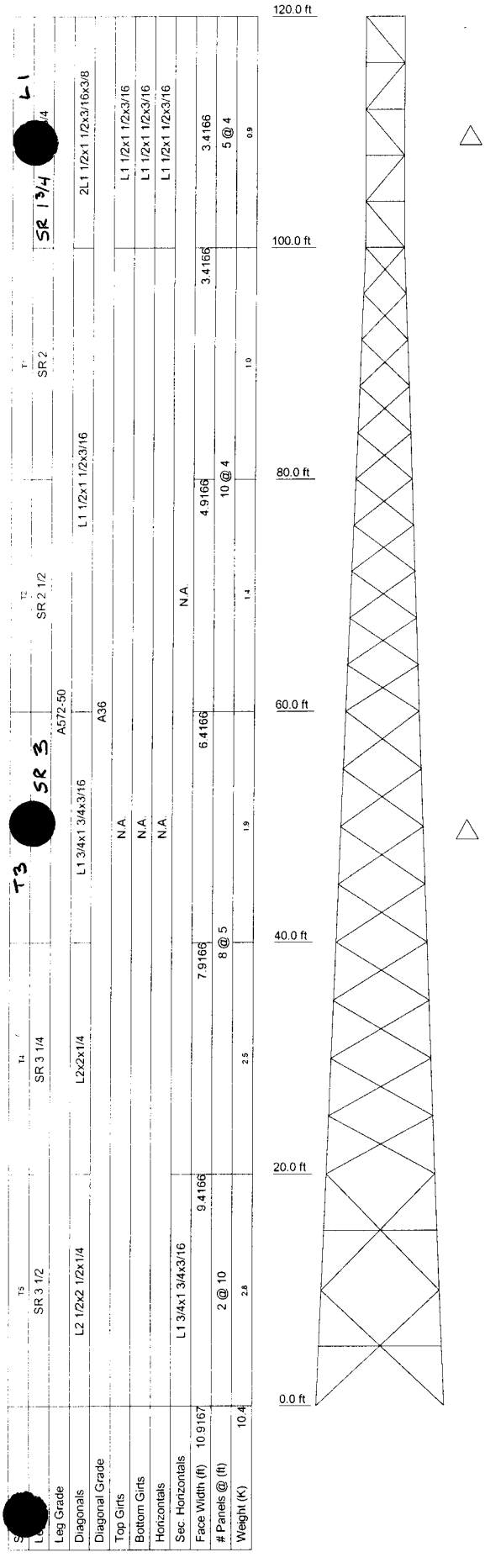


DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
(9) (9) FV90-12 (Nextel 1 5/8)	120	Pirod 13' Low Profile Platform	120

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

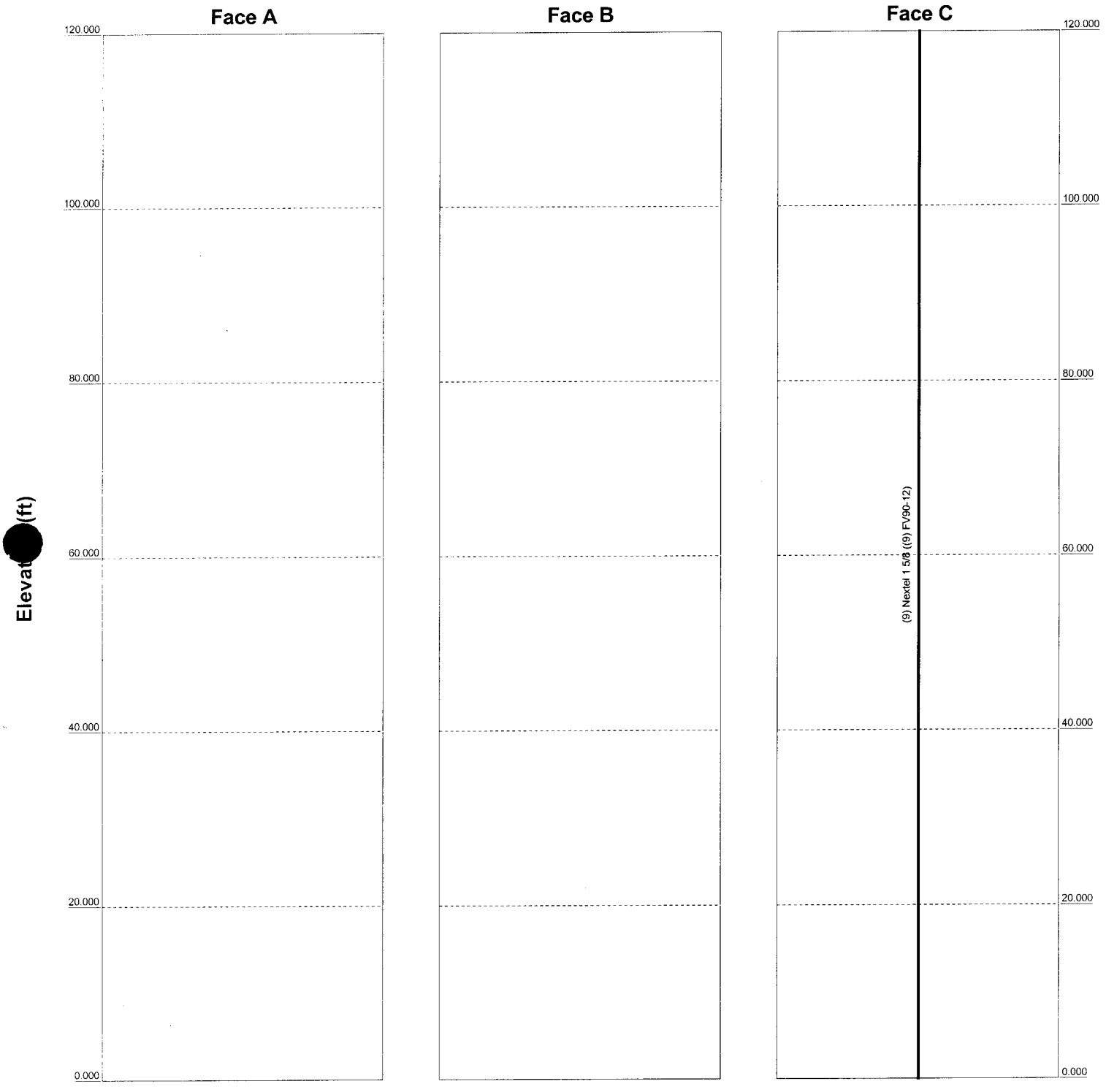
1. Tower designed for Exposure C to the TIA-222-G Standard.
2. Tower designed for a 100.0 mph basic wind in accordance with the TIA-222-G Standard.
3. Tower is also designed for a 45.0 mph basic wind with 0.50 in ice. Ice is considered to increase in thickness with height.
4. Structure Class II.
5. Topographic Category 1.

Electronics Research, Inc
7777 Gardner Rd.
Chandler, IN 47610-9219
Phone: (812) 925-6000
FAX: (812) 925-4030
Established in 1943

Job: *TIA-222-G - Tower Training*		
Project: *120' Self-Supporting Tower*		
Client:	Drawn by: TGroves	App'd:
Code: TIA-222-G	Date: 08/03/06	Scale: NTS
Path: J:\all\Tower Training - G Standard\Example 1 - 120' Self-Supporting Tower.eri		Dwg No. E-1

Feedline Distribution Chart
0' - 120'

Round Flat App In Face App Out Face Truss Leg



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7777 Gardner Rd.
Chandler, IN 47610-9219
Phone: (812) 925-6000
FAX: (812) 925-4030
Established in 1943

Job: TIA-222-G - Tower Training		
Project: 120' Self-Supporting Tower		
Client:	Drawn by: TGroves	App'd:
Code: TIA-222-G	Date: 08/03/06	Scale: NTS
Path: J:\all\Tower Training - G Standard\Example 1 - 120' Self-Supporting Tower.er		Dwg No. E-7

Tower Input Data

The main tower is a 3x free standing tower with an overall height of 120.000 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 3.417 ft at the top and 10.917 ft at the base.
There is a 3 sided latticed pole with a face width of 3.417 ft.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

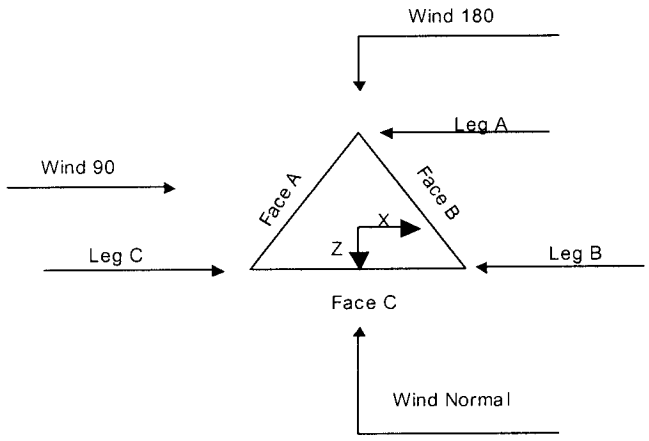
Basic wind speed of 100.0 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.000 ft.
Nominal ice thickness of 0.500 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 45.0 mph is used in combination with ice.
Structure Class II..
Topographic Category 1..
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in latticed pole member design is 1.
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
- Consider Moments - Horizontals
- Consider Moments - Diagonals
- Use Moment Magnification
- √ Use Code Stress Ratios
- √ Use Code Safety Factors - Guys
- Escalate Ice
- Always Use Max Kz
- Use Special Wind Profile
- √ Include Bolts In Member Capacity
- √ Leg Bolts Are At Top Of Section
- √ Secondary Horizontal Braces Leg
- Use Diamond Inner Bracing (4 Sided)
- Add IBC .6D+W Combination
- √ Distribute Leg Loads As Uniform
- Assume Legs Pinned
- Assume Rigid Index Plate
- Use Clear Spans For Wind Area
- Use Clear Spans For KL/r
- √ Retension Guys To Initial Tension
- √ Bypass Mast Stability Checks
- Use Azimuth Dish Coefficients
- Project Wind Area of Appurt.
- √ Autocalc Torque Arm Areas
- SR Members Have Cut Ends
- Sort Capacity Reports By Component
- √ Triangulate Diamond Inner Bracing
- Treat Feedline Bundles As Cylinder
- Use ASCE 10 X-Brace Ly Rules
- √ Calculate Redundant Bracing Forces
- Ignore Redundant Members in FEA
- SR Leg Bolts Resist Compression
- √ All Leg Panels Have Same Allowable
- Offset Girt At Foundation
- Consider Feedline Torque
- Include Angle Block Shear Check

Poles

- Include Shear-Torsion Interaction
- Always Use Sub-Critical Flow
- Use Top Mounted Sockets



Triangular Tower

3 Sided Latticed Pole Section Geometry

Tower Section	Tower Elevation	Assembly Database	Description	Section Width	Number of Sections	Section Length
	ft			ft		ft
L1	120.000-100.000			3.417	1	20.000

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Section	Tower Elevation	Diagonal Spacing	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset	Bottom Girt Offset
	ft	ft				in	in
L1	120.000-100.000	4.000	K Brace Right	No	Yes	0.000	0.000

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
ft						
L1 120.000-100.000	Solid Round	1 3/4	A572-50 (50 ksi)	Double Angle	2L1 1/2x1 1/2x3/16x3/8	A36 (36 ksi)

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
L1 120.000-100.000	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)

3 Sided Latticed Pole 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
L1 120.000-100.000	None	Flat Bar		A36 (36 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)

3 Sided Latticed Pole 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
L1 120.000-100.000	0.000	0.000	A36 (36 ksi)	1	1	1	36.000	36.000

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] 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
L1 120.000-100.000	Yes	Yes	1	1 1	1 1	1 1	1 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.*

3 Sided Latticed Pole 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
L1 120.000-100.000	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

Tower Section Geometry

Tower Section	Tower Elevation ft	Assembly Database	Description	Section Width ft	Number of Sections	Section Length ft
T1	100.000-80.000			3.417	1	20.000
T2	80.000-60.000			4.917	1	20.000
T3	60.000-40.000			6.417	1	20.000
T4	40.000-20.000			7.917	1	20.000
T5	20.000-0.000			9.417	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	100.000-80.000	4.000	X Brace	No	Yes	0.000	0.000
T2	80.000-60.000	4.000	X Brace	No	Yes	0.000	0.000
T3	60.000-40.000	5.000	X Brace	No	Yes	0.000	0.000
T4	40.000-20.000	5.000	X Brace	No	Yes	0.000	0.000
T5	20.000-0.000	10.000	X Brace	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 100.000-80.000	Solid Round	2	A572-50 (50 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)
T2 80.000-60.000	Solid Round	2 1/2	A572-50 (50 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)
T3 60.000-40.000	Solid Round	3	A572-50 (50 ksi)	Single Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T4 40.000-20.000	Solid Round	3 1/4	A572-50 (50 ksi)	Single Angle	L2x2x1/4	A36 (36 ksi)
T5 20.000-0.000	Solid Round	3 1/2	A572-50 (50 ksi)	Single Angle	L2 1/2x2 1/2x1/4	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation	Secondary Horizontal Type	Secondary Horizontal Size	Secondary Horizontal Grade	Inner Bracing Type	Inner Bracing Size	Inner Bracing Grade
ft						
T5 20.000-0.000	Single Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)	Solid Round		A572-50 (50 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation	Gusset Area (per face)	Gusset Thickness	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals	Double Angle Stitch Bolt Spacing Horizontals
ft	ft^2	in					in	in
T1 100.000-80.000	0.000	0.000	A36 (36 ksi)	1	1	1	36.000	36.000
T2 80.000-60.000	0.000	0.000	A36 (36 ksi)	1	1	1	36.000	36.000
T3 60.000-40.000	0.000	0.000	A36 (36 ksi)	1	1	1	36.000	36.000
T4 40.000-20.000	0.000	0.000	A36 (36 ksi)	1	1	1	36.000	36.000
T5 20.000-0.000	0.000	0.000	A36 (36 ksi)	1	1	1	36.000	36.000

Tower Section Geometry *(cont'd)*

Tower Elevation	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X	X Brace Diags Y	Single Diags X	Single Diags Y	Girts X	Girts Y	Horiz. X	Horiz. Y	Sec. Horiz. X	Sec. Horiz. Y	Inner Brace X	Inner Brace Y
ft															
T1 100.000-80.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1	1	1	1	1	1
T2 80.000-60.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1	1	1	1	1	1
T3 60.000-40.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1	1	1	1	1	1
T4 40.000-20.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1	1	1	1	1	1
T5 20.000-0.000	Yes	Yes	1	1	1	1	1	1	1	1	1	1	1	1	1
				1	1	1	1	1	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 100.000-80.000	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
T2 80.000-60.000	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
T3 60.000-40.000	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
T4 40.000-20.000	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
T5 20.000-0.000	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

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number	Number Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
Nextel 1 5/8 ((9) FV90-12)	C	No	Ar (CaAa)	120.000 - 0.000	9	9	2.000	2.040		0.800

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
L1	120.000-100.000	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	36.720	0.000	0.144
T1	100.000-80.000	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	36.720	0.000	0.144
T2	80.000-60.000	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	36.720	0.000	0.144
T3	60.000-40.000	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	36.720	0.000	0.144
T4	40.000-20.000	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	36.720	0.000	0.144
T5	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	36.720	0.000	0.144

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	120.000-100.000	A	1.128	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	91.540	0.000	1.108
T1	100.000-80.000	A	1.106	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	91.428	0.000	1.094
T2	80.000-60.000	A	1.078	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	91.290	0.000	1.078
T3	60.000-40.000	A	1.042	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	91.112	0.000	1.056
T4	40.000-20.000	A	0.991	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	72.379	0.000	0.804
T5	20.000-0.000	A	0.887	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	68.669	0.000	0.715

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
L1	1	Nextel 1 5/8	100.00 - 120.00	0.6000	0.6000
T1	1	Nextel 1 5/8	80.00 - 100.00	0.6000	0.6000
T2	1	Nextel 1 5/8	60.00 - 80.00	0.6000	0.6000
T3	1	Nextel 1 5/8	40.00 - 60.00	0.6000	0.6000
T4	1	Nextel 1 5/8	20.00 - 40.00	0.6000	0.6000
T5	1	Nextel 1 5/8	0.00 - 20.00	0.6000	0.6000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
(9) (9) FV90-12 (Nextel 1 5/8)	C	None		0.000	120.000	No Ice	6.000	6.000	0.030
						1/2" Ice	6.600	6.600	0.080
Pirod 13' Low Profile Platform	C	None		0.000	120.000	No Ice	15.300	15.300	1.340
						1/2" Ice	17.000	17.000	2.080

Tower Pressures - No Ice

G_H = 0.850 (base tower), 0.850 (upper structure)

Section Elevation ft	z ft	K_Z	q_z psf	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
L1 120.000-100.000	110.000	1.291	28.098	71.249	A	5.850	5.833	5.833	49.93	22.032	0.000
					B	5.850	5.833		49.93		
					C	5.850	5.833		49.93		
T1 100.000-80.000	90.000	1.238	26.936	86.668	A	7.230	6.673	6.673	48.00	22.032	0.000
					B	7.230	6.673		48.00		
					C	7.230	6.673		48.00		
T2 80.000-60.000	70.000	1.174	25.548	117.502	A	8.676	8.341	8.341	49.02	22.032	0.000
					B	8.676	8.341		49.02		
					C	8.676	8.341		49.02		
T3 60.000-40.000	50.000	1.094	23.801	148.336	A	10.199	10.009	10.009	49.53	22.032	0.000
					B	10.199	10.009		49.53		
					C	10.199	10.009		49.53		
T4 40.000-20.000	30.000	0.982	21.374	178.752	A	13.344	10.843	10.843	44.83	22.032	0.000
					B	13.344	10.843		44.83		
					C	13.344	10.843		44.83		
T5 20.000-0.000	10.000	0.85	18.496	209.170	A	14.848	11.678	11.678	44.02	22.032	0.000
					B	14.848	11.678		44.02		
					C	14.848	11.678		44.02		

Tower Pressure - With Ice

G_H = 0.850 (base tower), 0.850 (upper structure)

Section Elevation ft	z ft	K_Z	q_z psf	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
L1 120.000-100.000	110.000	1.291	5.690	1.128	75.008	A	11.716	13.353	13.353	53.27	54.924	0.000
						B	11.716	13.353		53.27		
						C	11.716	13.353		53.27		
T1 100.000-80.000	90.000	1.238	5.454	1.106	90.355	A	14.335	14.050	14.050	49.50	54.857	0.000
						B	14.335	14.050		49.50		
						C	14.335	14.050		49.50		
T2 80.000-60.000	70.000	1.174	5.173	1.078	121.098	A	16.991	15.535	15.535	47.76	54.774	0.000
						B	16.991	15.535		47.76		
						C	16.991	15.535		47.76		
T3 60.000-40.000	50.000	1.094	4.820	1.042	151.813	A	18.300	16.965	16.965	48.11	54.667	0.000
						B	18.300	16.965		48.11		
						C	18.300	16.965		48.11		
T4 40.000-20.000	30.000	0.982	4.328	0.991	182.057	A	22.156	17.453	17.453	44.06	43.427	0.000
						B	22.156	17.453		44.06		
						C	22.156	17.453		44.06		
T5 20.000-0.000	10.000	0.85	3.745	0.887	212.131	A	22.477	17.600	17.600	43.91	41.201	0.000
						B	22.477	17.600		43.91		
						C	22.477	17.600		43.91		

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 120.000-100.000	0.144	0.885	A	0.164	2.721	28.09	1	1	9.170	1.184	59.199	C
			B	0.164	2.721	8	1	1	9.170			
			C	0.164	2.721		1	1	9.170			
T1 100.000-80.000	0.144	0.953	A	0.16	2.734	26.93	1	1	11.025	1.254	62.688	C
			B	0.16	2.734	6	1	1	11.025			
			C	0.16	2.734		1	1	11.025			
T2 80.000-60.000	0.144	1.377	A	0.145	2.791	25.54	1	1	13.406	1.347	67.356	C
			B	0.145	2.791	8	1	1	13.406			
			C	0.145	2.791		1	1	13.406			
T3 60.000-40.000	0.144	1.888	A	0.136	2.823	23.80	1	1	15.868	1.404	70.215	C
			B	0.136	2.823	1	1	1	15.868			
			C	0.136	2.823		1	1	15.868			
T4 40.000-20.000	0.144	2.462	A	0.135	2.826	21.37	1	1	19.484	1.448	72.391	C
			B	0.135	2.826	4	1	1	19.484			
			C	0.135	2.826		1	1	19.484			
T5 20.000-0.000	0.144	2.788	A	0.127	2.859	18.49	1	1	21.453	1.351	67.564	C
			B	0.127	2.859	6	1	1	21.453			
			C	0.127	2.859		1	1	21.453			
Sum Weight:	0.864	10.353						OTM	464.536 kip-ft	7.988		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 120.000-100.000	0.144	0.885	A	0.164	2.721	28.09	0.8	1	8.000	1.108	55.397	C
			B	0.164	2.721	8	0.8	1	8.000			
			C	0.164	2.721		0.8	1	8.000			
T1 100.000-80.000	0.144	0.953	A	0.16	2.734	26.93	0.8	1	9.579	1.163	58.163	C
			B	0.16	2.734	6	0.8	1	9.579			
			C	0.16	2.734		0.8	1	9.579			
T2 80.000-60.000	0.144	1.377	A	0.145	2.791	25.54	0.8	1	11.671	1.242	62.098	C
			B	0.145	2.791	8	0.8	1	11.671			
			C	0.145	2.791		0.8	1	11.671			
T3 60.000-40.000	0.144	1.888	A	0.136	2.823	23.80	0.8	1	13.828	1.288	64.390	C
			B	0.136	2.823	1	0.8	1	13.828			
			C	0.136	2.823		0.8	1	13.828			
T4 40.000-20.000	0.144	2.462	A	0.135	2.826	21.37	0.8	1	16.815	1.311	65.539	C
			B	0.135	2.826	4	0.8	1	16.815			
			C	0.135	2.826		0.8	1	16.815			
T5 20.000-0.000	0.144	2.788	A	0.127	2.859	18.49	0.8	1	18.483	1.218	60.891	C
			B	0.127	2.859	6	0.8	1	18.483			
			C	0.127	2.859		0.8	1	18.483			
Sum Weight:	0.864	10.353						OTM	429.397 kip-ft	7.330		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 120.000-100.000	0.144	0.885	A	0.164	2.721	28.09	0.85	1	8.293	1.127	56.347	C
			B	0.164	2.721	8	0.85	1	8.293			
			C	0.164	2.721		0.85	1	8.293			
T1 100.000-80.000	0.144	0.953	A	0.16	2.734	26.93	0.85	1	9.940	1.186	59.295	C
			B	0.16	2.734	6	0.85	1	9.940			
			C	0.16	2.734		0.85	1	9.940			
T2 80.000-60.000	0.144	1.377	A	0.145	2.791	25.54	0.85	1	12.105	1.268	63.413	C
			B	0.145	2.791	8	0.85	1	12.105			
			C	0.145	2.791		0.85	1	12.105			
T3 60.000-40.000	0.144	1.888	A	0.136	2.823	23.80	0.85	1	14.338	1.317	65.846	C
			B	0.136	2.823	1	0.85	1	14.338			
			C	0.136	2.823		0.85	1	14.338			
T4 40.000-20.000	0.144	2.462	A	0.135	2.826	21.37	0.85	1	17.482	1.345	67.252	C
			B	0.135	2.826	4	0.85	1	17.482			
			C	0.135	2.826		0.85	1	17.482			
T5 20.000-0.000	0.144	2.788	A	0.127	2.859	18.49	0.85	1	19.226	1.251	62.559	C
			B	0.127	2.859	6	0.85	1	19.226			
			C	0.127	2.859		0.85	1	19.226			
Sum Weight:	0.864	10.353						OTM	438.182 kip-ft	7.494		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 120.000-100.000	1.108	1.888	A	0.334	2.209	5.690	1	1	19.865	0.509	25.456	C
			B	0.334	2.209		1	1	19.865			
			C	0.334	2.209		1	1	19.865			
T1 100.000-80.000	1.094	1.962	A	0.314	2.259	5.454	1	1	22.813	0.523	26.160	C
			B	0.314	2.259		1	1	22.813			
			C	0.314	2.259		1	1	22.813			
T2 80.000-60.000	1.078	2.537	A	0.269	2.383	5.173	1	1	26.153	0.543	27.162	C
			B	0.269	2.383		1	1	26.153			
			C	0.269	2.383		1	1	26.153			
T3 60.000-40.000	1.056	3.137	A	0.232	2.492	4.820	1	1	28.155	0.538	26.885	C
			B	0.232	2.492		1	1	28.155			
			C	0.232	2.492		1	1	28.155			
T4 40.000-20.000	0.804	3.880	A	0.218	2.538	4.328	1	1	32.240	0.480	23.982	C
			B	0.218	2.538		1	1	32.240			
			C	0.218	2.538		1	1	32.240			
T5 20.000-0.000	0.715	4.117	A	0.189	2.633	3.745	1	1	32.555	0.420	20.977	C
			B	0.189	2.633		1	1	32.555			
			C	0.189	2.633		1	1	32.555			
Sum Weight:	5.855	17.520						OTM	186.587 kip-ft	3.012		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 120.000-100.000	1.108	1.888	A	0.334	2.209	5.690	0.8	1	17.522	0.484	24.204	C
			B	0.334	2.209		0.8	1	17.522			
			C	0.334	2.209		0.8	1	17.522			
T1 100.000-80.000	1.094	1.962	A	0.314	2.259	5.454	0.8	1	19.946	0.493	24.658	C
			B	0.314	2.259		0.8	1	19.946			
			C	0.314	2.259		0.8	1	19.946			
T2 80.000-60.000	1.078	2.537	A	0.269	2.383	5.173	0.8	1	22.755	0.508	25.382	C
			B	0.269	2.383		0.8	1	22.755			
			C	0.269	2.383		0.8	1	22.755			
T3 60.000-40.000	1.056	3.137	A	0.232	2.492	4.820	0.8	1	24.495	0.500	25.017	C
			B	0.232	2.492		0.8	1	24.495			
			C	0.232	2.492		0.8	1	24.495			
T4 40.000-20.000	0.804	3.880	A	0.218	2.538	4.328	0.8	1	27.809	0.438	21.913	C
			B	0.218	2.538		0.8	1	27.809			
			C	0.218	2.538		0.8	1	27.809			
T5 20.000-0.000	0.715	4.117	A	0.189	2.633	3.745	0.8	1	28.060	0.382	19.092	C
			B	0.189	2.633		0.8	1	28.060			
			C	0.189	2.633		0.8	1	28.060			
Sum Weight:	5.855	17.520						OTM	175.152 kip-ft	2.805		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 120.000-100.000	1.108	1.888	A	0.334	2.209	5.690	0.85	1	18.108	0.490	24.517	C
			B	0.334	2.209		0.85	1	18.108			
			C	0.334	2.209		0.85	1	18.108			
T1 100.000-80.000	1.094	1.962	A	0.314	2.259	5.454	0.85	1	20.663	0.501	25.034	C
			B	0.314	2.259		0.85	1	20.663			
			C	0.314	2.259		0.85	1	20.663			
T2 80.000-60.000	1.078	2.537	A	0.269	2.383	5.173	0.85	1	23.605	0.517	25.827	C
			B	0.269	2.383		0.85	1	23.605			
			C	0.269	2.383		0.85	1	23.605			
T3 60.000-40.000	1.056	3.137	A	0.232	2.492	4.820	0.85	1	25.410	0.510	25.484	C
			B	0.232	2.492		0.85	1	25.410			
			C	0.232	2.492		0.85	1	25.410			
T4 40.000-20.000	0.804	3.880	A	0.218	2.538	4.328	0.85	1	28.917	0.449	22.430	C
			B	0.218	2.538		0.85	1	28.917			
			C	0.218	2.538		0.85	1	28.917			
T5 20.000-0.000	0.715	4.117	A	0.189	2.633	3.745	0.85	1	29.183	0.391	19.563	C
			B	0.189	2.633		0.85	1	29.183			
			C	0.189	2.633		0.85	1	29.183			
Sum Weight:	5.855	17.520						OTM	178.010 kip-ft	2.857		

Discrete Appurtenance Pressures - No Ice

G_H = 0.850 (base tower), 0.850 (upper structure)

Description	Aiming Azimuth °	Weight K	$Offset_x$ ft	$Offset_z$ ft	z ft	K_z	q_z psf	C_AA_C Front ft^2	C_AA_C Side ft^2
(9) FV90-12	0.000	0.270	0.000	0.000	120.000	1.315	31.984	54.000	54.000
Pirod 13' Low Profile Platform	0.000	1.340	0.000	0.000	120.000	1.315	31.984	15.300	15.300
	Sum Weight:	1.610							

Discrete Appurtenance Pressures - With Ice

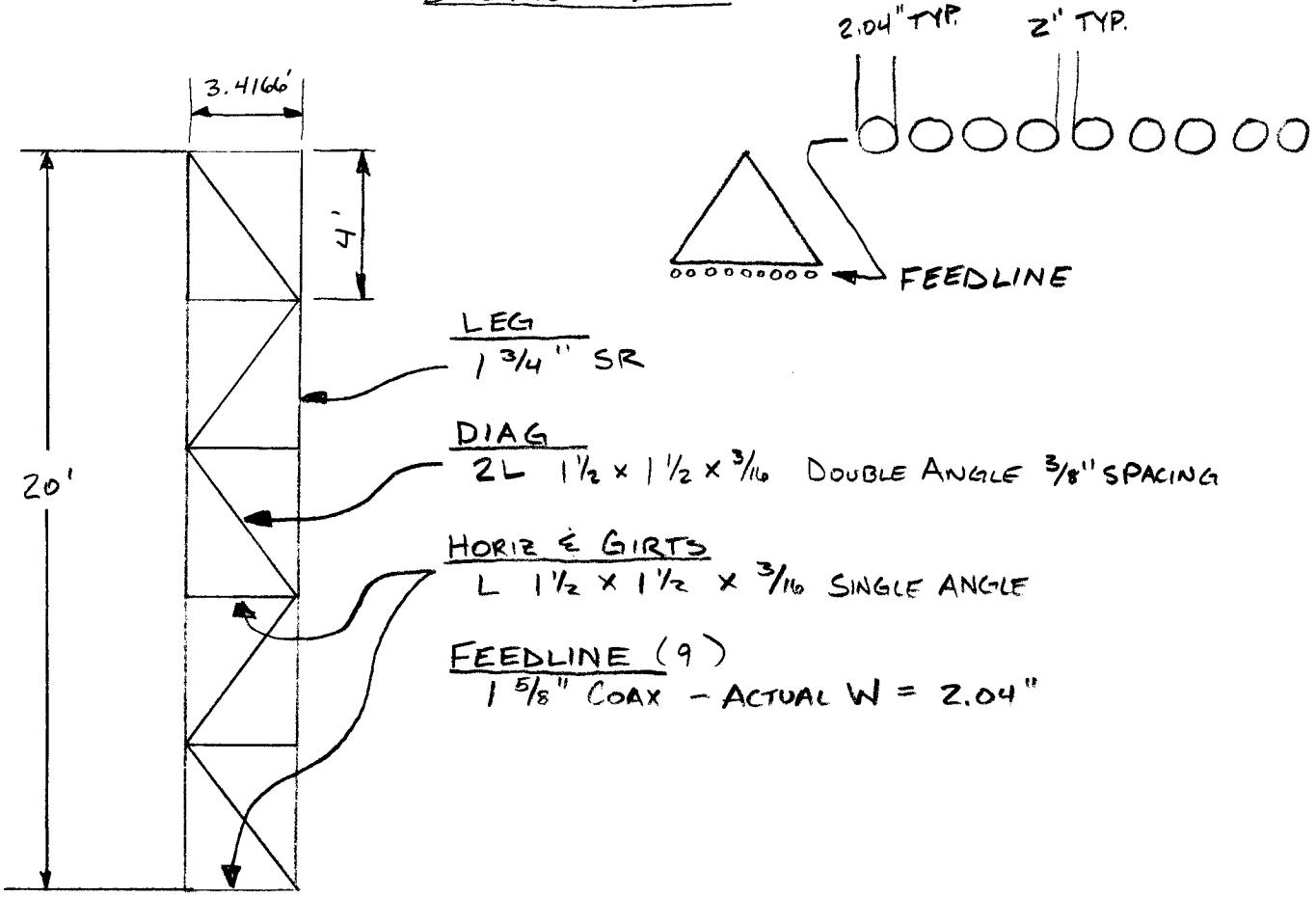
G_H = 0.850 (base tower), 0.850 (upper structure)

Description	Aiming Azimuth °	Weight K	$Offset_x$ ft	$Offset_z$ ft	z ft	K_z	q_z psf	C_AA_C Front ft^2	C_AA_C Side ft^2	t_z in
(9) FV90-12	0.000	1.294	0.000	0.000	120.000	1.315	6.477	66.288	66.288	1.138
Pirod 13' Low Profile Platform	0.000	3.024	0.000	0.000	120.000	1.315	6.477	19.169	19.169	1.138
	Sum Weight:	4.318								

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	7.242					
Bracing Weight	3.111					
Total Member Self-Weight	10.353			0.000	0.000	
Total Weight	12.827			0.000	0.000	
Wind 0 deg - No Ice		0.000	-9.872	-690.620	0.000	0.000
Wind 60 deg - No Ice		7.979	-4.607	-327.740	-567.663	0.000
Wind 90 deg - No Ice		9.378	0.000	0.000	-664.266	0.000
Member Ice	7.168					
Total Weight Ice	27.694			0.000	0.000	
Wind 0 deg - Ice		0.000	-3.483	-243.042	0.000	0.000
Wind 60 deg - Ice		2.837	-1.638	-115.804	-200.578	0.000
Wind 90 deg - Ice		3.328	0.000	0.000	-234.466	0.000

SECTION L1



COMPONENT	LENGTH	WIDTH	A_F (ft^2)	A_R (ft^2)
LEG	(2) 20'	.1458'		5.833
DIAG	(5) 5.26'	.125'	3.288	
HORIZ	(6) 3.4166'	.125'	2.563	
			5.851	5.833

$$A_G = 20' \times \left[3.4166' + \frac{1.75}{12}\right]$$

$$A_G = 71.249\ ft^2$$

CALCULATE SOLIDITY RATIO: [2.6.9.1.1]

$$e = \frac{A_F + A_R}{A_G} = \frac{5.851 + 5.833}{71.249}$$

$$e = .164$$

SECTION L1

CALCULATE DESIGN WIND LOAD [2.6.9] $F_W = F_{ST} + F_A + F_G$?

WIND DIR	F_{ST}	F_A	F_W (lb)
NORMAL	595.8	588	1184
60°	519.8	588	1108
90°	538.8	588	1127

CALCULATE F_{ST}

$$F_{ST} = q_z G_H (EPA)_s \quad [2.6.9.1]$$

[2.6.9.6] $q_z = .00256 K_z K_{zT} K_D V^2 I$

$K_z = 1.291$ $K_{zT} = 1.0$ $K_D = .85$ $V = 100$ $I = 1.0$

$q_z = 28.092$

[2.6.5.2] $K_z = 2.01 (z/z_g)^{(2/\alpha)}$

→ $z = 110'$ (mid-point L1)

[TABLE 2-4] – EXPOSURE CAT C

→ $K_z = 1.291$

$z_g = 900$ $\alpha = 9.5$ $K_{z\min} = .85$

[2.6.6.4] TOPO CAT 1 → $K_{zT} = 1.0$

[TABLE 2-2] LATTICED STRUCT. Δ CROSS-SECT → $K_D = .85$

[TABLE 2-3] STRUCTURE CLASS II → $I = 1.0$

WIND LOAD NO ICE

[2.6.7] – 2.6.7.1 120' SS → $G_H = .85$

[2.6.9.1.1] $(EPA)_s = C_F [D_F \Sigma A_F + D_R \Sigma (A_R R_A)]$

WIND DIR	$(EPA)_s$	F_{ST}
NORMAL	24.952	595.8
60°	21.767	519.8
90°	22.563	538.8

$C_F = 3.4e^2 - 4.7e + 3.4$ → $C_F = 2.721$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
D_F	1.0	.80	.85
D_R	1.0	1.0	1.0

[CALC. PAGE 1]

→ $\Sigma A_F = 5.851$

→ $\Sigma A_R = 5.833$

SECTION L1

[2.6.9.1.1] (CONT.)

$C = [I K_z K_{zT}]^{(1/2)} V D \longrightarrow D = \left(\frac{1.75}{12}\right)'$

$C = 16.57 < 32$ SUBCRITICAL FLOW

$\therefore R_R = .57 - .14e + .86e^2 - .24e^3 \longrightarrow R_R = .569$

CALCULATE F_A (FEEDLINES)

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[2.6.9.6] $q_z = .00256 K_z K_{zT} K_D V^2 I$

[2.6.5.2] $K_z = 2.01\left(z/z_g\right)^{(2/\alpha)}$ $\boxed{q_z = 31.397}$

[TABLE 2-4] EXPOSURE CAT C

$z_g = 900$ $\alpha = 9.5$ $K_{z\min} = .85$

$z = 110'$ (Centerline of appurtenance)

$\longrightarrow K_z = 1.291$

[2.6.6.4] TOPO CAT. 1 $\longrightarrow K_{zT} = 1.0$

[TABLE 2-2] * PRE-ERRATA 1.0 - APPURTENANCES $\longrightarrow K_D = .95$

[TABLE 2-3] STRUCTURE CLASS II $\longrightarrow I = 1.0$

WIND LOAD NO ICE

[2.6.7] - 2.6.7.1 120' SS $\longrightarrow \boxed{G_H = .85}$

$(EPA)_A = K_A \Sigma C_A A_A$ - when $(EPA)_N$ used as larger value

θ WIND DIR (NORMAL (0°))	$(EPA)_A$	F_A (lb.)
0°	22.032	588.0
60°	22.032	588.0
90°	22.032	588.0

$\Sigma C_A A_A = (1.2)(30.6) \rightarrow (EPA)_N = 36.72$

$A_A = (9)\left(\frac{2.04}{12}\right)'20' = 30.6$

SECTION 6.1

[2.6.9.2](cont.)

[TABLE 2-8] FIND C_A → $C_A = 1.2$

ASPECT RATIO $\frac{L}{W}$ $\frac{120'}{\left(\frac{2.04}{12}\right)'} = 706 > 25$

$C = (I\ K_{ZT}\ K_Z)^{.5}\ V\ D \qquad D = \left(\frac{2.04}{12}\right)'$

$C = 19.32 < 32$ SUBCRITICAL FLOW

$K_A = (1 - e) = .836$ K_A need not exceed .6

→ $K_A = .6$

CALCULATE DESIGN WIND FORCE W/ ICE

[2.6.8] Ice thickness $t_{iz} = 2.0\ t_i\ I\ K_{iz}\ (K_{ZT})^{.35}$

$t_{iz} = 1.128''$

→ $t_i = .5''$

[TABLE 2-3] STRUCT. CLASS II → $I = 1.0$

WIND LOAD W/ ICE

$K_{iz} = \left(\frac{z}{33}\right)^{.10}$ $z = 110'$ (Mid-point of Section) → $K_{iz} = 1.128$

[2.6.6.4] TOPO. CAT. 1 – 120' SS → $K_{ZT} = 1.0$

[2.6.9] $F_w = F_{ST} + F_A + F_G \qquad F_G = 0$ (SS)

WIND DIR	F_{ST}	F_A	F_w (lb)
NORMAL	212.2	296.8	509
60°	187.1	296.8	484
90°	193.4	296.8	490

[2.6.9.1] $F_{ST} = q_z\ G_H\ (EPA)_S$

[2.6.9.6] $q_z = .00256\ K_z\ K_{ZT}\ K_D\ V^2\ I$

[CALC. PAGE 2] → $K_z = 1.291$ $V_{ICE} = 45$ mph

→ $K_{ZT} = 1.0$

→ $K_D = .85$

→ $I = 1.0$

$q_z = 5.689$

SECTION 6.1

[2.6.9.1] (cont.)

[2.6.7] – 2.6.7.1 120' SS → **$G_H = .85$**

[2.6.9.1.1] $(EPA)_s = C_F [D_F \Sigma A_F + D_R \Sigma A_R R_R]$

Wind Dir	$(EPA)_s$	F_{ST}
NORMAL	43.874	212.2
60°	38.698	187.1
90°	39.992	193.4

$$A_G = \left[3.4166 + \left(\frac{1.75}{12}\right)^1 + (2)\left(\frac{1.128}{12}\right)^1\right] \times 20' \longrightarrow A_G = 75.008 \text{ ft}^2$$

Find e solidity ratio: $e = \frac{A_F + A_R}{A_G} = \frac{11.716 + 13.353}{75.008}$

$\longrightarrow e = .334$

$C_F = 3.4e^2 - 4.7e + 3.4 \longrightarrow C_F = 2.209$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
D_F	1.0	.80	.85
D_R	1.0	1.0	1.0

[CALC. PAGE 6]

$\longrightarrow \Sigma A_F = 11.716$

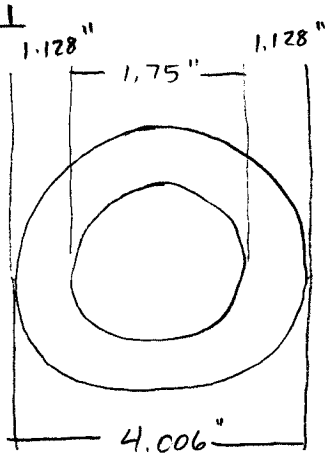
$\longrightarrow \Sigma A_R = 13.353$

$R_R = .57 - .14e + .86e^2 - .24e^3$ [For all iced conditions]

$\longrightarrow R_R = .610$

SECTION L1

ICE ACCUMULATION



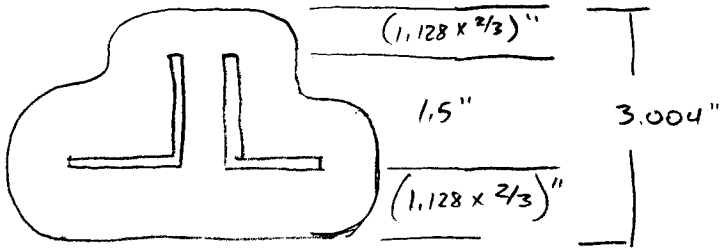
LEG

$$A_R = \left(\frac{4.006}{12}\right)'(2) \times 20' = 13.353 \text{ ft}^2$$

$$\boxed{A_R = 13.353 \text{ ft}^2}$$

DIAG

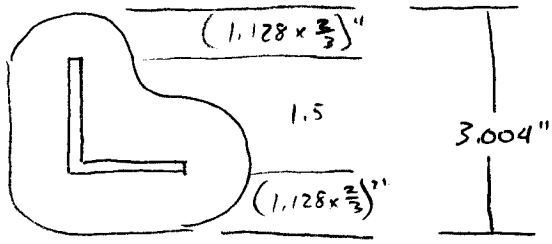
$$A_F = \left(\frac{3.004}{12}\right)' \times 26.3 = 6.584 \text{ ft}^2$$



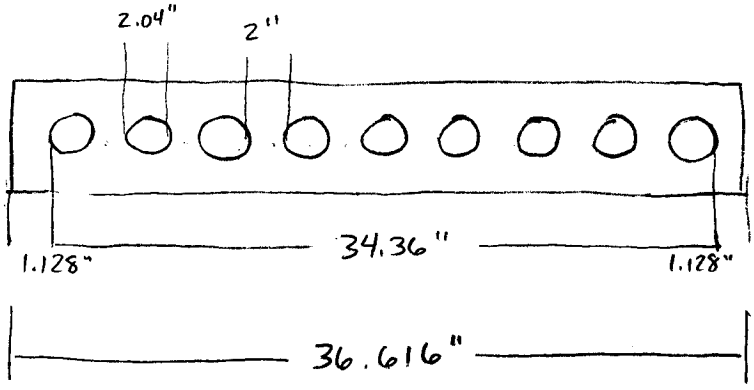
HORIZ.

$$A_F = \left(\frac{3.004}{12}\right)' \times 20.5' = 5.132 \text{ ft}^2$$

$$\boxed{A_F = 11.716 \text{ ft}^2}$$



FEEDLINE



[FIG. 2-12] $C_A = 1.5$ for cluster ice condition

$$C_A A_A = (1.5)\left(\frac{36.616}{12}\right) 20' \longrightarrow C_A A_A = 91.54$$

SECTION L1

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[2.6.9.6] $q_z = .00256 K_z K_{zT} K_D V^2 I$

[2.6.5.2] $K_z = 2.01 (z/z_g)^{(2/\alpha)}$

$\boxed{q_z = 6.358}$

[TABLE 2-4] EXPOSURE CAT. C

$z_g = 900$ $\alpha = 9.5$ $K_{zMIN} = .85$

$z = 110'$ (centerline of appurtenance)

→ $K_z = 1.291$

[2.6.6.4] TOPO. CAT. 1 → $K_{zT} = 1.0$

[TABLE 2-2] * Pre-Errata 1.0 - APPURTENANCES → $K_D = .95$

[TABLE 2-3] STRUCTURE CLASS II → $I = 1.0$

WIND LOAD W/ ICE

[2.6.7] - 2.6.7.1 120' SS → $\boxed{G_H = .85}$

$(EPA)_A = K_A \sum C_A A_A$ - when larger value EPA_N conservatively used.

$K_A = 1 - e$ $1 - .334 = .667$ K_A not to exceed .6

→ $K_A = .6$

[CALC. PAGE 6]

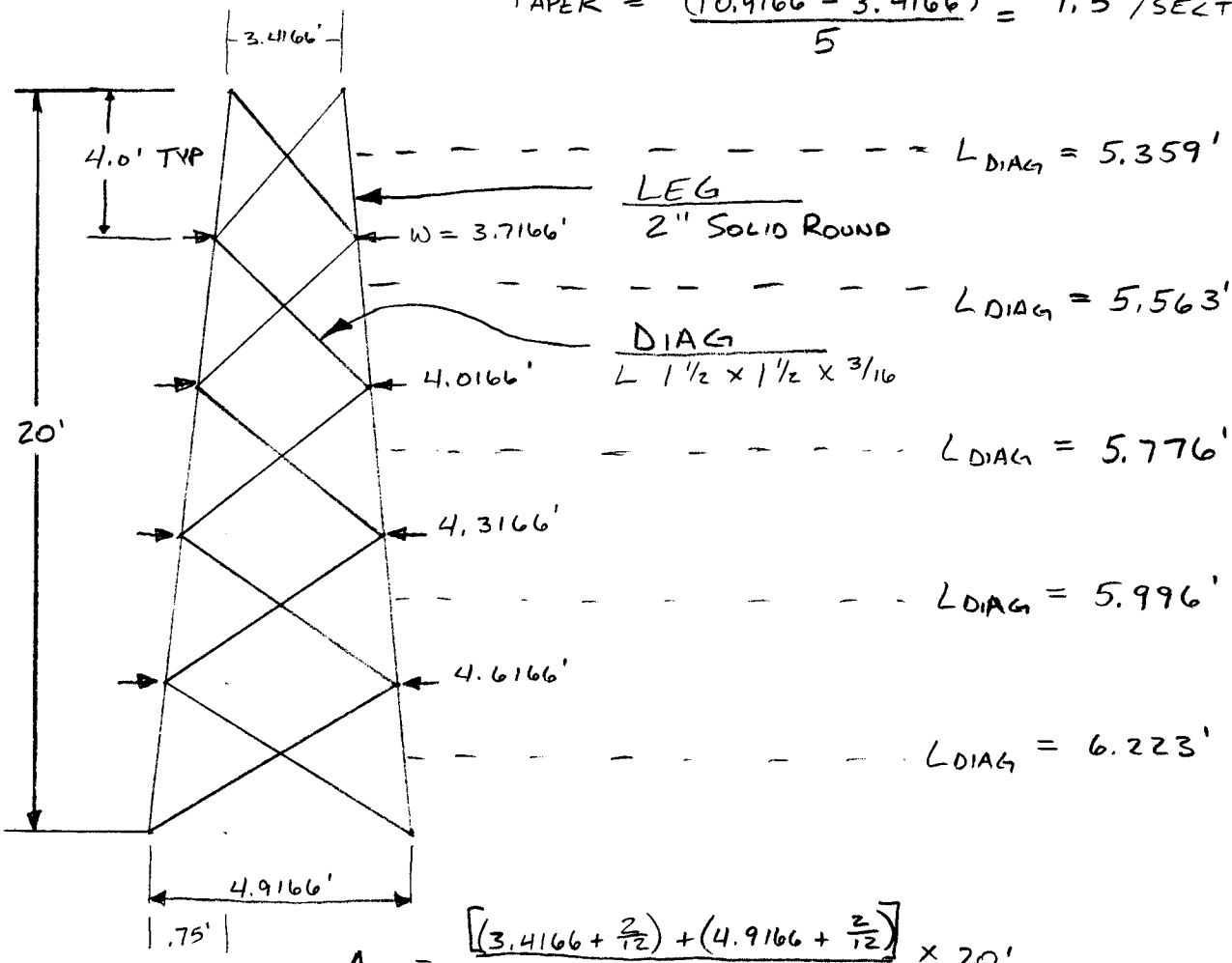
→ $\sum C_A A_A = 91.54$

→ $\boxed{(EPA)_A = 54.924 \text{ ft}^2}$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	54.924	296.8
60°	54.924	296.8
90°	54.924	296.8

SECTION T1

$$\text{TAPER} = \frac{(10.9166 - 3.4166)}{5} = 1.5'/\text{SECTION}$$



$$A_G = \frac{\left[\left(3.4166 + \frac{3}{12}\right) + \left(4.9166 + \frac{3}{12}\right)\right]}{2} \times 20'$$

$$A_G = 86.67 \text{ ft.}^2$$

COMPONENT	LENGTH	WIDTH	A_F (ft²)	A_R (ft²)
LEG	40.03'	.1667'		6.673
DIAG	57.834'	.125'	7.230	

CALCULATE SOLIDITY RATIO

$$e = \frac{A_F + A_R}{A_G} = \frac{7.23 + 6.673}{86.67}$$

$$\longrightarrow e = .160$$

SECTION T1

CALCULATE DESIGN WIND LOAD [2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	690.6	563.8	1254
60°	600.0	563.8	1164
90°	622.8	563.8	1187

CALCULATE q_z, G_H FOR T1

	z	* K_z	K_{zT}	K_D	V	I	** q_z
STRUCTURE NO ICE	90'	1.238	1.0	.85	100	1.0	26.939
W/ICE	90'	1.238	1.0	.85	45	1.0	5.455
FEEDLINE NO ICE	90'	1.238	1.0	.95	100	1.0	30.108
W/ICE	90'	1.238	1.0	.95	45	1.0	6.097

* $K_z = 2.01\left(z/z_g\right)^{(2/\alpha)}$ ** $q_z = .00256\, K_z\, K_{zT}\, K_D\, V^2 I$ [2.6.9.6]

[TABLE 2-4] $z_g = 900'$, $\alpha = 9.5$, $K_{zmin} = .85$

[2.6.7] – 2.6.7.1 – 120' SS – → $G_H = .85$

CALCULATE F_{ST} [2.6.9.1] $F_{ST} = q_z G_H (EPA)_S$

[2.6.9.1.1] $(EPA)_S = C_F\left[D_F \Sigma A_F + D_R \Sigma (A_R R_R)\right]$

WIND DIR	$(EPA)_S$	F_{ST}
NORMAL	30.16	690.6
60°	26.20	600.0
90°	27.20	622.8

$C_F = 3.4e^2 - 4.7e + 3.4$ → $C_F = 2.735$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°	
D_F	1.0	.80	.85	$\Sigma A_F = 7.23$
D_R	1.0	1.0	1.0	$\Sigma A_R = 6.673$

SECTION T1

[2.6.9.1] (cont.)

$$C = [I K_z K_{zT}]^{(1/2)} V D \qquad \rightarrow D = \left(\frac{2}{12}\right)'$$

$C = 18.54 < 32$ Subcritical Flow

$$R_R = .57 - .14e + .86e^2 - .24e^3 \rightarrow R_R = .569$$

CALCULATE F_A

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 9] → $q_z = 30.108$

→ $G_H = .85$

$$(EPA)_A = K_A \Sigma C_A A_A$$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	22.032	563.8
60°	22.032	563.8
90°	22.032	563.8

$K_A = 1 - e^{-.84}$ → $K_A = .6$ (K_A need not exceed .6)

[TABLE 2-8] FIND C_A

ASPECT RATIO: $\frac{L}{W} = \frac{120'}{\left(\frac{2.04}{12}\right)'} = 706 > 25$

$$C = (I K_z K_{zT})^{.5} V D \qquad \rightarrow D = \left(\frac{2.04}{12}\right)'$$

$C = 18.92 < 32$ Subcritical Flow

→ $C_A = 1.2$

$$A_A = (9)\left(\frac{2.04}{12}\right)'(20') \rightarrow A_A = 30.6$$

SECTION T1

CALCULATE DESIGN WIND FORCE W/ ICE

[2.6.8] ICE THICKNESS $t_{iz} = 2.0\, t_i\, I\, K_{iz}\, (K_{zT})^{.35}$

$\boxed{t_{iz} = 1.106"}$

$\longrightarrow t_i = .5"$

[TABLE 2-3] STRUCTURE CLASS II WIND LOAD W/ICE $\longrightarrow I = 1.0$

$K_{iz} = \left(\frac{z}{33}\right)^{.10}$ $z = 90'$ Mid-point section $\longrightarrow K_{iz} = 1.106$

[2.6.6.4] TOPO. CAT. 1 - 120' SS $\longrightarrow K_{zT} = 1.0$

[2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	238.9	284.3	523
60°	208.9	284.3	493
90°	216.4	284.3	501

[2.6.9.1] $F_{ST} = q_z G_H (EPA)_s$

[CALC. PAGE 9] $\longrightarrow \boxed{q_z = 5.455}$

$\longrightarrow \boxed{G_H = .85}$

[2.6.9.1.1] $(EPA)_s = C_F \left[D_F \Sigma A_F + D_R \Sigma (A_R R_R) \right]$

WIND DIR	$(EPA)_s$	F_{ST}
NORMAL	51.53	238.9
60°	45.05	208.9
90°	46.67	216.4

$$A_G = \frac{\left(3.4166 + \frac{2}{12} + (2)\frac{1.106}{12} + 4.9166 + \frac{2}{12} + (2)\frac{1.106}{12}\right)}{2} \times 20'$$

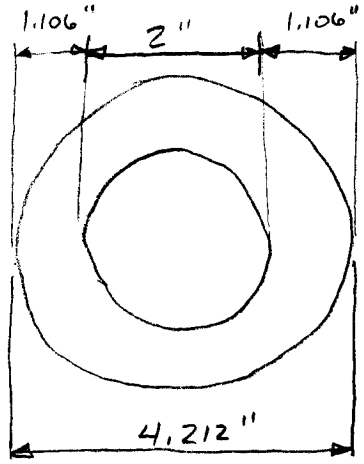
$\longrightarrow A_G = 90.35\ ft^2$

$$e = \frac{A_F + A_R}{A_G} = \frac{14.338 + 14.051}{90.35}$$

[CALC. PAGE 12] $\longrightarrow e = .314$

SECTION T1

ICE ACCUMULATION



LEG

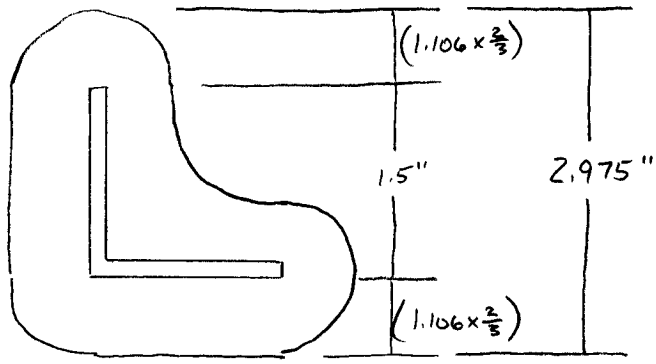
$$A_R = \left(\frac{4.212}{12}\right)' \times 40.03'$$

$$\boxed{A_R = 14.051 \text{ ft}^2}$$

DIAG

$$A_F = \left(\frac{2.975}{12}\right)' \times 57.834'$$

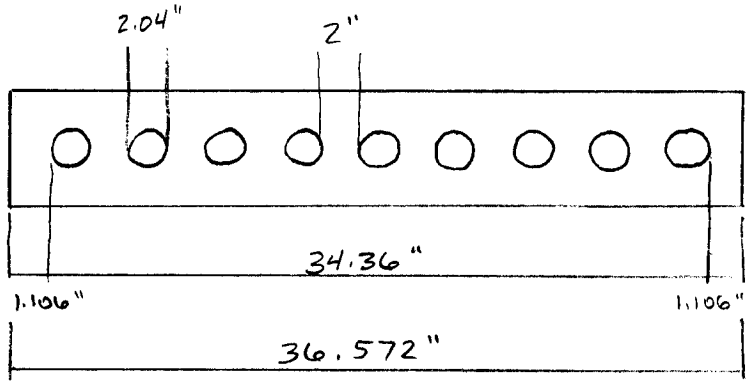
$$\boxed{A_F = 14.338 \text{ ft}^2}$$



FEEDLINE

$$C_A A_A = (1.5)\left(\frac{36.572}{12}\right) 20'$$

$$\boxed{C_A A_A = 91.43 \text{ ft}^2}$$



[FIG. 2-12] $C_A = 1.5$ for cluster ice condition

SECTION T 1

[2.6.9.1.1] (cont.)

$C_F = 3.4e^2 - 4.7e + 3.4 \longrightarrow C_F = 2.259$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
D_F	1.0	.80	.85
D_R	1.0	1.0	1.0

$R_R = .57 - .14e + .86e^2 - .24e^3$ [For all iced conditions]

$\longrightarrow R_R = .603$

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 9]

$\longrightarrow$ $q_z = 6.097$

$\longrightarrow$ $G_H = .85$

$(EPA)_A = K_A \Sigma C_A A_A$

$K_A = 1 - e^{-.314} = .686$ K_a not to exceed .6

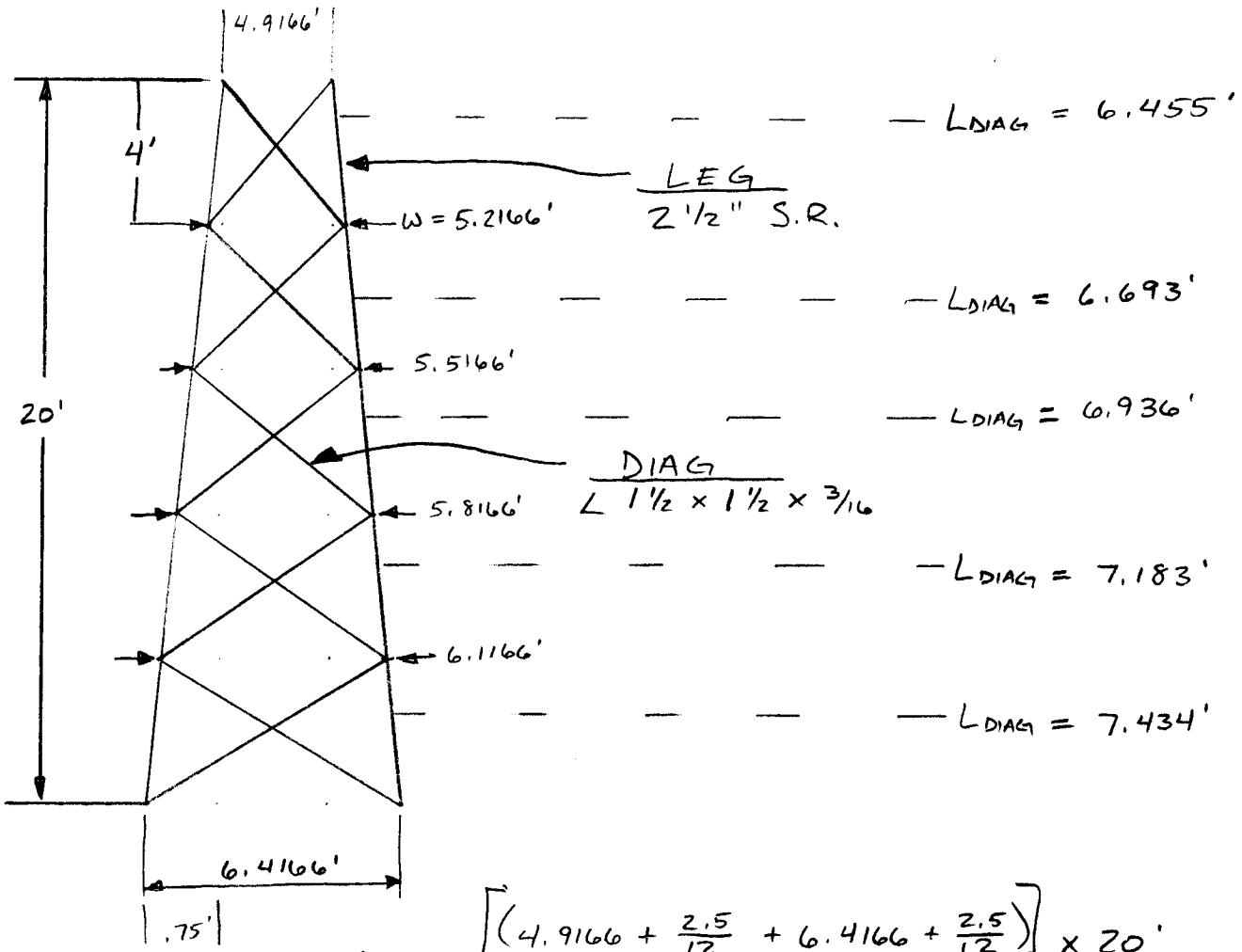
$\longrightarrow K_A = .6$

[CALC. PAGE 12]

$\longrightarrow \Sigma C_A A_A = 91.43\ ft^2$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	54.858	284.3
60°	54.858	284.3
90°	54.858	284.3

SECTION T2



$$A_G = \left[\frac{\left(4.9166 + \frac{2.5}{12} + 6.4166 + \frac{2.5}{12}\right)}{2}\right] \times 20'$$

$$\rightarrow A_G = 117.502\ ft^2$$

COMPONENT	LENGTH	WIDTH	A_F (ft^2)	A_R (ft^2)
LEG	40.03	.2083		8.340
DIAG	69.40	.125	8.676	

CALCULATE SOLIDITY RATIO

$$e = \frac{A_F + A_R}{A_G} = \frac{8.676 + 8.34}{117.502}$$

$$\rightarrow e = .145$$

SECTION T2

CALCULATE DESIGN WIND LOAD [2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	810.8	534.7	1346
60°	708.0	534.7	1243
90°	734.3	534.7	1269

CALCULATE q_z, G_H FOR T2

	z	* K_z	K_{ZT}	K_D	V	I	** q_z
STRUCTURE NO ICE	70'	1.174	1.0	.85	100	1.0	25.546
W/ ICE	70'	1.174	1.0	.85	45	1.0	5.173
FEEDLINE NO ICE	70'	1.174	1.0	.95	100	1.0	28.552
W/ ICE	70'	1.174	1.0	.95	45	1.0	5.782

$* K_z = 2.01 \left(z/z_g\right)^{(2/\alpha)}$ $** q_z = .00256\, K_z K_{ZT} K_D V^2 I$ [2.6.9.6]

[TABLE 2-4] $z_g = 900'$, $\alpha = 9.5$, $K_{zmin} = .85$

[2.6.7] - 2.6.7.1 - 120' SS' → $G_H = .85$

CALCULATE F_{ST} [2.6.9.1] $F_{ST} = q_z G_H (EPA)_s$

[2.6.9.1.1] $(EPA)_s = C_F \left[D_F \Sigma A_F + D_R \Sigma A_R R_R\right]$

WIND DIR	$(EPA)_s$	F_{ST}
NORMAL	37.340	810.8
60°	32.605	708.0
90°	33.815	734.3

$C_F = 3.4e^2 - 4.7e + 3.4$ → $C_F = 2.790$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°	
D_F	1.0	.80	.85	$\Sigma A_F = 8.676$
D_R	1.0	1.0	1.0	$\Sigma A_R = 8.34$

SECTION T2

[2.6.9.1] (cont.)

$$C = \left[I K_z K_{zT}\right]^{(1/2)} VD \longrightarrow D = \left(\frac{2.5}{12}\right)'$$

$C = 22.57 < 32$ Subcritical Flow

$$R_R = .57 - .14e + .86e^2 - .24e^3 \longrightarrow R_R = .567$$

CALCULATE F_A

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 15] → $q_z = 28.552$

→ $G_H = .85$

$(EPA)_A = K_A \Sigma C_A A_A$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	22.032	534.7
60°	22.032	534.7
90°	22.032	534.7

$K_A = 1 - e^{-.855}$ K_A not to exceed .6

→ $K_A = .6$

[TABLE 2-8] FIND C_A

ASPECT RATIO: $\frac{L}{W}\left(\frac{120'}{\frac{2.04}{12}}\right) = 706 > 25$

$$C = \left[I K_z K_{zT}\right]^{.5} VD \longrightarrow D = \left(\frac{2.04}{12}\right)'$$

$C = 18.42 < 32$ Subcritical Flow

→ $C_A = 1.2$

$A_A = 9\left(\frac{2.04}{12}\right)'(20)'$ → $A_A = 30.6$

SECTION T2

CALCULATE DESIGN WIND FORCE W/ICE

[2.6.8] ICE THICKNESS $t_{iz} = 2.0\, t_i\, I\, K_{iz} (K_{zT})^{.35}$

$$\boxed{t_{iz} = 1.078"}$$

$\longrightarrow t_i = .5"$

[TABLE 2-3] STRUCTURE CLASS II $\longrightarrow I = 1.0$

WIND LOAD W/ ICE

$K_{iz} = \left(\frac{z}{33}\right)^{.10}$ $z = 70'$ mid-point of section $\longrightarrow K_{iz} = 1.078$

[2.6.6.4] TOPO. CAT. 1 - 120' SS $\longrightarrow K_{zT} = 1.0$

[2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	274.1	269.2	543
60°	238.5	269.2	508
90°	247.4	269.2	517

[2.6.9.1] $F_{ST} = q_z G_H (EPA)_s$

[CALC. PAGE 15] $\longrightarrow \boxed{q_z = 5.173}$

$\longrightarrow \boxed{G_H = .85}$

[2.6.9.1.1] $(EPA)_s = C_F \left[D_F \Sigma A_F + D_R \Sigma (A_R R_a)\right]$

WIND DIR	$(EPA)_s$	F_{ST} (lb.)
NORMAL	62.340	274.1
60°	54.237	238.5
90°	56.263	247.4

$$A_G = \left[\frac{\left(4.9166 + \frac{2.5}{12} + (2)\frac{1.078}{12} + 6.4166 + \frac{2.5}{12} + (2)\frac{1.078}{12}\right)}{2}\right] \times 20'$$

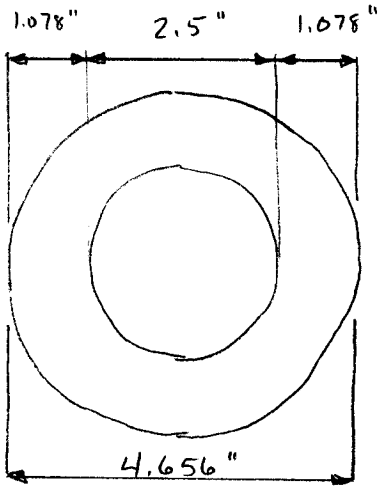
$\longrightarrow A_G = 121.092\ ft^2$

[CALC. PAGE 18] $e = \frac{A_F + A_R}{A_G} = \frac{16.986 + 15.512}{121.092}$

$\longrightarrow e = .268$

SECTION T2

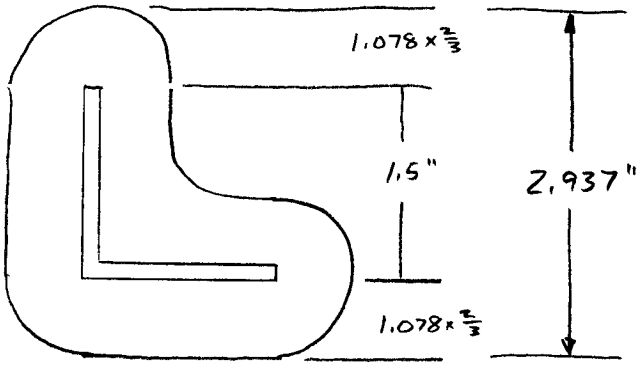
ICE ACCUMULATION



LEG

$$A_R = \left(\frac{4.656}{12}\right)' \times 40.03'$$

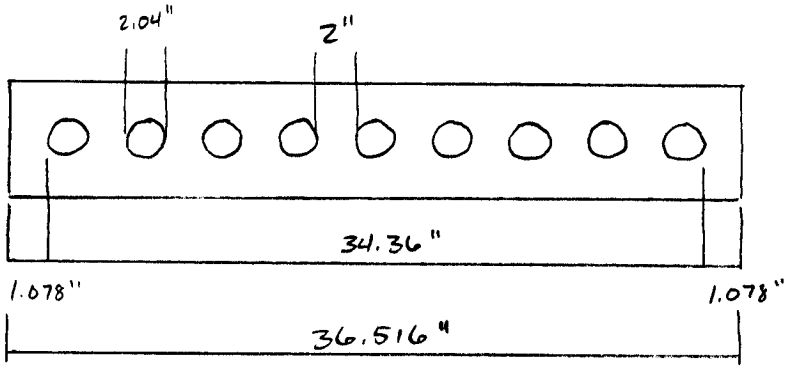
$$\boxed{A_R = 15{,}512 \text{ ft}^2}$$



DIAG

$$A_F = \left(\frac{2.937}{12}\right)' \times 69.40'$$

$$\boxed{A_F = 16{,}986 \text{ ft}^2}$$



FEEDLINE

$$C_A A_A = (1.5)\left(\frac{36.516}{12}\right)(20)$$

$$\boxed{C_A A_A = 91.29 \text{ ft}^2}$$

[FIG. 2-12] $C_A = 1.5$ for cluster ice condition

SECTION T2

[2.6.9.1.1] (cont.)

$C_F = 3.4e^2 - 4.7e + 3.4 \longrightarrow C_F = 2.385$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
DF	1.0	.80	.85
DR	1.0	1.0	1.0

$R_R = .57 - .14e + .86e^2 - .24e^3$ [For all iced conditions]

$\longrightarrow R_R = .590$

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 15]

$\longrightarrow q_z = 5.782$

$\longrightarrow G_H = .85$

$(EPA)_A = K_A \Sigma C_A A_A$

$K_A = 1 - e^{-.268}$ K_A not to exceed .6

$1 - .732$

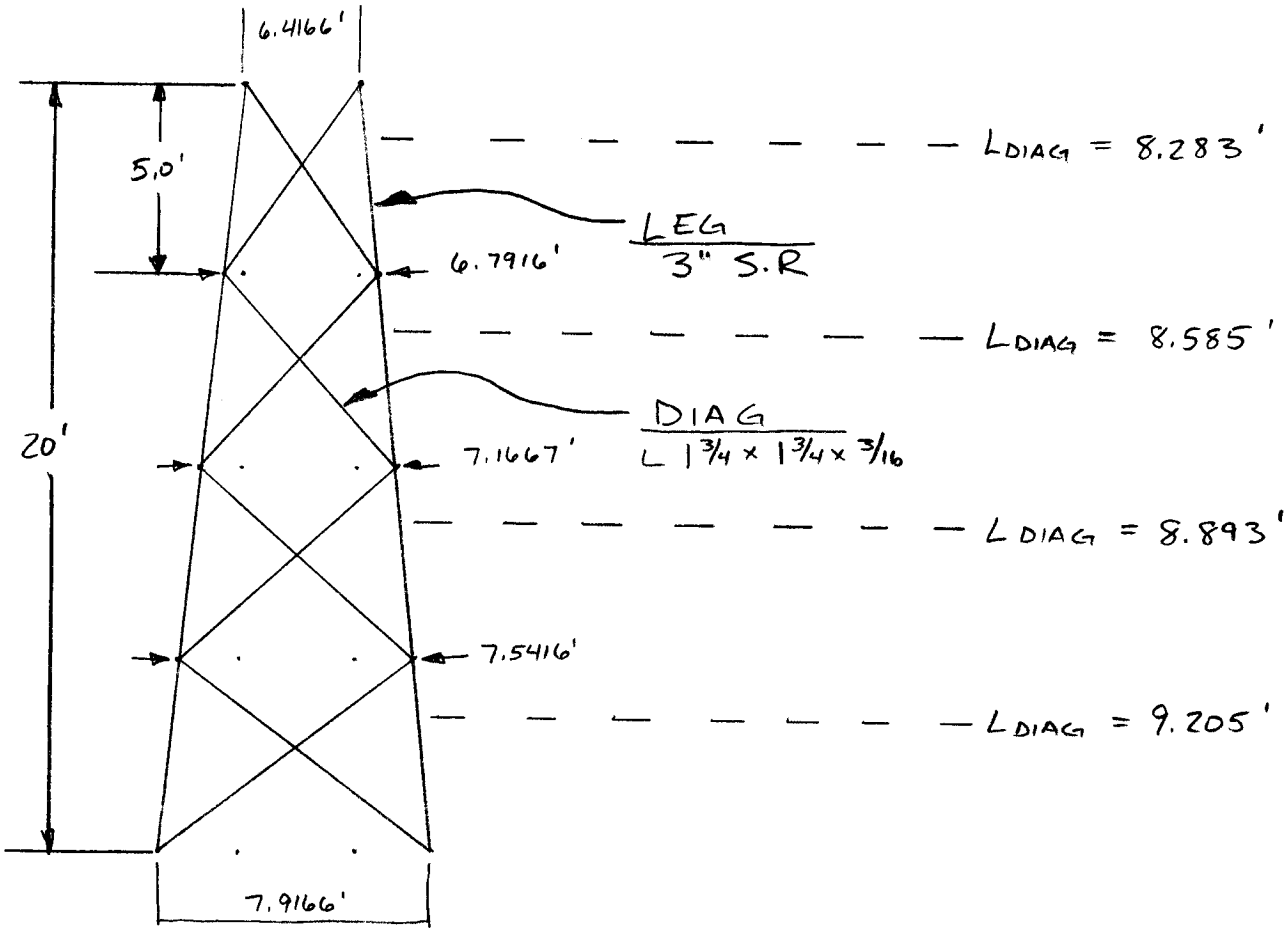
$\longrightarrow K_A = .6$

[CALC. PAGE 18]

$\longrightarrow \Sigma C_A A_A = 91.29$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	54.774	269.2
60°	54.774	269.2
90°	54.774	269.2

SECTION T3



$$A_G = \left[\frac{\left(6.4166 + \frac{3}{12} + 7.9166 + \frac{3}{12}\right)}{2}\right] 20'$$

$$\rightarrow A_G = 148.332 \text{ ft}^2$$

COMPONENT	LENGTH	WIDTH	A_F (ft²)	A_R (ft²)
LEG	40.03	.25		10.008
DIAG	69.932	.1458	10.196	

CALCULATE SOLIDITY RATIO

$$e = \frac{A_F + A_R}{A_G} = \frac{10.196 + 10.008}{148.332}$$

$$\rightarrow e = .136$$

SECTION T3

CALCULATE DESIGN WIND LOAD [2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	906.3	498.3	1405
60°	789.8	498.3	1288
90°	818.8	498.3	1317

CALCULATE q_z, G_H FOR T3

	z	* K_z	K_{zT}	K_D	V	I	** q_z
STRUCTURE NO ICE	50'	1.094	1.0	.85	100	1.0	23.805
W/ICE	50'	1.094	1.0	.85	45	1.0	4.821
FEEDLINE NO ICE	50'	1.094	1.0	.95	100	1.0	26.606
W/ICE	50'	1.094	1.0	.95	45	1.0	5.388

$* K_z = 2.01 \left(z/z_g\right)^{(2/\alpha)}$ $** q_z = .00256 K_z K_{zT} K_D V^2 I$ [2.6.9.6]

[TABLE 2-4] $z_g = 900'$, $\alpha = 9.5$, $K_{z\min} = .85$

[2.6.7] - 2.6.7.1 - 120' SS → $G_H = .85$

CALCULATE F_{ST} [2.6.9.1] $F_{ST} = q_z G_H (EPA)_s$

[2.6.9.1.1] $(EPA)_s = C_F \left[D_F \Sigma A_F + D_R \Sigma A_R R_R\right]$

WIND DIR	$(EPA)_s$	F_{ST} (lb.)
NORMAL	44.790	906.3
60°	39.031	789.8
90°	40.471	818.8

$C_F = 3.4e^2 - 4.7e + 3.4$ → $C_F = 2.824$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°	
D_F	1.0	.80	.85	$\Sigma A_F = 10,196$
D_R	1.0	1.0	1.0	$\Sigma A_R = 10,008$

SECTION T3

[2.6.9.1] (cont.)

$$C = [I K_z K_{zT}]^{(1/2)} V D \longrightarrow D = \left(\frac{3}{12}\right)'$$

$C = 26.15 < 32$ Subcritical Flow

$$R_R = .57 - .14e + .86e^2 - .24e^3 \longrightarrow R_R = .566$$

CALCULATE F_A

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 21] → $q_z = 26.606$

→ $G_H = .85$

$$(EPA)_A = K_A \Sigma C_A A_A$$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	22.032	498.3
60°	22.032	498.3
90°	22.032	498.3

$K_A = 1 - e = .864$ K_A not exceed .6

→ $K_A = .6$

[TABLE 2-8] FIND C_A

ASPECT RATIO: $\frac{L}{W} \frac{120'}{\left(\frac{2.04}{12}\right)'} = 706 > 25$

$$C = [I K_z K_{zT}]^{.5} V D \longrightarrow D = \left(\frac{2.04}{12}\right)'$$

$C = 17.78 < 32$ Subcritical Flow

→ $C_A = 1.2$

$A_A = (9)\left(\frac{2.04}{12}\right)' 20'$ → $A_A = 30.6$

SECTION T3

CALCULATE DESIGN WIND FORCE W/ ICE

[2.6.8] ICE THICKNESS $t_{iz} = 2.0\, t_i\, I\, K_{iz}\, (K_{zT})^{.35}$

$\boxed{t_{iz} = 1.042"}$

$\longrightarrow t_i = .5"$

[TABLE 2-3] STRUCTURE CLASS II $\longrightarrow I = 1.0$

WIND LOAD W/ ICE

$K_{iz} = \left(\frac{z}{33}\right)^{.10}$ $z = 50'$ MID-POINT OF SECTION $\longrightarrow K_{iz} = 1.042$

[2.6.6.4] TOPO. CAT. 1 - 120' SS $\longrightarrow K_{zT} = 1.0$

[2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	287.5	250.4	538
60°	250.2	250.4	501
90°	259.5	250.4	510

[2.6.9.1] $F_{ST} = q_z\, G_H\, (EPA)_S$

[CALC. PAGE 21] $\longrightarrow \boxed{q_z = 4.821}$

$\longrightarrow \boxed{G_H = .85}$

[2.6.9.1.1] $(EPA)_S = C_F\left[D_F \Sigma A_F + D_R \Sigma (A_R R_R)\right]$

WIND DIR	$(EPA)_S$	F_{ST} (lb.)
NORMAL	70.170	287.5
60°	61.049	250.2
90°	63.329	259.5

$$A_G = \left[\frac{\left(6.4166 + \frac{3}{12} + (2)\frac{1.042}{12} + 7.9166 + \frac{3}{12} + (2)\frac{1.042}{12}\right)}{2}\right] \times 20'$$

$\longrightarrow A_G = 151.805\ ft^2$

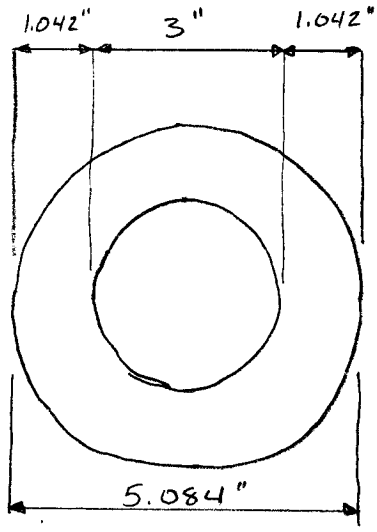
[CALC. PAGE 24] $e = \frac{A_F + A_R}{A_G}$ $\frac{18.293 + 16.960}{151.805}$

$\longrightarrow e = .232$

SECTION T3

ICE ACCUMULATION

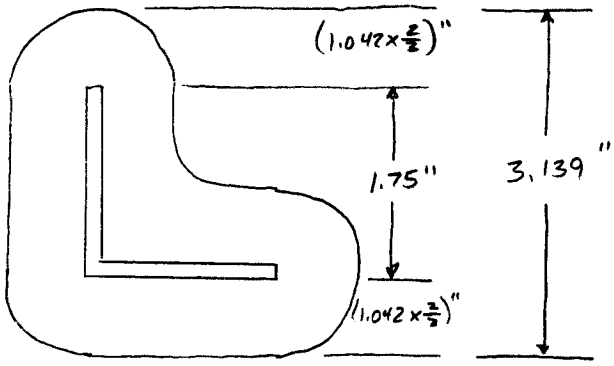
LEG



$$A_R = \left(\frac{5.084}{12}\right)' \times 40.03'$$

$$\boxed{A_R = 16.960\ ft^2}$$

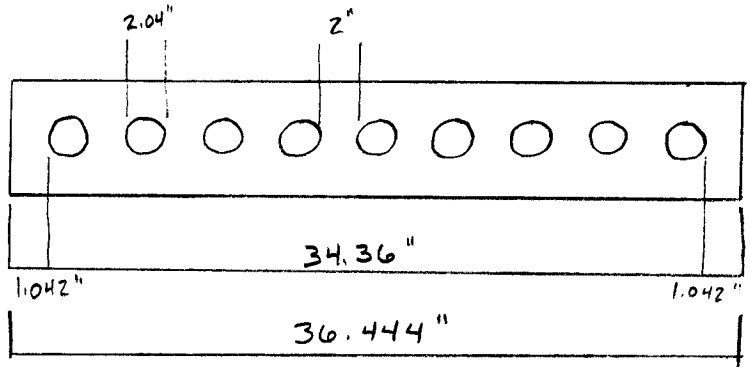
DIAG



$$A_F = \left(\frac{3.139}{12}\right)' \times 69.932'$$

$$\boxed{A_F = 18.293\ ft^2}$$

FEEDLINE



$$C_A A_A = (1.5)\left(\frac{36.444}{12}\right) \times 20'$$

$$\boxed{C_A A_A = 91.11\ ft^2}$$

[Fig 2-12] $C_A = 1.5$ for cluster ice condition

SECTION T3

[2.6.9.1.1] (cont.)

$C_F = 3.4e^2 - 4.7e + 3.4$ → $C_F = 2.493$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
DF	1.0	.80	.85
DR	1.0	1.0	1.0

$R_R = .57 - .14e + .86e^2 - .24e^3$ [For all iced conditions]

→ $R_R = .581$

CALCULATE F_A

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 21]

→ $q_z = 5.388$

→ $G_H = .85$

$(EPA)_A = K_A \Sigma C_A A_A$

$K_A = 1 - e^{-.232}$ K_A not to exceed .6

.768

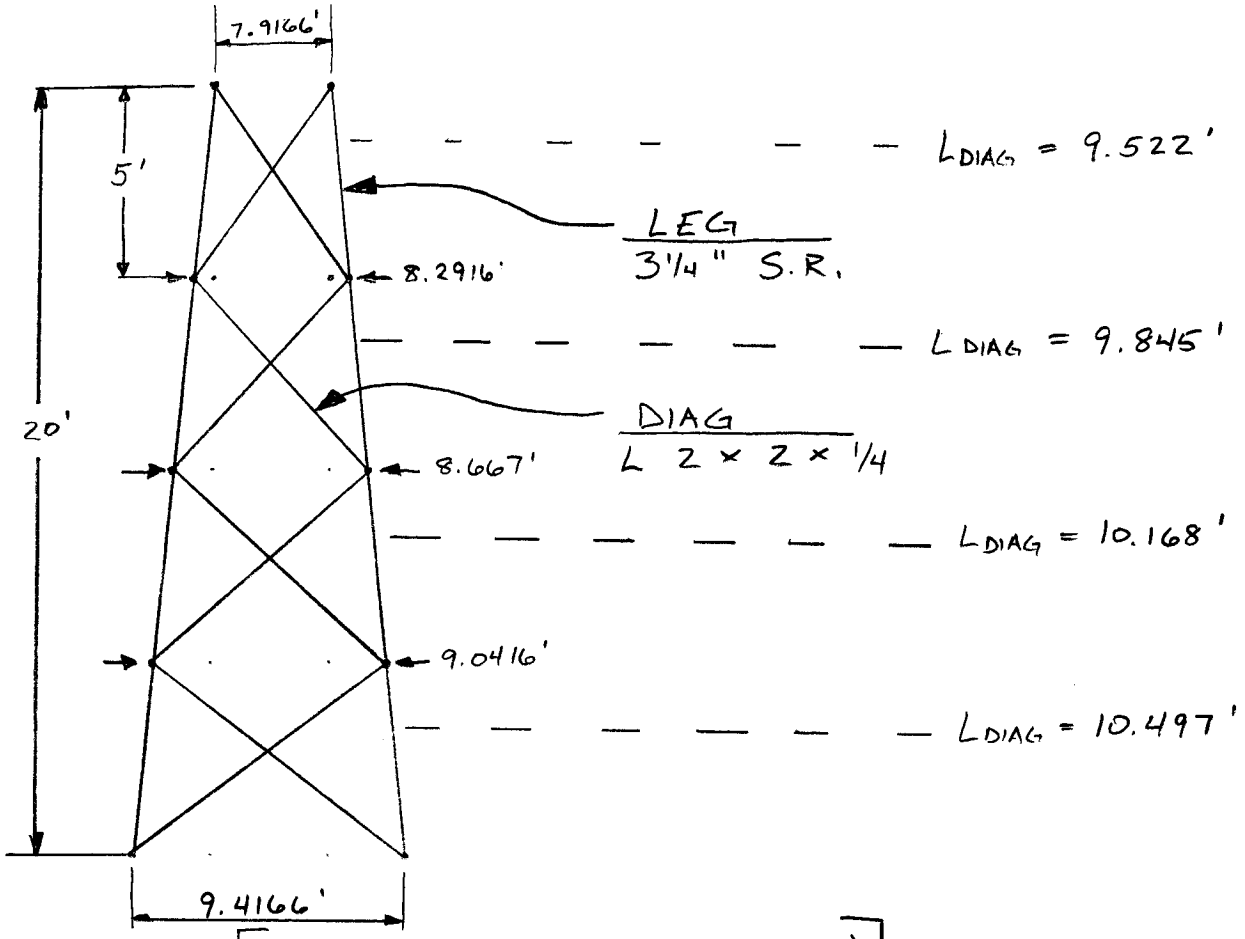
→ $K_A = .6$

[CALC. PAGE 24]

→ $\Sigma C_A A_A = 91.11$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	54.67	250.4
60°	54.67	250.4
90°	54.67	250.4

SECTION T4



$$A_G = \left[\frac{\left(7.9166 + \frac{3.25}{12} + 9.4166 + \frac{3.25}{12}\right)}{2}\right] \times 20'$$

$$\rightarrow A_G = 178.749 \text{ ft}^2$$

COMPONENT	LENGTH	WIDTH	A_F (ft²)	A_R (ft²)
LEG	40.03	.2708		10.840
DIAG	80.06	.1667	13.346	

CALCULATE SOLIDITY RATIO

$$e = \frac{A_F + A_R}{A_G} = \frac{13.346 + 10.84}{178.749}$$

$$\rightarrow e = .135$$

SECTION T4

CALCULATE DESIGN WIND LOAD [2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	1000.3	447.2	1448
60°	863.2	447.2	1310
90°	897.5	447.2	1345

CALCULATE q_z, G_H FOR T4

	z	*K_z	K_{zT}	K_D	V	I	**q_z
STRUCTURE NO ICE	30'	.982	1.0	.85	100	1.0	21.368
W/ ICE	30'	.982	1.0	.85	45	1.0	4.327
FEEDLINE NO ICE	30'	.982	1.0	.95	100	1.0	23.882
W/ ICE	30'	.982	1.0	.95	45	1.0	4.836

* $K_z = 2.01 \left(z/z_g\right)^{(2/\alpha)}$ ** $q_z = .00256\, K_z K_{zT} K_D V^2 I$ [2.6.9.6]

[TABLE 2-4] $z_g = 900'$, $\alpha = 9.5$, $K_{z\,MIN} = .85$

[2.6.7] - 2.6.7.1 - 120' SS → $G_H = .85$

CALCULATE F_{ST} [2.6.9.1] $F_{ST} = q_z G_H (EPA)_S$

[2.6.9.1.1] $(EPA)_S = C_F \left[D_F \Sigma A_F + D_R \Sigma (A_R R_R)\right]$

WIND DIR	$(EPA)_S$	F_{ST} (lb.)
NORMAL	55.074	1000.3
60°	47.528	863.2
90°	49.415	897.5

$C_F = 3.4e^2 - 4.7e + 3.4$ → $C_F = 2.827$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
D_F	1.0	.80	.85
D_R	1.0	1.0	1.0

SECTION T4

[2.6.9.1] (Cont.)

$$C = [I K_z K_{zT}]^{(1/2)} VD \longrightarrow D = \left(\frac{3.25}{12}\right)'$$

$C = 26.84 < 32$ Subcritical Flow

$$R_R = .57 - .14e + .86e^2 - .24e^3 \longrightarrow R_R = .566$$

CALCULATE F_A

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 27] → $q_z = 23.882$

→ $G_H = .85$

$$(EPA)_A = K_A \Sigma C_A A_A$$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	22.032	447.2
60°	22.032	447.2
90°	22.032	447.2

$K_A = 1 - e = 1 - .135 = .865$ K_A not to exceed .6

→ $K_A = .6$

[TABLE 2-8] FIND C_A

Aspect RATIO: $\frac{L}{W}$ $\frac{120'}{\left(\frac{2.04}{12}\right)'} = 706 > 25$

$$C = [I K_z K_{zT}]^{.5} VD \longrightarrow D = \left(\frac{2.04}{12}\right)'$$

$C = 16.85 < 32$ Subcritical Flow

→ $C_A = 1.2$

$A_A = (9)\left(\frac{2.04}{12}\right)' 20'$ → $A_A = 30.6$

SECTION T4

CALCULATE DESIGN WIND FORCE W/ ICE

[2.6.8] ICE THICKNESS $t_{iz} = 2.0\, t_i\, I\, K_{iz} (K_{zt})^{.35}$

$\boxed{t_{iz} = .991"}$

$\longrightarrow t_i = .5"$

[TABLE 2-3] STRUCTURE CLASS II $\longrightarrow I = 1.0$

WIND LOAD W/ ICE

$K_{iz} = \left(\frac{z}{33}\right)^{.10}$ $z = 30'$ MID-POINT OF SECTION $\longrightarrow K_{iz} = .991$

[2.6.6.4] TOPO. CAT. 1 - 120' SS $\longrightarrow K_{zt} = 1.0$

[2.6.9] $F_w = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_w (lb.)
NORMAL	301.0	178.6	480
60°	259.7	178.6	438
90°	270.0	178.6	449

[2.6.9.1] $F_{ST} = q_z G_H (EPA)_s$

[CALC. PAGE 27] $\longrightarrow \boxed{q_z = 4.327}$

$\longrightarrow \boxed{G_H = .85}$

[2.6.9.1.1] $(EPA)_s = C_F \left[D_F \Sigma A_F + D_R \Sigma (A_R R_R)\right]$

WIND DIR	$(EPA)_s$	F_{ST} (lb.)
NORMAL	81.849	301.0
60°	70.607	259.7
90°	73.418	270.0

$$A_G = \left[\frac{\left(7.9166 + \frac{3.25}{12} + (2)\frac{.991}{12} + 9.4166 + \frac{3.25}{12} + (2)\frac{.991}{12}\right)}{2}\right] \times 20'$$

$\longrightarrow A_G = 182.052$

[CALC. PAGE 30] $e = \frac{A_F + A_R}{A_G} = \frac{22.157 + 17.453}{182.052}$

$\longrightarrow e = .218$

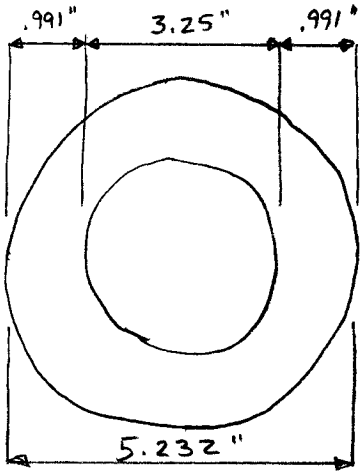
SECTION T4

ICE ACCUMULATION

LEG

$A_R = \left(\frac{5.232}{12}\right)' \times 40.03'$

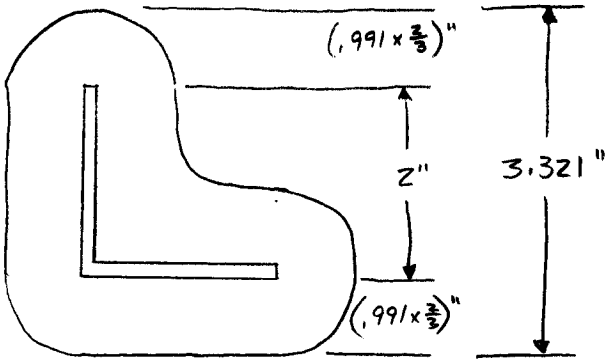
$A_R = 17.453\ ft^2$



DIAG

$A_F = \left(\frac{3.321}{12}\right)' \times 80.06'$

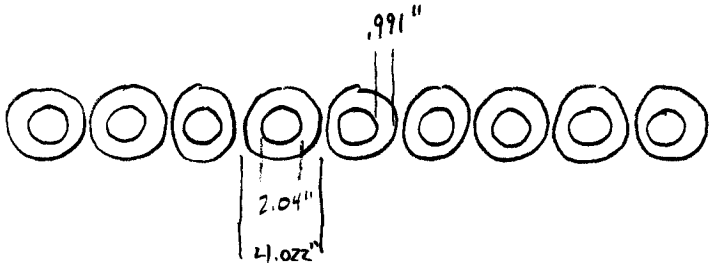
$A_F = 22.157\ ft^2$



FEEDLINE

$C_A A_A = 1.2\left(\frac{4.022"}{12}\right)' \times 20'(9)$

$C_A A_A = 72.396$



[TABLE 2-8]

Aspect Ratio = $\frac{L}{W} = \frac{120'}{\left(\frac{2.04 + (2).991}{12}\right)'}$

$358 > 25$

FOR ALL ICED CONDITIONS USE SUBCRITICAL FLOW

→ $C_A = 1.2$

SECTION T4

[2.6.9.1.1] (cont.)

$$C_F = 3.4e^2 - 4.7e + 3.4 \longrightarrow C_F = 2.537$$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
D_F	1.0	.80	.85
D_R	1.0	1.0	1.0

$$R_R = .57 - .14e + .86e^2 - .24e^3 \text{ [For all iced conditions]}$$

$$\longrightarrow R_R = .579$$

CALCULATE F_A

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 27]

$\longrightarrow q_z = 4.836$

$\longrightarrow G_H = .85$

$$(EPA)_A = K_A \Sigma C_A A_A$$

$K_A = 1 - e = 1 - .218$ K_A not to exceed .6

$.782$

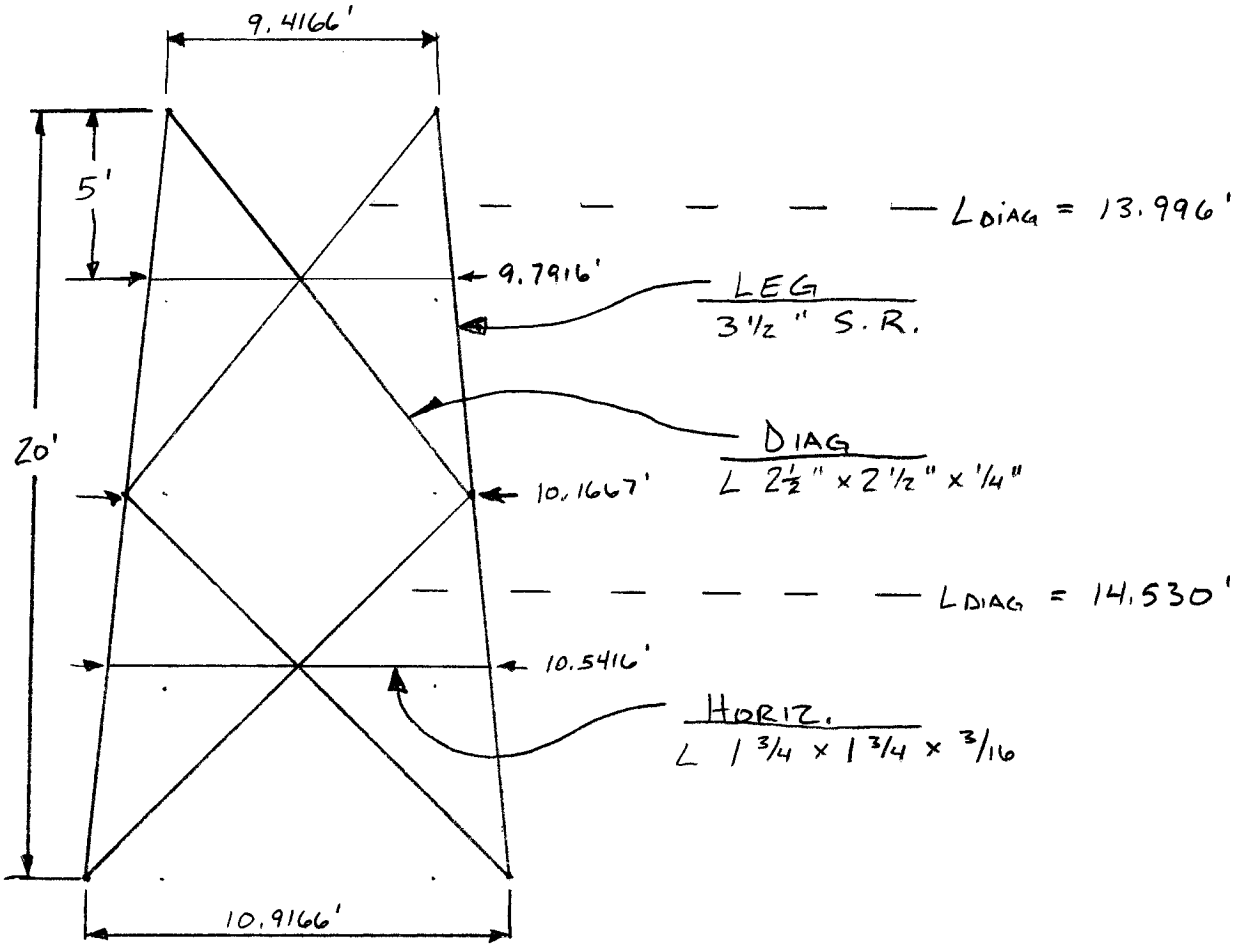
$\longrightarrow K_A = .6$

[CALC. PAGE 30]

$\longrightarrow \Sigma C_A A_A = 72.396$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	43.437	178.6
60°	43.437	178.6
90°	43.437	178.6

SECTION T5



$$A_G = \left[\frac{\left(9.4166 + \frac{3.5}{12} + 10.9166 + \frac{3.5}{12}\right)}{2}\right] \times 20'$$

$\rightarrow A_G = 209.165\ ft^2$

COMPONENT	LENGTH	WIDTH	$A_F (ft^2)$	$A_R (ft^2)$
LEG	40.03'	.2917		11.677
DIAG	57.05'	.2083	11.884	
HORIZ.	20.33'	.1458	2.964	
			14.848	

CALCULATE SOLIDITY RATIO

$$\epsilon = \frac{A_F + A_R}{A_G} = \frac{14.848 + 11.677}{209.165}$$

$\rightarrow \epsilon = .127$

SECTION T5

CALCULATE DESIGN WIND LOAD [2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	964.1	387.1	1351
60°	830.7	387.1	1218
90°	864.0	387.1	1251

CALCULATE q_z, G_H FOR T5

		z	*K_z	K_{ZT}	K_D	V	I	**q_z
STRUCTURE	NO ICE	10'	.85	1.0	.85	100	1.0	18.496
	W/ICE	10'	.85	1.0	.85	45	1.0	3.745
FEEDLINE	NO ICE	10'	.85	1.0	.95	100	1.0	20.672
	W/ICE	10'	.85	1.0	.85	45	1.0	4.186

* $K_z = 2.01 (z/z_g)^{(2/\alpha)}$

[TABLE 2-4] $z_g = 900'$, $\alpha = 9.5$, $K_{ZMIN} = .85$

** $q_z = .00256\, K_z K_{ZT} K_D V^2 I$ [2.6.9.6]

[2.6.7] - 2.6.7.1 - 120' SS → $G_H = .85$

CALCULATE F_{ST} [2.6.9.1] $F_{ST} = q_z G_H (EPA)_S$

[2.6.9.1.1] $(EPA)_S = C_F [D_F \Sigma A_F + D_R \Sigma (A_D R_R)]$

WIND DIR	$(EPA)_S$	F_{ST} (lb.)
NORMAL	61.325	964.1
60°	52.838	830.7
90°	54.959	864.0

$C_F = 3.4e^2 - 4.7e + 3.4$ → $C_F = 2.858$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
D_F	1.0	.80	.85
D_R	1.0	1.0	1.0

SECTION T5

[2.6.9.1] (cont.)

$C = [I K_z K_{zT}]^{(1/2)} V D$ → $D = \left(\frac{3.5}{12}\right)'$

$C = 26.89 < 32$ Subcritical Flow

$R_R = .57 - .14e + .86e^2 - .24e^3$ → $R_R = .566$

CALCULATE F_A

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 33] → $q_z = 20.672$

→ $G_H = .85$

$(EPA)_A = K_A \Sigma C_A A_A$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	22.032	387.1
60°	22.032	387.1
90°	22.032	387.1

$K_A = 1 - e = 1 - .127 = .873$ K_A not to exceed .6

→ $K_A = .6$

[TABLE 2-8] FIND C_A

Aspect Ratio: $\frac{L}{W}$ $\frac{120'}{\left(\frac{2.04}{12}\right)'} = 706 > 25$

$C = [I K_z K_{zT}]^{.5} V D$ → $D = \left(\frac{2.04}{12}\right)'$

$C = 15.67 < 32$ Subcritical Flow

→ $C_A = 1.2$

$A_A = (9)\left(\frac{2.04}{12}\right)(20)$ → $A_A = 30.6$

SECTION T5

CALCULATE DESIGN WIND FORCE W/ ICE

[2.6.8] ICE THICKNESS $t_{iz} = 2.0\, t_i\, I\, K_{iz}\, (K_{zT})^{.35}$

$t_{iz} = .887"$

$\rightarrow t_i = .5"$

[TABLE 2-3] STRUCTURE CLASS II $\rightarrow I = 1.0$

WIND LOAD W/ ICE

$K_{iz} = \left(\frac{z}{33}\right)^{.10}$ $z = 10'$ mid-point of section $\rightarrow K_{iz} = .887$

[2.6.6.4] TOPO. CAT. 1 - 120' SS $\rightarrow K_{zT} = 1.0$

[2.6.9] $F_W = F_{ST} + F_A + F_G$

WIND DIR	F_{ST}	F_A	F_W (lb.)
NORMAL	272.9	146.6	420
60°	235.2	146.6	382
90°	244.6	146.6	391

[2.6.9.1] $F_{ST} = q_z\, G_H\, (EPA)_s$

[CALC. PAGE 33]

$\rightarrow q_z = 3.745$

$\rightarrow G_H = .85$

[2.6.9.1.1] $(EPA)_s = C_F\left[D_F \Sigma A_F + D_R \Sigma(A_R R_R)\right]$

WIND DIR	$(EPA)_s$	F_{ST} (lb.)
NORMAL	85.730	272.9
60°	73.893	235.2
90°	76.852	244.6

$$A_G = \left[\frac{\left(9.4166 + \frac{3.5}{12} + (2)\frac{.887}{12} + 10.9166 + \frac{3.5}{12} + (2)\frac{.887}{12}\right)}{2}\right] \times 20'$$

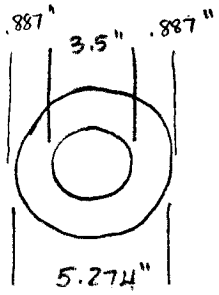
$\rightarrow A_G = 212.122\ ft^2$

[CALC. PAGE 36] $e = \frac{A_F + A_R}{A_G} = \frac{22.479 + 17.593}{212.122}$

$\rightarrow e = .189$

SECTION T5

ICE ACCUMULATION

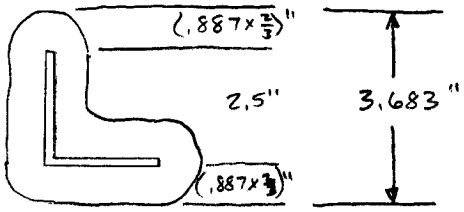


LEG

$$A_R = \left(\frac{5.274}{12}\right)' \times 40.03'$$

$$\boxed{A_L = 17.593 \text{ ft}^2}$$

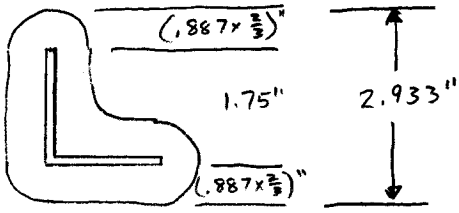
DIAG



$$A_F = \left(\frac{3.683}{12}\right)' \times 57.05'$$

$$A_F = 17.510 \text{ ft}^2$$

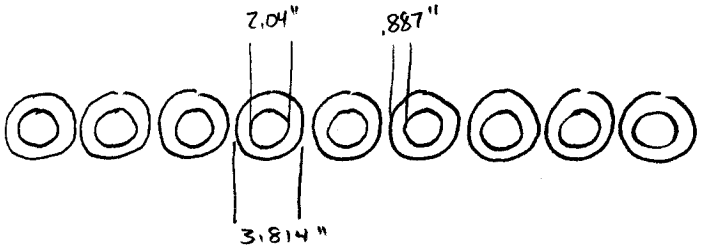
HORIZ.



$$A_F = \left(\frac{2.933}{12}\right)' \times 20.33'$$

$$A_F = 4.969 \text{ ft}^2$$

$$\boxed{A_F = 22.479 \text{ ft}^2}$$



FEEDLINE

$$C_A A_A = 1.2\left(\frac{3.814}{12}\right)' \times 20'(9)$$

$$C_A A_A = 68.652$$

[TABLE 2-8] Aspect Ratio: $\frac{L}{W}$ $\frac{120'}{\left(\frac{3.814}{12}\right)'} = 378 > 25$

For all iced conditions use subcritical flow

$\longrightarrow C_A = 1.2$

SECTION T5

[2.6.9.1.1] (cont.)

$C_F = 3.4e^2 - 4.7e + 3.4 \longrightarrow C_F = 2.633$

[TABLE 2-6]

WIND DIR	NORMAL	60°	90°
D_F	1.0	.80	.85
D_R	1.0	1.0	1.0

$R_R = .57 - .14e + .86e^2 - .24e^3$ [For all iced conditions]

$\longrightarrow R_R = .573$

CALCULATE F_A

[2.6.9.2] $F_A = q_z G_H (EPA)_A$

[CALC. PAGE 33]

$\longrightarrow q_z = 4.186$

$\longrightarrow G_H = .85$

$(EPA)_A = K_A \Sigma C_A A_A$

$K_A = 1 - e = 1 - .189 = .811$ K_A not to exceed .6

$\longrightarrow K_A = .6$

[CALC. PAGE 36]

$\longrightarrow \Sigma C_A A_A = 68.652$

WIND DIR	$(EPA)_A$	F_A (lb.)
NORMAL	41.191	146.6
60°	41.191	146.6
90°	41.191	146.6

DISCRETE APPURTENANCES

CALCULATE DESIGN WIND FORCE [2.6.9.2] $F_A = q_z G_H (EPA)_A$

WIND DIR	F_A (FV90-12)	F_A (13' PLATFORM)	F_A (lb.)
NORMAL (E)	1468	416	1884
60° (Z)	734	208	942
90° (X-AXIS)	1468	416	1884

CALCULATE q_z, G_H FOR DISCRETE APPURTENANCES

	z	* K_z	K_{zt}	K_D	V	I	** q_z
APPURTENANCE NO ICE	120'	1.315	1.0	.95	100	1.0	31.981
W/ ICE	120'	1.315	1.0	.95	45	1.0	6.476

* $K_z = 2.01 \left(z/z_g\right)^{(2/\alpha)}$

** $q_z = .00756\, K_z K_{zt} K_D V^2 I$ [2.6.9.6]

[TABLE 2-4] $z_g = 900'$, $\alpha = 9.5$, $K_{z\,MIN} = .85$

[2.6.7] - 2.6.7.1 - 120' SS → $G_H = .85$

[2.6.9.2] $(EPA)_A = K_A \Sigma C_A A_A$

FOR ALL CONDITIONS USE $K_A = 1.0$ conservatively

→ $K_A = 1.0$

(9) FV90-12	$C_A A_A = 54$
(9) FV90-12 w/ICE	$C_A A_A = 66.288$
13' PLATFORM	$C_A A_A = 15.3$
13' PLATFORM w/ICE	$C_A A_A = 19.169$

DESIGN WIND FORCE W/ ICE

WIND DIR	F_A (FV90-12)	F_A (13' PLATFORM)	F_A (lb.)
NORMAL (Z)	365	106	471
60° (Z)	183	53	236
90° (X-AXIS)	365	106	471

TOWER FORCES

SUMMARY OF FORCES & MOMENTS NO ICE

WIND NORMAL

SECTION	Z	FORCE (K)	OTM (K.FT)
L1	110	1.184	130.24
T1	90	1.254	112.86
T2	70	1.346	94.22
T3	50	1.405	70.25
T4	30	1.448	43.44
T5	10	1.351	13.51
TOTAL:		7.988	464.52
APPURTENCE	120	1.884	226.08

WIND 60°

SECTION	Z	FORCE (K)	OTM (K.FT)
L1	110	1.108	121.88
T1	90	1.164	104.76
T2	70	1.243	87.01
T3	50	1.288	64.40
T4	30	1.310	39.30
T5	10	1.218	12.18
TOTAL:		7.331	429.53
APPURTENANCE	120	.942	113.04

WIND 90°

SECTION	Z	FORCE (K)	OTM (K.FT)
L1	110	1.127	123.97
T1	90	1.187	106.83
T2	70	1.269	88.83
T3	50	1.317	65.85
T4	30	1.345	40.35
T5	10	1.251	12.51
TOTAL:		7.496	438.34
APPURTENANCE	120	1.884	226.08

TOWER FORCES

SUMMARY OF FORCES & MOMENTS W/ ICE

WIND NORMAL

SECTION	Z	FORCE (k)	OTM (k·ft)
L1	110	.509	55.99
T1	90	.523	47.07
T2	70	.543	38.01
T3	50	.538	26.90
T4	30	.480	14.40
T5	10	.420	4.20
TOTAL:		3.013	186.57
APPURTENANCE	120	.471	56.52

WIND 60°

SECTION	Z	FORCE (k)	OTM (k·ft)
L1	110	.484	53.24
T1	90	.493	44.37
T2	70	.508	35.56
T3	50	.501	25.05
T4	30	.438	13.14
T5	10	.382	3.82
TOTAL:		2.806	175.180
APPURTENANCE	120	.236	28.32

WIND 90°

SECTION	Z	FORCE (k)	OTM (k·ft)
L1	110	.490	53.90
T1	90	.501	45.09
T2	70	.517	36.19
T3	50	.510	25.50
T4	30	.449	13.47
T5	10	.391	3.91
TOTAL:		2.858	178.06
APPURTENANCE	120	.471	56.52