Otegui Structural Services, LLC
10812 West Powers Place Littleton, CO 80127
Phone: 720-981-5333
e-mail: mikeo@oteguieng.com

October 26, 2012

Charles Steckly
Charles Steckly Architecture
5935 S. Zang St
Suite 280
Littleton, CO 80127

RE:CO1 Hayden
N:40-24-47.4 W:-107-6-41.7
Routt County, Colorado
Verizon Wireless # 803

Dear Charles:
I am writing you this letter in response to your request for analysis of an existing 30'-0" three sided Rohn self supported tower with the intent to remove existing Omni antennas and replace with new flat panel antennas and 7/8" coax lines.

Analysis was done using the following: TIA/EIA-222-G code, 90 mph (3-sec gust), Exposure C, or 50 mph with ½" ice for maximum stress calculations, and a 60 mph wind speed for deflection calculations.

Our analysis based on the information in the attached report finds that the tower will have a **rating of 57%, or satisfactory** for the new loading conditions. Please refer to the attached report for more details.

Please feel free to call us with any questions or concerns.

Sincerely:

Michael A. Otegui, P.E.
Otegui Structural Services, LLC

COLORADO REGISTERED
MICHAEL A. OTEGUI
33955
PROFESSIONAL ENGINEER

GENERAL

The purpose of this report is to analyze an existing Rohn three sided self supporting tower with the intent to remove existing Omni antennas and coax, and install (15) new flat panel antennas and coax to determine if it complies with the TIA/EIA-222-G code and the current International Building Code.

The tower is 30 ft tall with steel pipe legs and steel pipe diagonals. See attached output for a more detailed description of geometry.

The existing tower is located in Routt County, Colorado. Wind load of 90 mph (3-sec gust), exposure C is required for the County. Tower is located on top of a hill therefore a topographic category of 3 was used.

INFORMATION PROVIDED FOR ANALYSIS

Analysis was based on tower drawings by Rohn Communications Corporation dated 1996, a report by Tower Technologies Inc. dated 2002, and a report by BCI Wireless dated 2007. All framing member sizes and steel grades were taken from these reports.

ASSUMPTIONS

Tower is assumed to be in good condition with no modifications from original design. All appurtenance information were provided by others.

DESIGN CRITERIA

The following is the design criteria used for this report:

- Tower is located in Routt County, Colorado.
- Basic wind speed of 90 mph.
- Structure Class III.
- Exposure Category C.
- Topographic Category 3.
- Crest Height 200 ft.
- Nominal ice thickness of 0.500 in.
- Ice thickness is considered to increase with height.
- Ice density of 56 pcf.
- A wind speed of 50 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 60 mph.
- Pressures are calculated at each section.
- Stress ratio used in tower member design is 1.

APPURTENANCES

The following appurtenaces attached to the tower were used in the analysis:

- (2) 7'-10"x10" LPD-6516 flat panel antennas at elevation 30' **(new)**
- (2) 5'-11"x6" LPA-185063-12CF flat panel antennas at elevation 30' **(new)**
- (4) 5'-11"x4" LPA-185080-12CF flat panel antennas at elevation 30' **(new)**
- (1) 7'-11"x11" BXA-70063-8CF flat panel antenna at elevation 30' **(new)**
- (2) 5'-11"x8" BXA-70080-6CF flat panel antenna at elevation 30' **(new)**
- (4) 5'-11"x6" LPA-80080-6CF flat panel antennas at elevation 30' **(new)**
- (18) 7/8" coax to elevation 30' **(new)**
- (1) 8'-0" diameter Microwave Dish with 7/8" Coax (existing)
- (1) Lightning rod **(new)**
- Feed line ladder full height (existing)

RESULTS

The analysis finds that the tower will have a rating of 57%. That is, the highest stress on any one member is at 57% of its code allowed maximum.

Highest stressed members are as follows:

Diagonals	57%
Leg	51%
Bolts	24%

Maximum deflections at service loading can be expected as follows:

Elevation	Deflection	Tilt	Twist
175ft	0.11"	0.02°	0.02°

Un-Factored total foundation reactions are as follows: Shear = 8 kips, Vertical = 14 kips, Overturning moment = 179 kip-ft. All values are in the range of the Rohn design values of: Shear =15 kips, Vertical = 44 kips, Overturning moment = 313 kip-ft. Therefore it can be assumed that the existing foundations are adequate for the new loading.

See output for a more detailed summary of all members.

CONCLUSIONS

In our opinion the tower is **adequate** for the addition of new coax cables and flat panel antennas described above.

No attempt was made by Otegui Structural Services LLC to verify sizes, elevations or condition of the existing tower or framing. All framing information used in this report was provided by others. It is assumed that the tower is in good condition with no deterioration. Owner should verify that the tower is in good condition. This report does not imply a warranty for the tower.

DESIGNED APPURTENANCE LOADING

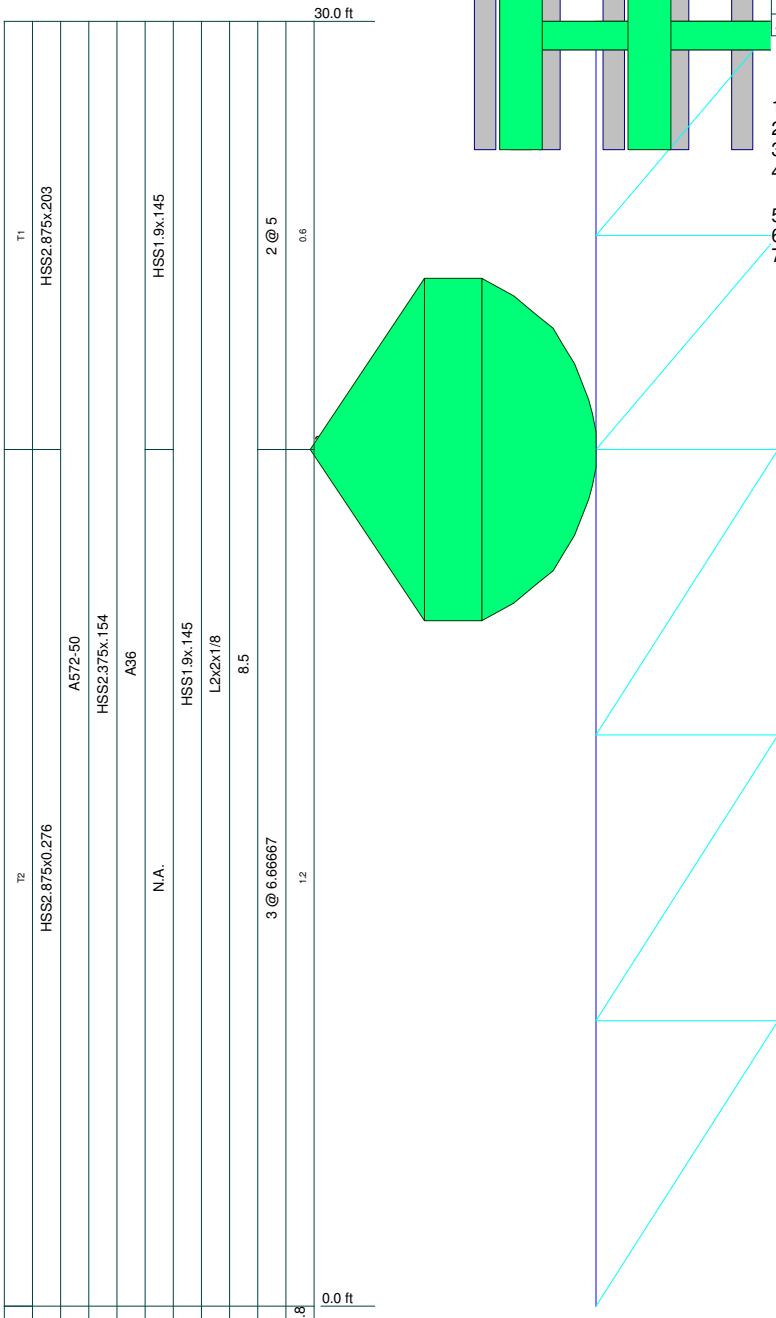
TYPE	ELEVATION	TYPE	ELEVATION
8' Lightning Rod	35	LPA-80080/6CF	30
LPA-185063-12CF-EDIN	30	LPA-80080/6CF	30
BXA-70063-8CF-DIN-X-FP	30	LPA-185080-12CF	30
LPD-6516 w/Mount Pipe	30	LPA-185080-12CF	30
LPD-6516 w/Mount Pipe	30	BXA-7080-6CF	30
LPA-80080/6CF	30	VFA12-U 12'-6" V-Frame	30
LPA-80080/6CF	30	VFA12-U 12'-6" V-Frame	30
LPA-185080-12CF	30	VFA12-U 12'-6" V-Frame	30
LPA-185080-12CF	30	LPA-185063-12CF-EDIN	30
BXA-7080-6CF	30	8' PAD w/ Radome	20

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi	A36	36 ksi	58 ksi

TOWER DESIGN NOTES

1. Tower is located in Routt County, Colorado.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 90 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 50 mph basic wind with 0.50 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Structure Class III.
7. Topographic Category 3 with Crest Height of 200.000 ft



Section											
Legs	HSS2.875x.203										HSS2.875x0.276
Leg Grade		A572-50									
Diagonals			HSS2.375x.154								
Diagonal Grade				A36							
Top Girts					N.A.						
Horizontals						HSS1.9x.145					
Inner Bracing							L2x2x1/8				
Face Width (ft)								8.5			
# Panels @ (ft)	2 @ 5								3 @ 6.66667		
Weight (K)											

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 39 K
UPLIFT: -38 K
SHEAR: 6 K

AXIAL 15 K
SHEAR 3 K
MOMENT 78 kip-ft
TORQUE 2 kip-ft
50 mph WIND - 0.500 in ICE

AXIAL 5 K
SHEAR 13 K
MOMENT 287 kip-ft
TORQUE 11 kip-ft
REACTIONS - 90 mph WIND

Otegui Structural Services, LLC
10812 West Powers Place
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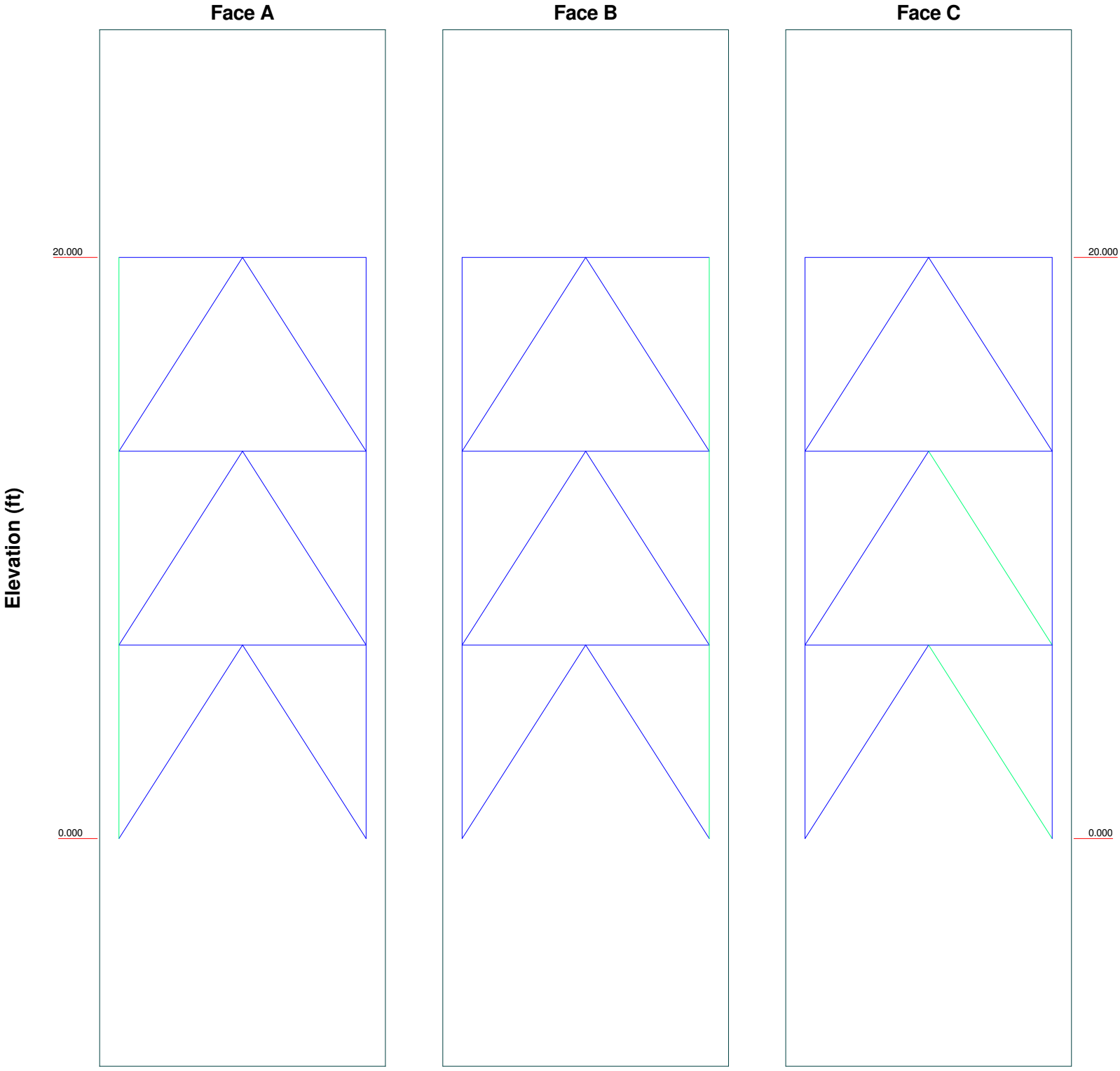
Phone: 720-981-5333
FAX:

Job: ***CO1 Hayden***			
Project: ***212120***			
Client: Verizon Wireless	Drawn by: Mike Otegui		App'd:
Code: TIA-222-G	Date: 10/26/12		Scale: NTS
Path: C:\Otegui Structural Services\Job Files\212120-CO1 Hayden\212120-CO1 Hayden.eri			Dwg No. E-1

Stress Distribution Chart
0' - 20'

> 100% | 90%-100% | 75%-90% | 50%-75% | < 50% Overstress



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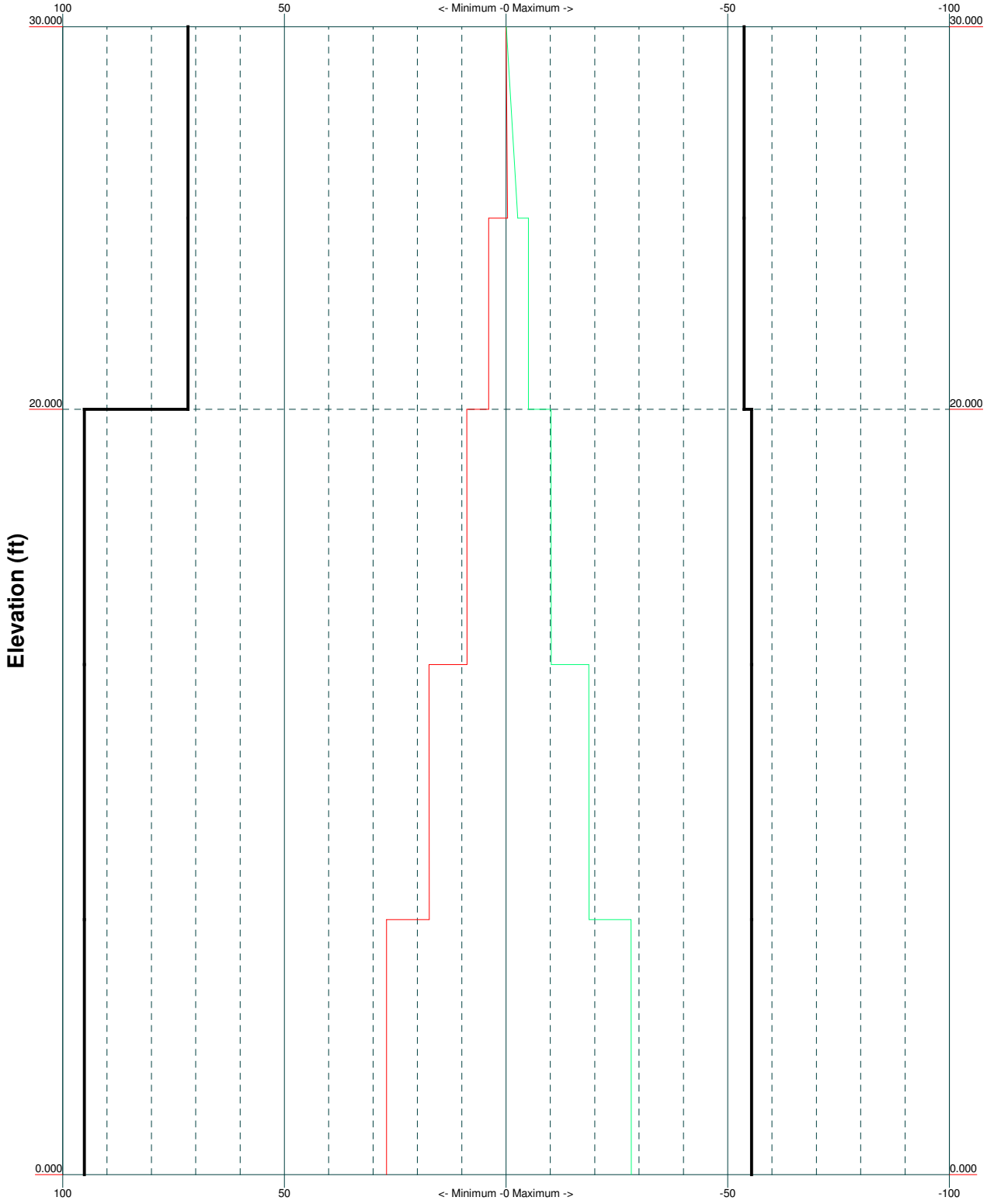
Job: ***CO1 Hayden***			
Project: ***212120***			
Client: Verizon Wireless	Drawn by: Mike Otegui	App'd:	
Code: TIA-222-G	Date: 10/26/12	Scale: NTS	
Path: C:\Otegui Structural Services\Job Files\212120-CO1 Hayden\212120-CO1 Hayden.eri		Dwg No. E-8	

TIA-222-G - 90 mph/50 mph 0.500 in Ice Exposure C

Leg Capacity ——— **Leg Compression (K)**



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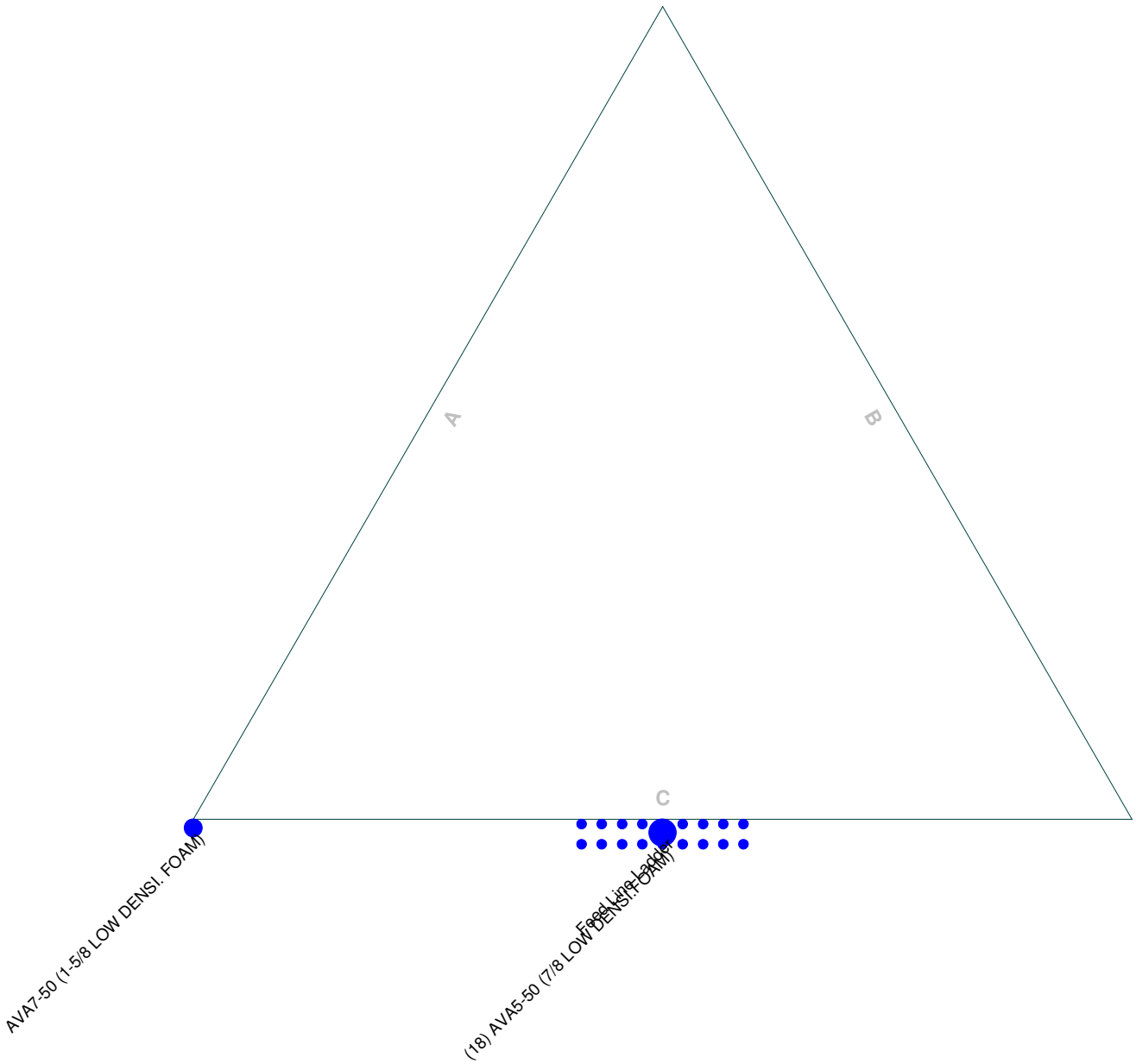
Job: ***CO1 Hayden***			
Project: ***212120***			
Client: Verizon Wireless	Drawn by: Mike Otegui		App'd:
Code: TIA-222-G	Date: 10/26/12		Scale: NTS
Path: C:\Otegui Structural Services\Job Files\212120-CO1 Hayden\212120-CO1 Hayden.eri			Dwg No. E-3

Feedline Plan

Round Flat App In Face App Out Face



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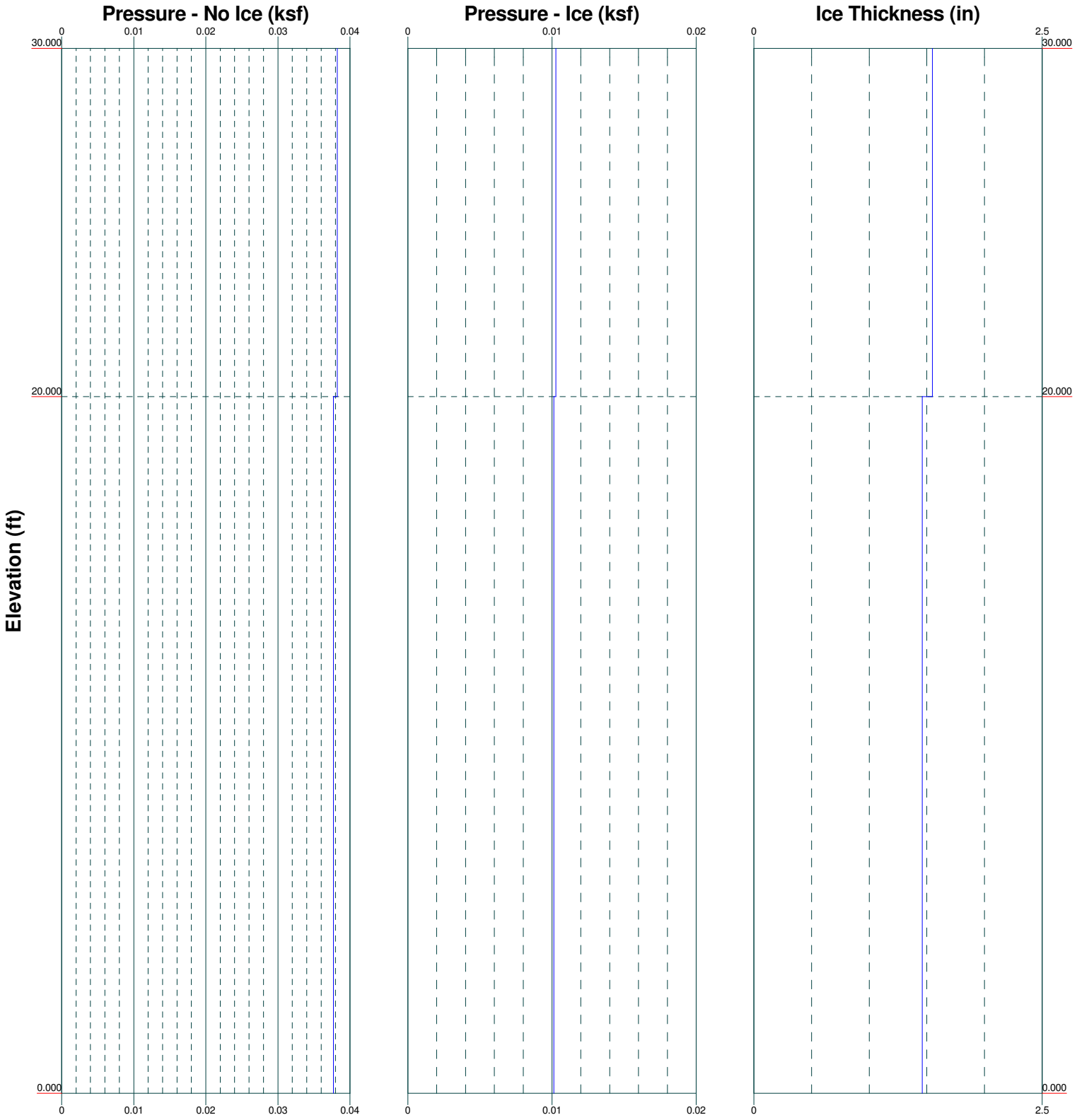
Job: ***CO1 Hayden***			
Project: ***212120***			
Client: Verizon Wireless	Drawn by: Mike Otegui	App'd:	
Code: TIA-222-G	Date: 10/26/12	Scale: NTS	
Path: C:\Otegui Structural Services\Job Files\212120-CO1 Hayden\212120-CO1 Hayden.eri		Dwg No. E-7	

Wind Pressures and Ice Thickness

TIA-222-G - 90 mph/50 mph 0.500 in Ice Exposure C



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Code: TIA-222-G	Date: 10/26/12		Scale: NTS
Path: C:\Otegui Structural Services\Job Files\212120-CO1 Hayden\212120-CO1 Hayden.eri			Dwg No. E-9

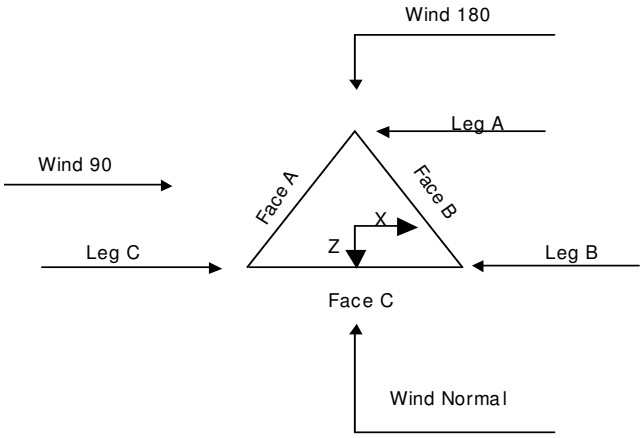
Tower Input Data

The main tower is a 3x free standing tower with an overall height of 30.000 ft above the ground line.
The base of the tower is set at an elevation of 0.000 ft above the ground line.
The face width of the tower is 8.500 ft at the top and 8.500 ft at the base.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

Tower is located in Routt County, Colorado.
Basic wind speed of 90 mph.
Structure Class III.
Exposure Category C.
Topographic Category 3.
Crest Height 200.000 ft.
Nominal ice thickness of 0.500 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 50 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 60 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in tower member design is 1.
Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs	Distribute Leg Loads As Uniform	Treat Feedline Bundles As Cylinder
Consider Moments - Horizontals	Assume Legs Pinned	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Diagonals	√ Assume Rigid Index Plate	√ Calculate Redundant Bracing Forces
Use Moment Magnification	√ Use Clear Spans For Wind Area	Ignore Redundant Members in FEA
√ Use Code Stress Ratios	√ Use Clear Spans For KL/r	SR Leg Bolts Resist Compression
√ Use Code Safety Factors - Guys	√ Retension Guys To Initial Tension	√ All Leg Panels Have Same Allowable
Escalate Ice	Bypass Mast Stability Checks	Offset Girt At Foundation
Always Use Max Kz	√ Use Azimuth Dish Coefficients	√ Consider Feedline Torque
Use Special Wind Profile	√ Project Wind Area of Appurt.	Include Angle Block Shear Check
√ Include Bolts In Member Capacity	√ Autocalc Torque Arm Areas	Poles
√ Leg Bolts Are At Top Of Section	SR Members Have Cut Ends	Include Shear-Torsion Interaction
√ Secondary Horizontal Braces Leg	Sort Capacity Reports By Component	Always Use Sub-Critical Flow
Use Diamond Inner Bracing (4 Sided)	√ Triangulate Diamond Inner Bracing	Use Top Mounted Sockets
Add IBC .6D+W Combination		



Triangular Tower

Tower Section Geometry

Tower Section	Tower Elevation ft	Assembly Database	Description	Section Width ft	Number of Sections	Section Length ft
T1	30.000-20.000			8.500	1	10.000
T2	20.000-0.000			8.500	1	20.000

Tower Section Geometry *(cont'd)*

Tower Section	Tower Elevation ft	Diagonal Spacing ft	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset in	Bottom Girt Offset in
T1	30.000-20.000	5.000	K Brace Down	No	Yes	0.000	0.000
T2	20.000-0.000	6.667	K Brace Down	No	Yes	0.000	0.000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 30.000-20.000	Pipe	HSS2.875x.203	A572-50	Pipe	HSS2.375x.154	A36

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T2 20.000-0.000	Pipe	HSS2.875x0.276	(50 ksi) A572-50 (50 ksi)	Pipe	HSS2.375x.154	(36 ksi) A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	No. of Mid Girts	Mid Girt Type	Mid Girt Size	Mid Girt Grade	Horizontal Type	Horizontal Size	Horizontal Grade
T1 30.000-20.000	None	Flat Bar		A36 (36 ksi)	Pipe	HSS1.9x.145	A36 (36 ksi)
T2 20.000-0.000	None	Flat Bar		A36 (36 ksi)	Pipe	HSS1.9x.145	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Secondary Horizontal Type	Secondary Horizontal Size	Secondary Horizontal Grade	Inner Bracing Type	Inner Bracing Size	Inner Bracing Grade
T1 30.000-20.000	Solid Round		A572-50 (50 ksi)	Single Angle	L2x2x1/8	A36 (36 ksi)
T2 20.000-0.000	Solid Round		A572-50 (50 ksi)	Single Angle	L2x2x1/8	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
T1 30.000-20.000	0.000	0.250	A36 (36 ksi)	1	1	1	36.000	36.000
T2 20.000-0.000	0.000	0.250	A36 (36 ksi)	1	1	1	36.000	36.000

Tower Section Geometry *(cont'd)*

K Factors[1]

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T1	Yes	Yes	1	1	1	1	1	1	1	1
30.000-20.000				1	1	1	1	1	1	1
T2	Yes	Yes	1	1	1	1	1	1	1	1
20.000-0.000				1	1	1	1	1	1	1

[1]*Note: K factors are applied to member segment lengths. K-braces without inner supporting members will have the K factor in the out-of-plane direction applied to the overall length.*

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U
T1	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
30.000-20.000														
T2	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
20.000-0.000														

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Connection Type	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
		Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.
T1	Flange	0.625 A325N	4	0.625 A325N	3	0.625 A325N	2	0.625 A325N	2	0.625 A325N	0	0.625 A325N	2	0.625 A325N	0
30.000-20.000															
T2	Flange	0.750 A325N	4	0.625 A325N	3	0.625 A325N	2	0.625 A325N	2	0.625 A325N	0	0.625 A325N	2	0.625 A325N	0
20.000-0.000															

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight klf
AVA5-50 (7/8 LOW DENSI.FOAM)	C	No	Ar (CaAa)	30.000 - 0.000	0.000	0	18	9	1.100	1.100		0.000
AVA7-50 (1-5/8 LOW DENSI. FOAM)	C	No	Ar (CaAa)	20.000 - 0.000	0.000	0.5	1	1	1.980	1.980		0.001
Feed Line	C	No	Ar (CaAa)	30.000 - 0.000	0.000	0	1	1	3.000	3.000		0.002

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight klf
Ladder												

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
T1	30.000-20.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	22.697	0.000	0.074
T2	20.000-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	49.393	0.000	0.162

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
T1	30.000-20.000	A	1.548	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	34.492	0.000	0.621
T2	20.000-0.000	A	1.459	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	77.873	0.000	1.330

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	30.000-20.000	0.000	4.758	0.000	3.430
T2	20.000-0.000	-0.619	5.065	-0.856	3.919

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T1	1	AVA5-50 (7/8 LOW DENSI.FOAM)	20.00 - 30.00	0.6000	0.6000
T1	3	Feed Line Ladder	20.00 - 30.00	1.0000	1.0000
T2	1	AVA5-50 (7/8 LOW DENSI.FOAM)	0.00 - 20.00	0.6000	0.6000
T2	2	AVA7-50 (1-5/8 LOW	0.00 - 20.00	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T2	3	DENSI. FOAM) Feed Line Ladder	0.00 - 20.00	1.0000	1.0000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
LPA-185063-12CF-EDIN	C	From Face	2.000 3.000 0.000	0.000	30.000	No Ice 1/2" Ice	4.972 5.417	5.094 5.722	0.031 0.070
LPA-185063-12CF-EDIN	C	From Face	2.000 -3.000 0.000	0.000	30.000	No Ice 1/2" Ice	4.972 5.417	5.094 5.722	0.031 0.070
BXA-70063-8CF-DIN-X-FP	C	From Leg	2.000 0.000 0.000	0.000	30.000	No Ice 1/2" Ice	10.656 11.260	7.060 7.914	0.047 0.113
LPD-6516 w/Mount Pipe	C	From Face	2.000 6.000 0.000	0.000	30.000	No Ice 1/2" Ice	12.874 13.594	12.557 13.990	0.090 0.151
LPD-6516 w/Mount Pipe	C	From Face	2.000 -6.000 0.000	0.000	30.000	No Ice 1/2" Ice	12.874 13.594	12.557 13.990	0.090 0.151
LPA-80080/6CF	A	From Face	2.000 6.000 0.000	0.000	30.000	No Ice 1/2" Ice	4.331 4.769	9.694 10.432	0.032 0.087
LPA-80080/6CF	A	From Face	2.000 -6.000 0.000	0.000	30.000	No Ice 1/2" Ice	4.331 4.769	9.694 10.432	0.032 0.087
LPA-185080-12CF	A	From Face	2.000 3.000 0.000	0.000	30.000	No Ice 1/2" Ice	3.532 3.964	5.151 5.780	0.031 0.064
LPA-185080-12CF	A	From Face	2.000 -3.000 0.000	0.000	30.000	No Ice 1/2" Ice	3.532 3.964	5.151 5.780	0.031 0.064
BXA-7080-6CF	A	From Face	2.000 0.000 0.000	0.000	30.000	No Ice 1/2" Ice	5.769 6.221	4.962 5.534	0.025 0.066
LPA-80080/6CF	B	From Face	2.000 6.000 0.000	0.000	30.000	No Ice 1/2" Ice	4.331 4.769	9.694 10.432	0.032 0.087
LPA-80080/6CF	B	From Face	2.000 -6.000 0.000	0.000	30.000	No Ice 1/2" Ice	4.331 4.769	9.694 10.432	0.032 0.087
LPA-185080-12CF	B	From Face	2.000 3.000 0.000	0.000	30.000	No Ice 1/2" Ice	3.532 3.964	5.151 5.780	0.031 0.064
LPA-185080-12CF	B	From Face	2.000 -3.000 0.000	0.000	30.000	No Ice 1/2" Ice	3.532 3.964	5.151 5.780	0.031 0.064
BXA-7080-6CF	B	From Face	2.000	0.000	30.000	No Ice	5.769	4.962	0.025

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.000 0.000			1/2" Ice	6.221	5.534	0.066
VFA12-U 12'-6" V-Frame	A	From Face	1.000 0.000 0.000	0.000	30.000	No Ice 1/2" Ice	6.000 8.000	2.500 4.000	0.300 0.500
VFA12-U 12'-6" V-Frame	B	From Face	1.000 0.000 0.000	0.000	30.000	No Ice 1/2" Ice	6.000 8.000	2.500 4.000	0.300 0.500
VFA12-U 12'-6" V-Frame	C	From Face	1.000 0.000 0.000	0.000	30.000	No Ice 1/2" Ice	6.000 8.000	2.500 4.000	0.300 0.500
8' Lightning Rod	C	None		0.000	35.000	No Ice 1/2" Ice	1.600 2.425	1.600 2.425	0.020 0.032

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft^2	Weight K
8' PAD w/ Radome	C	Paraboloid w/Radome	From Leg	0.000 0.000 0.000	45.000		20.000	8.000	No Ice 1/2" Ice	50.270 51.320	0.380 0.560

Tower Pressures - No Ice

$G_H = 0.850$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg % %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
T1 30.000-20.000	25.000	0.945	0.038	87.396	A B C	0.000 0.000 0.000	12.456 12.456 12.456	4.792	38.47 38.47 38.47	0.000 0.000 22.697	0.000 0.000 0.000
T2 20.000-0.000	10.000	0.85	0.038	174.792	A B C	0.000 0.000 0.000	22.631 22.631 22.631	9.583	42.35 42.35 42.35	0.000 0.000 49.393	0.000 0.000 0.000

Tower Pressure - With Ice

$G_H = 0.850$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
T1	25.000	0.945	0.010	1.548	89.977	A	0.000	28.465	9.953	34.97	0.000	0.000
30.000-20.000						B	0.000	28.465		34.97	0.000	0.000
						C	0.000	28.465		34.97	34.492	0.000
T2 20.000-0.000	10.000	0.85	0.010	1.459	179.656	A	0.000	49.600	19.312	38.94	0.000	0.000
						B	0.000	49.600		38.94	0.000	0.000
						C	0.000	49.600		38.94	77.873	0.000

Tower Pressure - Service

$G_H = 0.850$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
T1	25.000	0.945	0.015	87.396	A	0.000	12.456	4.792	38.47	0.000	0.000
30.000-20.000					B	0.000	12.456		38.47	0.000	0.000
					C	0.000	12.456		38.47	22.697	0.000
T2	10.000	0.85	0.015	174.792	A	0.000	22.631	9.583	42.35	0.000	0.000
20.000-0.000					B	0.000	22.631		42.35	0.000	0.000
					C	0.000	22.631		42.35	49.393	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
T1	0.074	0.603	A	0.143	2.799	0.038	1	1	7.060	1.123	0.112	C
30.000-20.000			B	0.143	2.799		1	1	7.060			
			C	0.143	2.799		1	1	7.060			
T2	0.162	1.175	A	0.129	2.848	0.038	1	1	12.804	2.194	0.110	C
20.000-0.000			B	0.129	2.848		1	1	12.804			
			C	0.129	2.848		1	1	12.804			
Sum Weight:	0.236	1.778						OTM	50.010 kip-ft	3.317		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
T1	0.074	0.603	A	0.143	2.799	0.038	0.8	1	7.060	1.123	0.112	C
30.000-20.000			B	0.143	2.799		0.8	1	7.060			
			C	0.143	2.799		0.8	1	7.060			
T2	0.162	1.175	A	0.129	2.848	0.038	0.8	1	12.804	2.194	0.110	C

Section Elevation (ft)	Add Weight (K)	Self Weight (K)	Face	e	C_F	q_z (ksf)	D_F	D_R	A_E (ft^2)	F (K)	w (klf)	Ctrl. Face
20.000-0.000			B	0.129	2.848		0.8	1	12.804			
			C	0.129	2.848		0.8	1	12.804			
Sum Weight:	0.236	1.778						OTM	50.010 kip-ft	3.317		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation (ft)	Add Weight (K)	Self Weight (K)	Face	e	C_F	q_z (ksf)	D_F	D_R	A_E (ft^2)	F (K)	w (klf)	Ctrl. Face
T1	0.074	0.603	A	0.143	2.799	0.038	0.85	1	7.060	1.123	0.112	C
30.000-20.000			B	0.143	2.799		0.85	1	7.060			
			C	0.143	2.799		0.85	1	7.060			
T2	0.162	1.175	A	0.129	2.848	0.038	0.85	1	12.804	2.194	0.110	C
20.000-0.000			B	0.129	2.848		0.85	1	12.804			
			C	0.129	2.848		0.85	1	12.804			
Sum Weight:	0.236	1.778						OTM	50.010 kip-ft	3.317		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation (ft)	Add Weight (K)	Self Weight (K)	Face	e	C_F	q_z (ksf)	D_F	D_R	A_E (ft^2)	F (K)	w (klf)	Ctrl. Face
T1	0.621	1.983	A	0.316	2.253	0.010	1	1	17.198	0.540	0.054	C
30.000-20.000			B	0.316	2.253		1	1	17.198			
			C	0.316	2.253		1	1	17.198			
T2	1.330	3.362	A	0.276	2.362	0.010	1	1	29.355	1.039	0.052	C
20.000-0.000			B	0.276	2.362		1	1	29.355			
			C	0.276	2.362		1	1	29.355			
Sum Weight:	1.951	5.345						OTM	23.890 kip-ft	1.579		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation (ft)	Add Weight (K)	Self Weight (K)	Face	e	C_F	q_z (ksf)	D_F	D_R	A_E (ft^2)	F (K)	w (klf)	Ctrl. Face
T1	0.621	1.983	A	0.316	2.253	0.010	0.8	1	17.198	0.540	0.054	C
30.000-20.000			B	0.316	2.253		0.8	1	17.198			
			C	0.316	2.253		0.8	1	17.198			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
T2	1.330	3.362	A	0.276	2.362	0.010	0.8	1	29.355	1.039	0.052	C
20.000-0.000			B	0.276	2.362		0.8	1	29.355			
			C	0.276	2.362		0.8	1	29.355			
Sum Weight:	1.951	5.345						OTM	23.890 kip-ft	1.579		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
T1	0.621	1.983	A	0.316	2.253	0.010	0.85	1	17.198	0.540	0.054	C
30.000-20.000			B	0.316	2.253		0.85	1	17.198			
			C	0.316	2.253		0.85	1	17.198			
T2	1.330	3.362	A	0.276	2.362	0.010	0.85	1	29.355	1.039	0.052	C
20.000-0.000			B	0.276	2.362		0.85	1	29.355			
			C	0.276	2.362		0.85	1	29.355			
Sum Weight:	1.951	5.345						OTM	23.890 kip-ft	1.579		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
T1	0.074	0.603	A	0.143	2.799	0.015	1	1	7.060	0.434	0.043	C
30.000-20.000			B	0.143	2.799		1	1	7.060			
			C	0.143	2.799		1	1	7.060			
T2	0.162	1.175	A	0.129	2.848	0.015	1	1	12.804	0.848	0.042	C
20.000-0.000			B	0.129	2.848		1	1	12.804			
			C	0.129	2.848		1	1	12.804			
Sum Weight:	0.236	1.778						OTM	19.327 kip-ft	1.282		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
T1	0.074	0.603	A	0.143	2.799	0.015	0.8	1	7.060	0.434	0.043	C
30.000-20.000			B	0.143	2.799		0.8	1	7.060			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
			C	0.143	2.799		0.8	1	7.060			
T2	0.162	1.175	A	0.129	2.848	0.015	0.8	1	12.804	0.848	0.042	C
20.000-0.000			B	0.129	2.848		0.8	1	12.804			
			C	0.129	2.848		0.8	1	12.804			
Sum Weight:	0.236	1.778						OTM	19.327 kip-ft	1.282		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
T1	0.074	0.603	A	0.143	2.799	0.015	0.85	1	7.060	0.434	0.043	C
30.000-20.000			B	0.143	2.799		0.85	1	7.060			
			C	0.143	2.799		0.85	1	7.060			
T2	0.162	1.175	A	0.129	2.848	0.015	0.85	1	12.804	0.848	0.042	C
20.000-0.000			B	0.129	2.848		0.85	1	12.804			
			C	0.129	2.848		0.85	1	12.804			
Sum Weight:	0.236	1.778						OTM	19.327 kip-ft	1.282		

Force Totals

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Leg Weight	0.594					
Bracing Weight	1.184					
Total Member Self-Weight	1.778			2.111	1.957	
Total Weight	3.906			2.111	1.957	
Wind 0 deg - No Ice		0.182	-7.878	-179.007	-2.197	-5.868
Wind 90 deg - No Ice		8.289	-0.047	0.652	-183.537	6.933
Wind 180 deg - No Ice		0.180	8.089	187.445	-1.138	6.504
Member Ice	3.567					
Total Weight Ice	14.274			8.125	5.824	
Wind 0 deg - Ice		0.048	-3.240	-64.072	4.767	-1.823
Wind 90 deg - Ice		3.365	-0.010	7.829	-67.890	2.184
Wind 180 deg - Ice		0.055	3.299	81.512	4.836	2.003
Total Weight	3.906			2.111	1.957	
Wind 0 deg - Service		0.070	-3.045	-68.497	0.291	-2.268
Wind 90 deg - Service		3.204	-0.018	0.936	-69.792	2.680
Wind 180 deg - Service		0.070	3.126	73.127	0.700	2.514

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	0.9 Dead+1.6 Wind 0 deg - No Ice
4	1.2 Dead+1.6 Wind 90 deg - No Ice
5	0.9 Dead+1.6 Wind 90 deg - No Ice
6	1.2 Dead+1.6 Wind 180 deg - No Ice
7	0.9 Dead+1.6 Wind 180 deg - No Ice
8	1.2 Dead+1.0 Ice+1.0 Temp
9	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
10	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp
11	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
12	Dead+Wind 0 deg - Service
13	Dead+Wind 90 deg - Service
14	Dead+Wind 180 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
T1	30 - 20	Leg	Max Tension	7	3.938	0.003	-0.035
			Max. Compression	2	-5.071	0.017	0.036
			Max. Mx	4	-0.688	-0.046	-0.019
			Max. My	6	-0.766	-0.008	-0.047
			Max. Vy	4	-1.987	0.000	-0.000
			Max. Vx	2	2.269	-0.000	-0.000
		Diagonal	Max Tension	5	3.660	0.000	0.000
			Max. Compression	4	-3.722	0.000	0.000
			Max. Mx	11	0.650	0.040	0.000
			Max. My	6	-0.210	0.000	-0.000
			Max. Vy	11	0.024	0.000	0.000
			Max. Vx	6	0.000	0.000	0.000
		Horizontal	Max Tension	4	2.403	0.000	0.000
			Max. Compression	5	-2.364	0.000	0.000
			Max. Mx	11	0.063	-0.025	-0.001
			Max. My	6	-0.051	-0.011	-0.005
			Max. Vy	11	-0.026	-0.025	-0.001
			Max. Vx	6	0.001	-0.011	-0.005
		Top Girt	Max Tension	6	2.617	-0.007	0.003
			Max. Compression	2	-2.618	-0.008	-0.003
			Max. Mx	11	-0.323	-0.024	-0.002
			Max. My	6	-1.111	-0.008	-0.007
			Max. Vy	11	-0.026	-0.024	-0.002
			Max. Vx	6	0.002	-0.008	-0.007
		Inner Bracing	Max Tension	2	0.045	0.000	0.000
			Max. Compression	2	-0.045	0.000	0.000
			Max. Mx	8	0.000	-0.023	0.000
			Max. My	11	-0.001	0.000	0.000
			Max. Vy	8	0.022	0.000	0.000
			Max. Vx	11	0.000	0.000	0.000
T2	20 - 0	Leg	Max Tension	7	26.961	0.002	-0.103
			Max. Compression	2	-28.258	0.000	0.000
			Max. Mx	5	13.968	-0.111	-0.017
			Max. My	6	17.108	0.002	-0.103
			Max. Vy	4	-1.043	-0.025	0.007
			Max. Vx	6	-0.940	0.014	-0.015

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
		Diagonal	Max Tension	5	8.971	0.000	0.000
			Max. Compression	4	-9.037	0.000	0.000
			Max. Mx	11	1.395	0.046	0.000
			Max. My	6	-1.488	0.000	-0.000
			Max. Vy	11	0.023	0.000	0.000
			Max. Vx	6	0.000	0.000	0.000
		Horizontal	Max Tension	4	4.839	0.000	0.000
			Max. Compression	5	-4.825	-0.006	0.000
			Max. Mx	11	0.160	-0.027	-0.002
			Max. My	6	-0.270	-0.023	-0.008
			Max. Vy	11	-0.026	-0.027	-0.002
			Max. Vx	6	0.002	-0.023	-0.008
		Inner Bracing	Max Tension	6	0.005	0.000	0.000
			Max. Compression	4	-0.006	0.000	0.000
			Max. Mx	8	0.000	-0.022	0.000
			Max. My	11	-0.001	0.000	0.000
			Max. Vy	8	0.020	0.000	0.000
			Max. Vx	11	0.000	0.000	0.000

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Leg C	Max. Vert	6	20.725	1.279	-3.888
	Max. H_x	6	20.725	1.279	-3.888
	Max. H_z	3	-18.109	-1.462	3.831
	Min. Vert	5	-32.099	-5.837	1.124
	Min. H_x	5	-32.099	-5.837	1.124
	Min. H_z	6	20.725	1.279	-3.888
Leg B	Max. Vert	4	34.752	-5.813	-1.120
	Max. H_x	3	-16.961	1.851	2.633
	Max. H_z	3	-16.961	1.851	2.633
	Min. Vert	3	-16.961	1.851	2.633
	Min. H_x	4	34.752	-5.813	-1.120
	Min. H_z	6	21.337	-2.231	-2.755
Leg A	Max. Vert	2	38.894	-0.681	6.149
	Max. H_x	6	-37.375	0.664	-6.299
	Max. H_z	2	38.894	-0.681	6.149
	Min. Vert	7	-37.675	0.664	-6.307
	Min. H_x	5	1.230	-1.620	0.068
	Min. H_z	7	-37.675	0.664	-6.307

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	3.906	0.000	0.000	2.111	1.957	0.000
1.2 Dead+1.6 Wind 0 deg - No Ice	4.687	0.291	-12.604	-274.808	-4.292	-9.392
0.9 Dead+1.6 Wind 0 deg - No Ice	3.515	0.291	-12.604	-275.413	-4.880	-9.391

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
1.2 Dead+1.6 Wind 90 deg - No Ice	4.687	13.263	-0.076	0.206	-281.996	11.096
0.9 Dead+1.6 Wind 90 deg - No Ice	3.515	13.263	-0.076	-0.428	-282.554	11.096
1.2 Dead+1.6 Wind 180 deg - No Ice	4.687	0.288	12.942	286.625	-2.600	10.409
0.9 Dead+1.6 Wind 180 deg - No Ice	3.515	0.288	12.942	285.961	-3.187	10.408
1.2 Dead+1.0 Ice+1.0 Temp	15.055	0.000	0.000	8.545	6.213	0.000
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	15.055	0.048	-3.240	-59.975	5.169	-1.825
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	15.055	3.365	-0.010	8.260	-63.820	2.185
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	15.055	0.055	3.299	78.270	5.232	2.004
Dead+Wind 0 deg - Service	3.906	0.070	-3.045	-64.874	0.353	-2.269
Dead+Wind 90 deg - Service	3.906	3.204	-0.018	1.548	-66.720	2.680
Dead+Wind 180 deg - Service	3.906	0.070	3.126	70.728	0.761	2.514

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.000	-3.906	0.000	0.000	3.906	0.000	0.000%
2	0.291	-4.687	-12.604	-0.291	4.687	12.604	0.000%
3	0.291	-3.515	-12.604	-0.291	3.515	12.604	0.000%
4	13.263	-4.687	-0.076	-13.263	4.687	0.076	0.000%
5	13.263	-3.515	-0.076	-13.263	3.515	0.076	0.000%
6	0.288	-4.687	12.942	-0.288	4.687	-12.942	0.000%
7	0.288	-3.515	12.942	-0.288	3.515	-12.942	0.000%
8	0.000	-15.055	0.000	0.000	15.055	0.000	0.000%
9	0.048	-15.055	-3.240	-0.048	15.055	3.240	0.000%
10	3.365	-15.055	-0.010	-3.365	15.055	0.010	0.000%
11	0.055	-15.055	3.299	-0.055	15.055	-3.299	0.000%
12	0.070	-3.906	-3.045	-0.070	3.906	3.045	0.000%
13	3.204	-3.906	-0.018	-3.204	3.906	0.018	0.000%
14	0.070	-3.906	3.126	-0.070	3.906	-3.126	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	6	0.00000001	0.00000001
2	Yes	6	0.00000001	0.00000001
3	Yes	6	0.00000001	0.00000001
4	Yes	6	0.00000001	0.00000001
5	Yes	6	0.00000001	0.00000001
6	Yes	6	0.00000001	0.00000001
7	Yes	6	0.00000001	0.00000001
8	Yes	6	0.00000001	0.00000001
9	Yes	6	0.00000001	0.00000001
10	Yes	6	0.00000001	0.00000001

11	Yes	6	0.00000001	0.00000001
12	Yes	6	0.00000001	0.00000001
13	Yes	6	0.00000001	0.00000001
14	Yes	6	0.00000001	0.00000001

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	30 - 20	0.118	14	0.020	0.015
T2	20 - 0	0.068	14	0.018	0.014

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
35.000	8' Lightning Rod	14	0.118	0.020	0.015	161390
30.000	LPA-185063-12CF-EDIN	14	0.118	0.020	0.015	161390
20.000	8' PAD w/ Radome	14	0.068	0.018	0.014	92223

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	30 - 20	0.476	6	0.077	0.061
T2	20 - 0	0.279	6	0.071	0.056

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
35.000	8' Lightning Rod	6	0.476	0.077	0.061	41997
30.000	LPA-185063-12CF-EDIN	6	0.476	0.077	0.061	41997
20.000	8' PAD w/ Radome	6	0.279	0.071	0.056	23998

Bolt Design Data

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt K	Allowable Load K	Ratio Load / Allowable	Allowable Ratio	Criteria
T1	30	Leg	A325N	0.625	4	0.219	20.709	0.011 ✔	1	Bolt Tension
		Diagonal	A325N	0.625	3	1.241	12.425	0.100 ✔	1	Bolt Shear
		Horizontal	A325N	0.625	2	1.201	12.425	0.097 ✔	1	Bolt Shear
		Top Girt	A325N	0.625	2	1.309	12.425	0.105 ✔	1	Bolt Shear
T2	20	Leg	A325N	0.750	4	2.209	29.821	0.074 ✔	1	Bolt Tension
		Diagonal	A325N	0.625	3	3.012	12.425	0.242 ✔	1	Bolt Shear
		Horizontal	A325N	0.625	2	2.419	12.425	0.195 ✔	1	Bolt Shear

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	HSS2.875x.203	10.000	5.000	63.0 K=1.00	1.595	-5.071	53.678	0.094 [1] ✔
T2	20 - 0	HSS2.875x0.276	20.000	6.667	86.0 K=1.00	2.114	-28.258	55.376	0.510 [1] ✔

[1] P_u / ϕP_n controls

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	HSS2.375x.154	6.562	6.377	96.8 K=1.00	1.003	-3.722	19.842	0.188 [1] ✔
T2	20 - 0	HSS2.375x.154	7.906	7.683	116.6 K=1.00	1.003	-9.037	15.882	0.569 [1] ✔

[1] P_u / ϕP_n controls

Horizontal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	HSS1.9x.145	8.500	4.130	79.2 K=1.00	0.749	-2.364	17.434	0.136 [1] ✔
T2	20 - 0	HSS1.9x.145	8.500	4.130	79.2 K=1.00	0.749	-4.825	17.434	0.277 [1] ✔

[1] P_u / ϕP_n controls

Top Girt Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	HSS1.9x.145	8.500	4.130	79.2 K=1.00	0.749	-2.618	17.434	0.150 [1] ✔

[1] P_u / ϕP_n controls

Inner Bracing Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	L2x2x1/8	4.250	4.250	128.3 K=1.00	0.484	-0.045	6.565	0.007 [1] ✔
T2	20 - 0	L2x2x1/8	4.250	4.250	128.3 K=1.00	0.484	-0.006	6.565	0.001 [1] ✔

[1] P_u / ϕP_n controls

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	HSS2.875x.203	10.000	5.000	63.0	1.595	3.938	71.768	0.055 [1] ✔
T2	20 - 0	HSS2.875x0.276	20.000	6.667	86.0	2.114	26.961	95.118	0.283 [1] ✔

[1] P_u / ϕP_n controls

Diagonal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	HSS2.375x.154	6.562	6.377	96.8	1.003	3.660	32.488	0.113 [1] ✔
T2	20 - 0	HSS2.375x.154	7.906	7.683	116.6	1.003	8.971	32.488	0.276 [1] ✔

[1] P_u / ϕP_n controls

Horizontal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	HSS1.9x.145	8.500	4.130	79.2	0.749	2.403	24.253	0.099 [1] ✔
T2	20 - 0	HSS1.9x.145	8.500	4.130	79.2	0.749	4.839	24.253	0.200 [1] ✔

[1] P_u / ϕP_n controls

Top Girt Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	HSS1.9x.145	8.500	4.130	79.2	0.749	2.617	24.253	0.108 [1] ✔

[1] P_u / ϕP_n controls

Inner Bracing Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	30 - 20	L2x2x1/8	4.250	4.250	81.4	0.484	0.045	15.694	0.003 [1] ✔
T2	20 - 0	L2x2x1/8	4.250	4.250	81.4	0.484	0.005	15.694	0.000 [1] ✔

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$

[1] P_u / ϕP_n controls

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
T1	30 - 20	Leg	HSS2.875x.203	3	-5.071	53.678	9.4	Pass
		Diagonal	HSS2.375x.154	9	-3.722	19.842	18.8	Pass
		Horizontal	HSS1.9x.145	7	-2.364	17.434	13.6	Pass
		Top Girt	HSS1.9x.145	6	-2.618	17.434	15.0	Pass
		Inner Bracing	L2x2x1/8	26	-0.045	6.565	0.7	Pass
T2	20 - 0	Leg	HSS2.875x0.276	30	-28.258	55.376	51.0	Pass
		Diagonal	HSS2.375x.154	33	-9.037	15.882	56.9	Pass
		Horizontal	HSS1.9x.145	31	-4.825	17.434	27.7	Pass
		Inner Bracing	L2x2x1/8	40	0.005	15.694	0.4	Pass
							Summary	
						Leg (T2)	51.0	Pass
						Diagonal (T2)	56.9	Pass
						Horizontal (T2)	27.7	Pass
						Top Girt (T1)	15.0	Pass
						Inner Bracing (T1)	0.7	Pass
						Bolt Checks	24.2	Pass
						RATING =	**56.9**	**Pass**