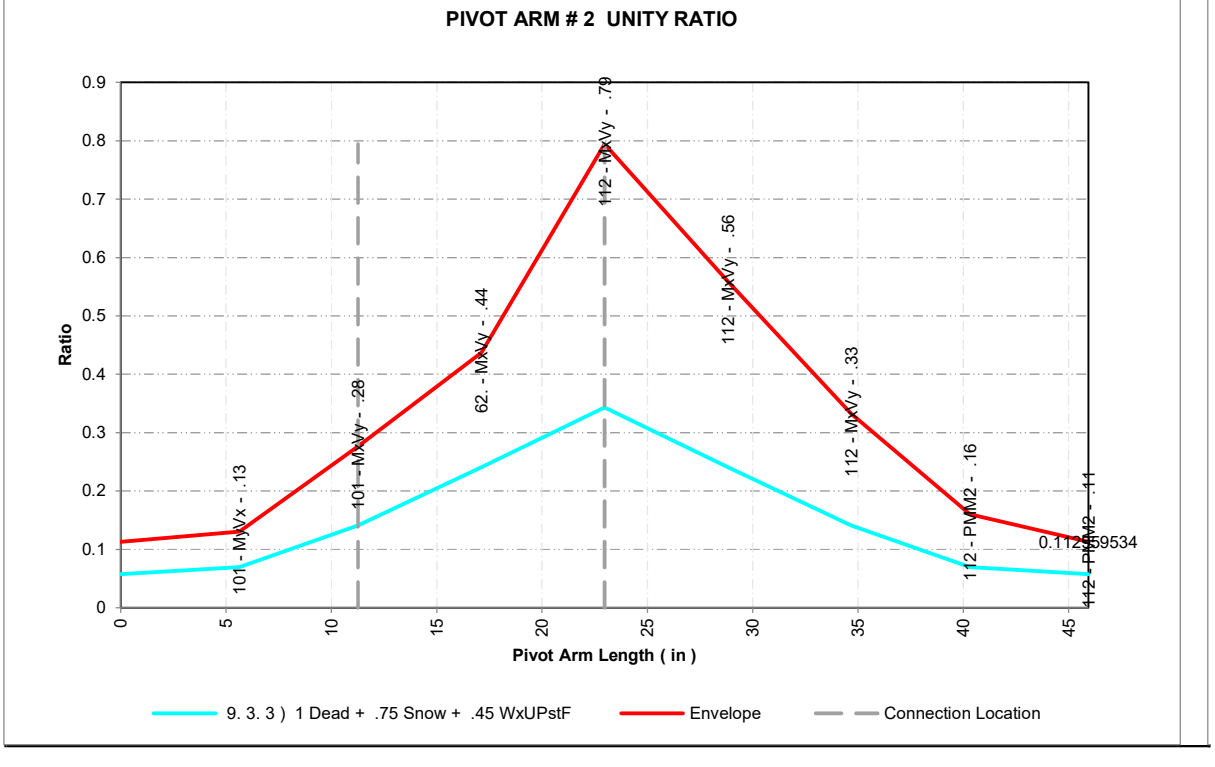


PURLIN # 2 UNITY RATIO

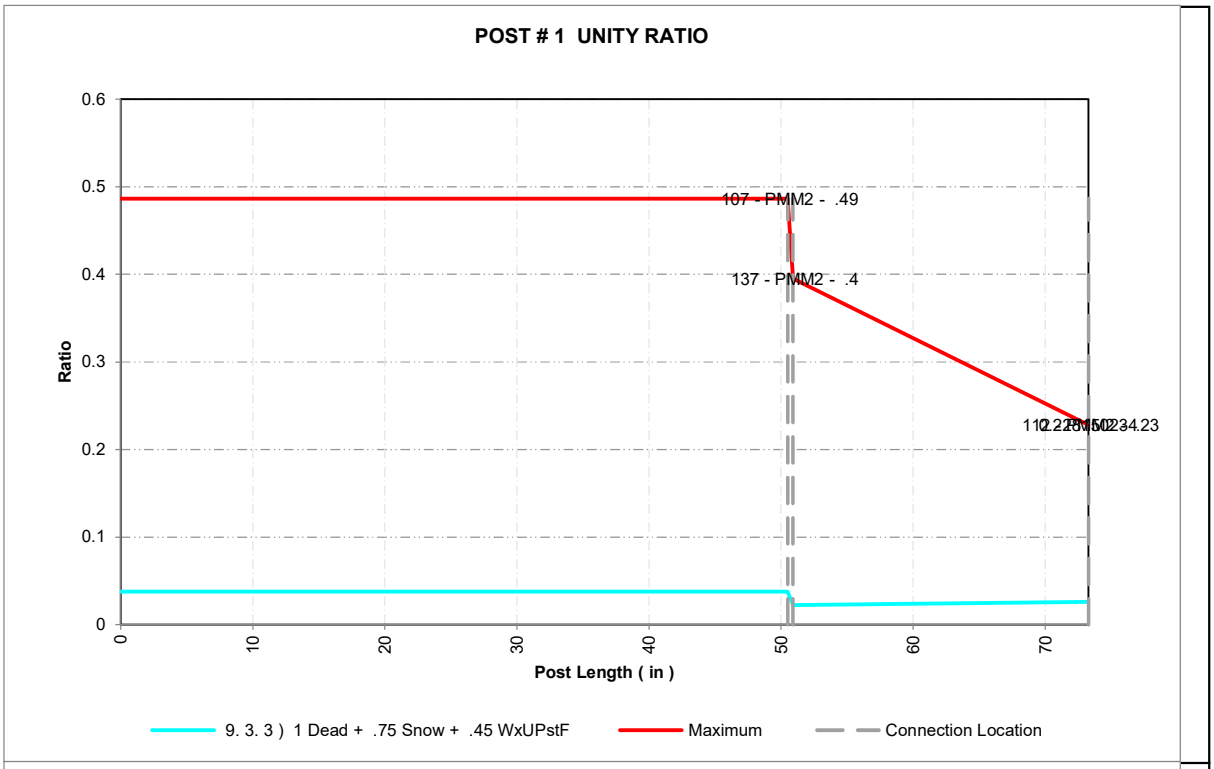


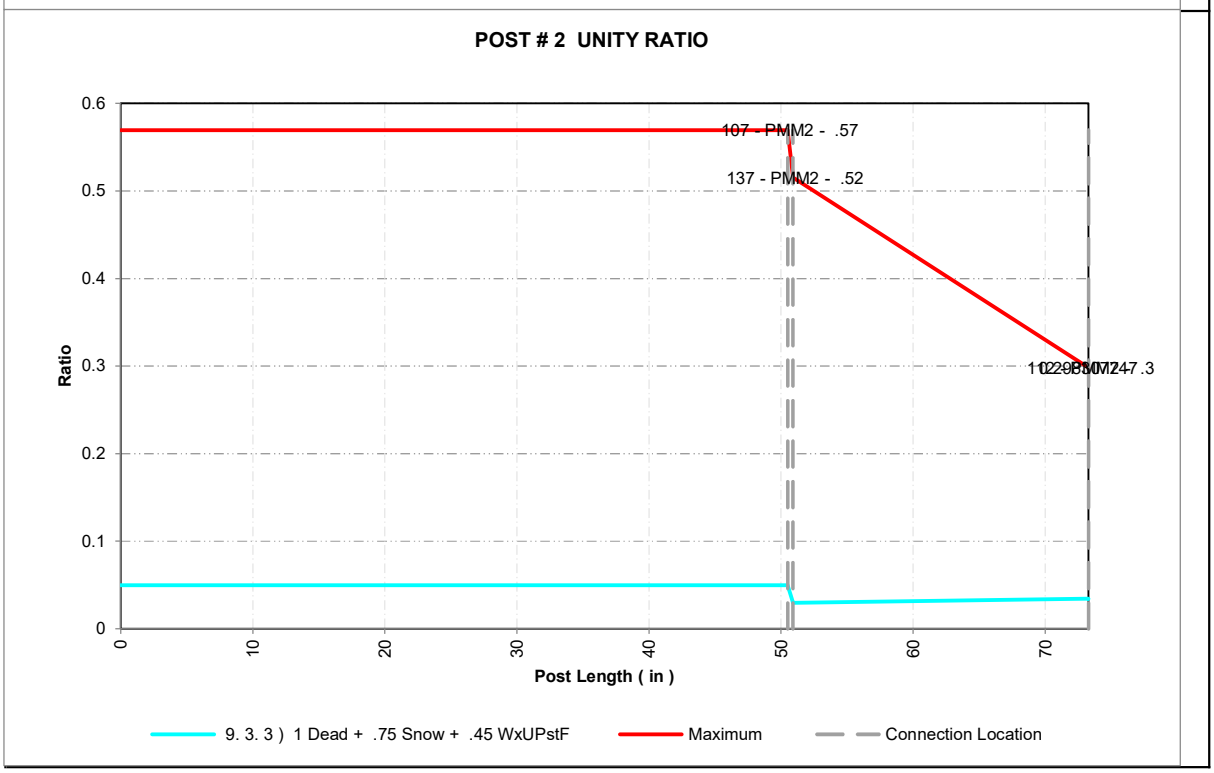
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *0 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *0 degree*





PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

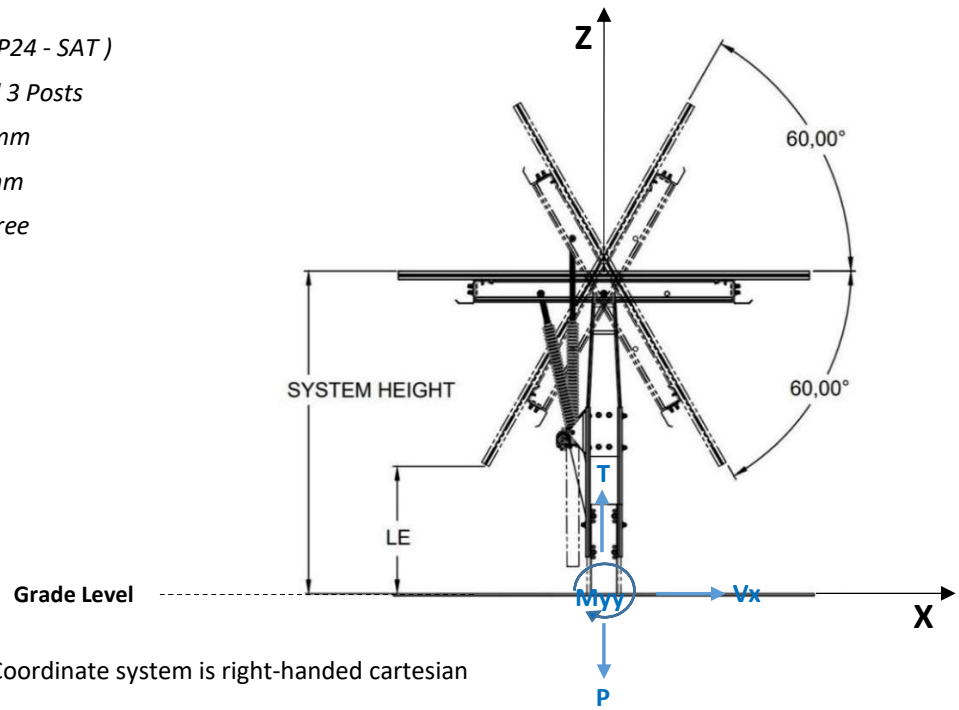
TABLE : *X25 (1P24 - SAT)*

CLASS : *Central 3 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *30 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.78	0.62	0.00	0.09	≈ 0	0.00	0.09
	T	n/a	0.00	n/a	-0.14	≈ 0	n/a	-0.14
	V_x	-0.01	-0.02 , 0	0.00	± 0.08	± 0.09	0.00	-0.08 , 0.05
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	-0.05	-0.29 , 0.21	0.00	± 0.88	± 0.54	0.00	-0.88 , 0.53
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.57	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.01	0.83	0.00	0.12	≈ 0	0.00	0.12
	T	n/a	0.00	n/a	-0.18	≈ 0	n/a	-0.18
	V_x	0.02	0 , 0.05	0.00	± 0.1	± 0.11	0.00	-0.1 , 0.07
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	0.19	-0.2 , 0.43	0.00	± 1.01	± 0.63	0.00	-1.01 , 0.67
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.74	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

Reaction Loads & Member Sizing Summary

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X25 (1P24 - SAT)*

LENGTH : *2279 mm*

CLASS : *Central 3 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *30 degree*

CHORD LENGTH : *27758 mm*

POST SPAN : *10230 mm*

CHORD CONTILEVER : *3649 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	2.15	4	20	45
Splice / Z	GR_70	142.7	69	4.2	4	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		2.3	note * : standard baseline section		
Pivot Arm - Mid / Ω	GR_70	see note *		2.7	note * : standard baseline section		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O - ext (int)	GR_50	88.9	n/a	4.5 (4.5)	n/a	n/a	n/a

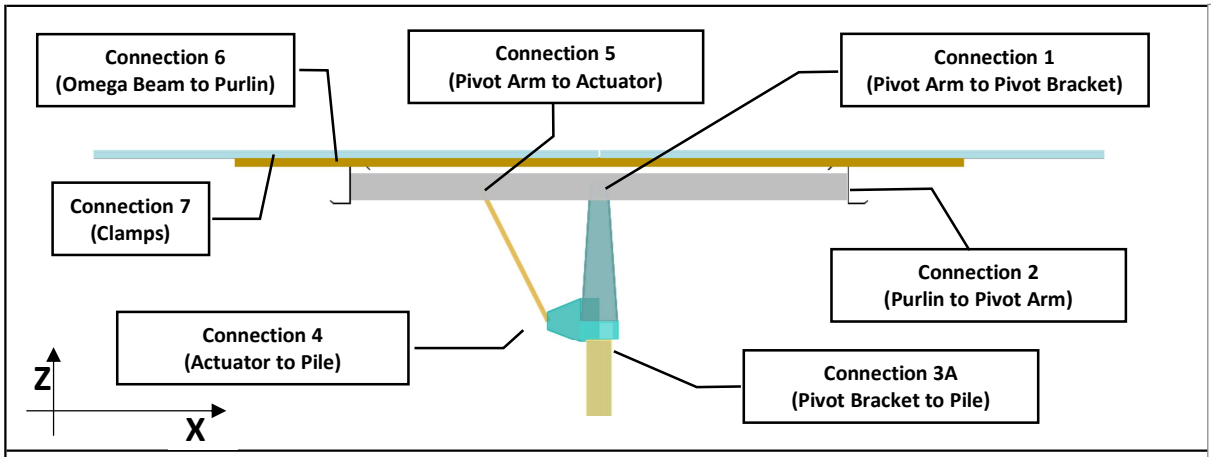
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.78	0.62	0.00	0.09	≈ 0	0.00	0.09
	T	n/a	0.00	n/a	-0.14	≈ 0	n/a	-0.14
	V_x	-0.01	-0.02 , 0	0.00	± 0.08	± 0.09	0.00	-0.08 , 0.05
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	-0.05	-0.29 , 0.21	0.00	± 0.88	± 0.54	0.00	-0.88 , 0.53
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.57	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.01	0.83	0.00	0.12	≈ 0	0.00	0.12
	T	n/a	0.00	n/a	-0.18	≈ 0	n/a	-0.18
	V_x	0.02	0 , 0.05	0.00	± 0.1	± 0.11	0.00	-0.1 , 0.07
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	0.19	-0.2 , 0.43	0.00	± 1.01	± 0.63	0.00	-1.01 , 0.67
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.74	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

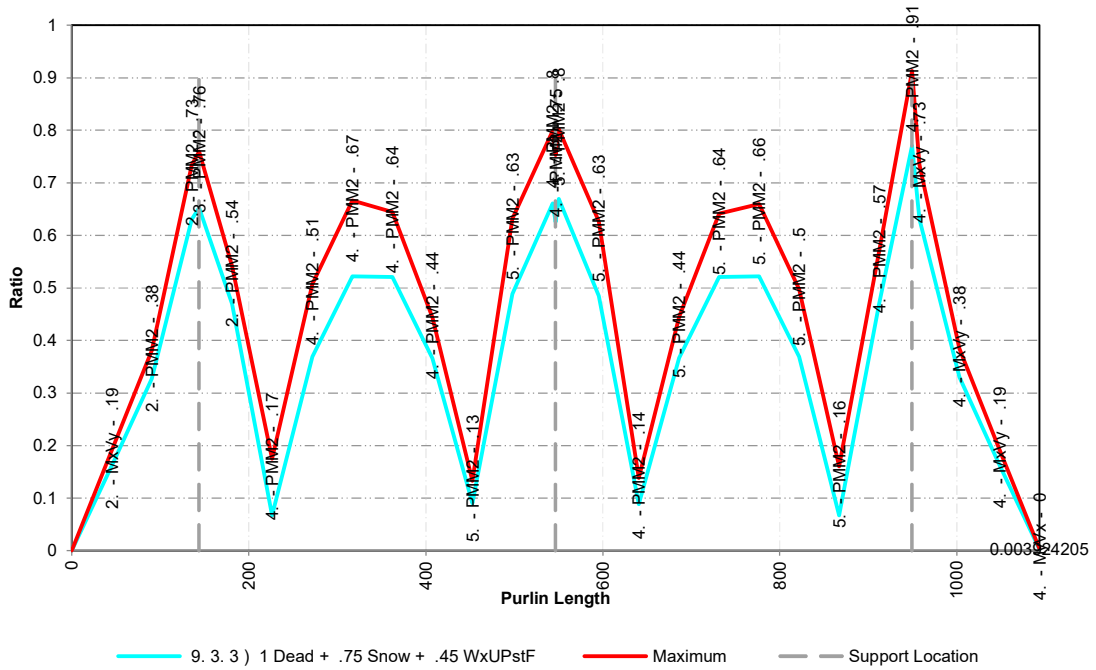


Note: coordinate system is right-handed cartesian

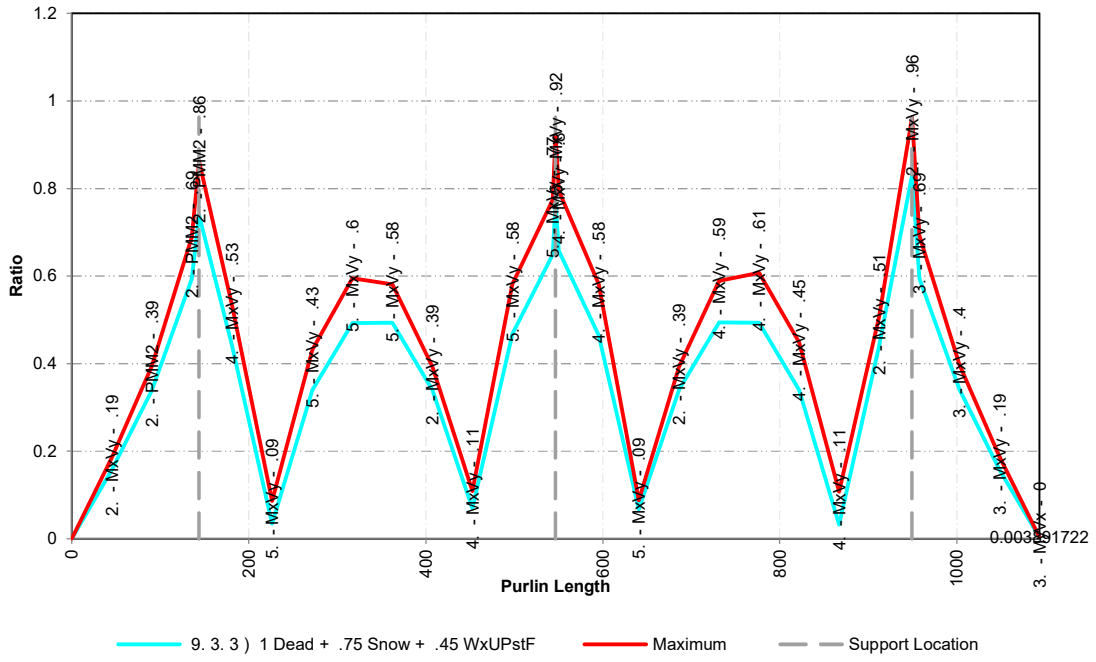
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-1.91	0.01	0.00	0.00	0.00	0.00	6. 2. 5) 1 Dead + 1 S4_s2s_+
-0.92	-0.03	0.08	0.00	0.00	0.00	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 2						
1.88	-0.79	0.00	0.00	0.02	0.17	5. 2. 4) 1 Dead + 1 S3_lhhl
1.88	-0.79	0.00	0.00	0.02	0.17	5. 2. 4) 1 Dead + 1 S3_lhhl
Connection : 3						
-0.50	0.05	0.00	0.00	0.00	0.41	136. 5. 22) .6 Dead + .6 WxUPst+T
-1.84	-0.07	0.00	0.00	0.00	-0.51	5. 2. 4) 1 Dead + 1 S3_lhhl
-1.63	-0.12	0.00	0.00	0.00	-0.76	165. 13. 7) 1 Dead + .75 S3_lhhl + -.525 Quake_x
-1.45	-0.09	0.00	0.00	0.00	-0.84	169. 13. 11) 1 Dead + .75 S4_s2s_- + -.525 Quake_x
-1.01	-0.02	-0.08	0.01	-0.52	-0.19	158. 12. 2) 1 Dead + -.7 Quake_y
-1.01	-0.02	-0.08	0.01	-0.52	-0.19	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
-0.52	*	0.00	0.00	0.00	0.00	82. 3. 124) 1 Dead + .75 S4_s2s_- + .45 WxDNstH-
Connection : 5		** Note : the load is axial in actuator direction*				
-0.52	*	0.00	0.00	0.00	0.00	82. 3. 124) 1 Dead + .75 S4_s2s_- + .45 WxDNstH-
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.01						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.01						0.6 WLup

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

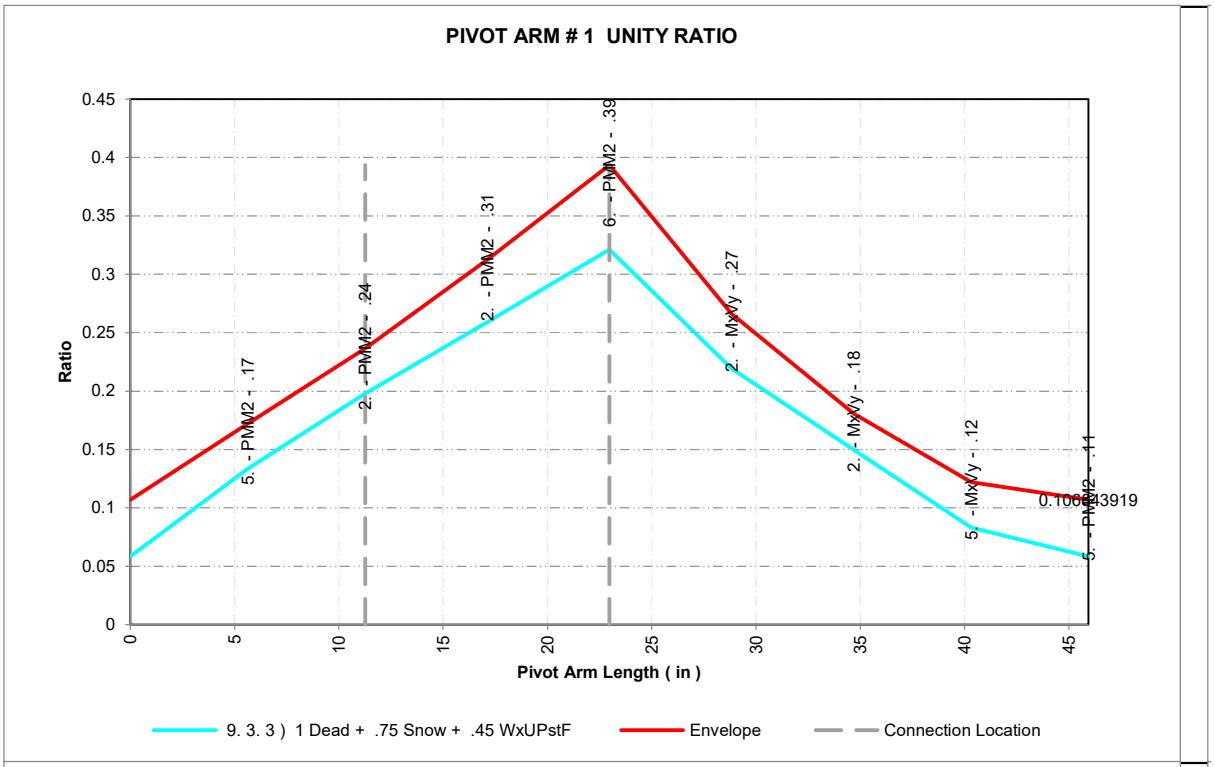
PURLIN # 1 UNITY RATIO

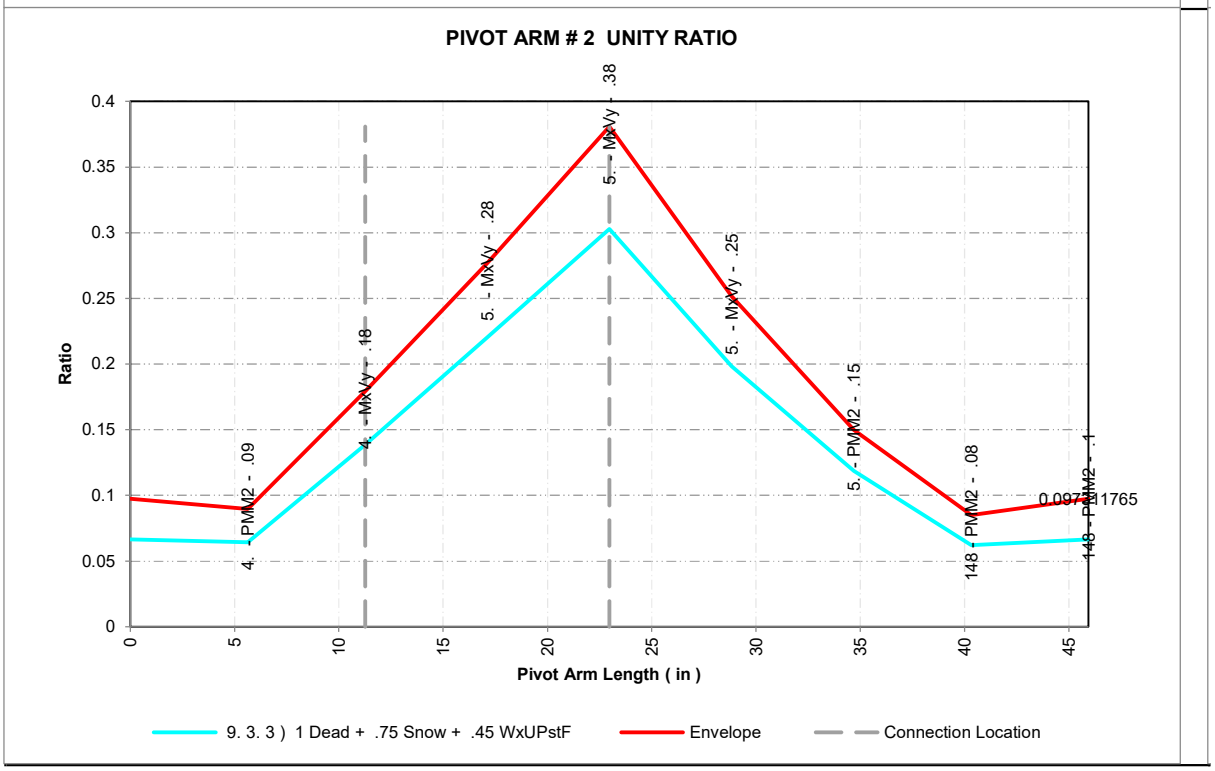


PURLIN # 2 UNITY RATIO



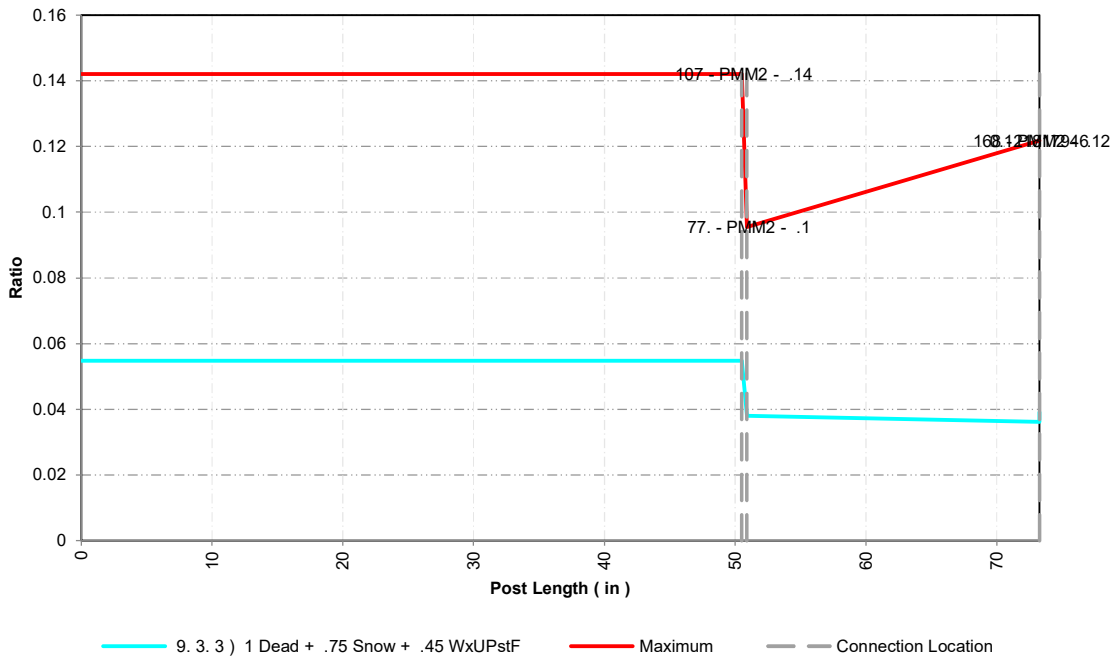
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*



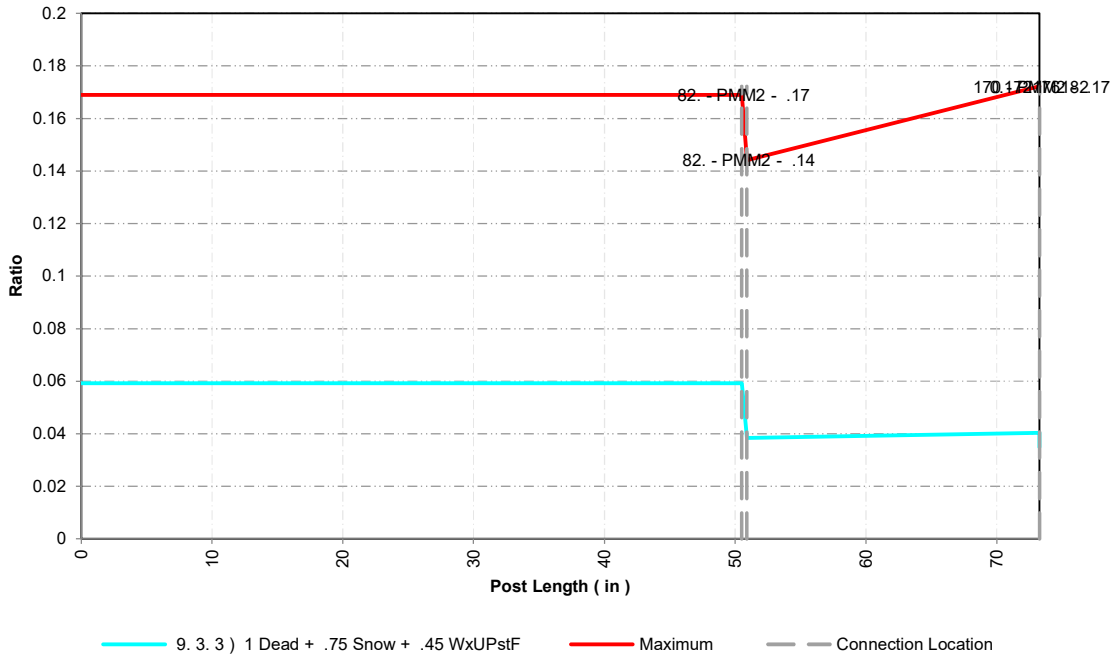


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

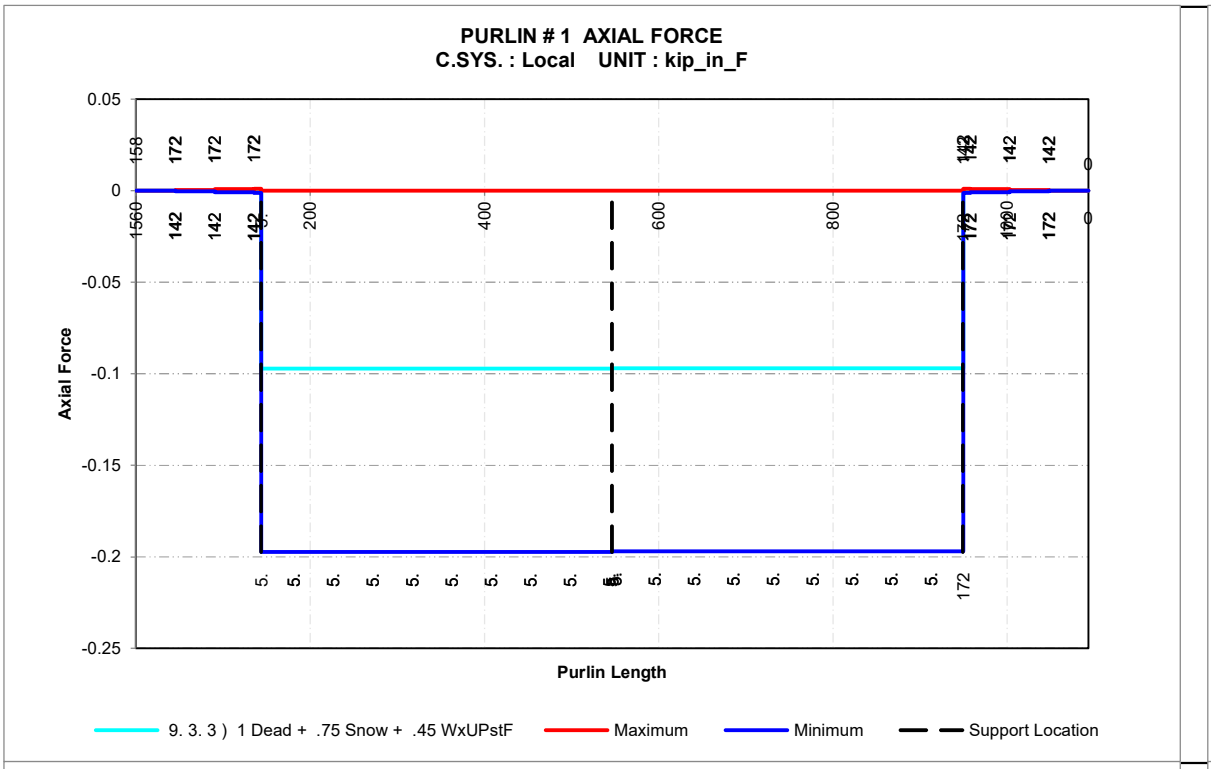
POST # 1 UNITY RATIO

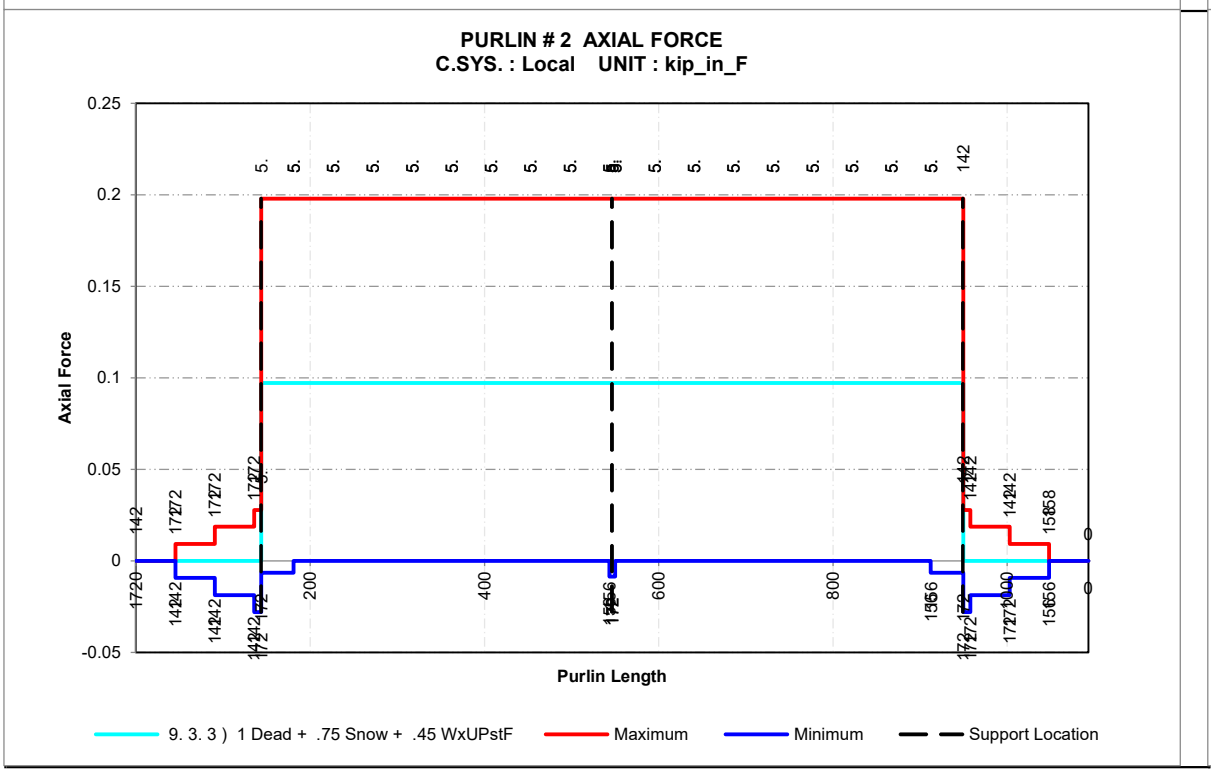


POST # 2 UNITY RATIO



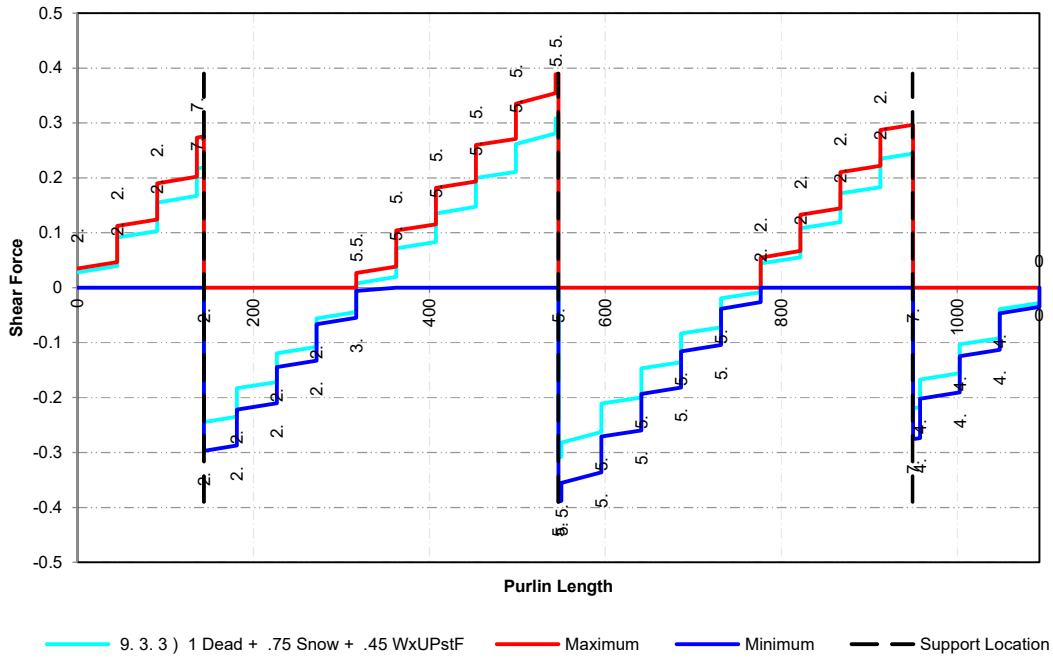
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*





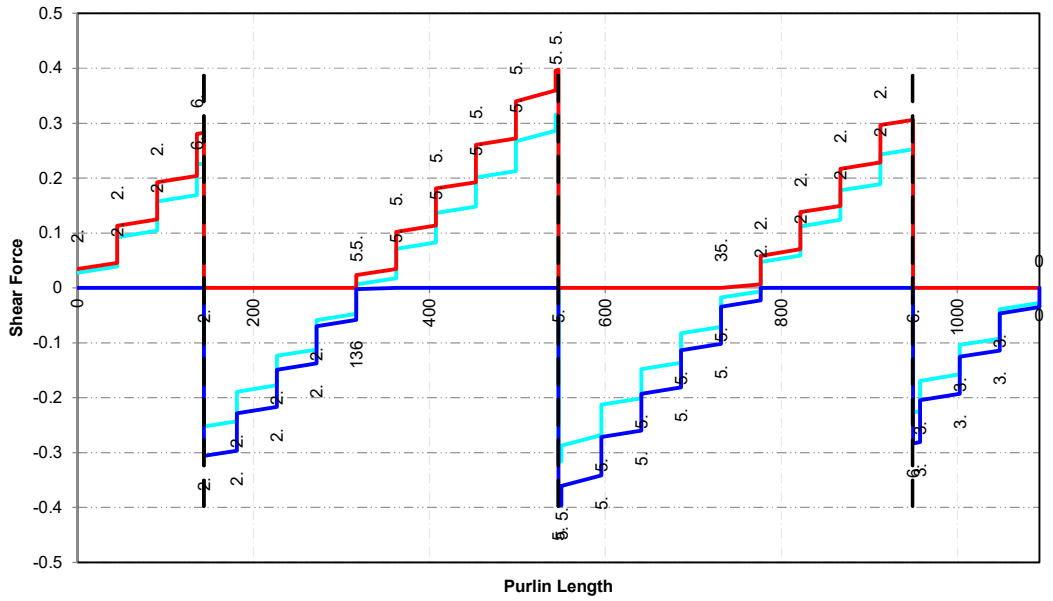
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

PURLIN # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



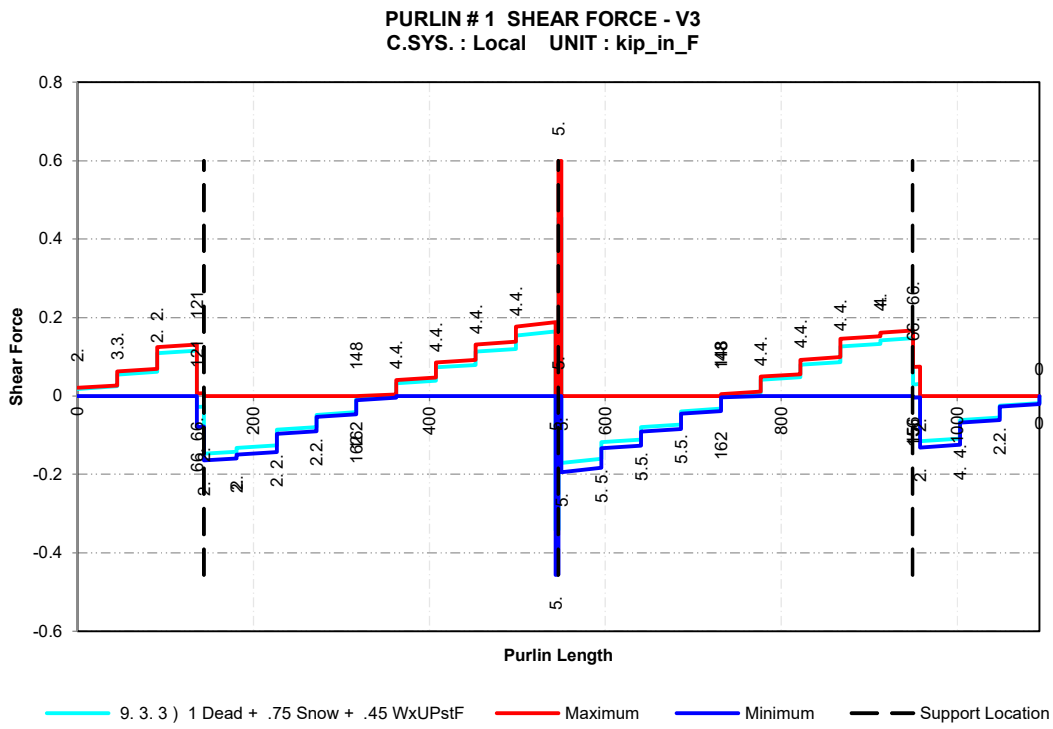
9. 3. 3) 1 Dead + .75 Snow + .45 WxUPstF — Maximum — Minimum — Support Location

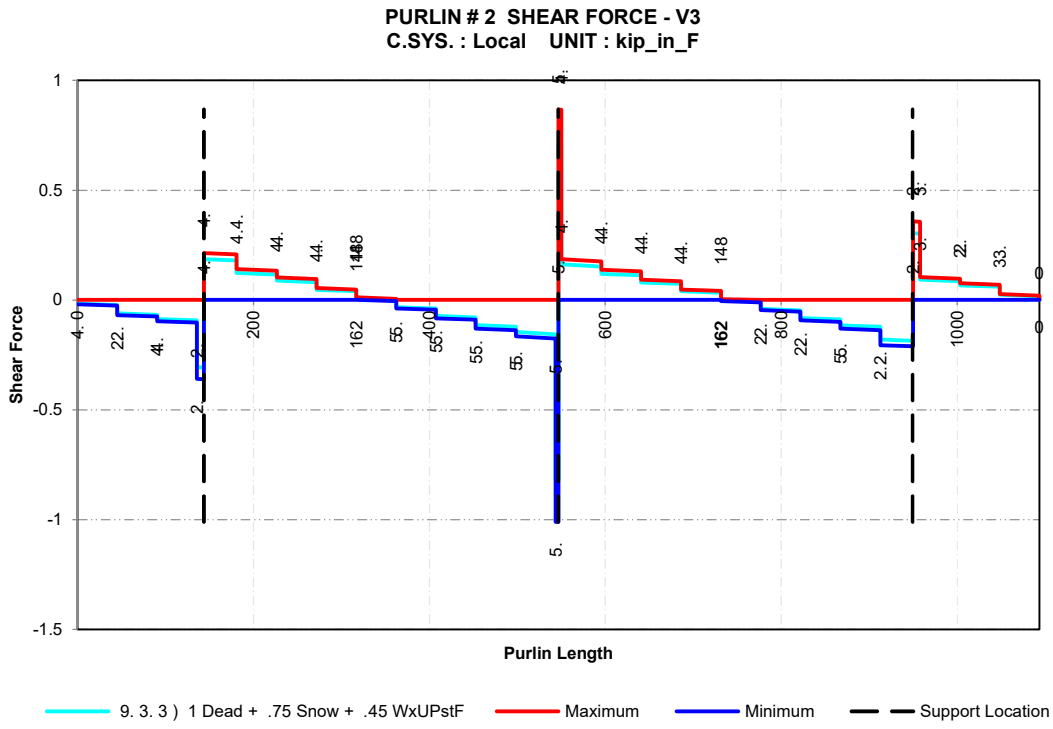
PURLIN # 2 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



9. 3. 3) 1 Dead + .75 Snow + .45 WxUPstF — Maximum — Minimum — Support Location

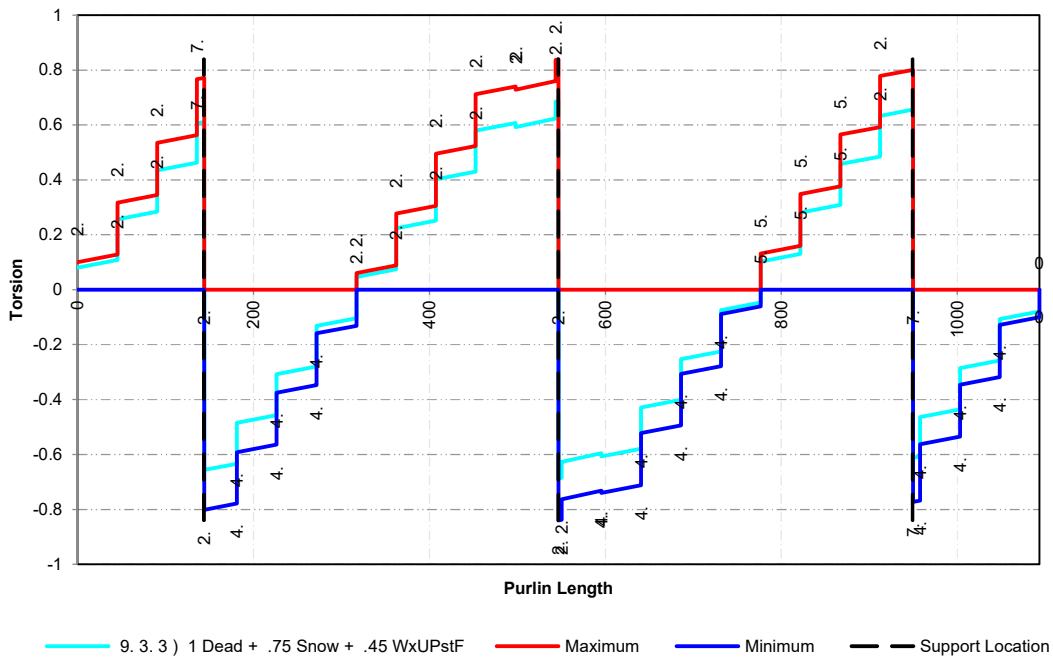
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

PURLIN # 1 TORSION
C.SYS. : Local UNIT : kip_in_F



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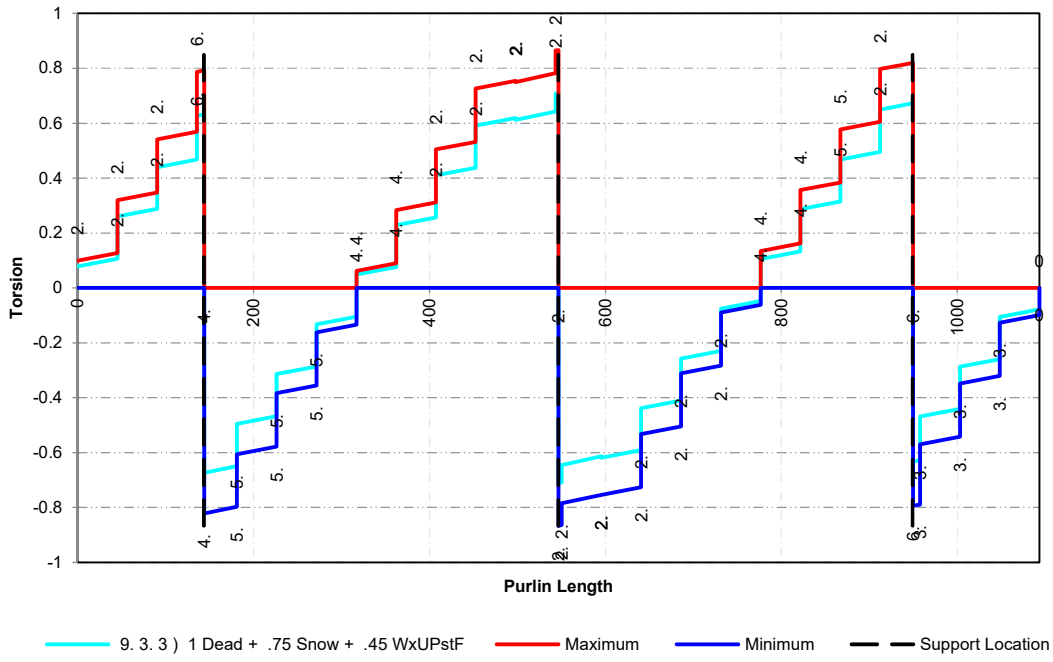
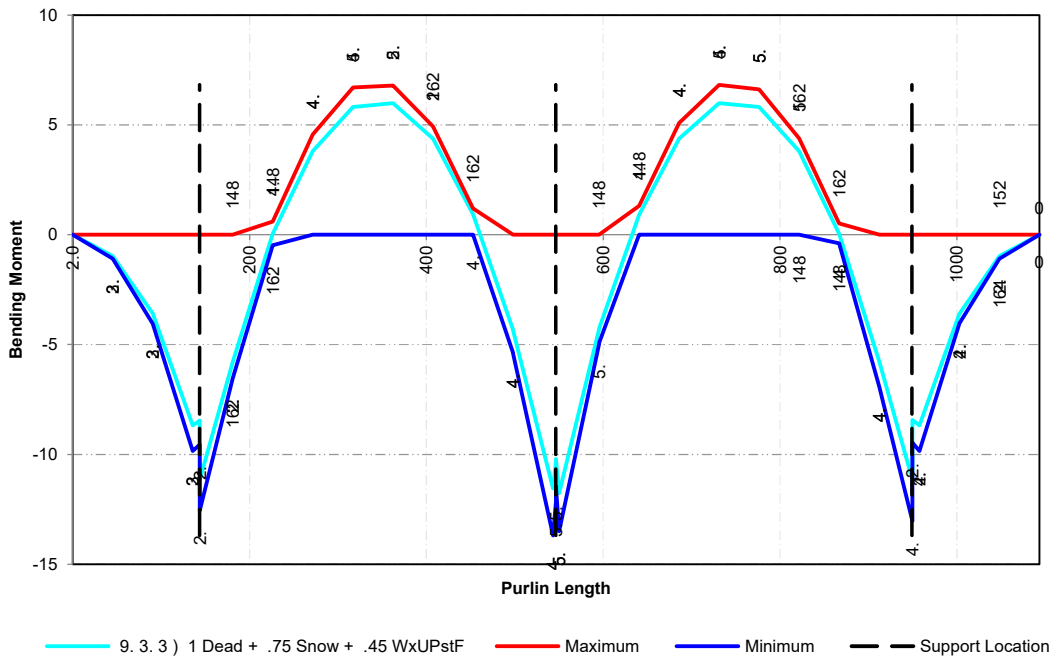


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

PURLIN # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F



PURLIN # 2 MOMENT M2
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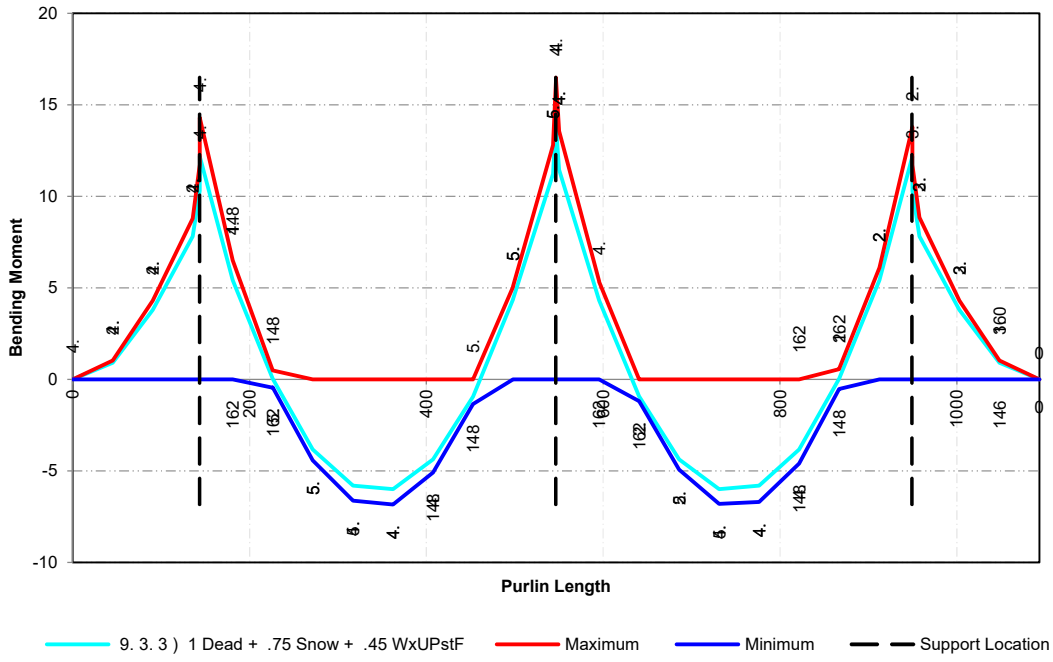
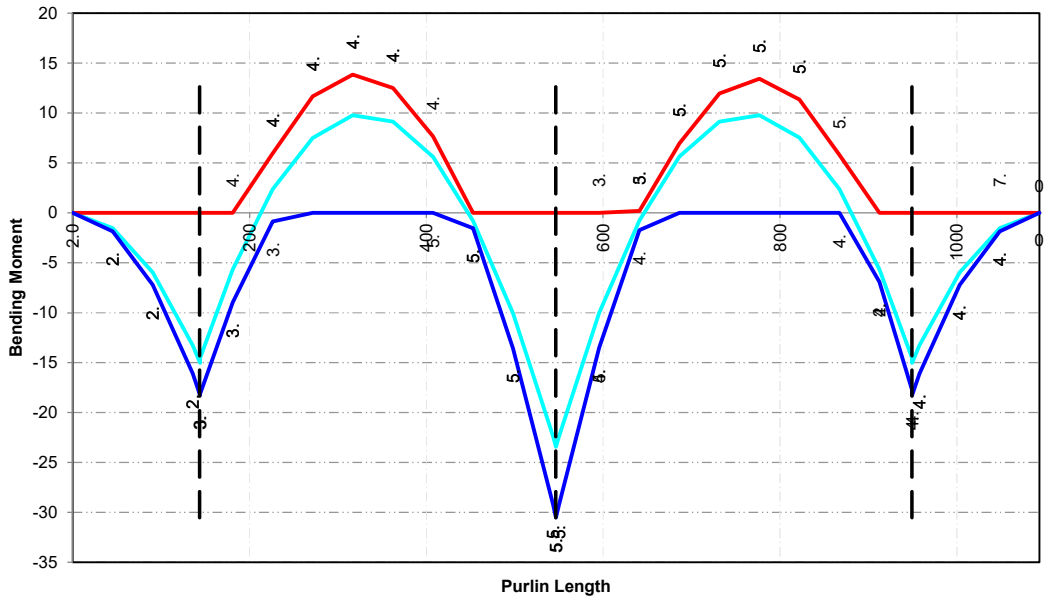
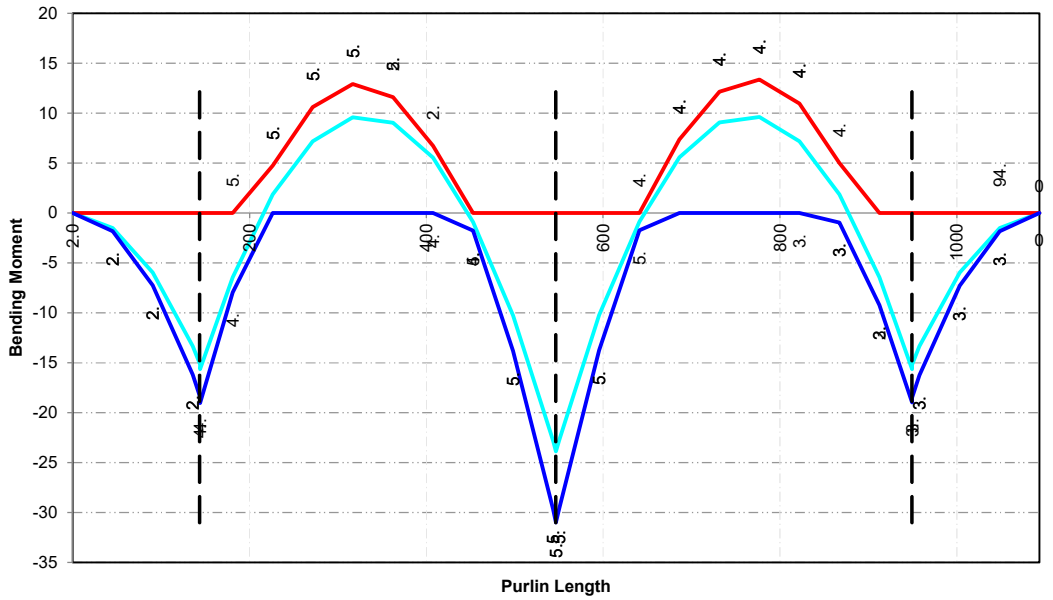


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

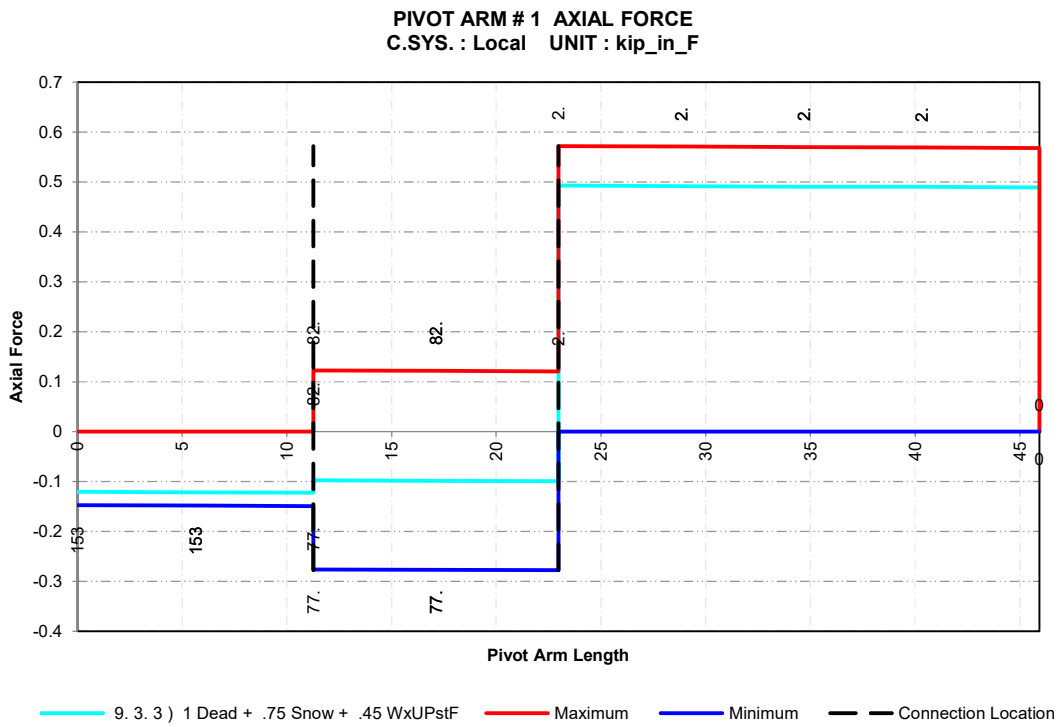
PURLIN # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

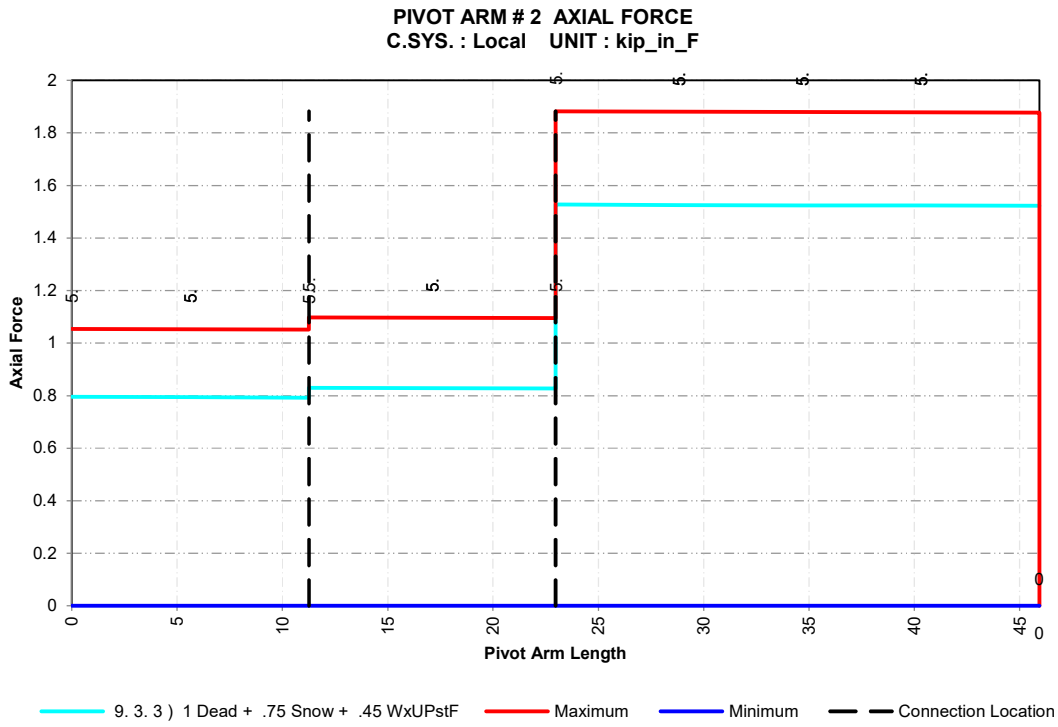


PURLIN # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

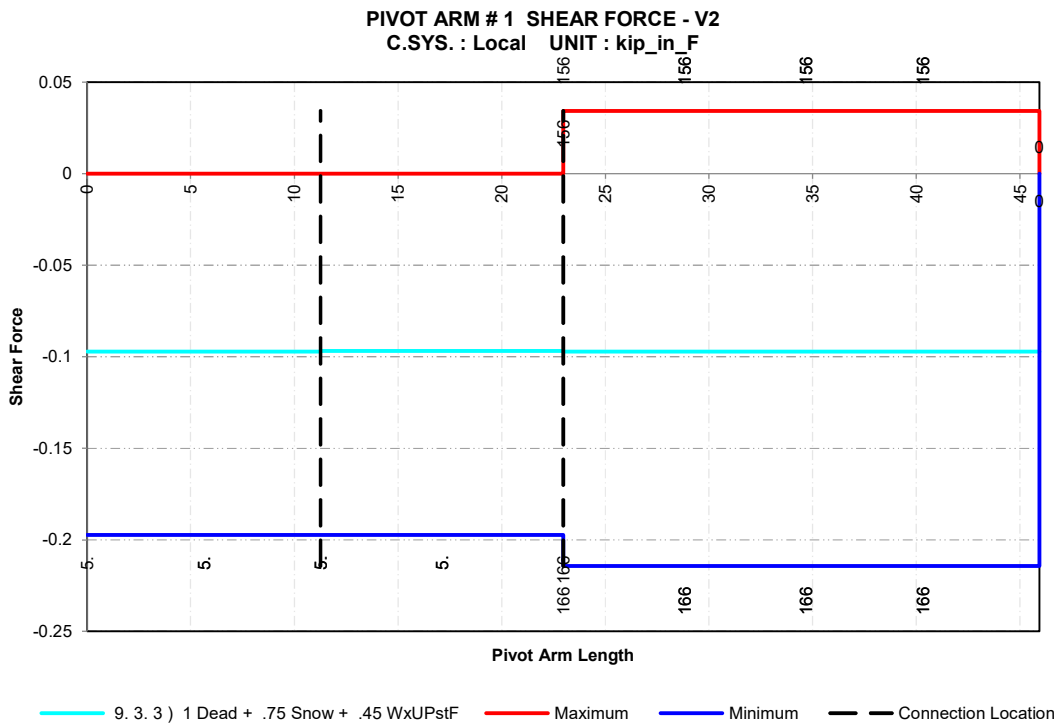


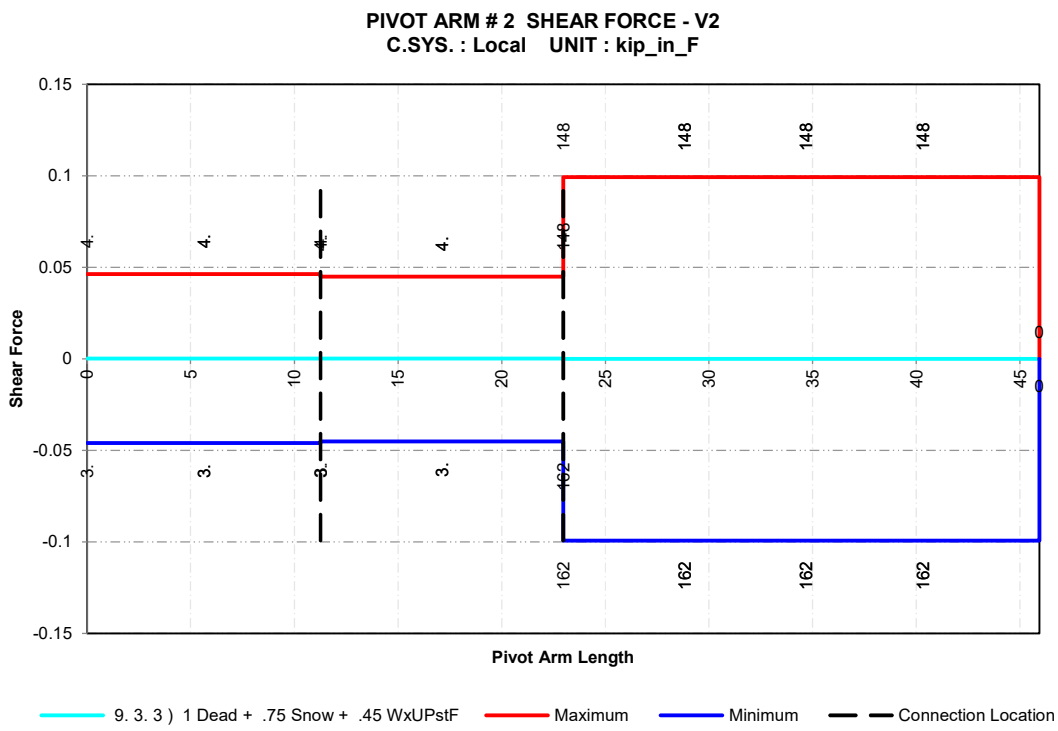
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*



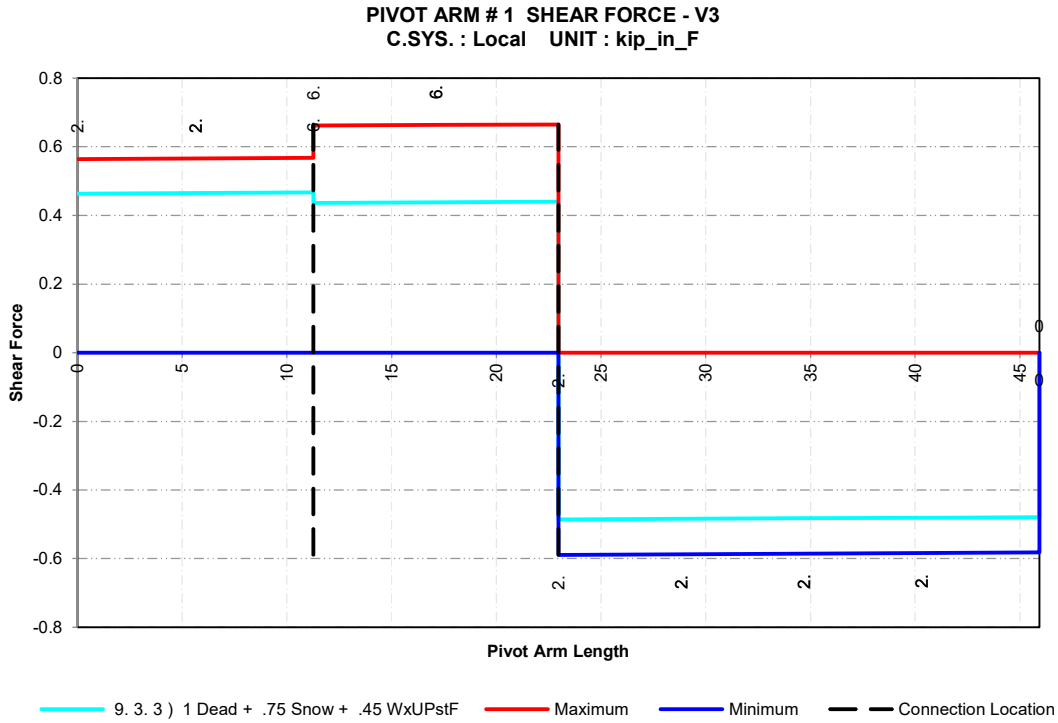


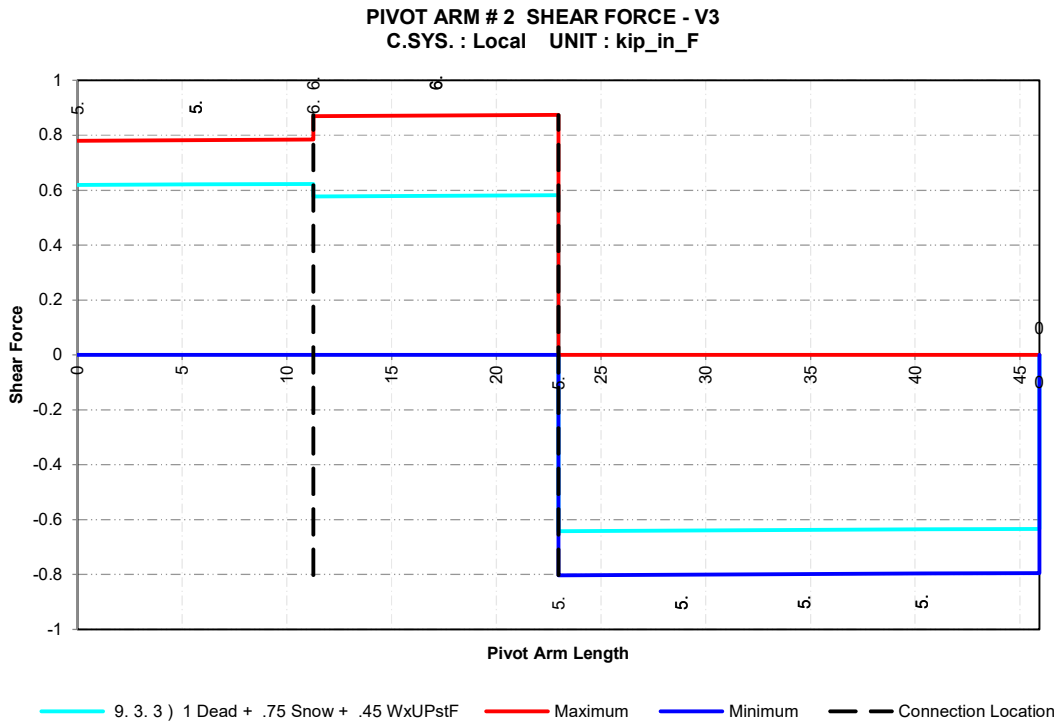
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*



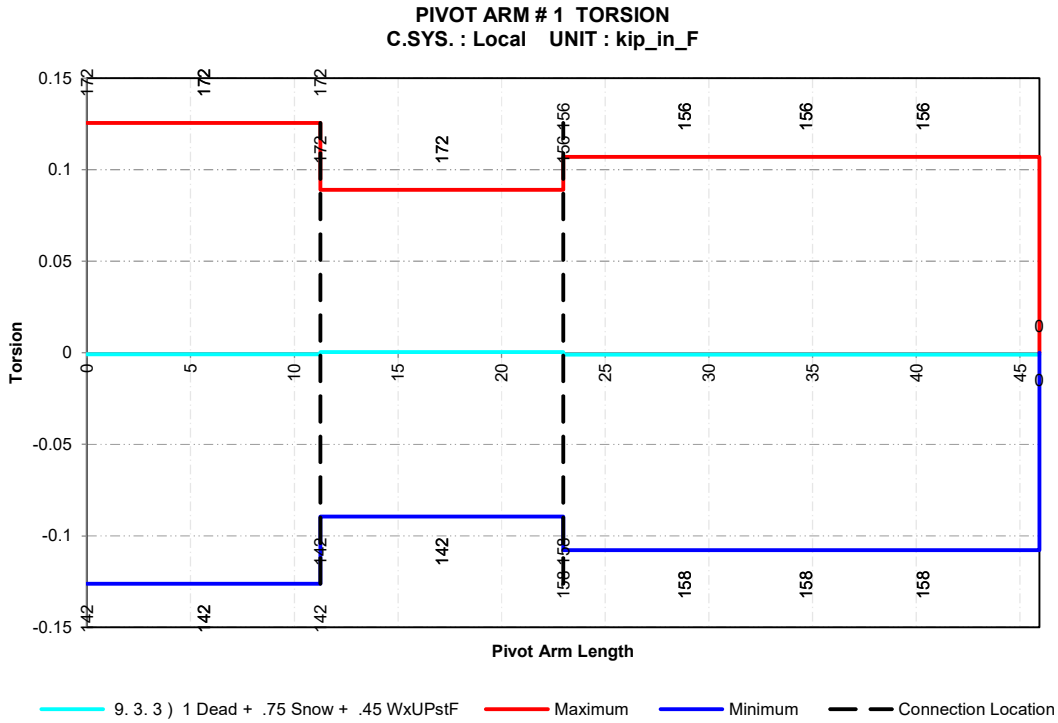


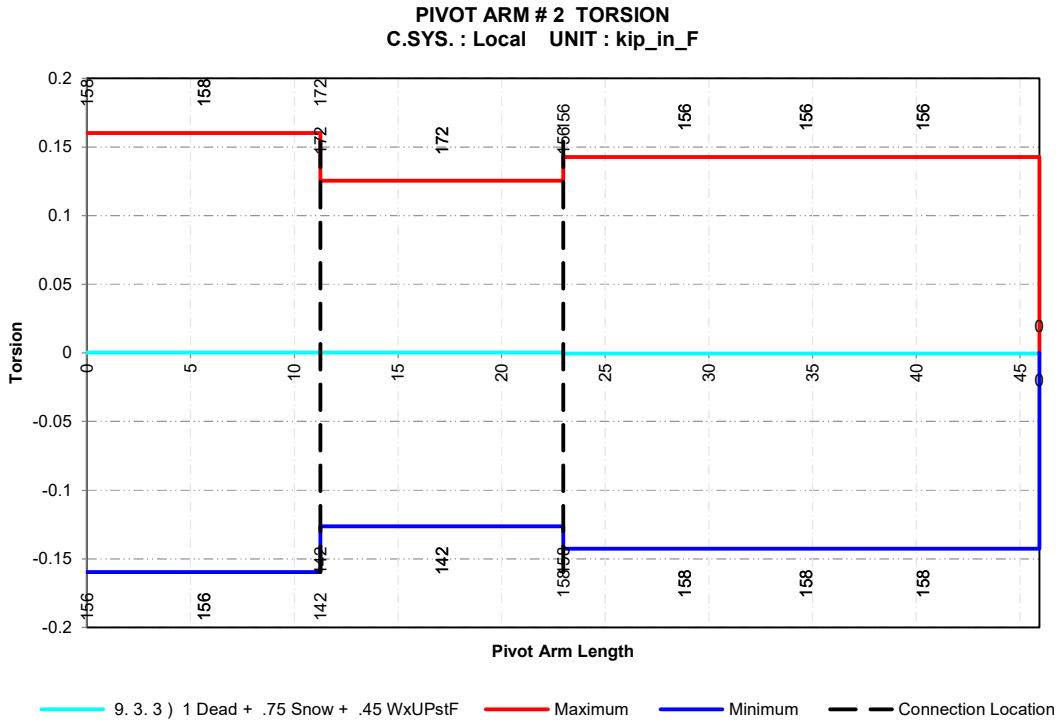
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*



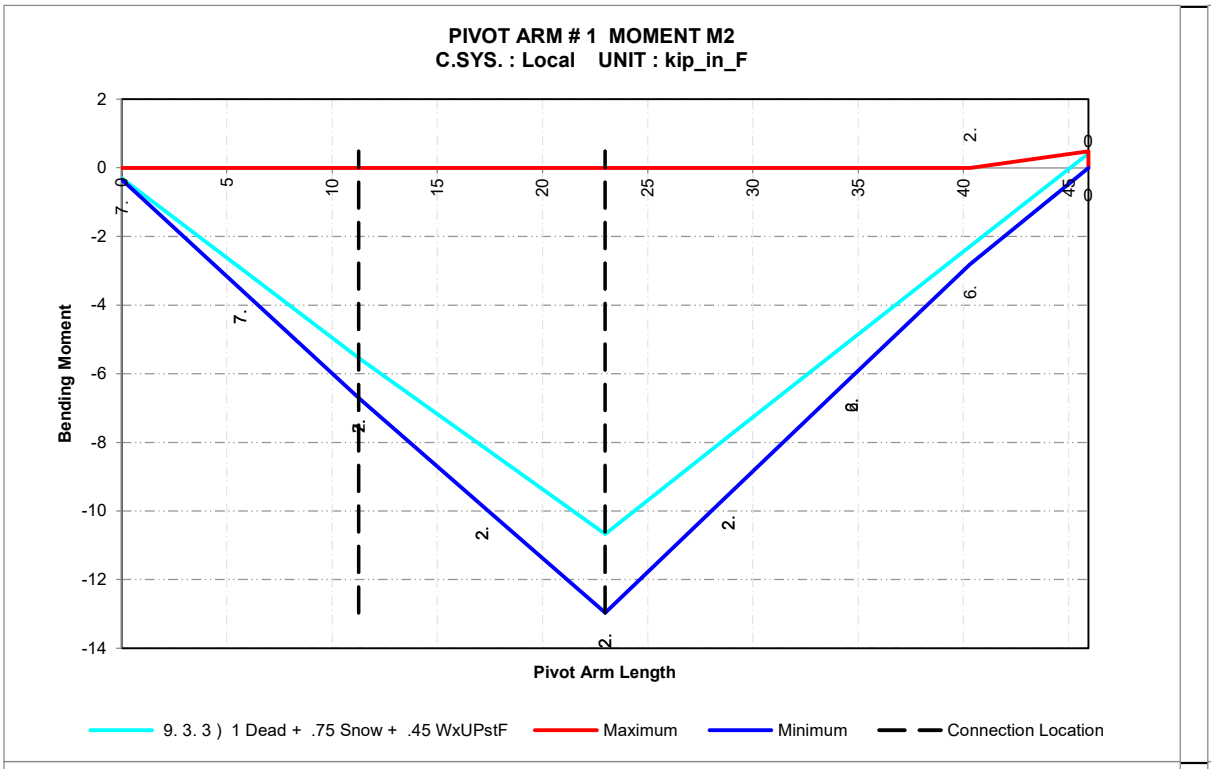


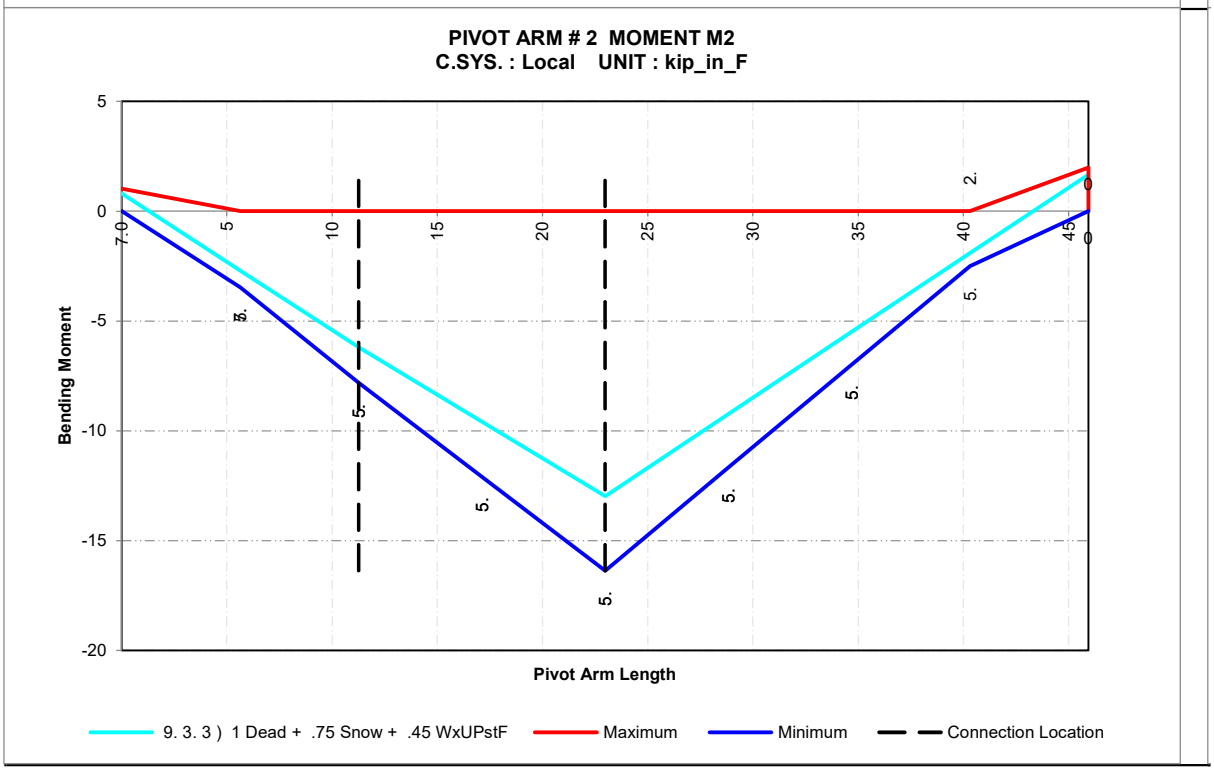
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*





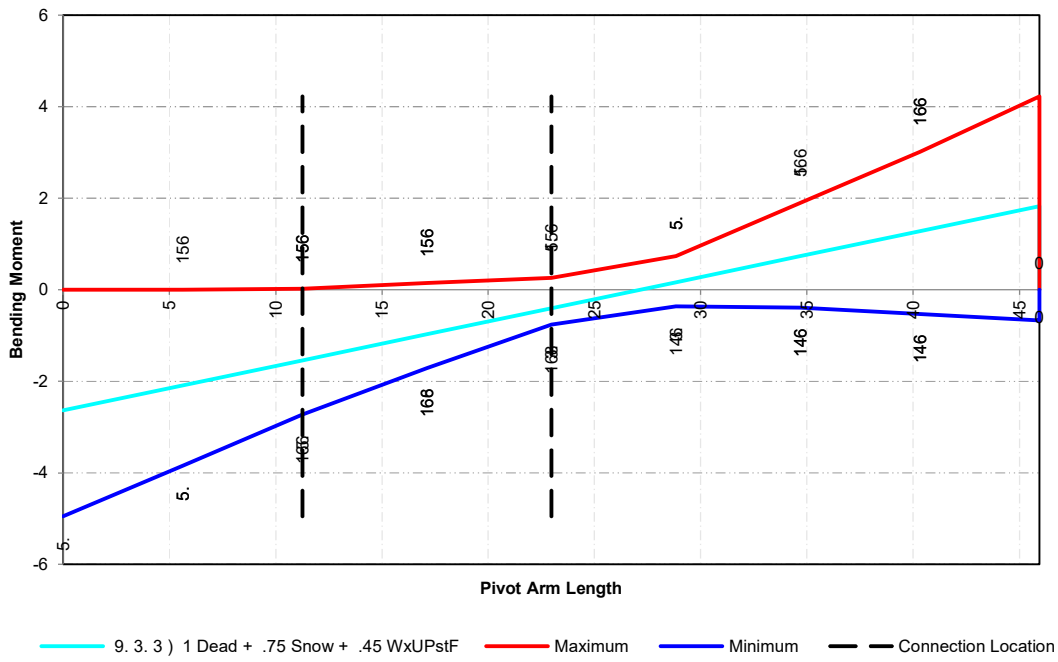
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*



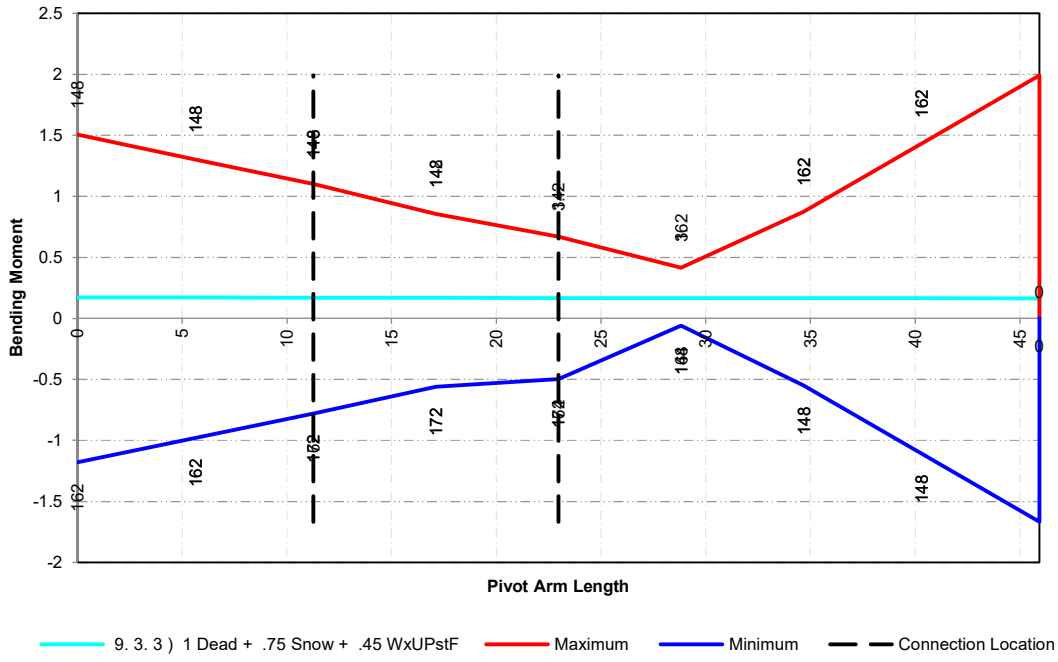


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

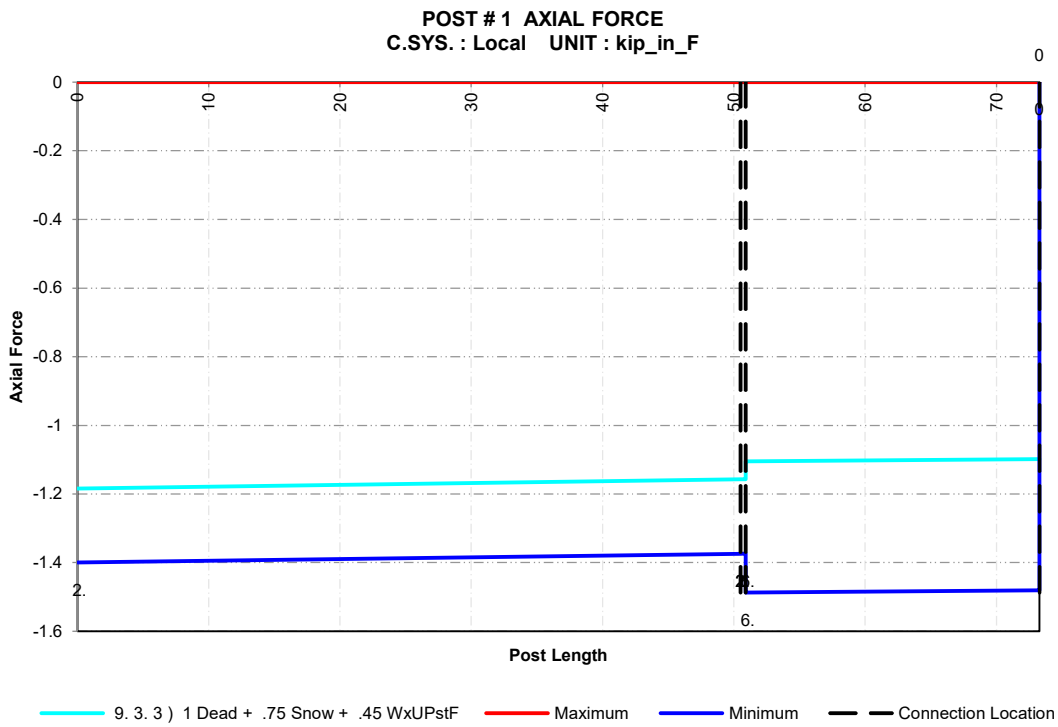
PIVOT ARM # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F

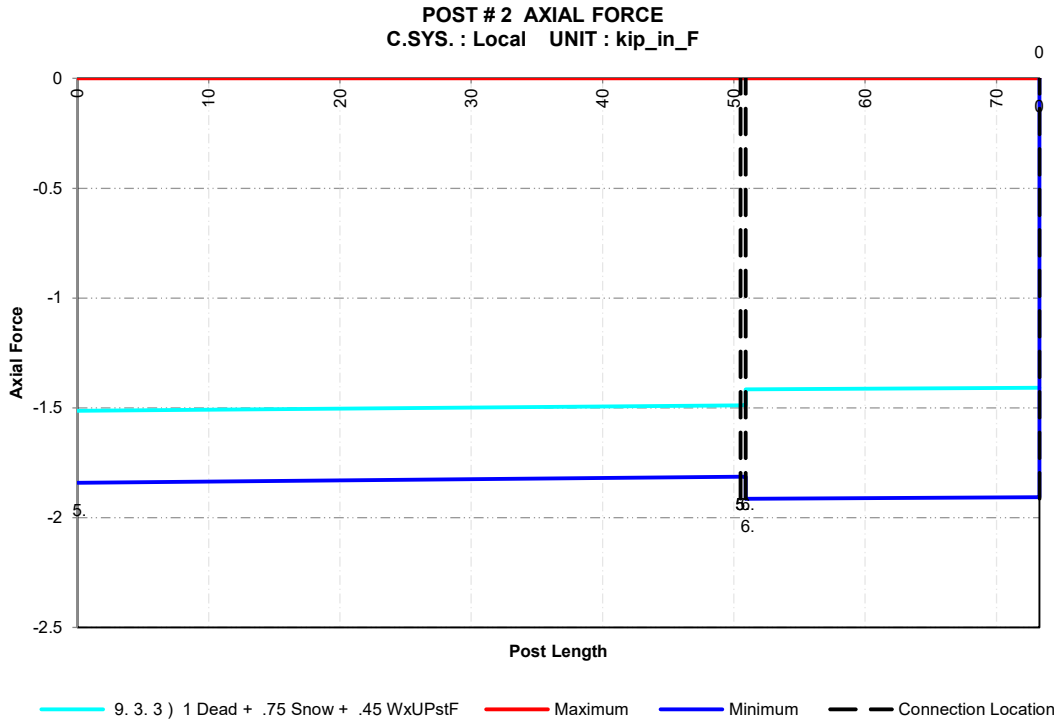


PIVOT ARM # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



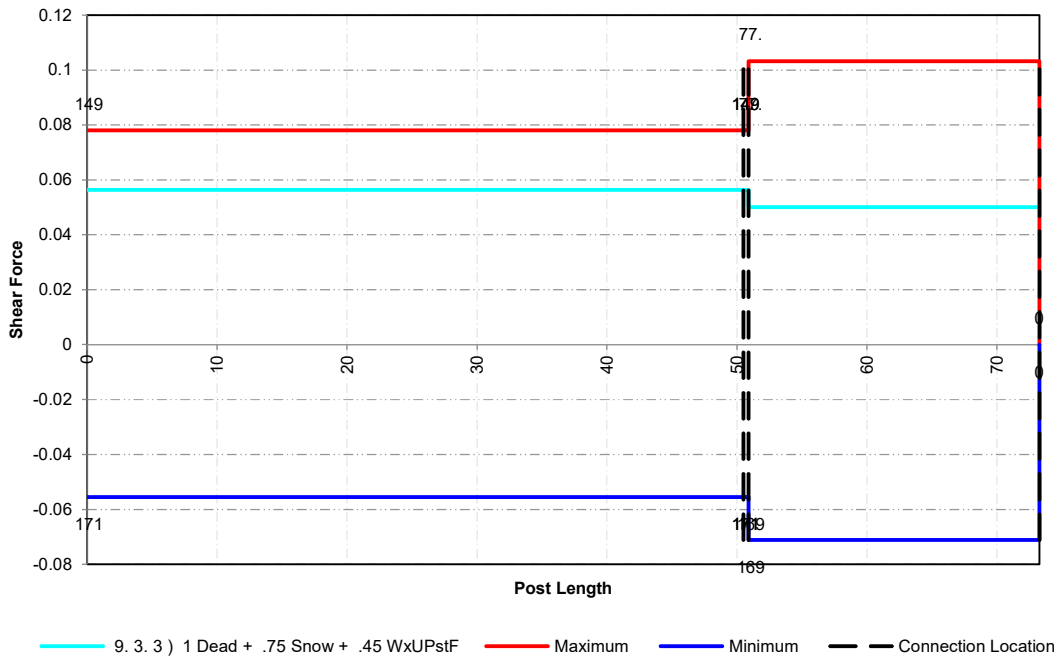
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

POST # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



POST # 2 SHEAR FORCE - V2
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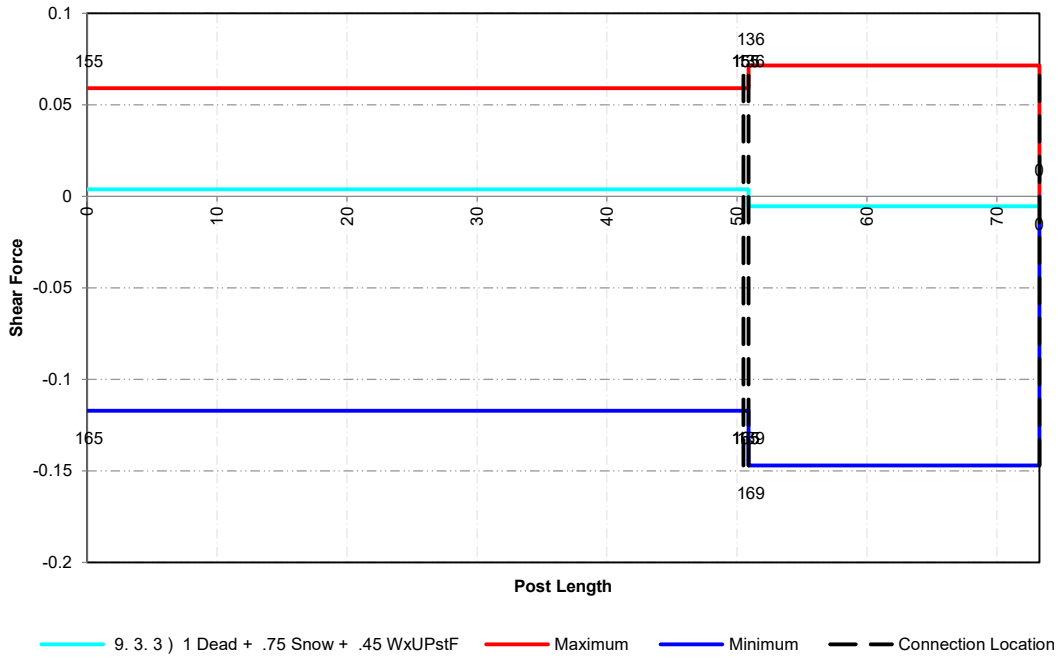
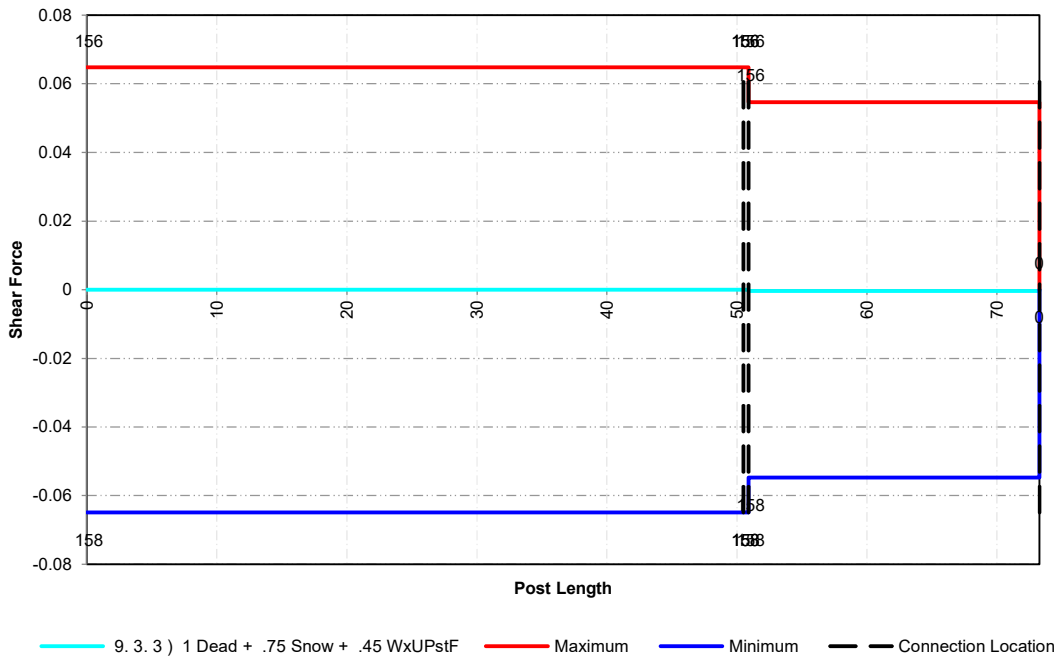
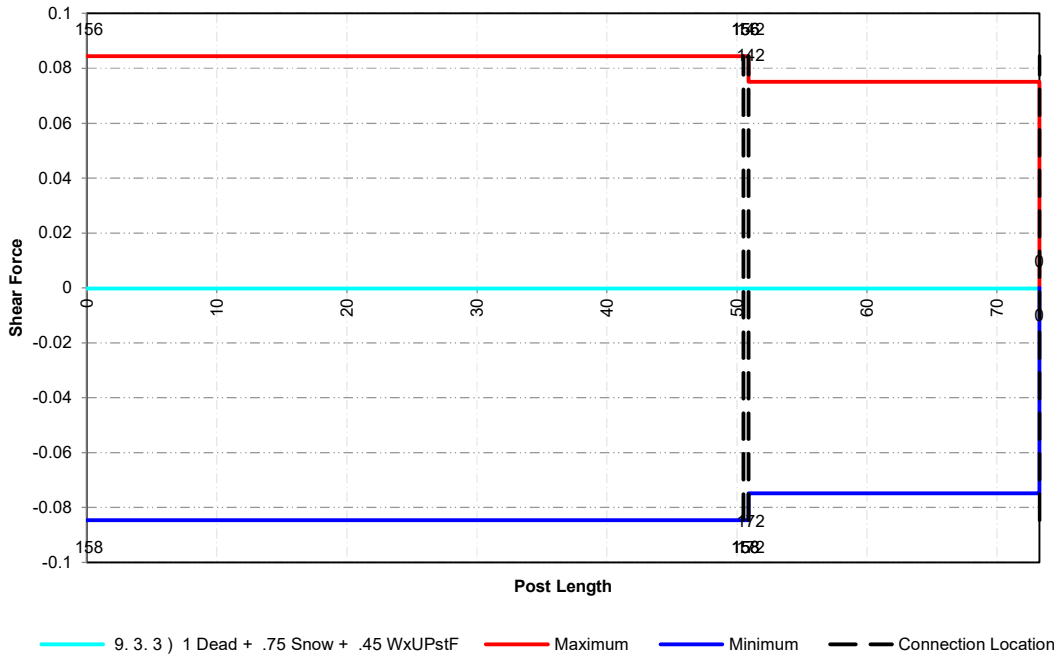


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

POST # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F

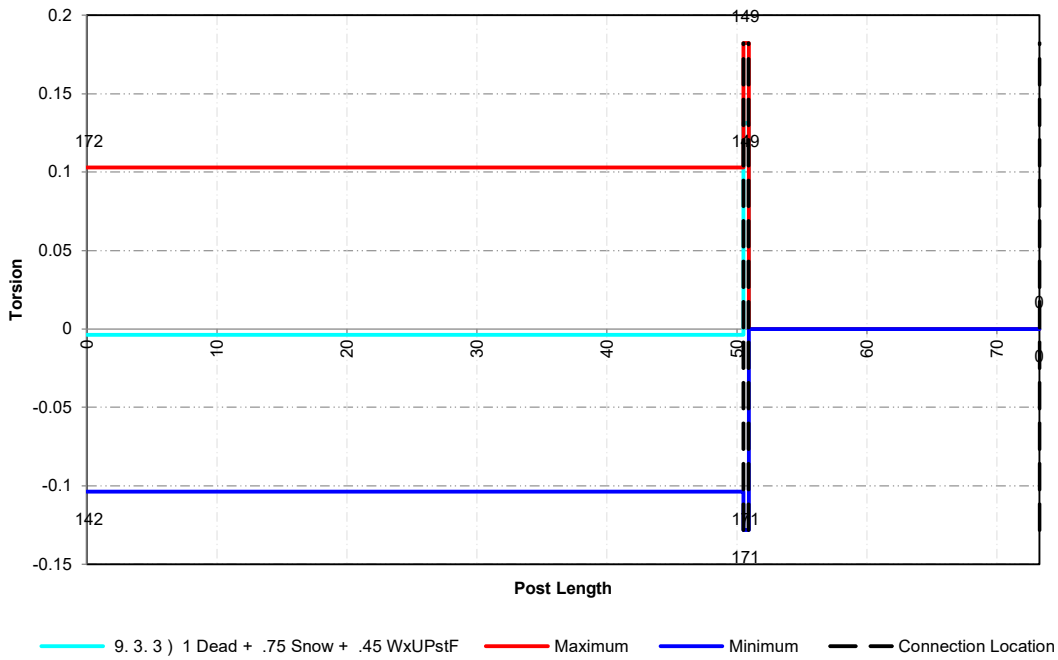


POST # 2 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

POST # 1 TORSION
C.SYS. : Local UNIT : kip_in_F



POST # 2 TORSION
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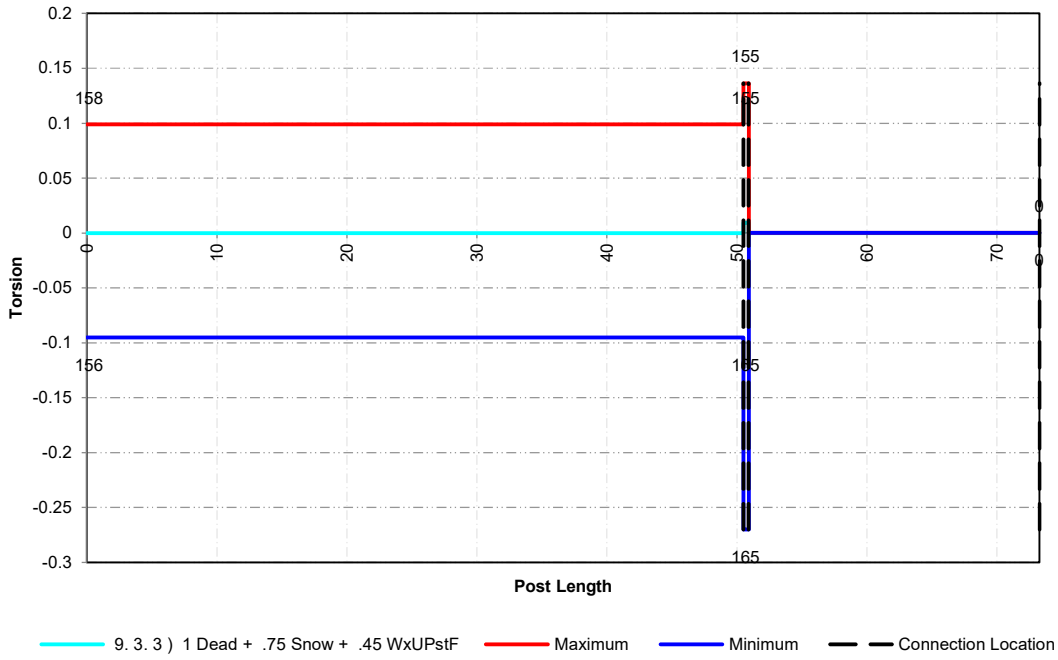
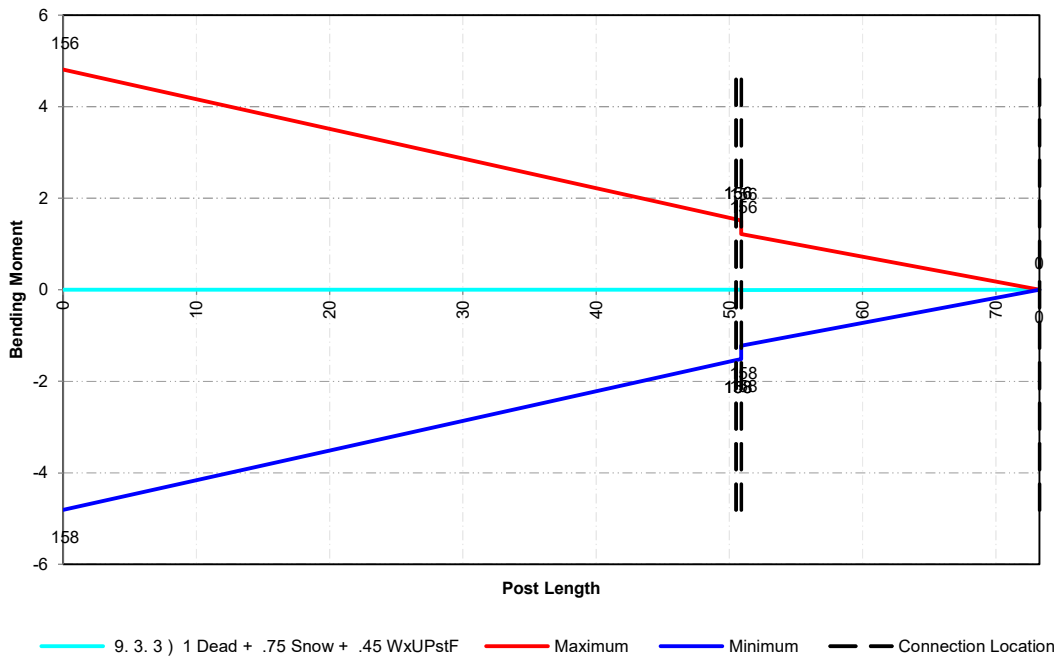
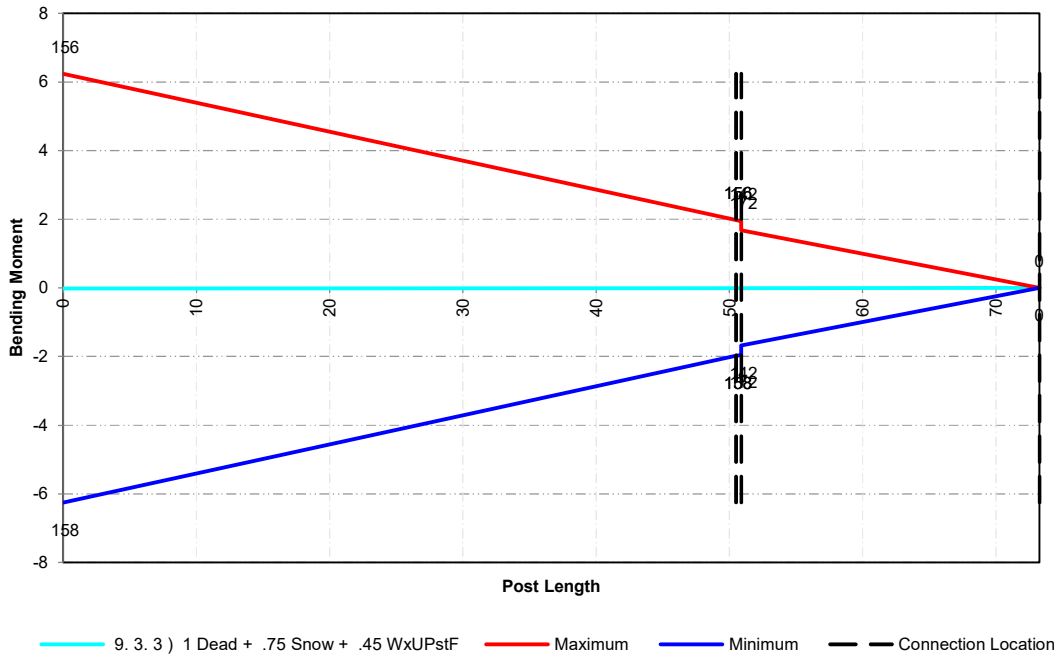


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

POST # 1 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

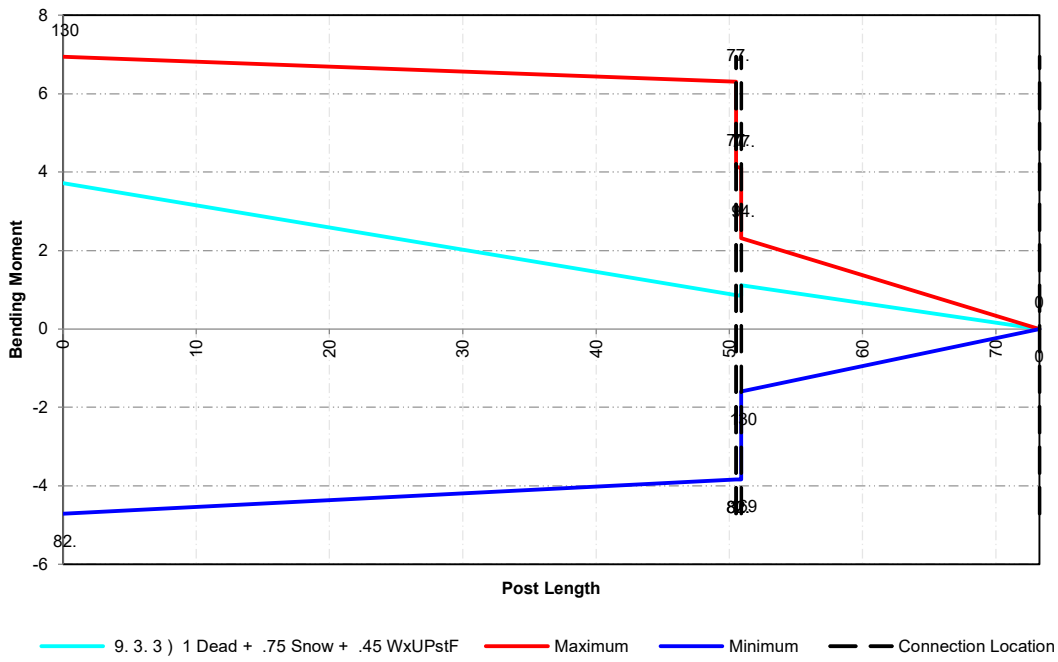


POST # 2 MOMENT M2
C.SYS. : Local UNIT : kip_in_F

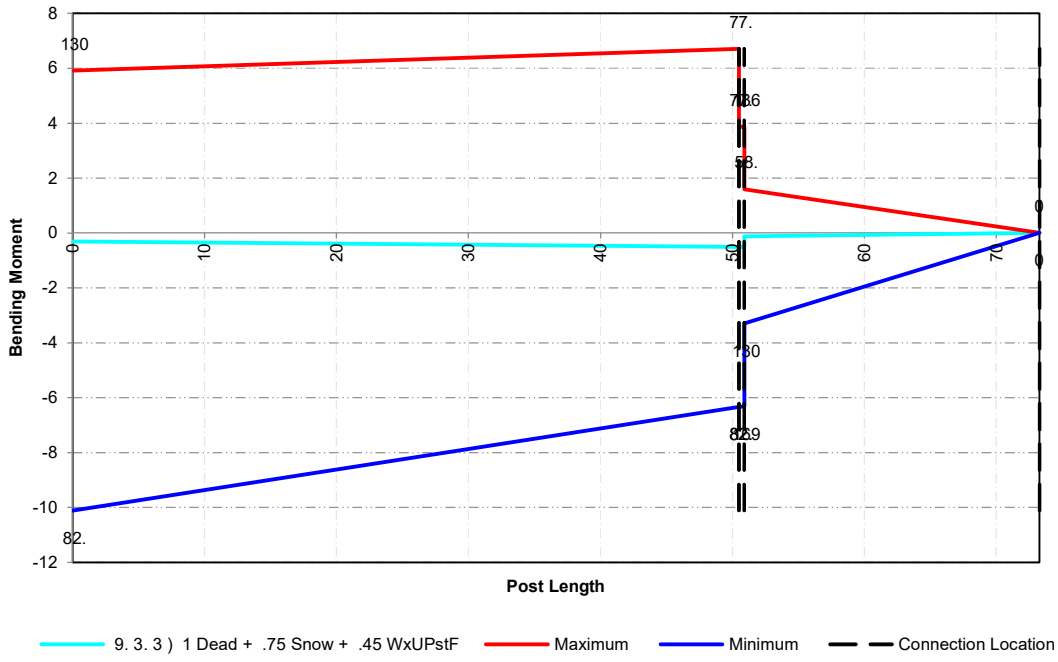


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *30 degree*

POST # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



POST # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

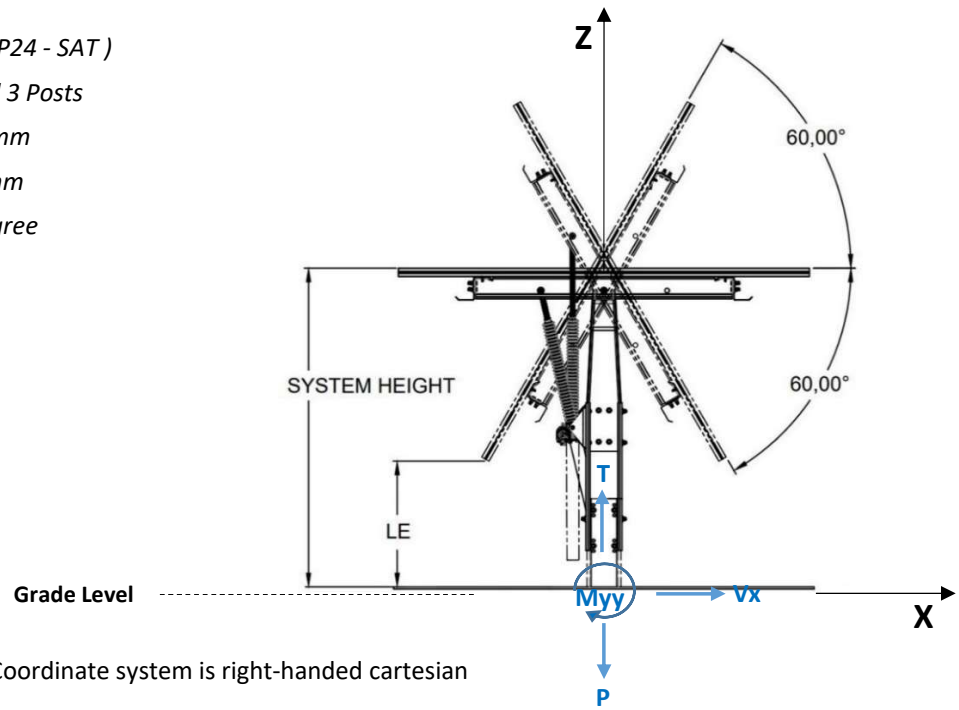
TABLE : *X25 (1P24 - SAT)*

CLASS : *Central 3 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *-30 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.78	0.62	0.00	0.09	≈ 0	0.00	0.09
	T	n/a	0.00	n/a	-0.14	≈ 0	n/a	-0.14
	V_x	0.01	0 , 0.02	0.00	± 0.08	± 0.09	0.00	-0.05 , 0.08
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.06	-0.21 , 0.29	0.00	± 0.88	± 0.54	0.00	-0.53 , 0.88
	M_{xx}	0.00	-0.01 , 0	0.00	± 0	± 0.55	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.01	0.83	0.00	0.12	≈ 0	0.00	0.12
	T	n/a	0.00	n/a	-0.18	≈ 0	n/a	-0.18
	V_x	-0.02	-0.05 , 0	0.00	± 0.1	± 0.11	0.00	-0.07 , 0.1
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	-0.18	-0.43 , 0.2	0.00	± 1.01	± 0.63	0.00	-0.67 , 1.01
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.71	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X25 (1P24 - SAT)*

LENGTH : *2279 mm*

CLASS : *Central 3 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *-30 degree*

CHORD LENGTH : *27758 mm*

POST SPAN : *10230 mm*

CHORD CONTILEVER : *3649 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	2.15	4	20	45
Splice / Z	GR_70	142.7	69	4.2	4	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		2.3	note * : standard baseline section		
Pivot Arm - Mid / Ω	GR_70	see note *		2.7	note * : standard baseline section		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O - ext (int)	GR_50	88.9	n/a	4.5 (4.5)	n/a	n/a	n/a

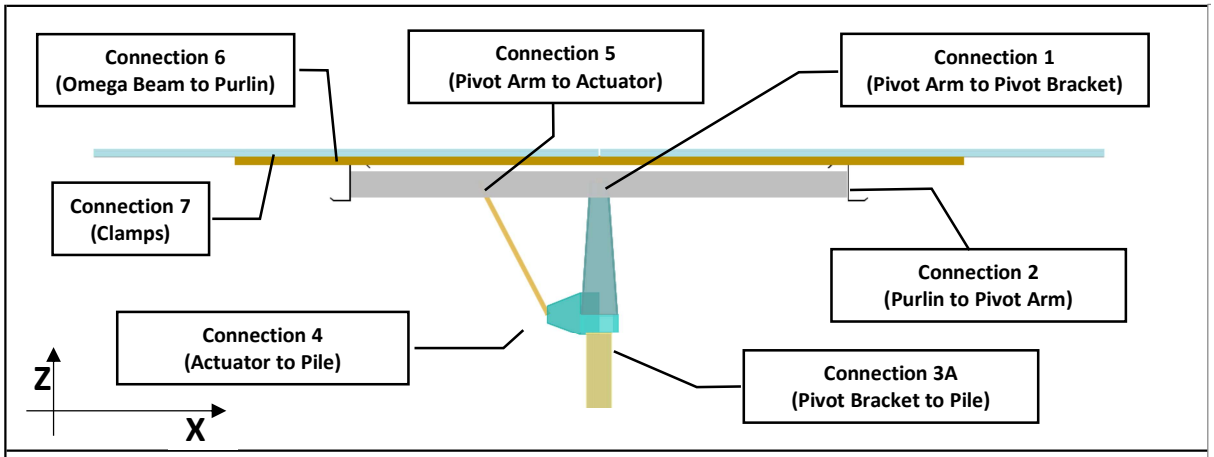
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.78	0.62	0.00	0.09	≈ 0	0.00	0.09
	T	n/a	0.00	n/a	-0.14	≈ 0	n/a	-0.14
	V_x	0.01	0 , 0.02	0.00	± 0.08	± 0.09	0.00	-0.05 , 0.08
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.06	-0.21 , 0.29	0.00	± 0.88	± 0.54	0.00	-0.53 , 0.88
	M_{xx}	0.00	-0.01 , 0	0.00	± 0	± 0.55	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	1.01	0.83	0.00	0.12	≈ 0	0.00	0.12
	T	n/a	0.00	n/a	-0.18	≈ 0	n/a	-0.18
	V_x	-0.02	-0.05 , 0	0.00	± 0.1	± 0.11	0.00	-0.07 , 0.1
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	-0.18	-0.43 , 0.2	0.00	± 1.01	± 0.63	0.00	-0.67 , 1.01
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.71	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

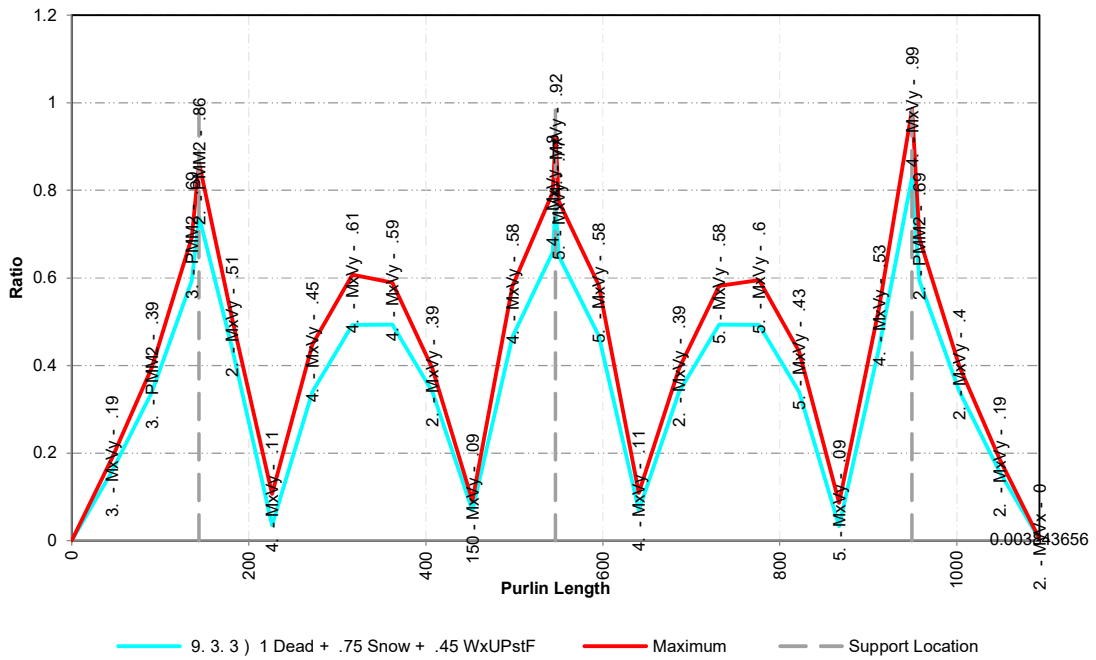


Note: coordinate system is right-handed cartesian

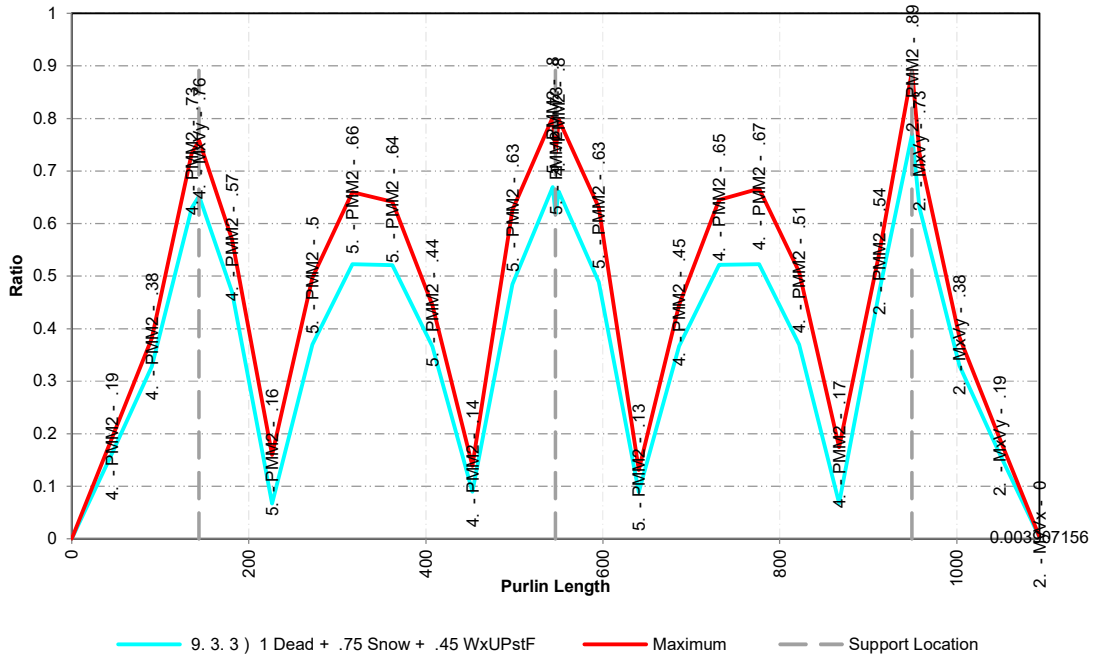
Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-1.92	0.14	0.00	0.00	0.00	0.00	6. 2. 5) 1 Dead + 1 S4_s2s_+
-0.99	0.03	-0.06	0.00	0.00	0.00	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 2						
1.90	0.80	0.00	0.00	0.02	0.17	5. 2. 4) 1 Dead + 1 S3_lhhl
1.90	0.80	0.00	0.00	0.02	0.17	5. 2. 4) 1 Dead + 1 S3_lhhl
Connection : 3						
-0.50	-0.05	0.00	0.00	0.00	-0.41	136. 5. 22) .6 Dead + .6 WxUPst+T
-1.84	0.07	0.00	0.00	0.00	0.50	5. 2. 4) 1 Dead + 1 S3_lhhl
-1.63	0.12	0.00	0.00	0.00	0.75	149. 10. 7) 1 Dead + .75 S3_lhhl + .525 Quake_x
-1.45	0.09	0.00	0.00	0.00	0.83	151. 10. 9) 1 Dead + .75 S4_s2s_+ + .525 Quake_x
-1.01	0.02	0.08	-0.03	0.50	0.18	142. 9. 2) 1 Dead + .7 Quake_y
-1.01	0.02	0.08	-0.03	0.50	0.18	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
0.42	*	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
Connection : 5		** Note : the load is axial in actuator direction*				
0.42	*	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.01						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
-0.01						0.6 WLup

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

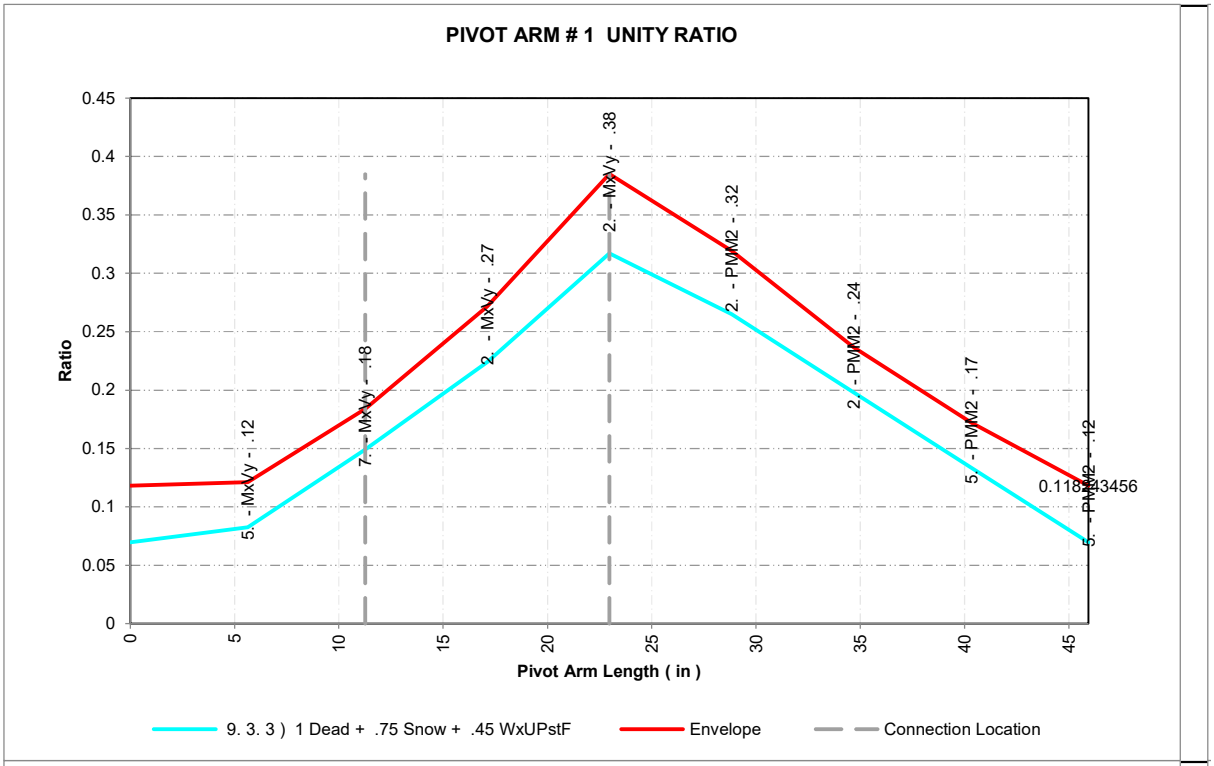
PURLIN # 1 UNITY RATIO

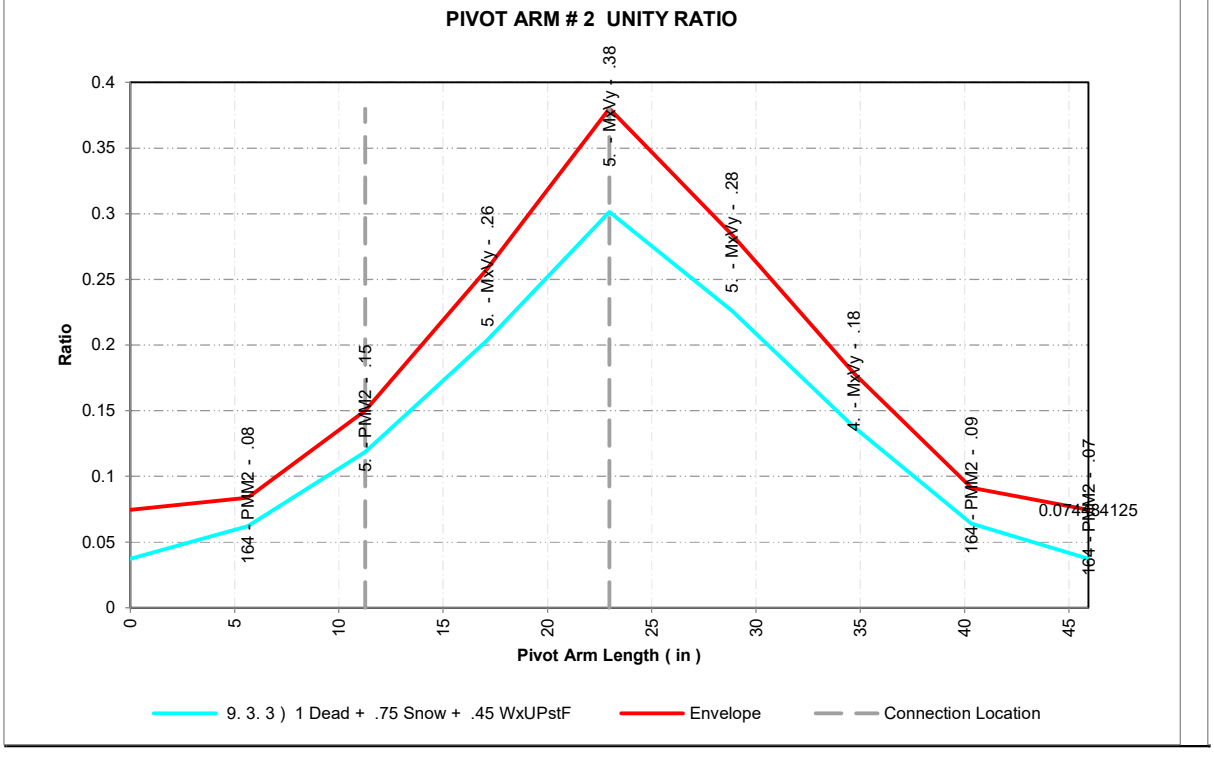


PURLIN # 2 UNITY RATIO



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

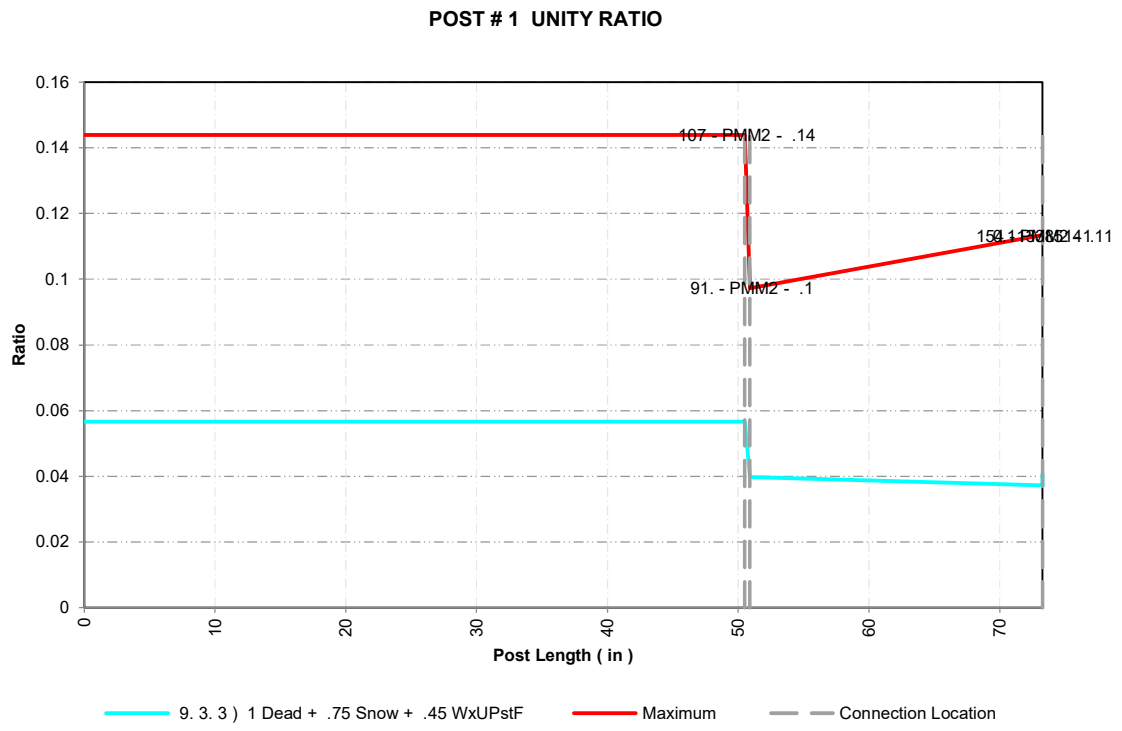


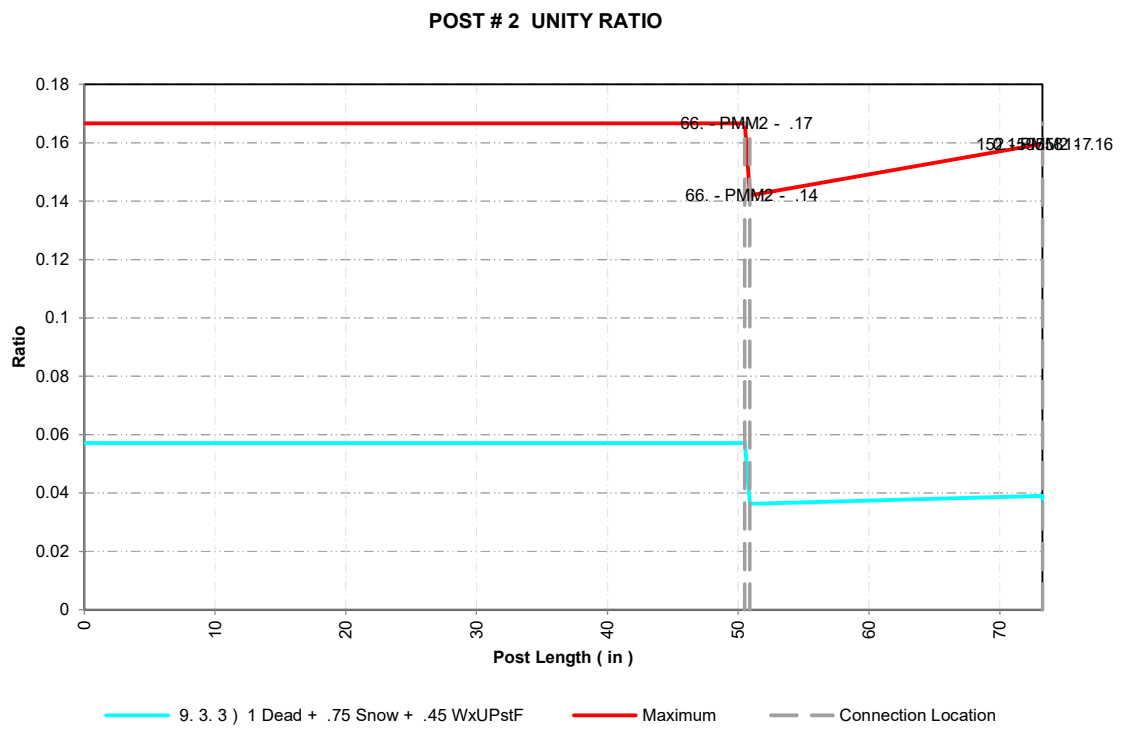


Post Unity Ratio Charts

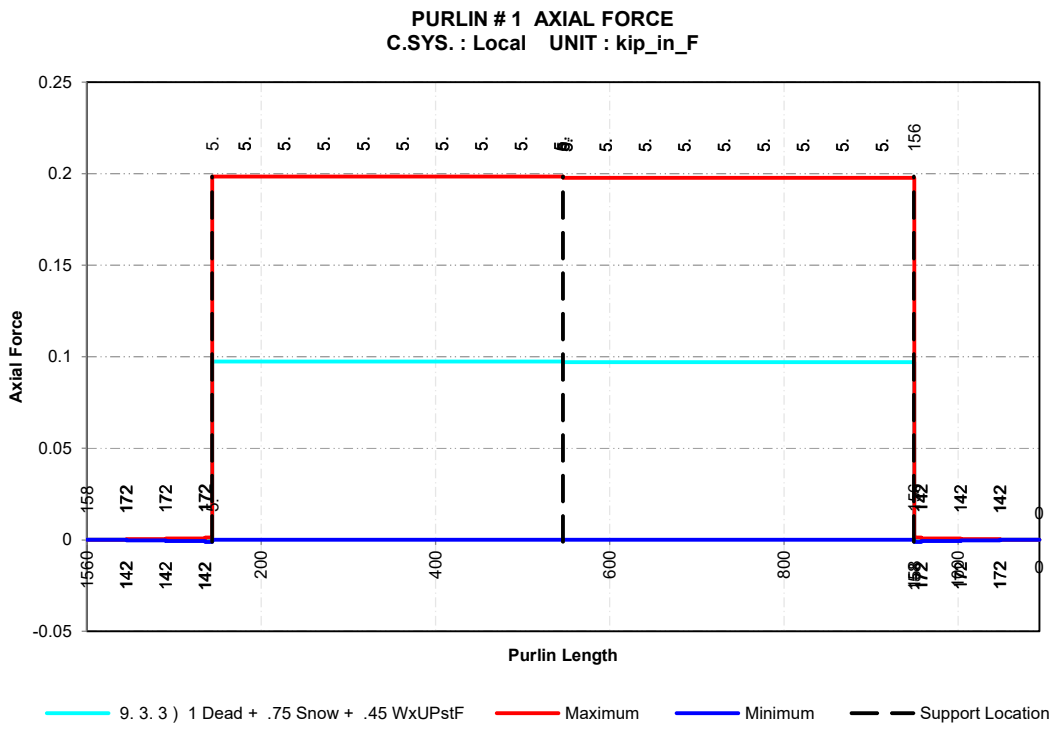
DESIGN PART *page X-006*

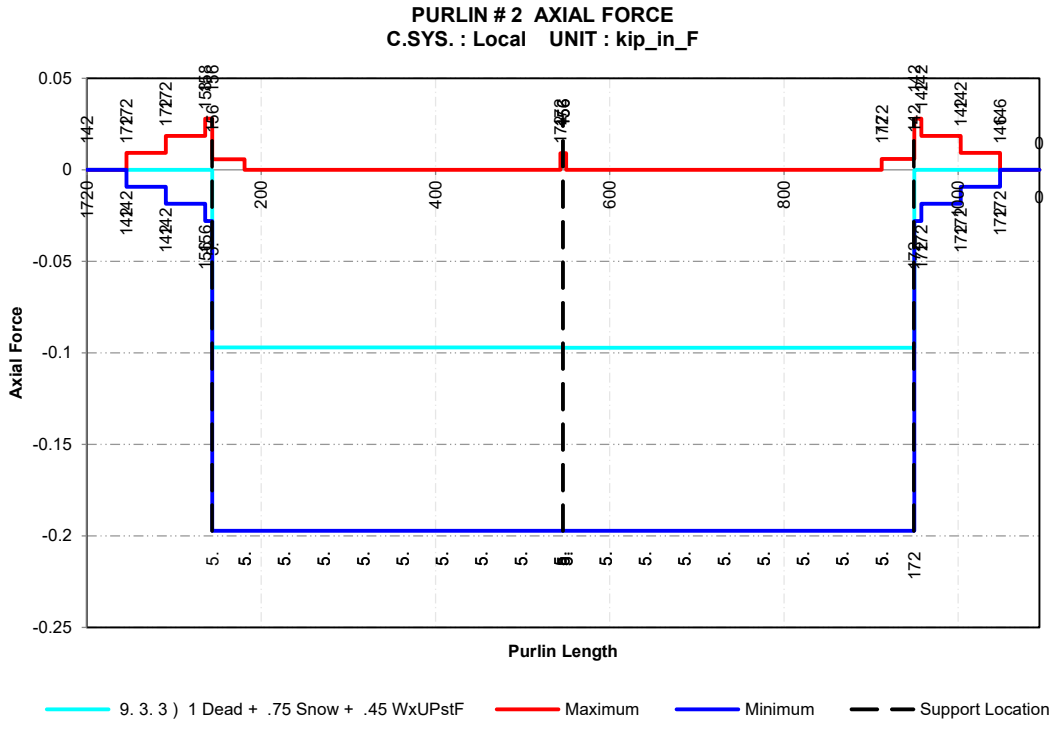
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*





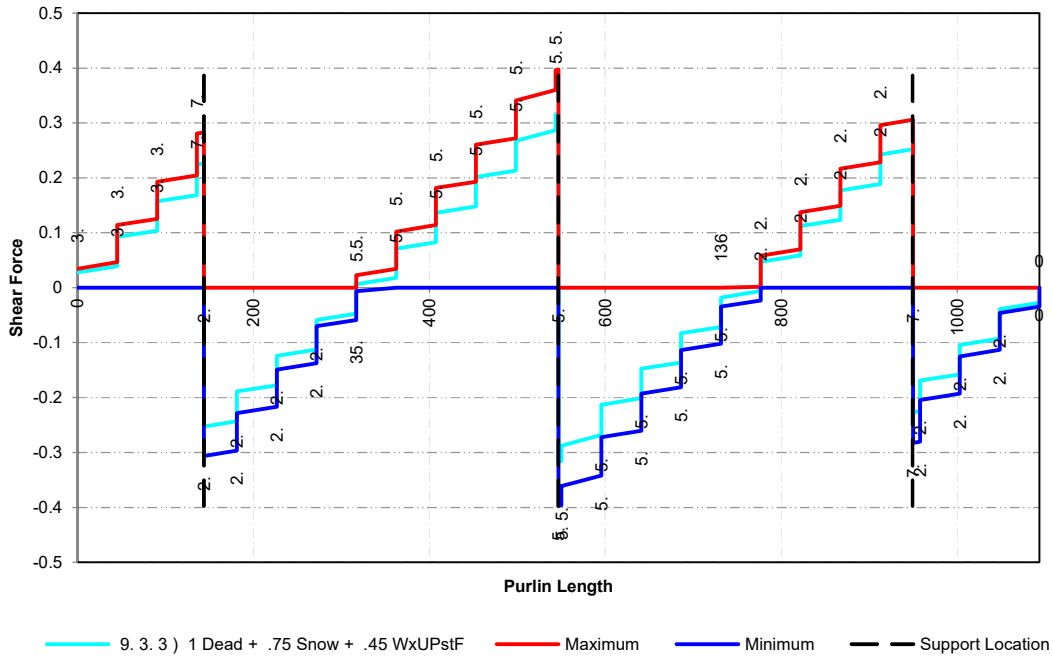
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*



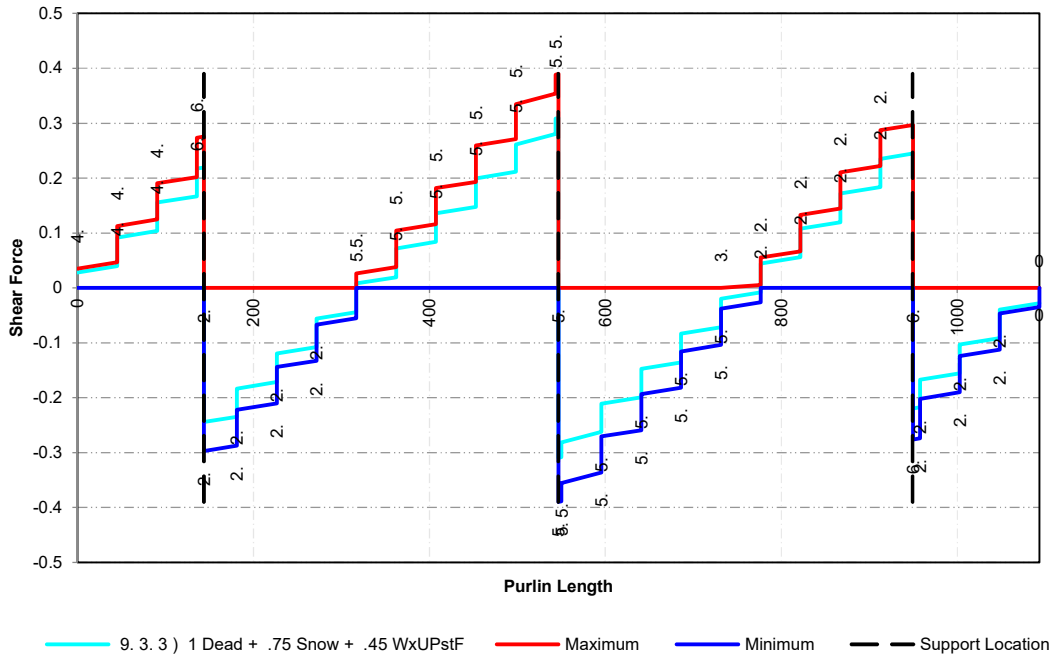


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

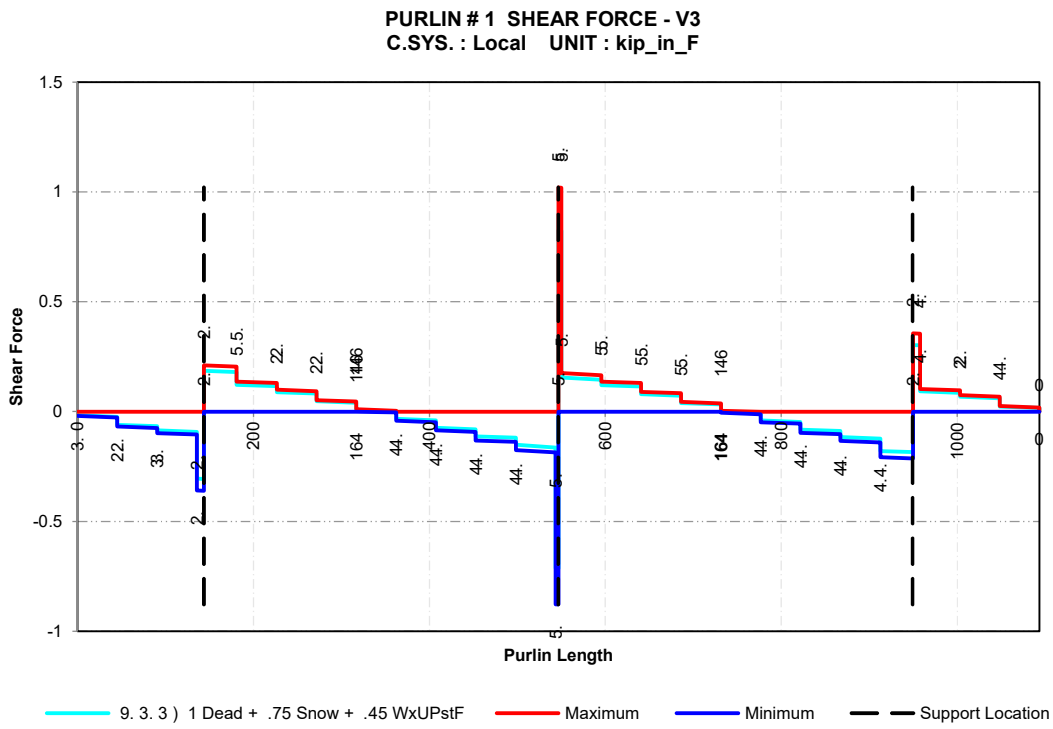
PURLIN # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F

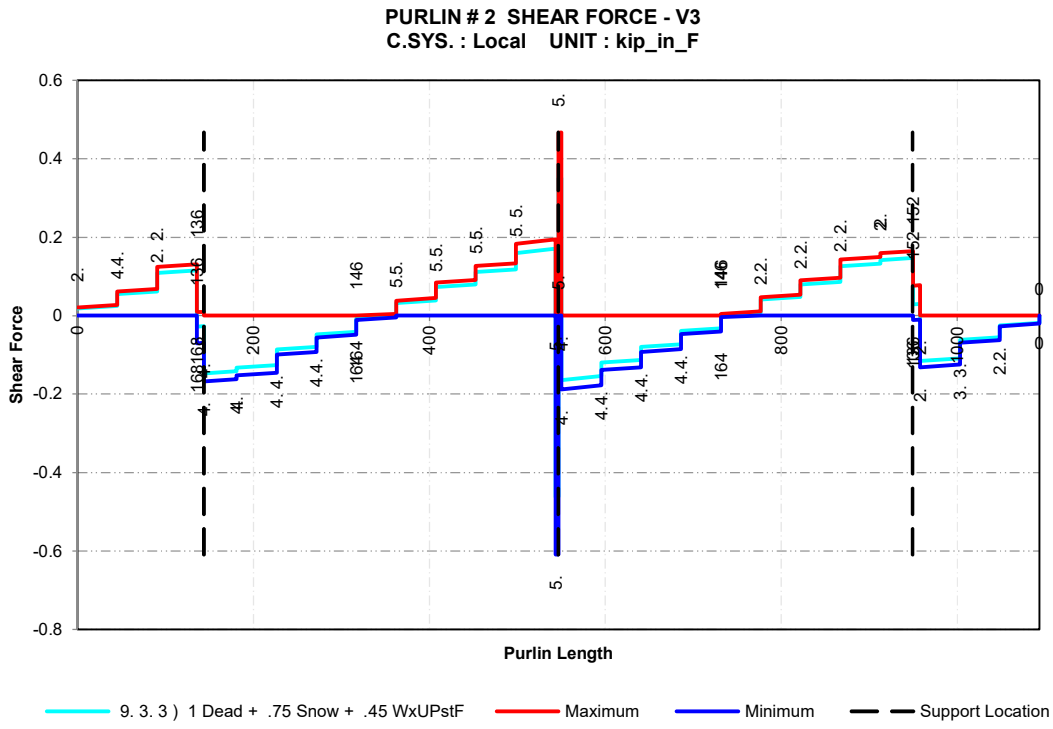


PURLIN # 2 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*





PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

PURLIN # 1 TORSION
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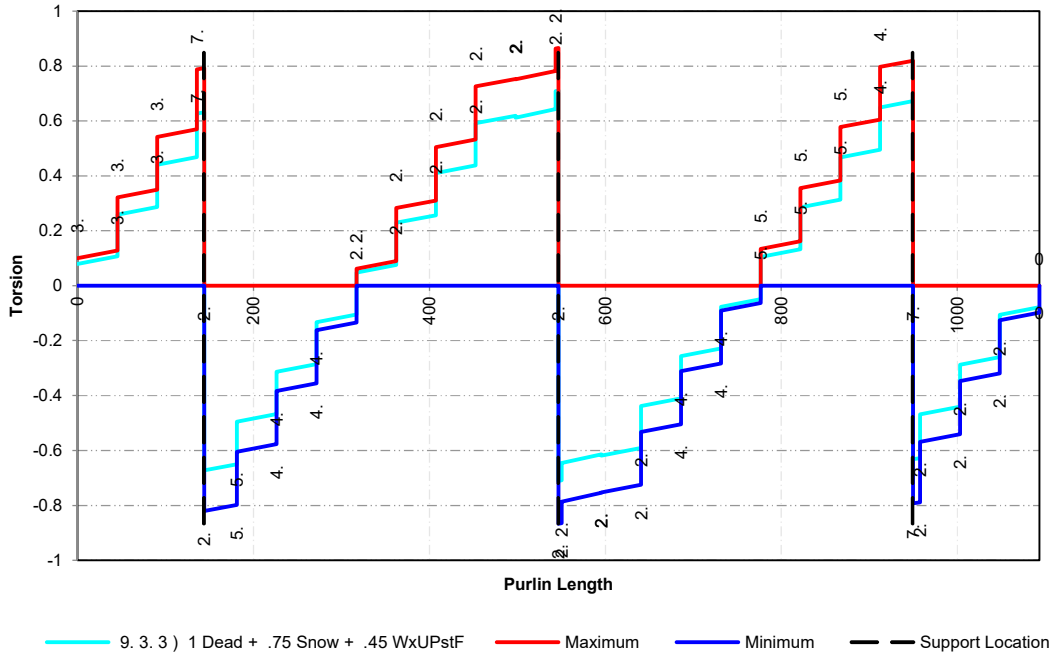

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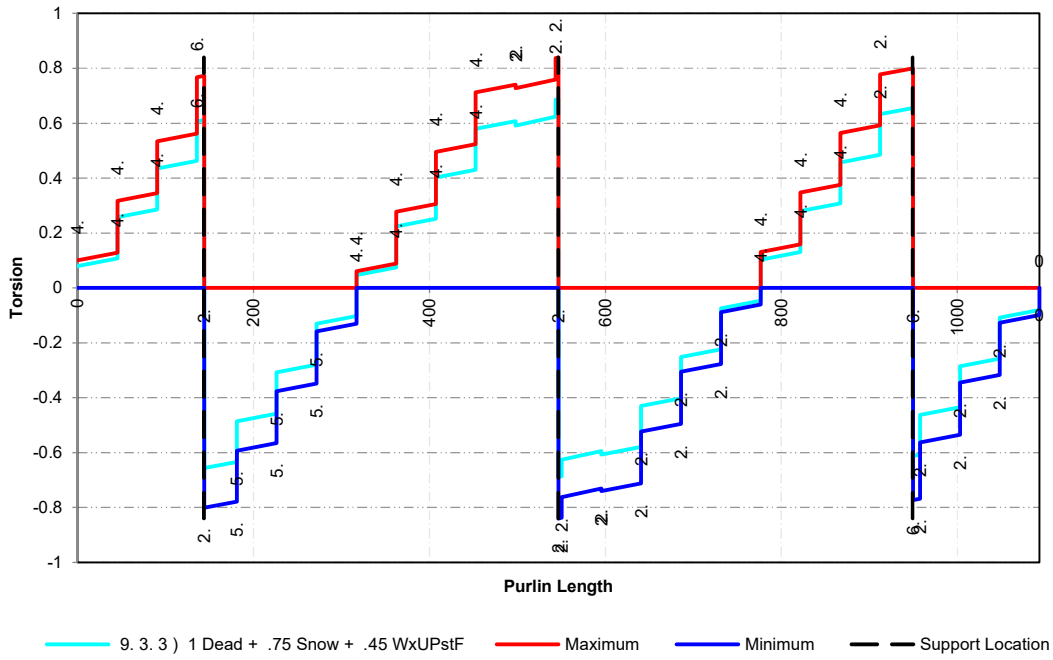

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

PURLIN # 1 MOMENT M2
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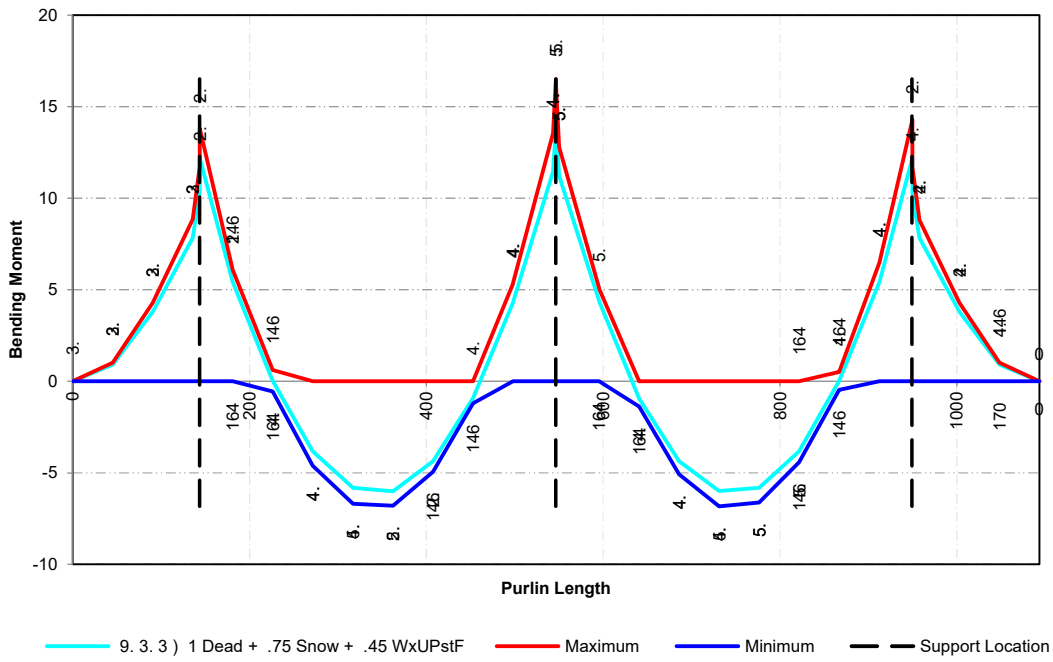

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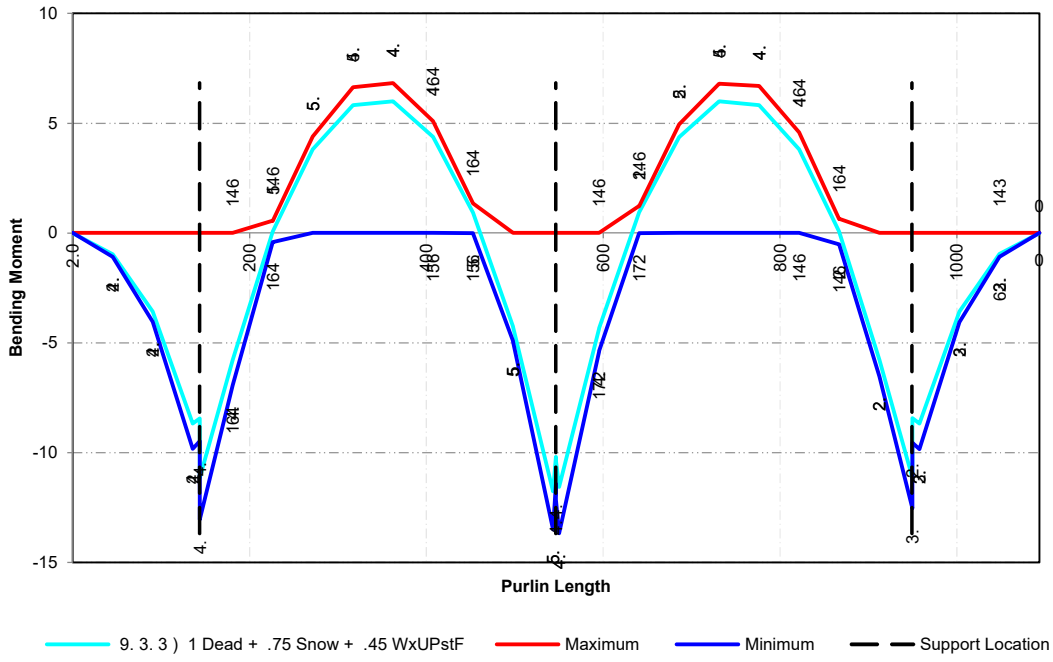

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

PURLIN # 1 MOMENT M3
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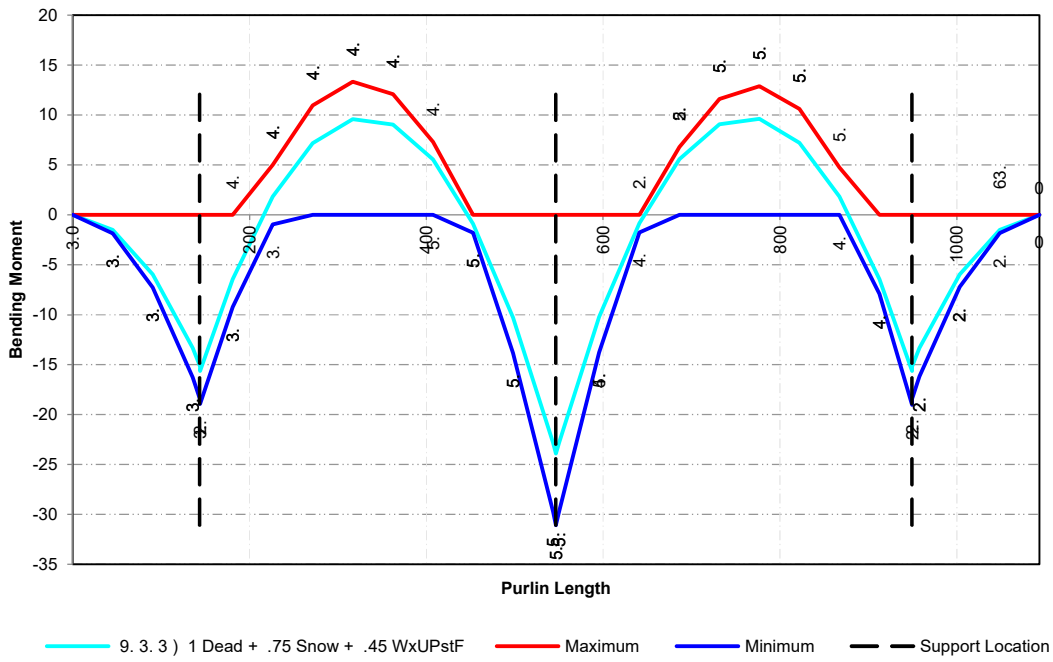

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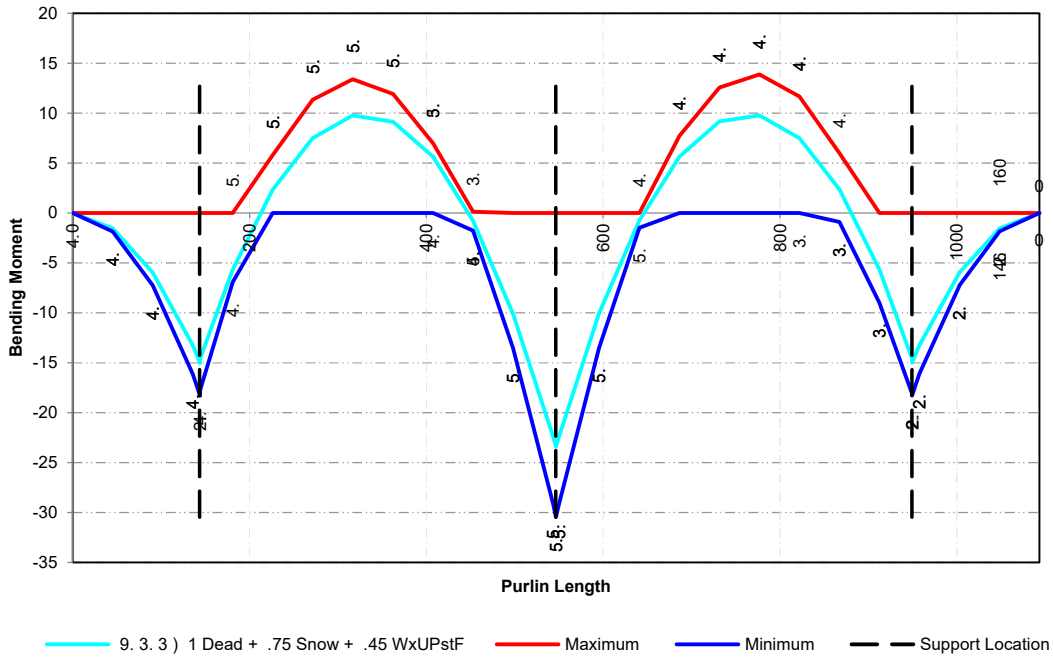
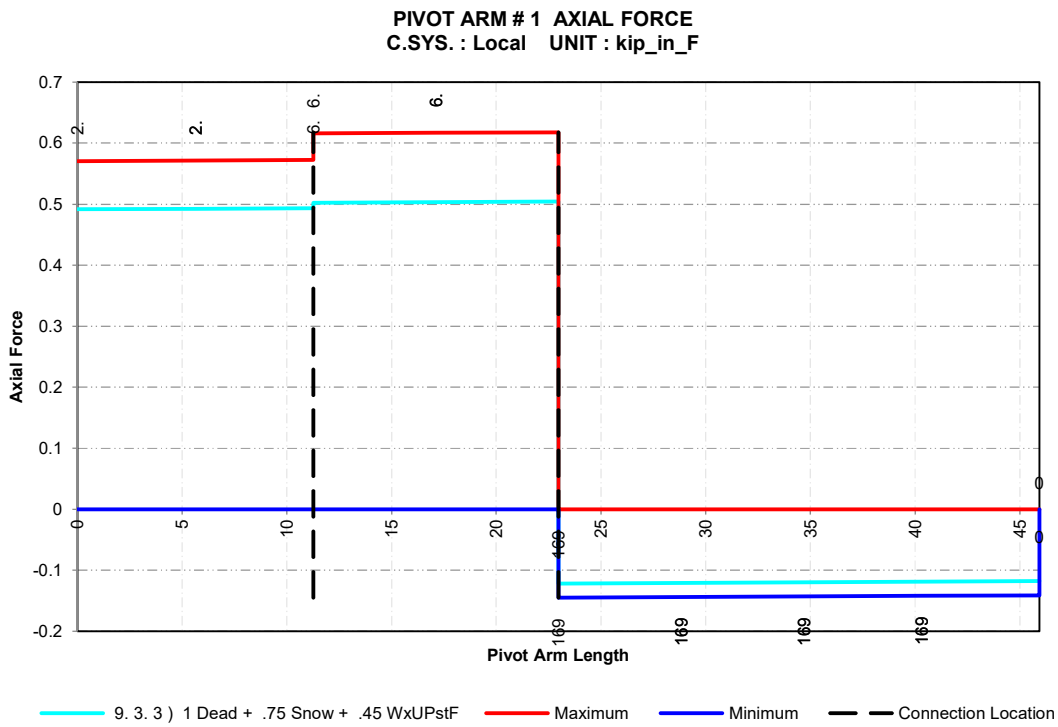
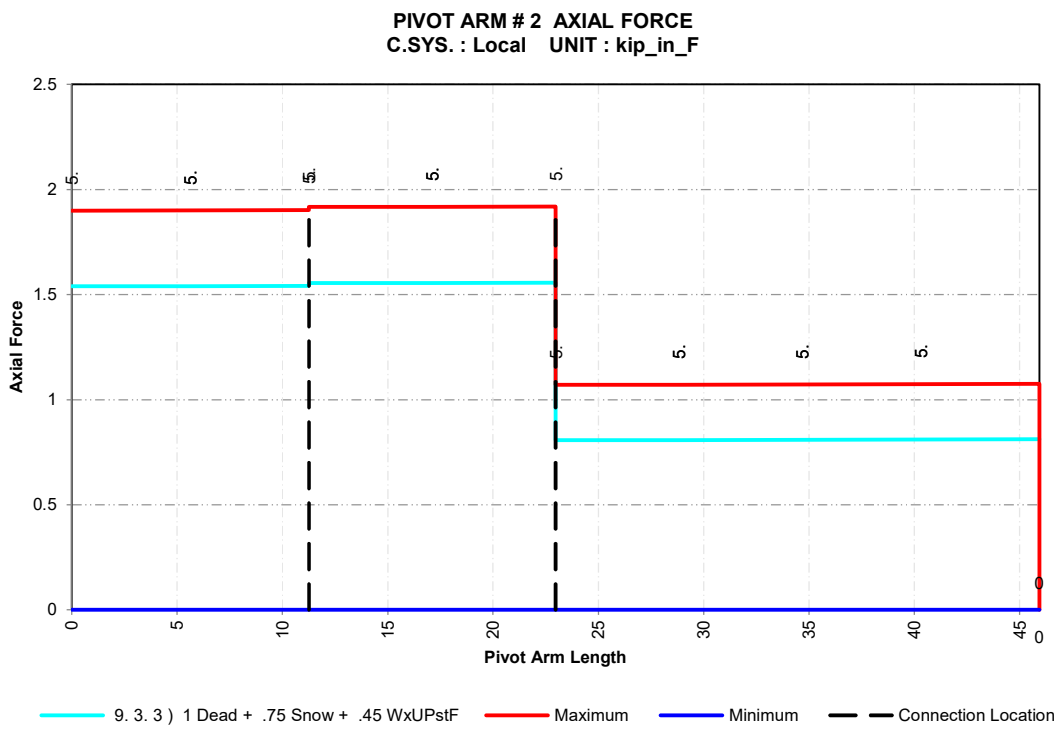
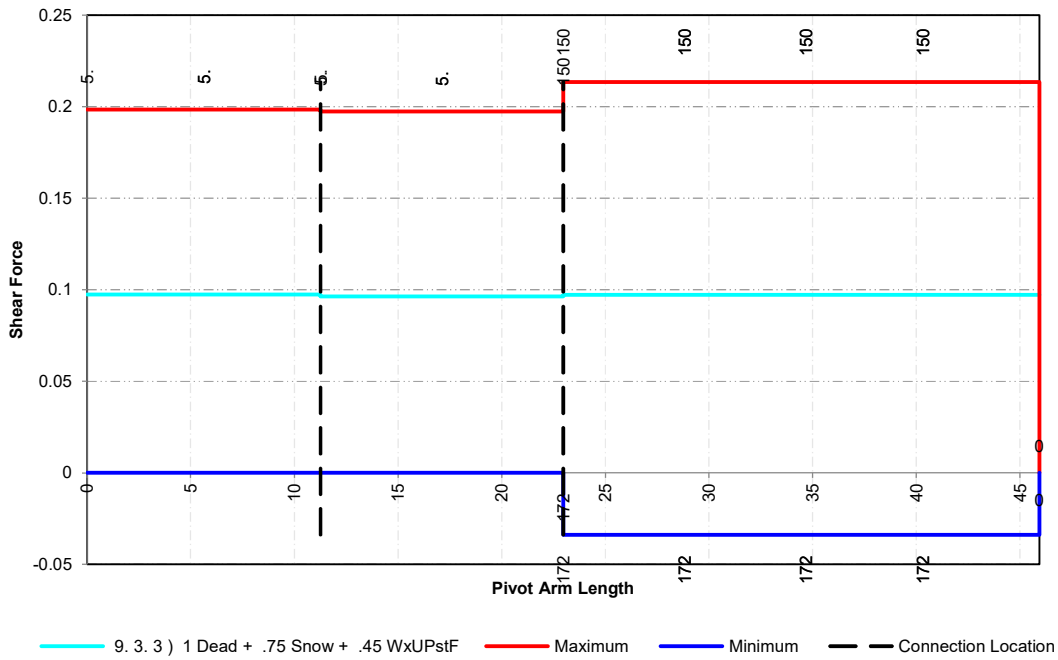


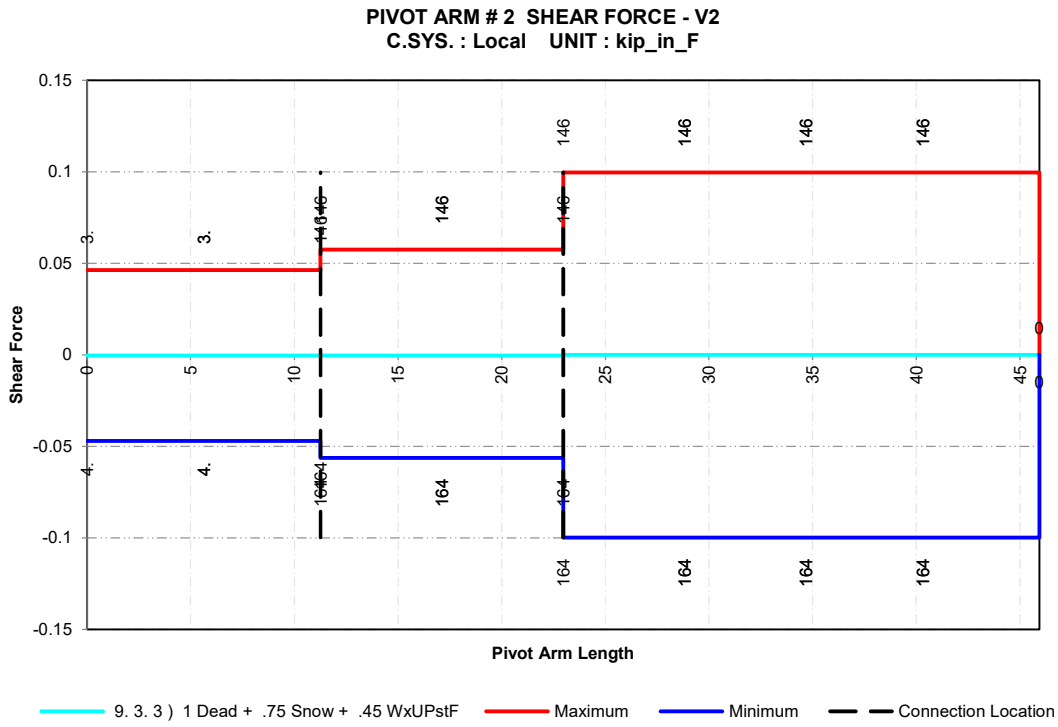
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*



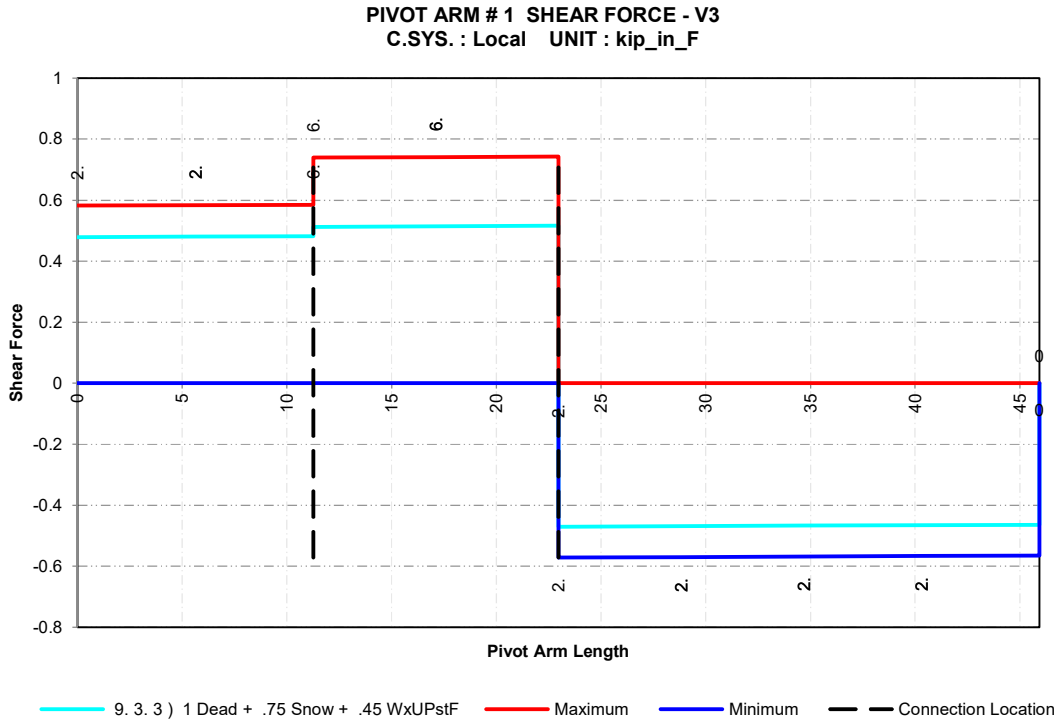


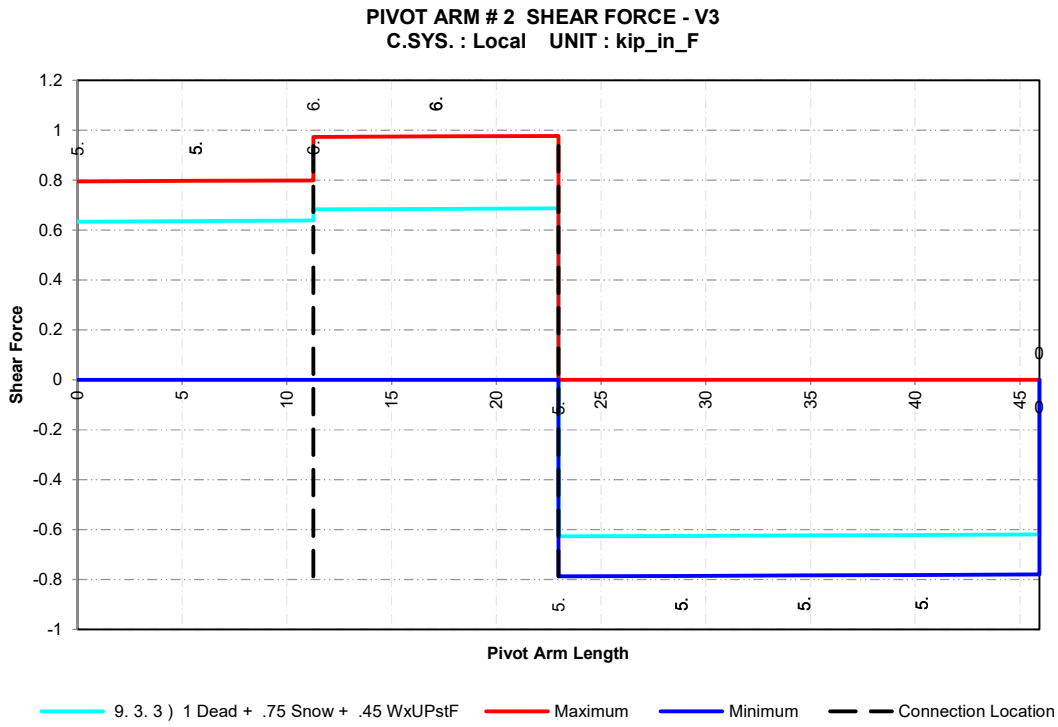
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*



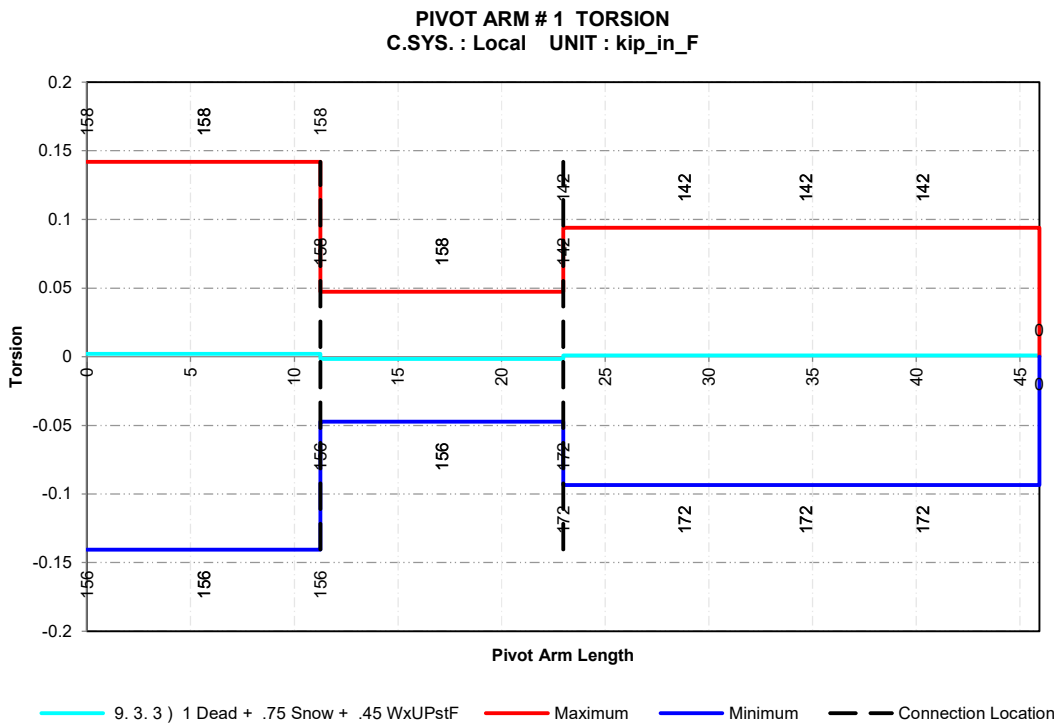


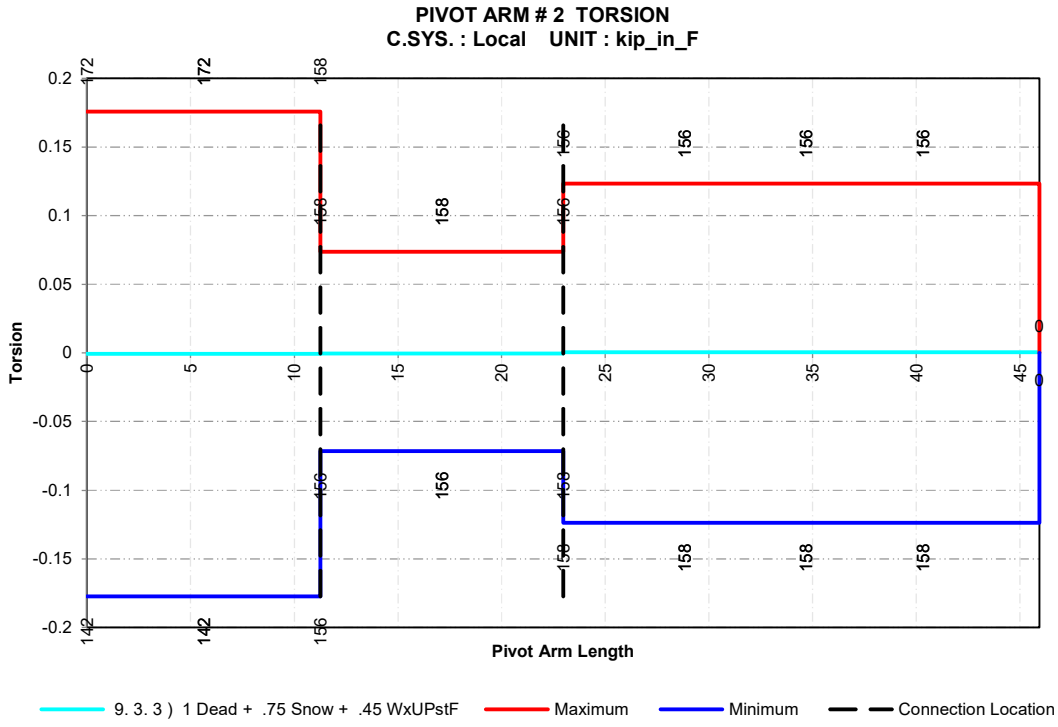
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*



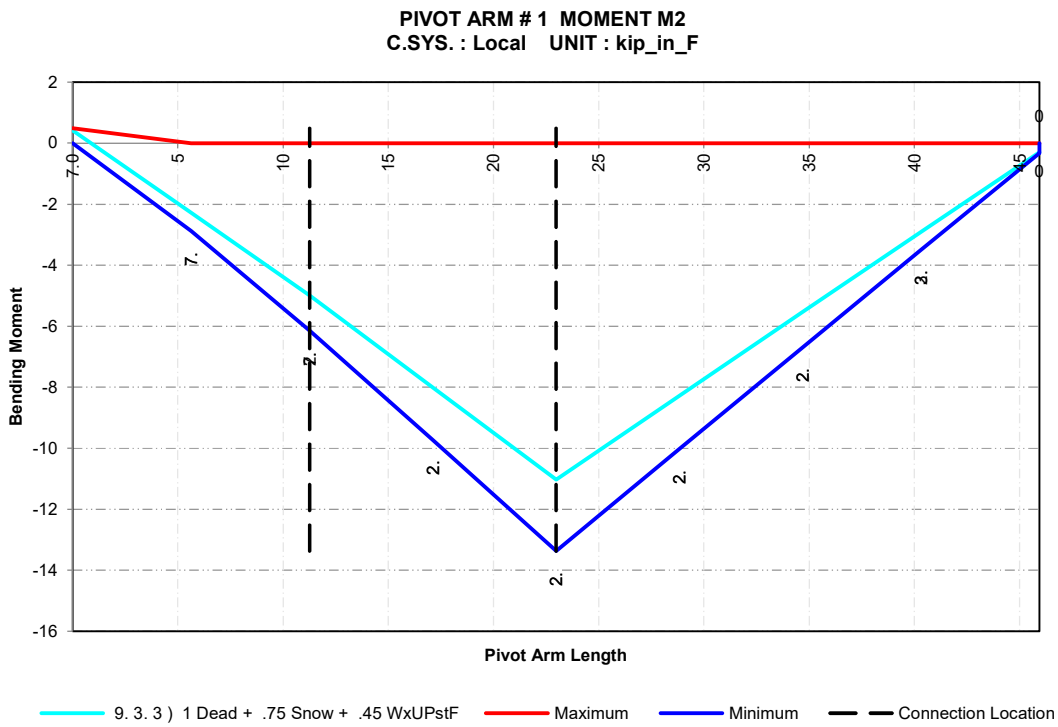


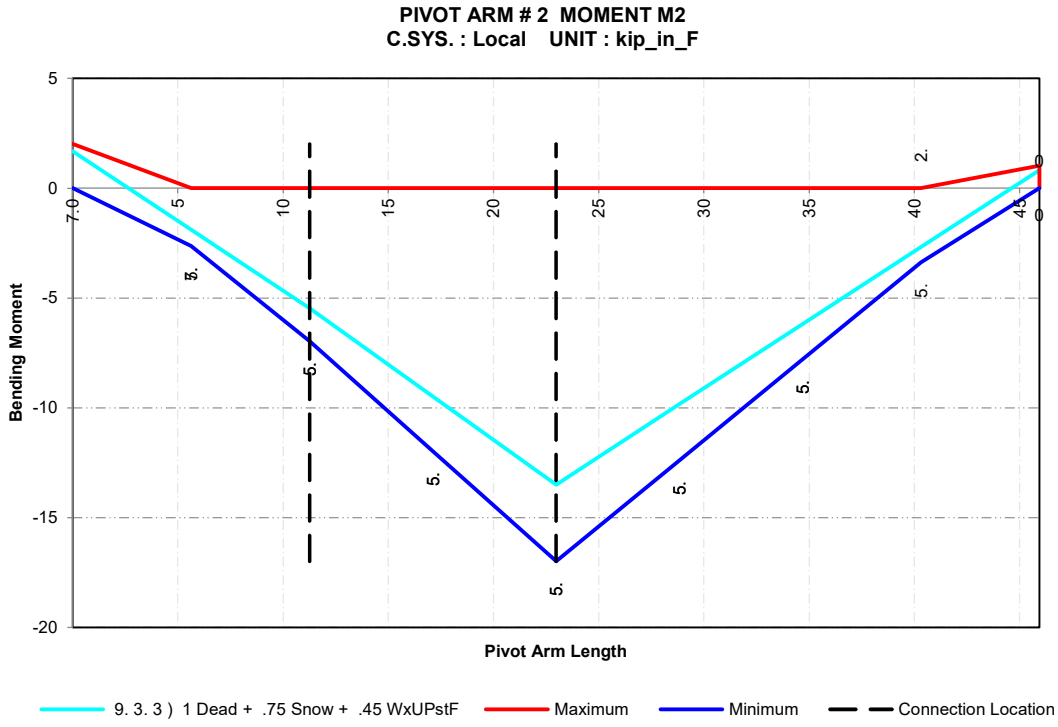
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*



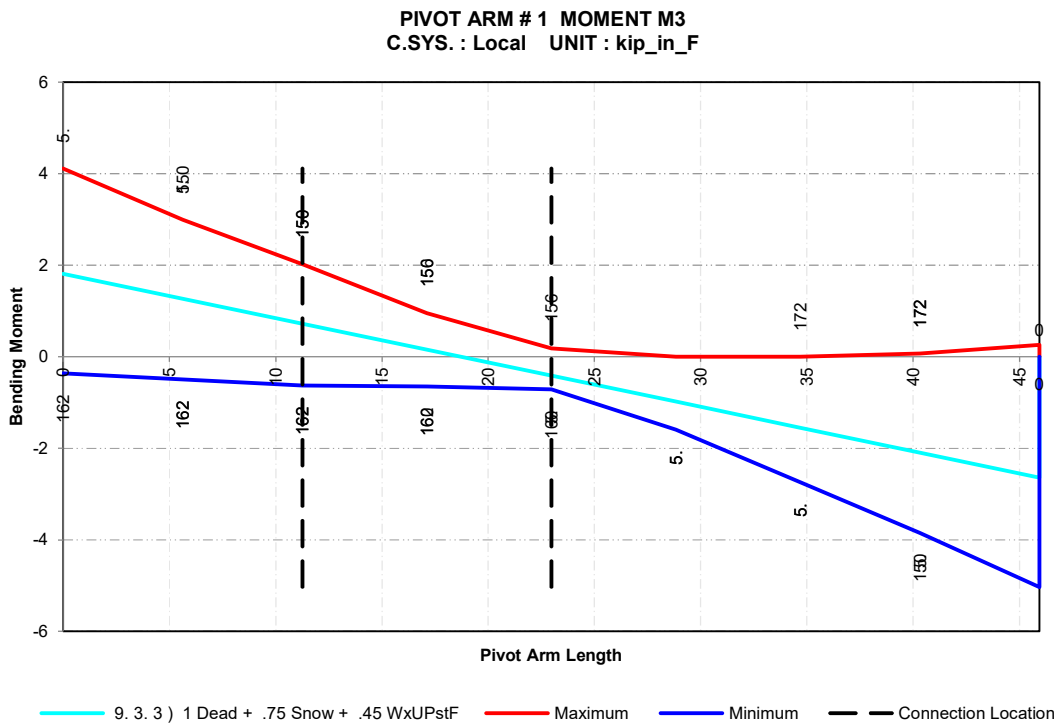


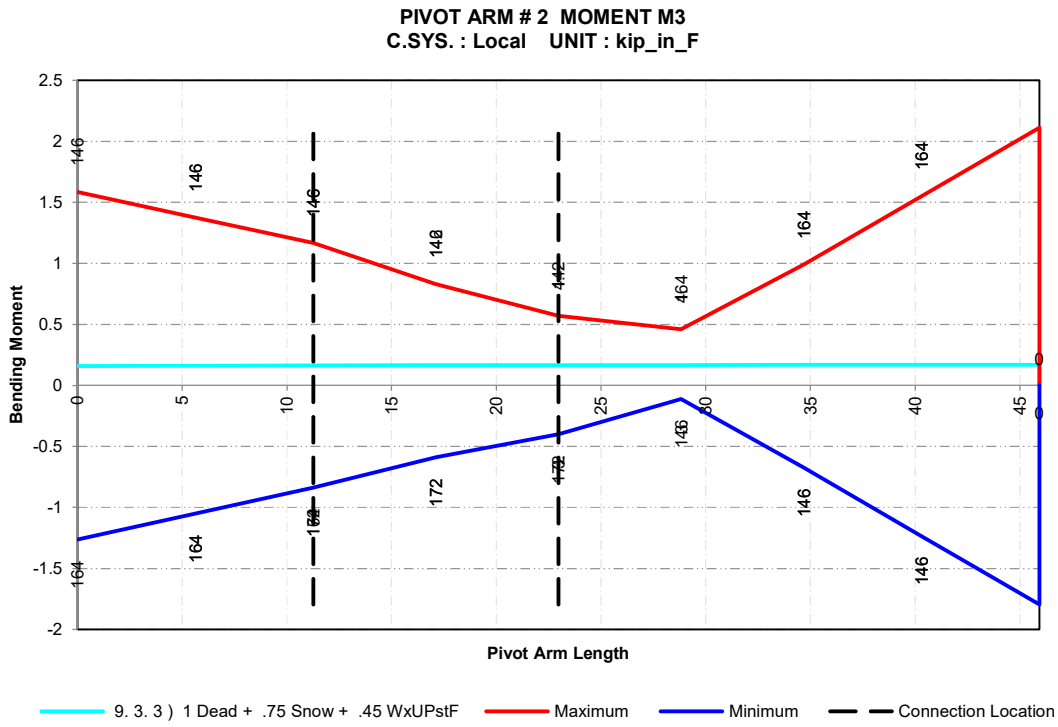
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*



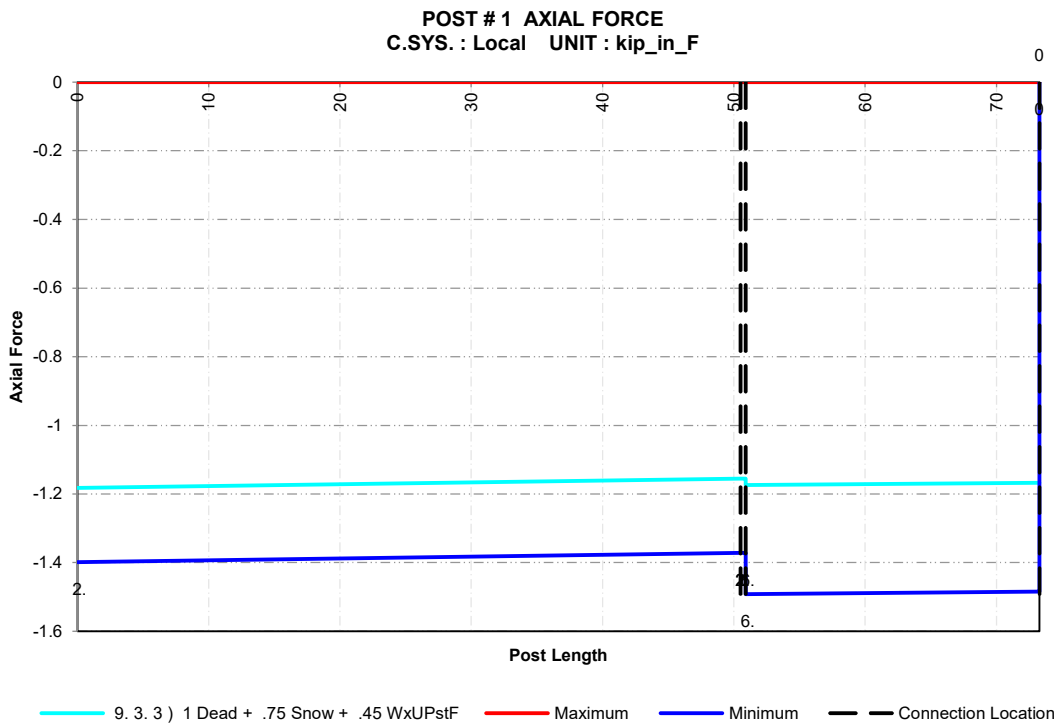


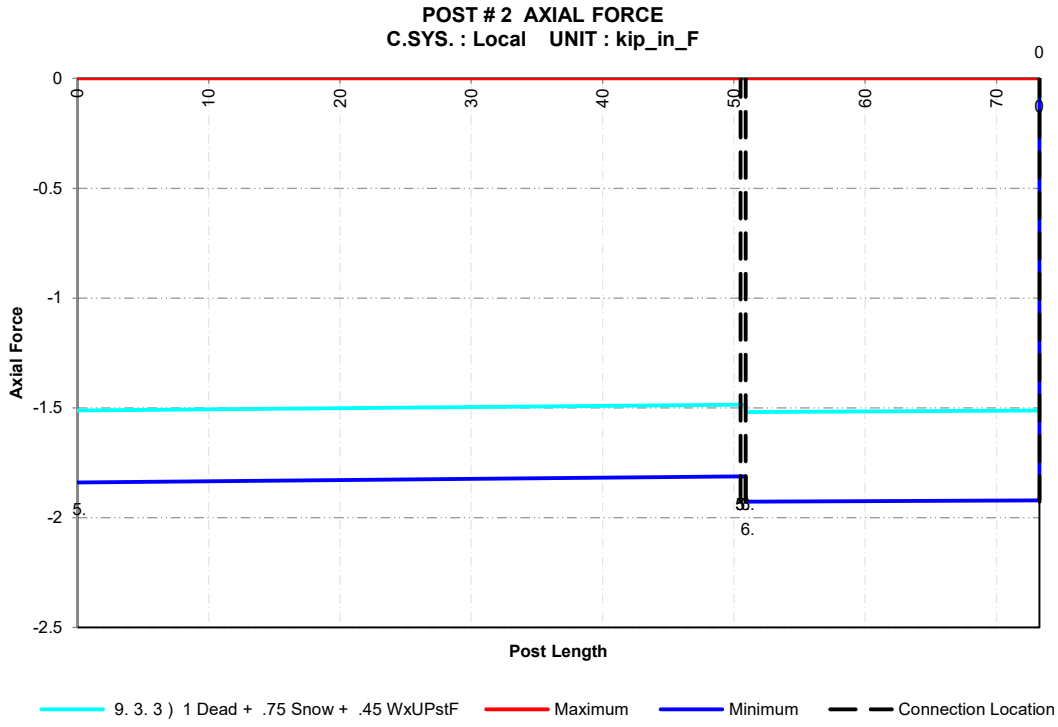
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*





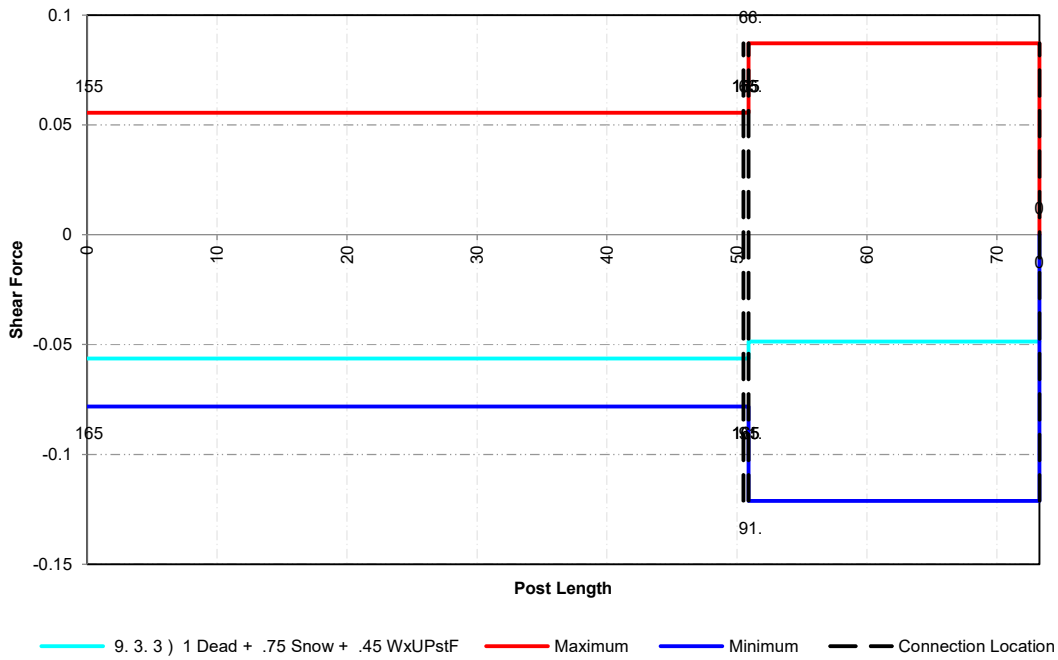
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*



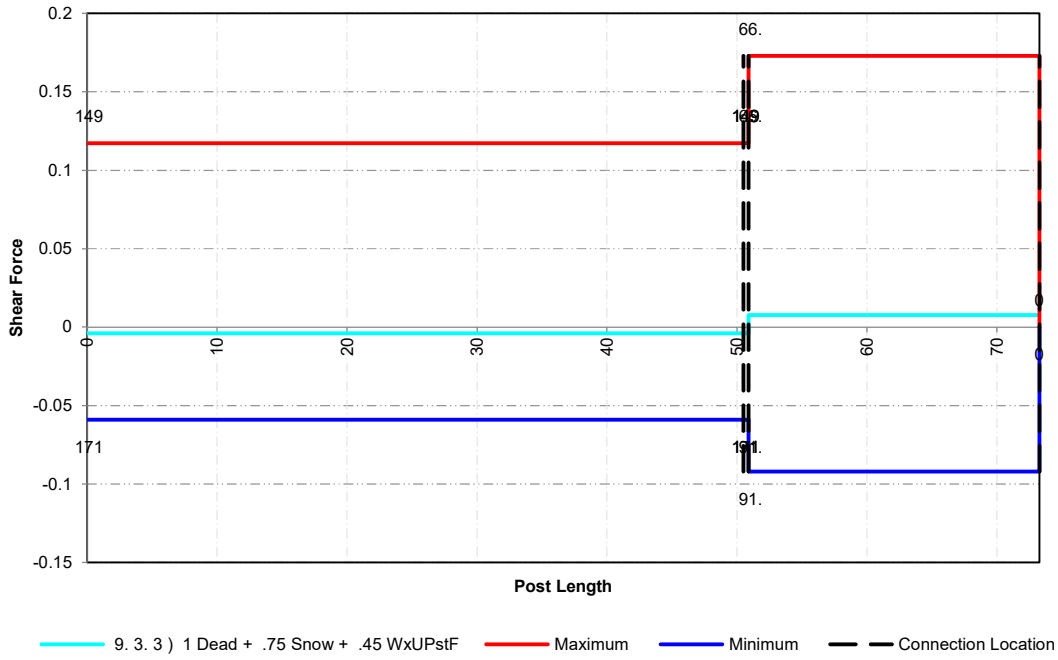


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

POST # 1 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F

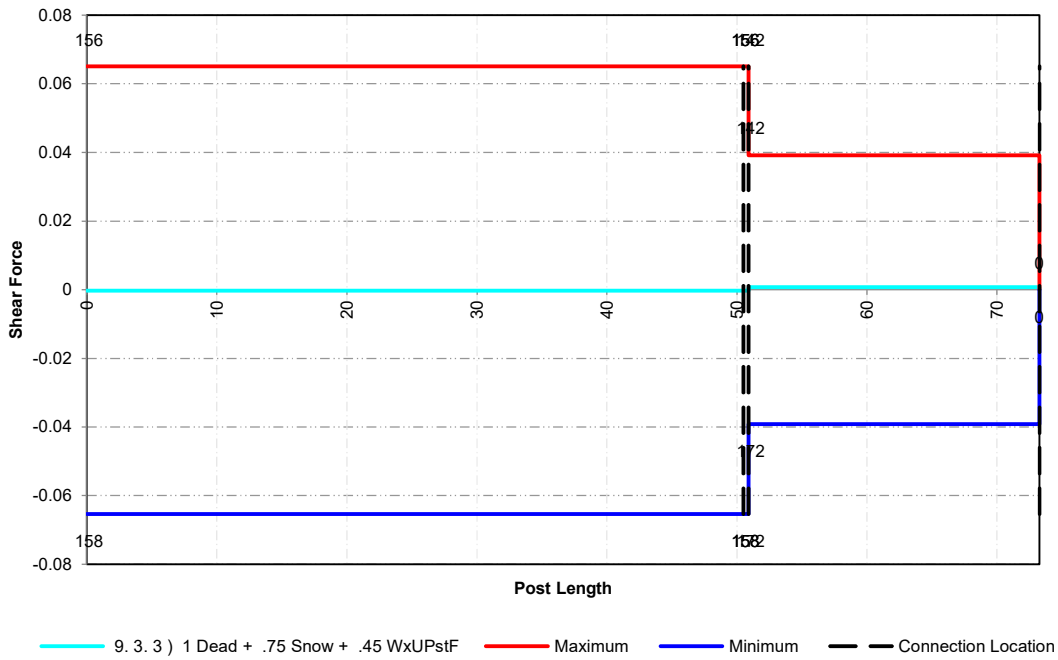


POST # 2 SHEAR FORCE - V2
C.SYS. : Local UNIT : kip_in_F



PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

POST # 1 SHEAR FORCE - V3
C.SYS. : Local UNIT : kip_in_F



POST # 2 SHEAR FORCE - V3
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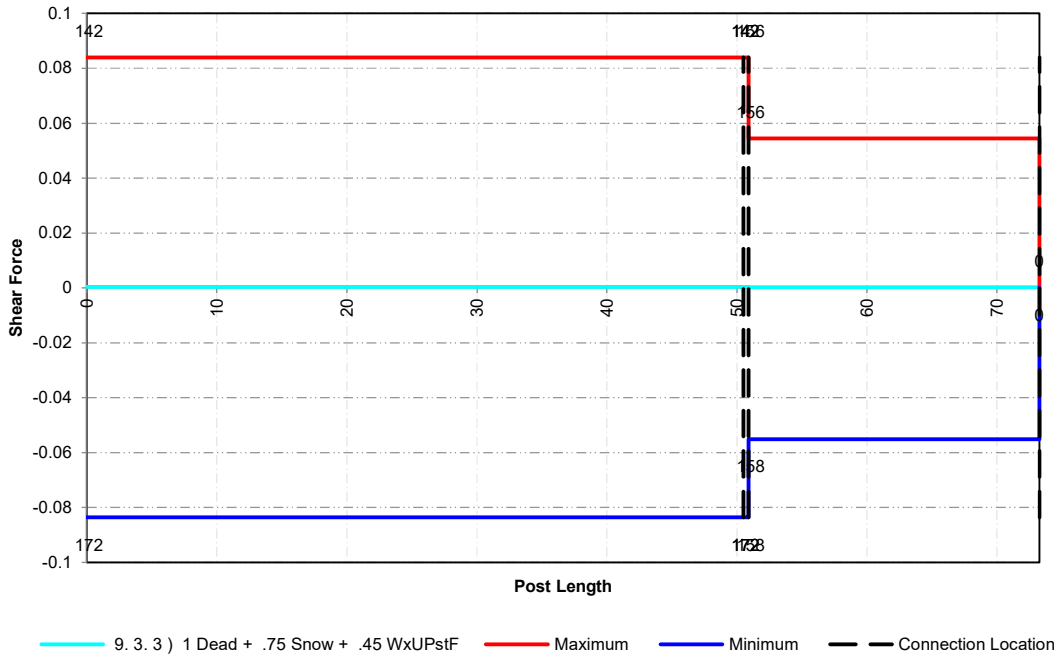
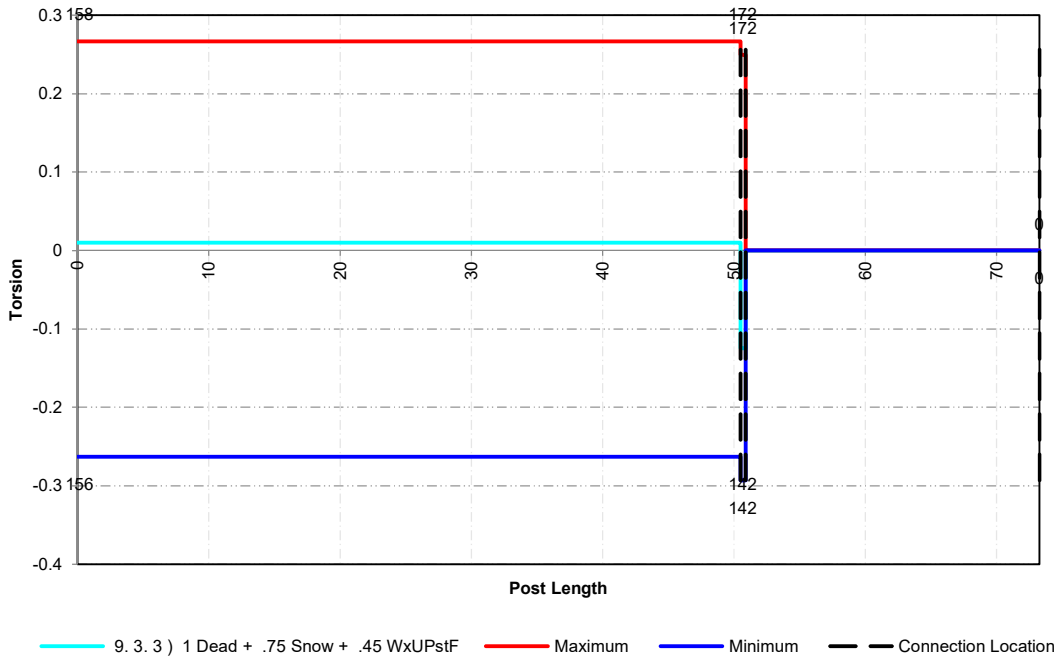


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

POST # 1 TORSION
C.SYS. : Local UNIT : kip_in_F



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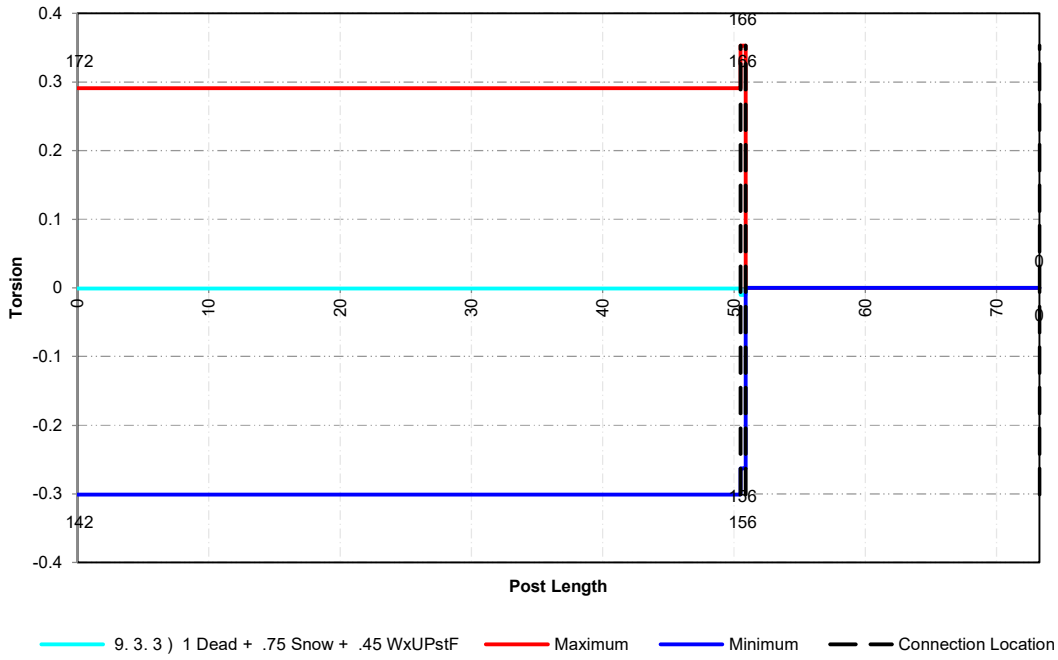
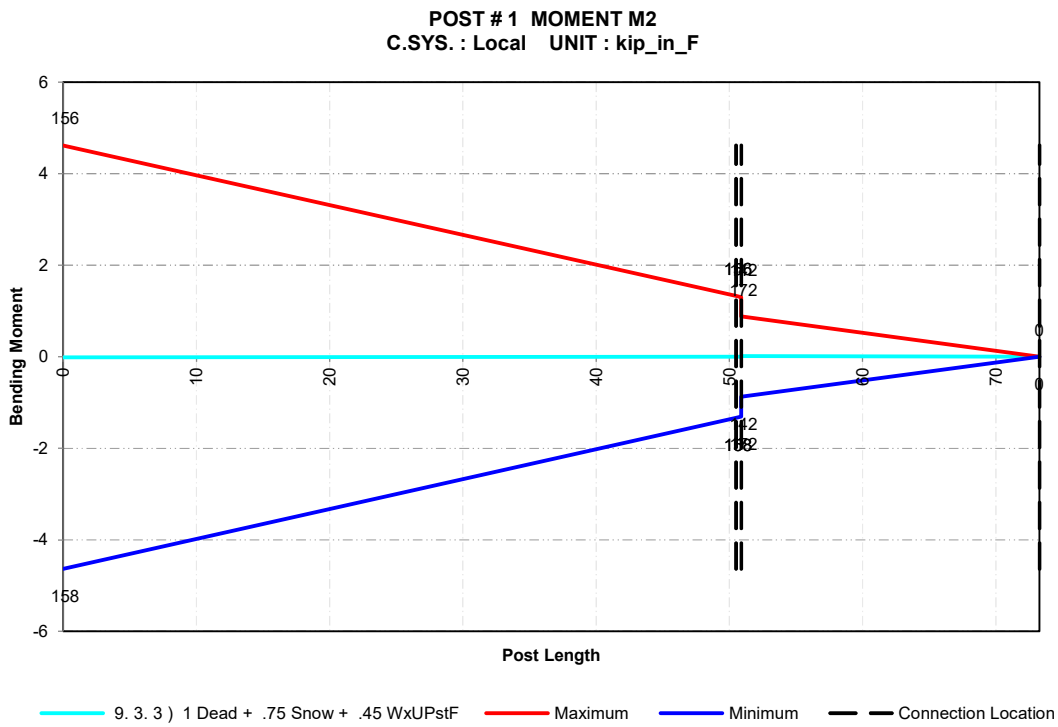
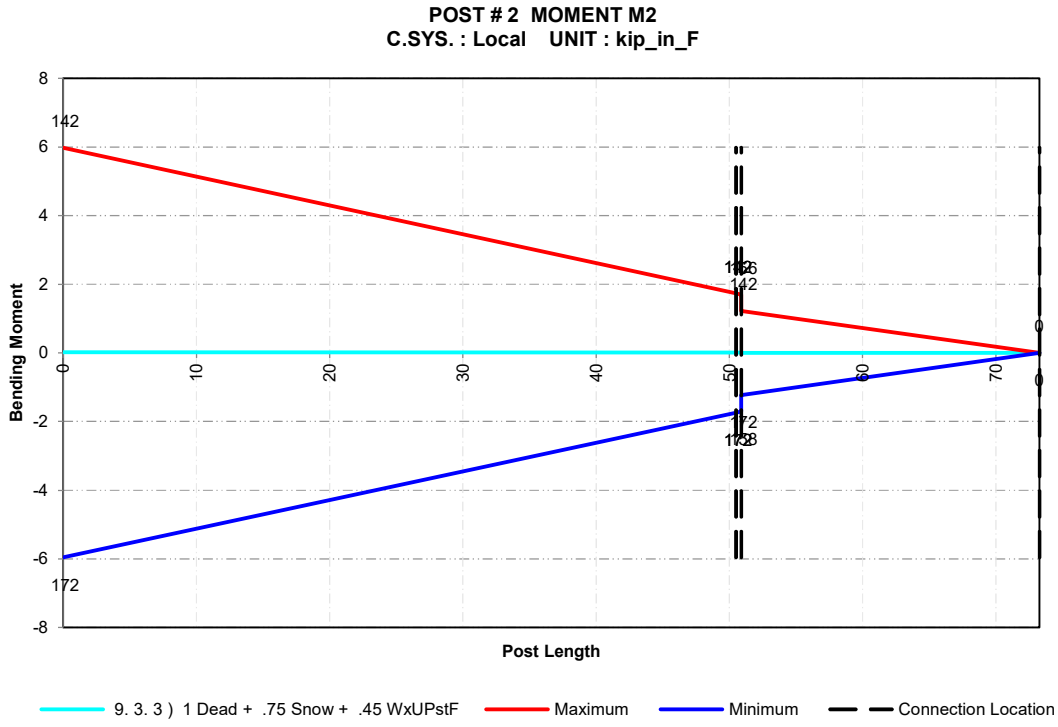


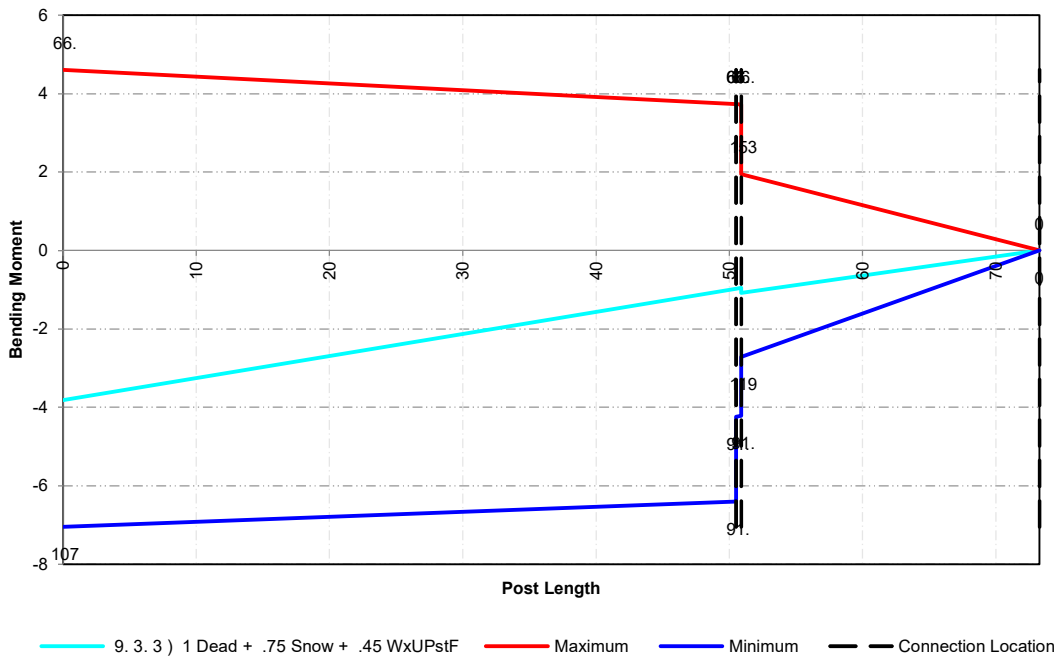
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*



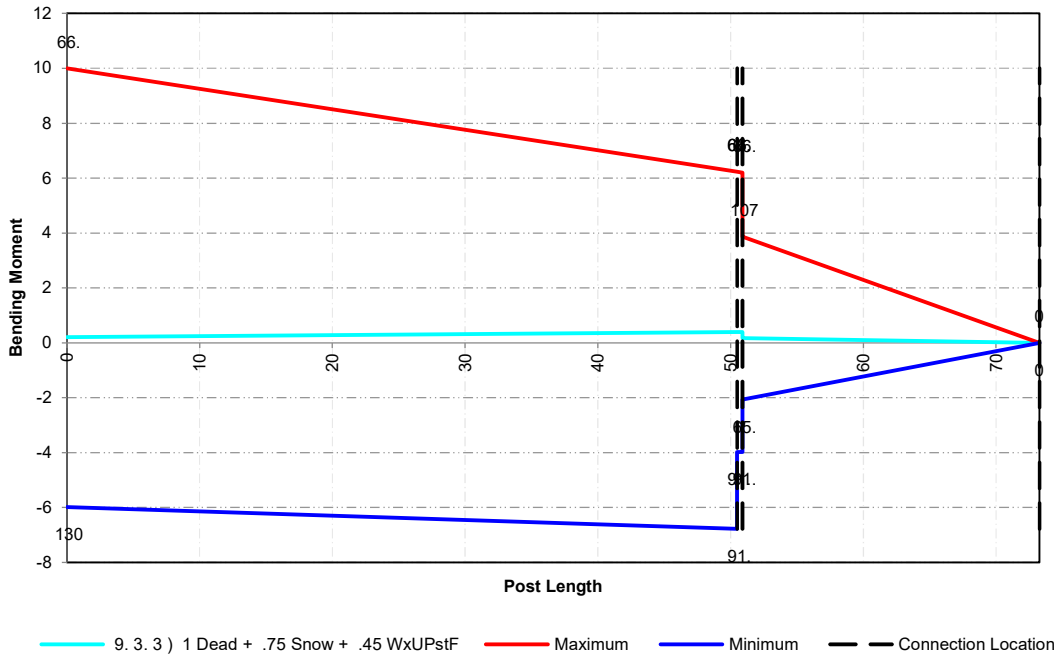


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-30 degree*

POST # 1 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



POST # 2 MOMENT M3
C.SYS. : Local UNIT : kip_in_F



PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

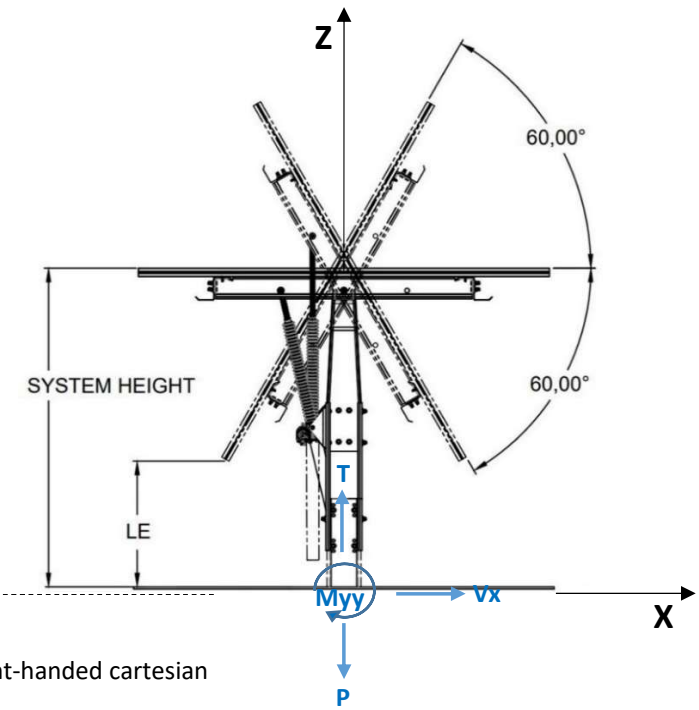
TABLE : *X25 (1P24 - SAT)*

CLASS : *Central 3 Posts*

L.E : *914.4 mm*

SYS. H : *1976 mm*

TILT : *-60 degree*



Note: Coordinate system is right-handed cartesian

Note:

Reaction Loads (Unfactored)								
Post	***Reaction***	***Dead***	***Snow***	***Ice***	***Wind***	***Seismic***	***Wind on Ice***	***Wind w/ Snow***
END	**P**	0.79	0.09	0.00	0.02	≈ 0	0.00	0.02
	T	n/a	0.00	n/a	-0.02	≈ 0	n/a	-0.02
	V_x	0.01	0 , 0	0.00	± 0.04	± 0.09	0.00	-0.04 , 0.04
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.04	-0.02 , 0.03	0.00	± 0.35	± 0.54	0.00	-0.27 , 0.35
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.52	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	0.98	0.11	0.00	0.03	≈ 0	0.00	0.03
	T	n/a	0.00	n/a	-0.03	≈ 0	n/a	-0.03
	V_x	-0.02	-0.01 , 0	0.00	± 0.05	± 0.11	0.00	-0.05 , 0.05
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	-0.20	-0.05 , 0.01	0.00	± 0.39	± 0.66	0.00	-0.34 , 0.39
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.68	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT : *Greenskies Clean Energy (7140)*

SITE : *CT, US*

MODULE : Module: Heliene

TABLE : *X25 (1P24 - SAT)*

LENGTH : *2279 mm*

CLASS : *Central 3 Posts*

WIDTH : *1134 mm*

LEADING EDGE : *914.4 mm*

THICKNESS : *35 mm*

SYSTEM HEIGHT : *1976 mm*

WEIGTH : *29.2 kg*

TILT POSITION : *-60 degree*

CHORD LENGTH : *27758 mm*

POST SPAN : *10230 mm*

CHORD CONTILEVER : *3649 mm*

Member / Section	Grade	Depth	Width	Thickness	Radious	Lip	Angle
Purlin / Z	GR_70	140	75	2.15	4	20	45
Splice / Z	GR_70	142.7	69	4.2	4	n/a	n/a
Pivot Arm - End / Ω	GR_70	see note *		2.3	note * : standard baseline section		
Pivot Arm - Mid / Ω	GR_70	see note *		2.7	note * : standard baseline section		
Omega Beam / Ω	GR_50	35	40	1.5	2	25	n/a
C Shape / U	GR_50	40	35	1.5	2	n/a	n/a
Pile / O - ext (int)	GR_50	88.9	n/a	4.5 (4.5)	n/a	n/a	n/a

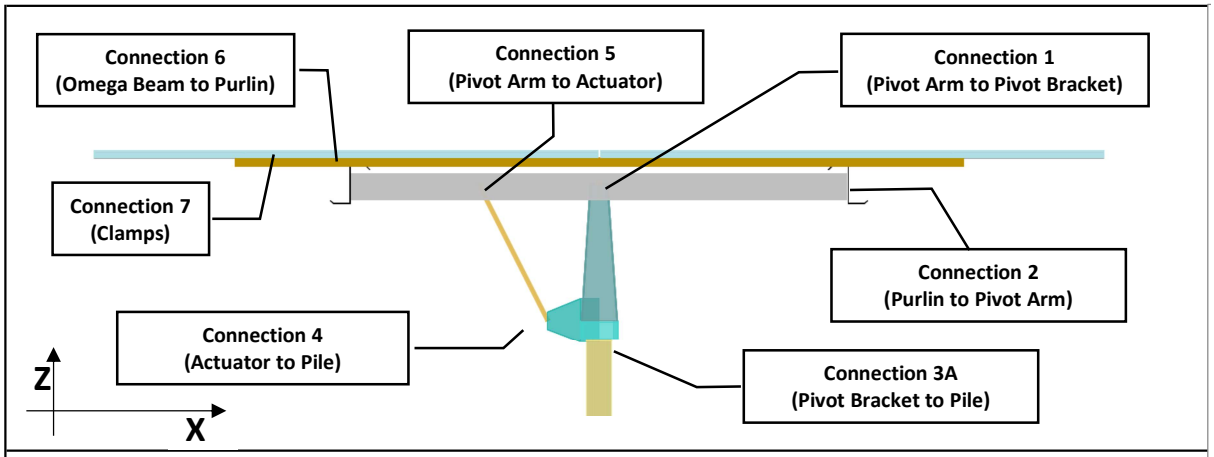
Note : Dimensions are in mm / Min. Number of Purlin Bottom Flange Braces is 3 # / span

Reaction Loads (Unfactored)

Post	*Reaction*	*Dead*	*Snow*	*Ice*	*Wind*	*Seismic*	*Wind on Ice*	*Wind w/ Snow*
END	**P**	0.79	0.09	0.00	0.02	≈ 0	0.00	0.02
	T	n/a	0.00	n/a	-0.02	≈ 0	n/a	-0.02
	V_x	0.01	0 , 0	0.00	± 0.04	± 0.09	0.00	-0.04 , 0.04
	V_y	0.00	0 , 0	0.00	± 0	± 0.09	0.00	± 0
	M_{yy}	0.04	-0.02 , 0.03	0.00	± 0.35	± 0.54	0.00	-0.27 , 0.35
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.52	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0
MIDDLE	**P**	0.98	0.11	0.00	0.03	≈ 0	0.00	0.03
	T	n/a	0.00	n/a	-0.03	≈ 0	n/a	-0.03
	V_x	-0.02	-0.01 , 0	0.00	± 0.05	± 0.11	0.00	-0.05 , 0.05
	V_y	0.00	0 , 0	0.00	± 0	± 0.12	0.00	± 0
	M_{yy}	-0.20	-0.05 , 0.01	0.00	± 0.39	± 0.66	0.00	-0.34 , 0.39
	M_{xx}	0.00	0 , 0	0.00	± 0	± 0.68	0.00	± 0
	M_{zz}	0.00	0 , 0	0.00	± 0	≈ 0	0.00	± 0

Note : P = Downforce (kip), T = Uplift Force (kip), V = Base Shear Force (kip), M = Bending Moment (kip.ft)

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-60 degree*

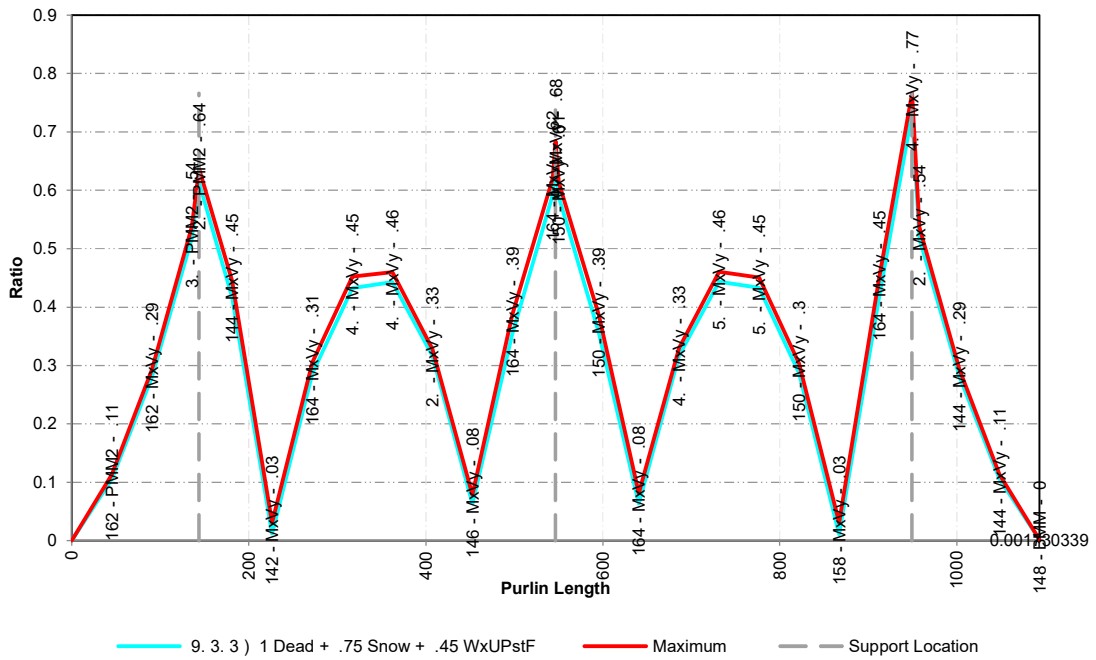


Note: coordinate system is right-handed cartesian

Fz	Fx	Fy	Mzz	Mxx	Myy	Load Combination
kip	*kip*	*kip*	*kip.ft*	*kip.ft*	*kip.ft*	*ASD Factored*
Connection : 1						
-1.25	0.05	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
-1.05	0.02	-0.04	0.00	0.00	0.00	158. 12. 2) 1 Dead + -.7 Quake_y
Connection : 2						
0.95	0.29	0.00	0.00	0.01	0.09	149. 10. 7) 1 Dead + .75 S3_lhhl + .525 Quake_x
0.95	0.29	0.00	0.00	0.01	0.09	149. 10. 7) 1 Dead + .75 S3_lhhl + .525 Quake_x
Connection : 3						
-0.57	-0.01	0.00	0.00	0.00	-0.11	136. 5. 22) .6 Dead + .6 WxUPst+T
-1.09	0.03	0.00	0.00	0.00	0.25	5. 2. 4) 1 Dead + 1 S3_lhhl
-0.98	0.10	0.00	0.00	0.00	0.66	141. 9. 1) 1 Dead + .7 Quake_x
-0.98	0.10	0.00	0.00	0.00	0.66	141. 9. 1) 1 Dead + .7 Quake_x
-0.98	0.02	0.08	-0.02	0.48	0.20	142. 9. 2) 1 Dead + .7 Quake_y
-0.98	0.02	0.08	-0.02	0.48	0.20	142. 9. 2) 1 Dead + .7 Quake_y
Connection : 4		** Note : the load is axial in actuator direction*				
0.24	*	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
Connection : 5		** Note : the load is axial in actuator direction*				
0.24	*	0.00	0.00	0.00	0.00	66. 3. 97) 1 Dead + .75 S4_s2s_+ + .45 WxDNstH
Connection : 6		*Note : see half strip panel uplift, self weight is not considered conservatively*				
0.00						0.6 WLup
Connection : 7		*Note : see half strip panel uplift, self weight is not considered conservatively*				
0.00						0.6 WLup

PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-60 degree*

PURLIN # 1 UNITY RATIO



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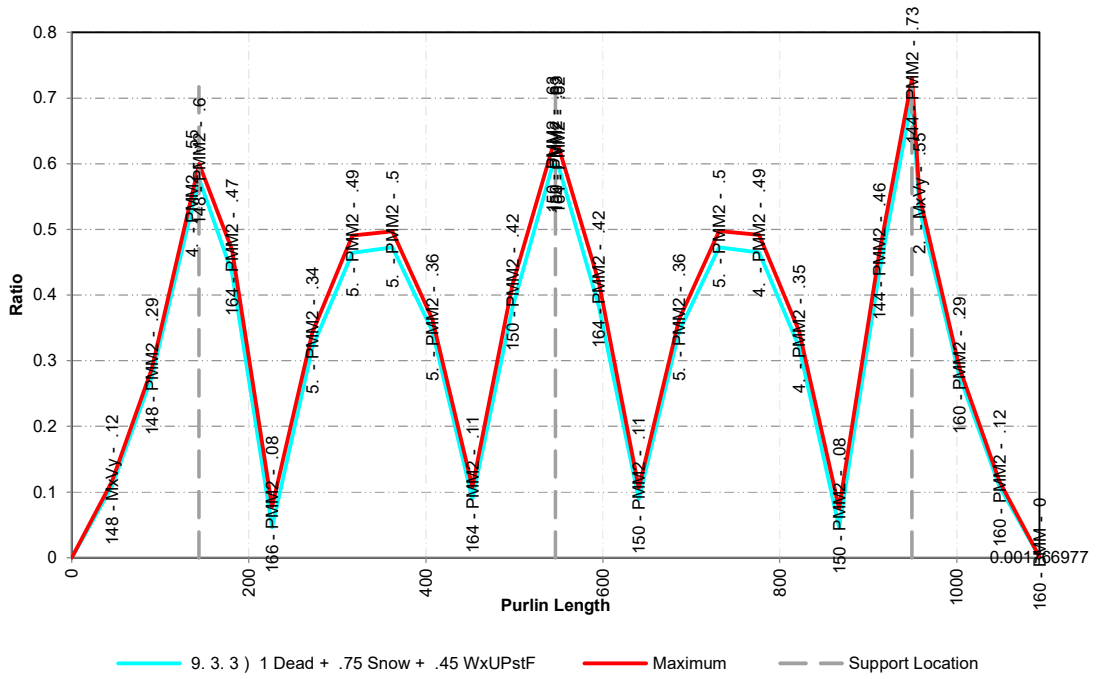
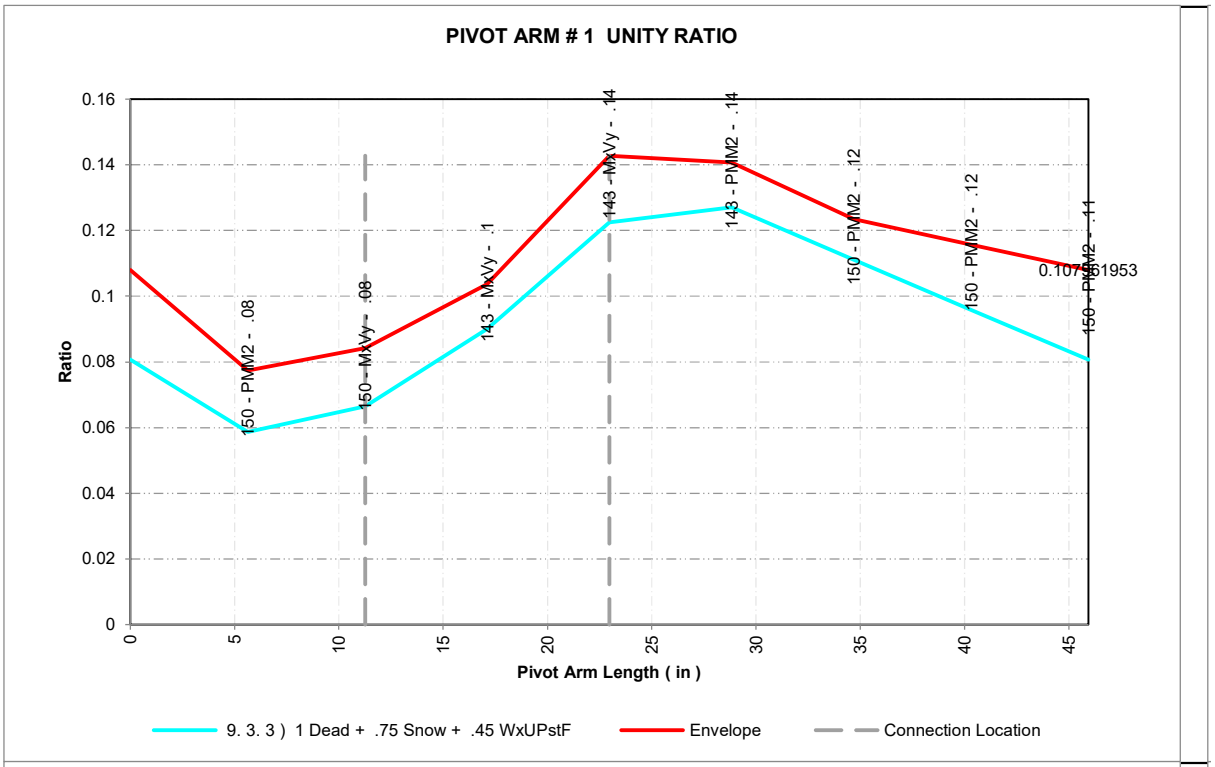
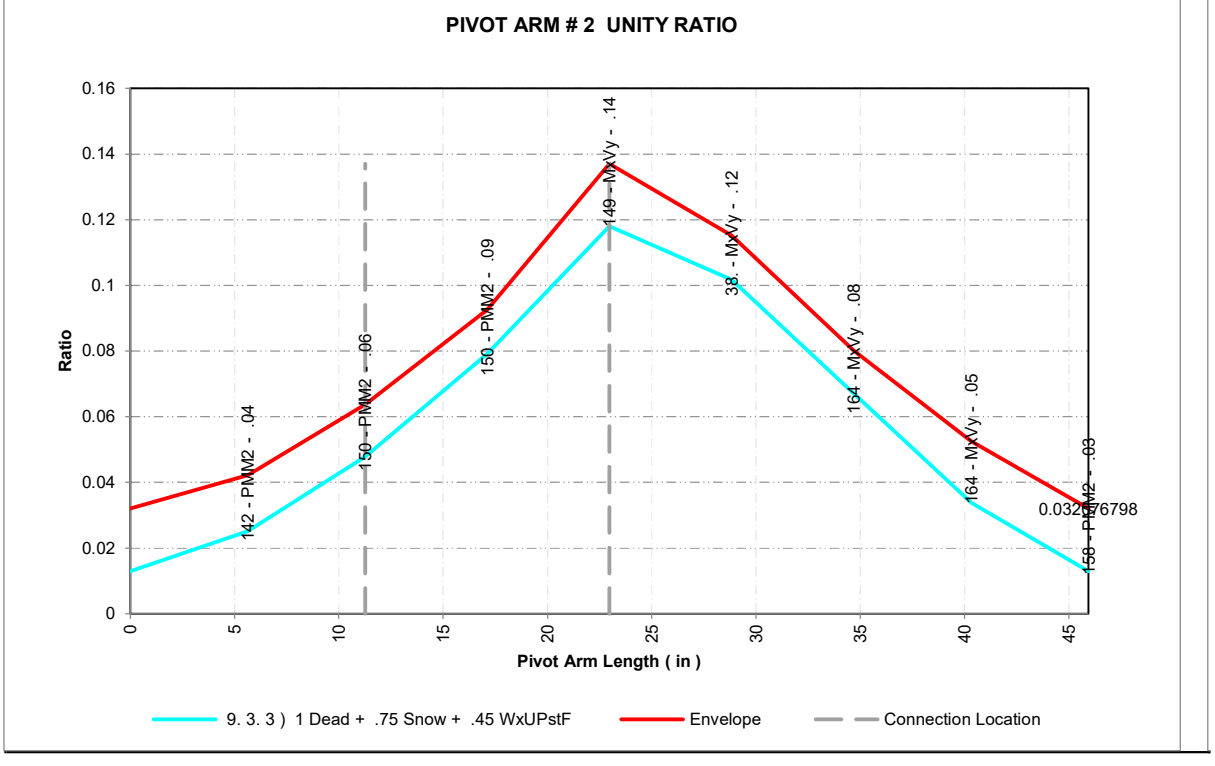


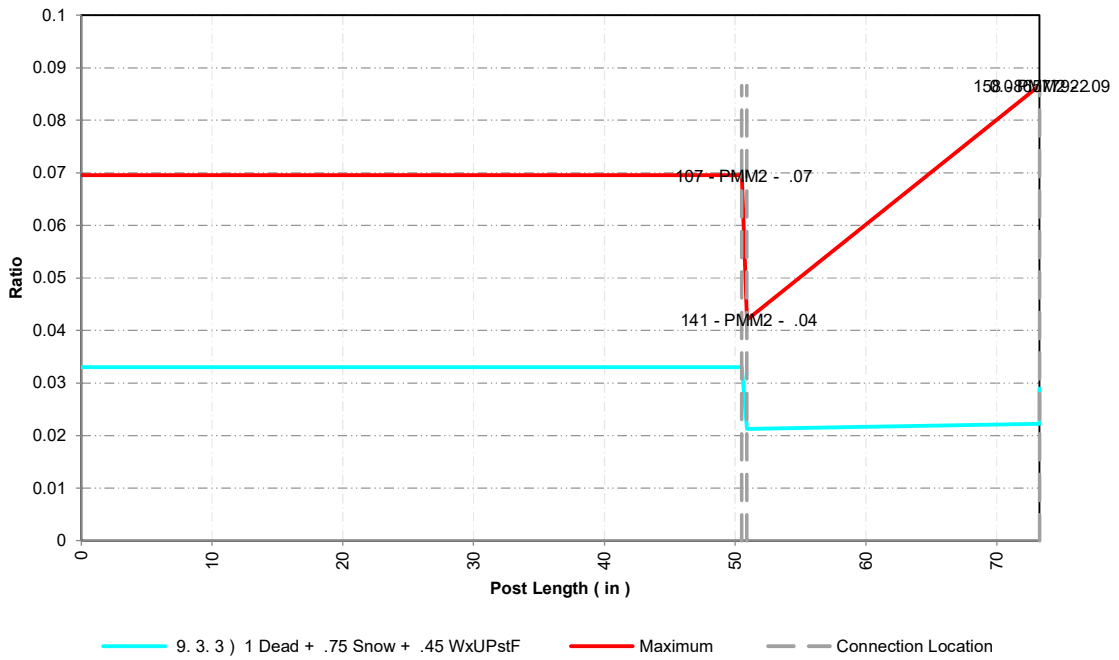
PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-60 degree*



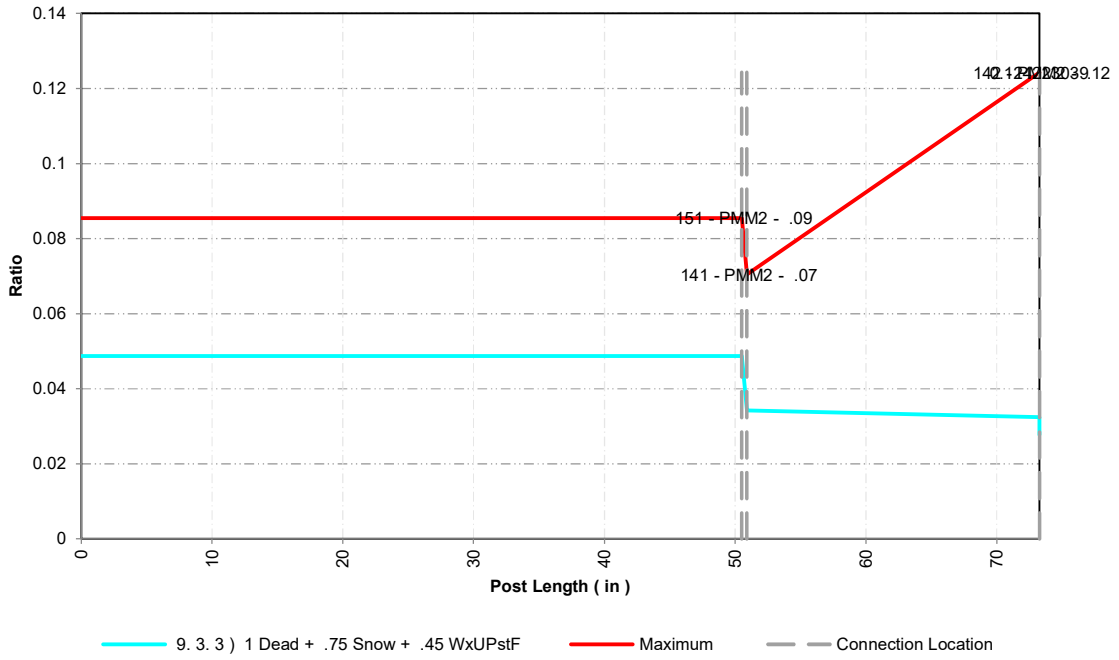


PROJECT: *Greenskies Clean Energy (714*	**TABLE :** *X25 (1P24 - SAT)*	**L.EDGE :** *914.4 mm*
SITE : *CT, US*	**CLASS :** *Central 3 Posts*	**TILT :** *-60 degree*

POST # 1 UNITY RATIO



POST # 2 UNITY RATIO



FINAL DESIGN SUMMARY

Below is the summary of member maximum interaction ratios for all the tilt angles and Final member thickness are also presented below for X20 and X25 tables.

Table Type	Tilt Angle	Purlin, (mm)	Pivot Arm, (mm)		Post (mm)	Splice (mm)	Unity check (Maximum Envelope case)							
			End	Mid			Purlin-1	Purlin-2	Splice-1	Splice-2	Pivot arm-1	Pivot arm-2	Post-1	Post-2
X20	0	1.95	3.1	-	4.5	-	0.7	0.86	-	-	0.85	0.85	0.83	0.83
	3	1.95	3.1	-	4.5	-	0.8	0.99	-	-	0.97	0.98	0.91	0.91
	-3	1.95	3.1	-	4.5	-	0.99	0.8	-	-	0.7	0.7	0.91	0.91
	30	1.95	3.1	-	4.5	-	0.68	0.7	-	-	0.25	0.25	0.18	0.18
	-30	1.95	3.1	-	4.5	-	0.73	0.65	-	-	0.23	0.23	0.18	0.18
	-60	1.95	3.1	-	4.5	-	0.59	0.56	-	-	0.09	0.09	0.12	0.12
X25	0	2.15	2.3	2.7	4.5	4.2	0.61	0.74	0.57	0.7	0.82	0.79	0.49	0.57
	3	2.15	2.3	2.7	4.5	4.2	0.61	0.88	0.57	0.84	0.96	0.93	0.65	0.76
	-3	2.15	2.3	2.7	4.5	4.2	0.82	0.65	0.77	0.61	0.76	0.73	0.65	0.76
	30	2.15	2.3	2.7	4.5	4.2	0.91	0.96	0.8	0.92	0.39	0.38	0.14	0.17
	-30	2.15	2.3	2.7	4.5	4.2	0.99	0.89	0.92	0.8	0.38	0.38	0.14	0.17
	-60	2.15	2.3	2.7	4.5	4.2	0.77	0.73	0.68	0.62	0.14	0.14	0.09	0.12

Members	Module	Thickness, (mm)	Material Grade
Purlins	X20	**1.95**	Gr.70
	X25	**2.15**	Gr.70
Pivot Arm	X20	**3.1**	Gr.70
	X25-Mid	**2.7**	Gr.70
	X25-End	**2.3**	Gr.70
Post	X20	**4.5**	Gr.50
	X25	**4.5**	Gr.50
Splice	X25	**4.2**	Gr.70