Robinson+Cole

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Also admitted in Massachusetts
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April 14, 2022

Melanie A. Bachman, Esq.
Executive Director/Staff Attorney
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: **Petition No. 1494 – Cellco Partnership d/b/a Verizon Wireless, 24 Townhouse Road, Durham, Connecticut**

Dear Attorney Bachman:

As you are aware, on April 5, 2022, Cellco Partnership d/b/a Verizon Wireless ("Cellco") filed responses to Siting Council Interrogatories regarding the above-referenced Petition. Interrogatory No. 8 requested a structural analysis for the proposed wood pole Cellco intends to install. After filing its responses, Cellco determined that the structural analysis submitted was based on a prior RFDS and did not include the most recent antenna upgrades planned for this facility.

As a supplement to Cellco's Response to Interrogatory No. 8, attached is the updated RFDS, new antenna data sheet for the XGU-MB-134 antenna and structural analysis dated April 8, 2022, confirming that the proposed wood pole could support Cellco's proposed updated antenna loading.

Please feel free to contact me if you have any questions or need any additional information.

Sincerely,

Kenneth C. Baldwin

KCB/kmd
Enclosure

verizon fuze | RFDS

EAST > North East > New England > New England West > DURHAM FAIR 2 CT

Cheiban, Ziad - ziad.cheiban@verizonwireless.com - 11/15/2021 20:0:45

Project Details

FUZE Project ID:	2054637
Project Name:	Capacity MACRO
Project Alt Name:	DURHAM FAIR 2 CT
Project Type:	Initial Build
Modification Type:	
Designed Sector Carrier 4G:	18
Designed Sector Carrier 5G:	N/A
Additional Sector Carrier 4G:	N/A
Additional Sector Carrier 5G:	N/A
FP Solution Type & Tech Type:	MCR;4G_700,4G_850,4G_AWS,4G_CBRS,4G_PCS
Carrier Aggregation:	false
MPT Id:	103356
eCIP-0:	false
Suffix:	Rev3_2021-11-15

Location Information

Site ID:	616825617
E-NodeB ID:	064226,0064226
PSLC:	470849
Switch Name:	Eugene
Tower Owner:	
Tower Type:	Pole Non-Utility
Site Type:	MACRO
Site Sub Type:	CRAN
Street Address:	24 Townhouse Rd
City:	Durham
State:	CT
Zip Code:	06422
County:	Middlesex
Latitude:	41.46853056 / 41° 28' 6.71" N
Longitude:	-72.68202222 / 72° 40' 55.28" W

RFDS Project Scope: New build

Rev3_2021-11-15: Changed from AWS/PCS MMU to RRHs. Added low band. Changed azimuths to 0, 120, 240.
Rev2_2021-09-15: Changed to 3 sectors. Added C-Band and CBRS
Rev1_2021-04-06: Initial

Antenna Summary

Added

700	850	1900	AWS	CBRS	L-Sub6	Make	Model	Centerline	Tip Height	Azimuth	RET	4xRx	Inst. Type	Quantity	Item ID
					5G	Samsung	MT6407-77A	37	38.5	0(0001) 120(0002) 240(0003)	false	false	PHYSICAL	3	
LTE	LTE	LTE	LTE			JMA	XGU-MB-134	30	30.6	0(01) 120(02) 240(03)	false	false	PHYSICAL	3	
				LTE		SAMSUNG	XXDWMM-12.5-65-8T	34	34.5	0(19) 120(20) 240(21)	false	true	PHYSICAL	3	

Removed

700	850	1900	AWS	CBRS	L-Sub6	Make	Model	Centerline	Tip Height	Azimuth	RET	4xRx	Inst. Type	Quantity	Item ID

No data available.

Retained

700	850	1900	AWS	CBRS	L-Sub6	Make	Model	Centerline	Tip Height	Azimuth	RET	4xRx	Inst. Type	Quantity	Item ID

No data available.

Added: 9 **Removed:** 0 **Retained:** 0

Equipment Summary

Added

Equipment Type	Location	700	850	1900	AWS	CBRS	L-Sub6	Make	Model	Cable Length	Cable Size	Install Type	Quantity	Item ID
OVP Box	Tower							N/A	6 OVP			PHYSICAL	1	
Coaxial Cables	Tower							N/A	7/8" Coax	45'		PHYSICAL	12	
Hybrid Cable	Tower							N/A	LI 6x12			PHYSICAL	1	
RRU	Tower					LTE		Samsung	CBRS RRH - RT4401-48A			PHYSICAL	3	SLS-BR0542EAEX
RRU	Tower						5G	Samsung	MT6407-77A			PHYSICAL	3	
Diplexer	Ground (Outdoor)							Commscope	CBC61923T-DS-43			PHYSICAL	6	
Coaxial Cables	Ground (Outdoor)							N/A	1/2" Coax	6'	Jumper	PHYSICAL	36	
OVP Box	Ground (Outdoor)							N/A	6 OVP			PHYSICAL	1	
RRU	Ground (Outdoor)			LTE	LTE			Samsung	RF4439d-25A			PHYSICAL	3	
RRU	Ground (Outdoor)	LTE	LTE					Samsung	RF4440d-13A			PHYSICAL	3	

Removed

Equipment Type	Location	700	850	1900	AWS	CBRS	L-Sub6	Make	Model	Cable Length	Cable Size	Install Type	Quantity	Item ID

No data available.

Retained

Equipment Type	Location	700	850	1900	AWS	CBRS	L-Sub6	Make	Model	Cable Length	Cable Size	Install Type	Quantity	Item ID

No data available.

Service Info

CBRS 3_5 GHz

	0002		
Sector	**19**	**20**	**21**
Azimuth	0	120	240
Cell / ENode B ID	064226	064226	064226
Antenna Model	XXDWMM-12.5-65-8T-C BRS_Port1_3550_8DT	XXDWMM-12.5-65-8T-C BRS_Port1_3550_8DT	XXDWMM-12.5-65-8T-C BRS_Port1_3550_8DT
Antenna Make	SAMSUNG	SAMSUNG	SAMSUNG
Antenna Centerline(Ft)	34	34	34
Mechanical Down-Tilt(Deg.)	0	0	0
Electrical Down-Tilt	8	8	8
Tip Height	34.5	34.5	34.5
Regulatory Power	15.35	15.35	15.35
DLEARFCN	55343	55343	55343
Channel Bandwidth(MHz)	20	20	20
Total ERP (W)	42.12	42.12	42.12
TMA Make			
TMA Model			
RRU Make	Samsung	Samsung	Samsung
RRU Model	CBRS RRH - RT4401-48A	CBRS RRH - RT4401-48A	CBRS RRH - RT4401-48A
Number of Tx, Rx Lines	4,4	4,4	4,4
Position			
Transmitter Id	11019073	11019074	11019075
Source	ATOLL_API	ATOLL_API	ATOLL_API

700 MHz LTE

	0002		
Sector	**01**	**02**	**03**
Azimuth	0	120	240
Cell / ENode B ID	064226	064226	064226
Antenna Model	XGU-MB-134_750MHZ_L EFT-BEAM-LB	XGU-MB-134_750MHZ_L EFT-BEAM-LB	XGU-MB-134_750MHZ_L EFT-BEAM-LB
Antenna Make	JMA	JMA	JMA
Antenna Centerline(Ft)	30	30	30
Mechanical Down-Tilt(Deg.)	0	0	0
Electrical Down-Tilt	0	0	0
Tip Height	30.6	30.6	30.6
Regulatory Power	31.68	31.68	31.68
DLEARFCN	5230	5230	5230
Channel Bandwidth(MHz)	10	10	10
Total ERP (W)	285.1	285.1	285.1
TMA Make			
TMA Model			
RRU Make	Samsung	Samsung	Samsung
RRU Model	RF4440d-13A	RF4440d-13A	RF4440d-13A
Number of Tx, Rx Lines	2,2	2,2	2,2
Position			
Transmitter Id	11508208	11508209	11508210
Source	ATOLL_API	ATOLL_API	ATOLL_API

850 MHz LTE

	0002		
Sector	**01**	**02**	**03**
Azimuth	0	120	240
Cell / ENode B ID	064226	064226	064226
Antenna Model	XGU-MB-134_850MHZ_L EFT-BEAM-LB	XGU-MB-134_850MHZ_L EFT-BEAM-LB	XGU-MB-134_850MHZ_L EFT-BEAM-LB
Antenna Make	JMA	JMA	JMA
Antenna Centerline(Ft)	30	30	30
Mechanical Down-Tilt(Deg.)	0	0	0
Electrical Down-Tilt	0	0	0
Tip Height	30.6	30.6	30.6
Regulatory Power	76.17	76.17	76.17
DLEARFCN	2450	2450	2450
Channel Bandwidth(MHz)	10	10	10
Total ERP (W)	342.77	342.77	342.77
TMA Make			
TMA Model			
RRU Make	Samsung	Samsung	Samsung
RRU Model	RF4440d-13A	RF4440d-13A	RF4440d-13A
Number of Tx, Rx Lines	2,2	2,2	2,2
Position			
Transmitter Id	11508303	11508304	11508305
Source	ATOLL_API	ATOLL_API	ATOLL_API

1900 MHz LTE

	0002		
Sector	**01**	**02**	**03**
Azimuth	0	120	240
Cell / ENode B ID	064226	064226	064226
Antenna Model	XGU-MB-134_1900MHZ_ LEFT-BEAM-HB	XGU-MB-134_1900MHZ_ LEFT-BEAM-HB	XGU-MB-134_1900MHZ_ LEFT-BEAM-HB
Antenna Make	JMA	JMA	JMA
Antenna Centerline(Ft)	30	30	30
Mechanical Down-Tilt(Deg.)	0	0	0
Electrical Down-Tilt	0	0	0
Tip Height	30.6	30.6	30.6
Regulatory Power	65.43	65.43	65.43
DLEARFCN	1050	1050	1050
Channel Bandwidth(MHz)	10	10	10
Total ERP (W)	358.92	358.92	358.92
TMA Make			
TMA Model			
RRU Make	Samsung	Samsung	Samsung
RRU Model	RF4439d-25A	RF4439d-25A	RF4439d-25A
Number of Tx, Rx Lines	2,2	2,2	2,2
Position			
Transmitter Id	10129437	10129438	10129439
Source	ATOLL_API	ATOLL_API	ATOLL_API

2100 MHz LTE

	0002		
Sector	**01**	**02**	**03**
Azimuth	0	120	240
Cell / ENode B ID	064226	064226	064226
Antenna Model	XGU-MB-134_2100MHZ_ LEFT-BEAM-HB	XGU-MB-134_2100MHZ_ LEFT-BEAM-HB	XGU-MB-134_2100MHZ_ LEFT-BEAM-HB
Antenna Make	JMA	JMA	JMA
Antenna Centerline(Ft)	30	30	30
Mechanical Down-Tilt(Deg.)	0	0	0
Electrical Down-Tilt	0	0	0
Tip Height	30.6	30.6	30.6
Regulatory Power	35.05	35.05	35.05
DLEARFCN	2050	2050	2050
Channel Bandwidth(MHz)	20	20	20
Total ERP (W)	384.59	384.59	384.59
TMA Make			
TMA Model			
RRU Make	Samsung	Samsung	Samsung
RRU Model	RF4439d-25A	RF4439d-25A	RF4439d-25A
Number of Tx, Rx Lines	2,2	2,2	2,2
Position			
Transmitter Id	10129342	10129343	10129344
Source	ATOLL_API	ATOLL_API	ATOLL_API

nL-Sub6

	0002		
Sector	**0001**	**0002**	**0003**
Azimuth	0	120	240
Cell / ENode B ID	0064226	0064226	0064226
Antenna Model	MT6407-77A	MT6407-77A	MT6407-77A
Antenna Make	Samsung	Samsung	Samsung
Antenna Centerline(Ft)	37	37	37
Mechanical Down-Tilt(Deg.)	0	0	0
Electrical Down-Tilt	6	6	6
Tip Height	38.5	38.5	38.5
Regulatory Power	1175.32	1175.32	1175.32
DLEARFCN	648672	648672	648672
Channel Bandwidth(MHz)	60	60	60
Total ERP (W)	20417.38	20417.38	20417.38
TMA Make			
TMA Model			
RRU Make	Samsung	Samsung	Samsung
RRU Model	MT6407-77A	MT6407-77A	MT6407-77A
Number of Tx, Rx Lines	2,2	2,2	2,2
Position			
Transmitter Id	10479699	10479700	10479701
Source	ATOLL_API	ATOLL_API	ATOLL_API

Service Comments

Callsigns Per Antenna

Sector	Antenna Ma	Antenna Mo	Ant CL Height AGL	Tip Height	Azimuth (TI	Electrical Tilt	Mechanical Tilt	Gain	Beamwidth	Regulatory Power	Callsigns						
											700	850	1900	2100	28 GHz	31 GHz	39 GHz
01	JMA	XGU-MB-134_850MH BEAM-LB	30	30.6	0	0	0	9.6	31.25	76.17		KNKA404					
0003	Samsung	MT6407-77A	37	38.5	240	6	0	23.35	100	1175.32							
0001	Samsung	MT6407-77A	37	38.5	0	6	0	23.35	100	1175.32							
03	JMA	XGU-MB-134_1900M BEAM-HB	30	30.6	240	0	0	9.8	39.5	65.43			KNLH251 WPOJ730				
01	JMA	XGU-MB-134_750MH BEAM-LB	30	30.6	0	0	0	8.8	35.25	31.68	WQJQ689						
02	JMA	XGU-MB-134_850MH BEAM-LB	30	30.6	120	0	0	9.6	31.25	76.17		KNKA404					
01	JMA	XGU-MB-134_1900M BEAM-HB	30	30.6	0	0	0	9.8	39.5	65.43			KNLH251 WPOJ730				
03	JMA	XGU-MB-134_2100M BEAM-HB	30	30.6	240	0	0	10.1	31.5	35.05				WQGA906 WQGB276			
01	JMA	XGU-MB-134_2100M BEAM-HB	30	30.6	0	0	0	10.1	31.5	35.05				WQGA906 WQGB276			
0002	Samsung	MT6407-77A	37	38.5	120	6	0	23.35	100	1175.32							
03	JMA	XGU-MB-134_850MH BEAM-LB	30	30.6	240	0	0	9.6	31.25	76.17		KNKA404					

02	JMA	XGU-MB-134_1900M BEAM-HB	30	30.6	120	0	0	9.8	39.5	65.43			KNLH251 WPOJ730				
19	SAMSUNG	XXDWMM-12.5-65-8T-CBRS_Port	34	34.5	0	8	0	10.448	64.7	15.35							
03	JMA	XGU-MB-134_750MH BEAM-LB	30	30.6	240	0	0	8.8	35.25	31.68	WQJQ689						
20	SAMSUNG	XXDWMM-12.5-65-8T-CBRS_Port	34	34.5	120	8	0	10.448	64.7	15.35							
21	SAMSUNG	XXDWMM-12.5-65-8T-CBRS_Port	34	34.5	240	8	0	10.448	64.7	15.35							
02	JMA	XGU-MB-134_2100M BEAM-HB	30	30.6	120	0	0	10.1	31.5	35.05				WQGA906 WQGB276			
02	JMA	XGU-MB-134_750MH BEAM-LB	30	30.6	120	0	0	8.8	35.25	31.68	WQJQ689						

Callsigns

Callsign	Market	Radio Code	Market Number	Block	State	County	Licensee Name	Wholly Owned	Total MHZ	Freq Range 1	Freq Range 2	Freq Range 3	Freq Range 4	Regulatory Power	Threshold (W)	POPs/Sq Mi	Status	Action	Approved for Insvc
WQJQ689	Northeast	WU	REA001	C	CT	Middlesex	Cellco Partnership	Yes	22.000	746.000-757.000	776.000-787.000	.000-.000	.000-.000	31.68	1000	448.62	Active	added	Yes
KNKA404	Hartford-New Britain-Bristol, CT	CL	CMA032	A	CT	Middlesex	Cellco Partnership	Yes	25.000	824.000-835.000	869.000-880.000	845.000-846.500	890.000-891.500	76.17	400	448.62	Active	added	Yes
WPOJ730	Hartford, CT	CW	BTA184	C	CT	Middlesex	Cellco Partnership	Yes	15.000	1895.000-1902.500	1975.000-1982.500	.000-.000	.000-.000	65.43	1640	448.62	Active	added	Yes
KNLH251	Hartford, CT	CW	BTA184	F	CT	Middlesex	Cellco Partnership	Yes	10.000	1890.000-1895.000	1970.000-1975.000	.000-.000	.000-.000	65.43	1640	448.62	Active	added	Yes
CBRS_CALL	UNLICENSE	3.5 GHz	UNLICENSE	UNLICENSE	CT	Middlesex	UNLICENSE	UNLICENSE	UNLICENSE	UNLICENSE UNLICENSE	UNLICENSE UNLICENSE	UNLICENSE UNLICENSE	UNLICENSE UNLICENSE	15.35		448.62	Active	added	No
WQGB276	Hartford-New Britain-Bristol, CT	AW	CMA032	A	CT	Middlesex	Cellco Partnership	Yes	20.000	1710.000-1720.000	2110.000-2120.000	.000-.000	.000-.000	35.05	1640	448.62	Active	added	Yes
WRNE581	New York, NY	PM	PEA001	A1	CT	Middlesex	Cellco Partnership	Yes	20.000	3700.000-3720.000	.000-.000	.000-.000	.000-.000	1175.32	1640	448.62	Active	added	No
WRNE582	New York, NY	PM	PEA001	A2	CT	Middlesex	Cellco Partnership	Yes	20.000	3720.000-3740.000	.000-.000	.000-.000	.000-.000	1175.32	1640	448.62	Active	added	No
WRNE583	New York, NY	PM	PEA001	A3	CT	Middlesex	Cellco Partnership	Yes	20.000	3740.000-3760.000	.000-.000	.000-.000	.000-.000	1175.32	1640	448.62	Active	added	No
WQGA906	New York-No. New Jer.-Long Island, NY-NJ-CT-PA-MA-	AW	BEA010	B	CT	Middlesex	Cellco Partnership	Yes	20.000	1720.000-1730.000	2120.000-2130.000	.000-.000	.000-.000	35.05	1640	448.62	Active	added	Yes
WRBA710	Hartford, CT	UU	BTA184	L1	CT	Middlesex	Cellco Partnership	Yes	325.000	27500.000-27600.000	27700.000-27925.000	.000-.000	.000-.000			448.62	Active		Yes
WRBA711	Hartford, CT	UU	BTA184	L2	CT	Middlesex	Cellco Partnership	Yes	325.000	27925.000-28050.000	28150.000-28350.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD609	New York, NY	UU	PEA001	M1	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	37600.000-37700.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD610	New York, NY	UU	PEA001	M10	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	38500.000-38600.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD611	New York, NY	UU	PEA001	M2	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	37700.000-37800.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes

WRHD612	New York, NY	UU	PEA001	M3	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	37800.000-37900.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD613	New York, NY	UU	PEA001	M4	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	37900.000-38000.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD614	New York, NY	UU	PEA001	M5	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	38000.000-38100.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD615	New York, NY	UU	PEA001	M6	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	38100.000-38200.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD616	New York, NY	UU	PEA001	M7	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	38200.000-38300.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD617	New York, NY	UU	PEA001	M8	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	38300.000-38400.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD618	New York, NY	UU	PEA001	M9	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	38400.000-38500.000	.000-.000	.000-.000	.000-.000			448.62	Active		Yes
WRHD619	New York, NY	UU	PEA001	N1	CT	Middlesex	Straight Path Spectrum, LLC	Yes	100.000	38600.000-38700.000	.000-.000	.000-.000	.000-.000			448.62	Active	N/A	No
WRNE584	New York, NY	PM	PEA001	A4	CT	Middlesex	Cellco Partnership	Yes	20.000	3760.000-3780.000	.000-.000	.000-.000	.000-.000		1640	448.62	Active		No
WRNE585	New York, NY	PM	PEA001	A5	CT	Middlesex	Cellco Partnership	Yes	20.000	3780.000-3800.000	.000-.000	.000-.000	.000-.000		1640	448.62	Active		No
WRNE586	New York, NY	PM	PEA001	B1	CT	Middlesex	Cellco Partnership	Yes	20.000	3800.000-3820.000	.000-.000	.000-.000	.000-.000		1640	448.62	Active		No
WRNE587	New York, NY	PM	PEA001	B2	CT	Middlesex	Cellco Partnership	Yes	20.000	3820.000-3840.000	.000-.000	.000-.000	.000-.000		1640	448.62	Active		No
WRNE588	New York, NY	PM	PEA001	B3	CT	Middlesex	Cellco Partnership	Yes	20.000	3840.000-3860.000	.000-.000	.000-.000	.000-.000		1640	448.62	Active		No

Product Specifications

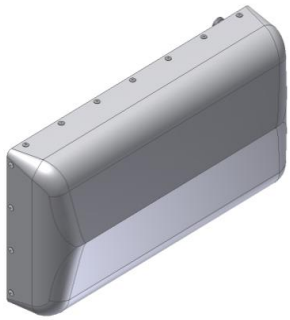
XGU-MB-134

Antenna Systems Group

X-pol Dual Band Antenna, 698–960/1695–2700 MHz

Split Beam 34° Horizontal Pattern

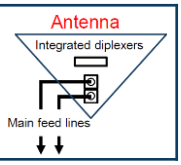
- Split beam, 2-sector MIMO Stadium Antenna reduces sector overlap
- Separate housing and reflector construction optimizes RF performance while maximizing mechanical strength
- Good passive intermodulation (PIM) performance reduces harmful interference
- Perfect for stadium/arena /special event coverage
- Includes flexible stadium bracket
- Suitable for WCS/LTE/CDMA/UMTS/GSM/WiMAX (Neutral Host)
- Optional internal diplexers reduce external cabling and improve aesthetics



Includes integrated diplexers

Reduces mainline cables

Eliminates external tower devices



Electrical specifications

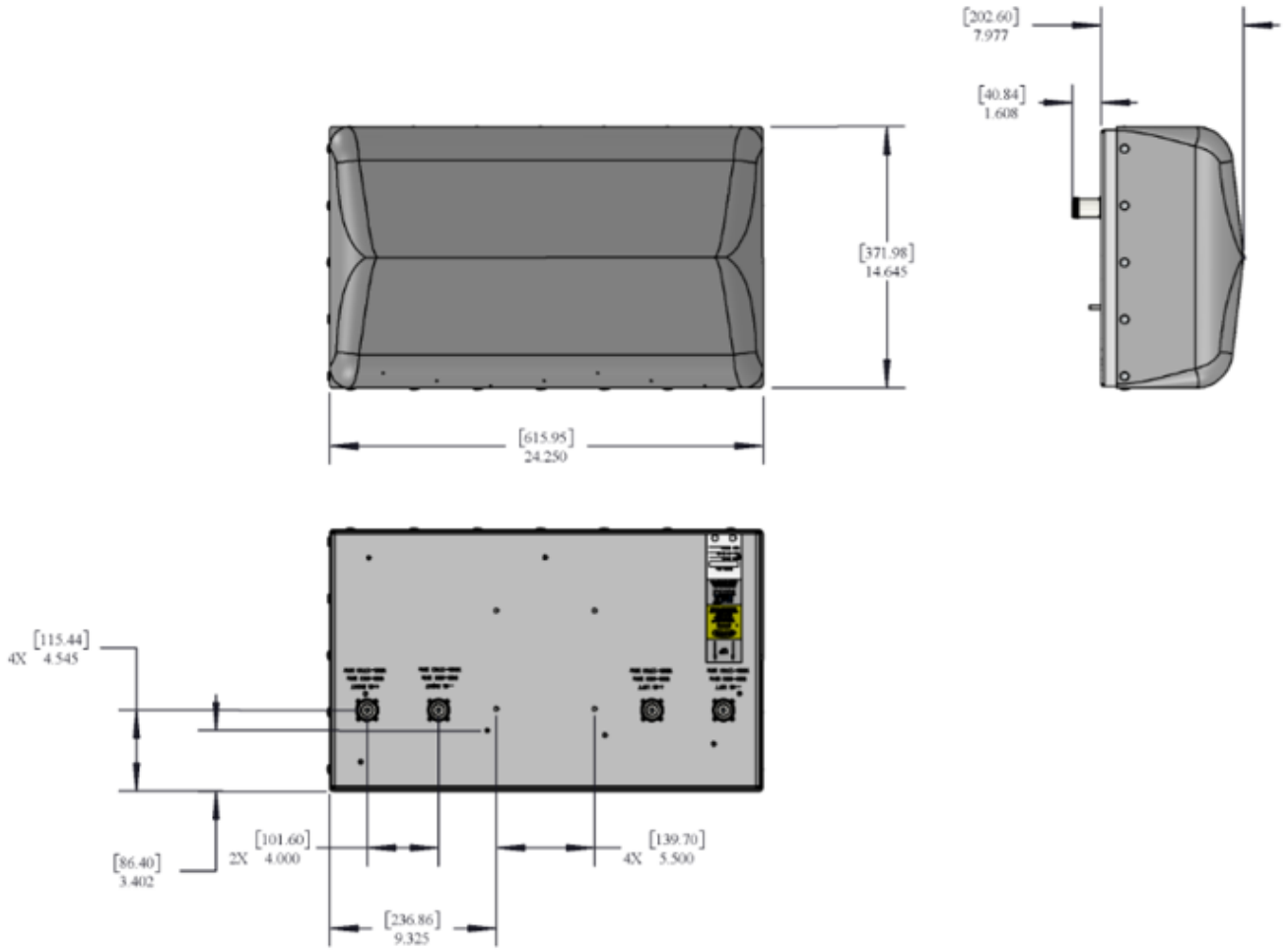
Frequency band, MHz	698–824	824–960	1695–1920	1920–2200	2200–2360	2360–2700
Horizontal beamwidth, 3 dB points	36°	30°	40°	36°	31°	29°
Gain, dBi	9.2	10.6	10.7	10.5	11.2	11.7
Vertical beamwidth, 3dB points	65°	56°	65°	66°	57°	53°
Front-to-back at 180°, dB	> 20		> 28			
Polarization	+/-45°		+/-45°			
Electrical downtilt	0°		0°			
VSWR / return loss, dB, maximum	1.5:1/14		1.5:1/14			
Isolation between ports, dB, minimum	25		25			
Intermodulation (2 x 20 W), IM3, dBc, maximum	-153		-153			
Impedance, ohms	50		50			
Maximum power per connector, CW (W)	250 @ 800 MHz		125 @ 1900 MHz			

Mechanical specifications	
Dimensions, length/width/depth	14.6/24.3/7.1 in (372.0/616.0/180.6 mm)
Connector (quantity) type	(4 or 8) 7-16 DIN Female
Connector torque	220-265 lbf·in (23-30 Nm)
Connector location	Back
Antenna weight	15.0 lb (6.8 kg)
Bracket weight	5.0 lb (2.3 kg)
Standard bracket kit	P/N 919050 (Included)
Mechanical down tilt range	+/- 35° Lateral & +/- 55° Vertical
Radome material	High Strength Luran, UV Stabilized, ASTM D1925
Wind survival	120 mph (193 km/h)
Front wind load @ 100 mph	59.4 lbf (264.3 N) @100 mph
Equivalent flat plate @ 100 mph	1.18 sq ft (c=2) @ 100 mph

Order information

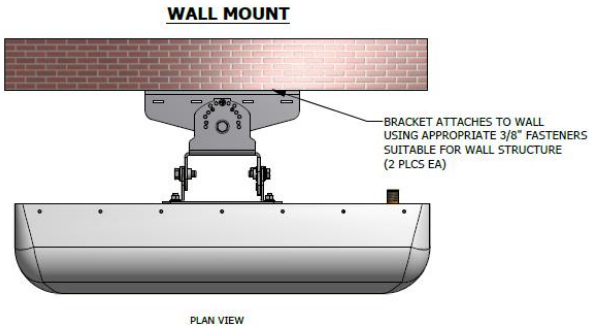
Model	Description
XGU-MB-134-I	X-Pol dual band, 0° electrical downtilt with four (4) DIN connectors, w/ internal duplexers
919055	Optional inverted mounting kit for 4.0-10.0 in. OD pole.
91900313	Optional bracket kit for extended horizontal and vertical tilt ranges.

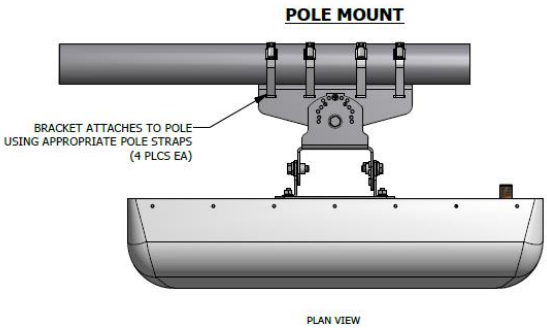
Mechanical Outline Drawing, XGU-MB-134-I (diplexed)

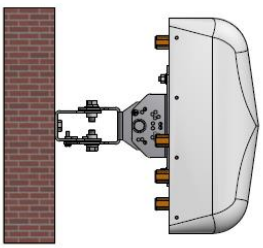


Examples of standard stadium bracket kit 919050 installation

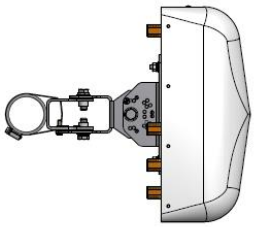
Note: For mounting details, refer to installation drawing, P/N 919050, on the JMA website Antenna Matrix.







Note: If the bracket is used in applications that provide additional tilt to the antenna (e.g. slanted poles, upside down hanging, etc.), different weep holes may be required. Please consult our weep hole guide at jmawireless.com/support.



PAUL J. FORD & COMPANY

Report Date: April 8, 2022

Client: On Air Engineering, LLC
88 Foundry Pond Road
Cold Spring, NY 10516
Attn: David Weinpahl, P.E.
(201) 456-4624
dweinpahl@onaireng.com

Structure: Proposed 38.5-ft Monopole
Site Name: Durham Fair 2 CT
Site Address: 24 Townhouse Rd.
City, County, State: Durham, Middlesex County, CT
Latitude, Longitude: 41.468380, -72.682021

PJF Project: A42920-0009.001.7805

Paul J. Ford and Company is pleased to submit this "**Structural Analysis Report**" to determine the tower stress level.

Analysis Criteria:
This analysis utilizes an ultimate 3-second gust wind speed of 120 mph as required by the 2015 International Building Code. Applicable Standard references and design criteria are listed in Section 2 - Analysis Criteria.

Proposed Appurtenance Loads:
The structure was analyzed with the proposed loading configuration shown in Table 1 of this report.

Summary of Analysis Results:
Proposed Structure: Pass – 89.2%
Proposed Foundation: Pass – 93.2%

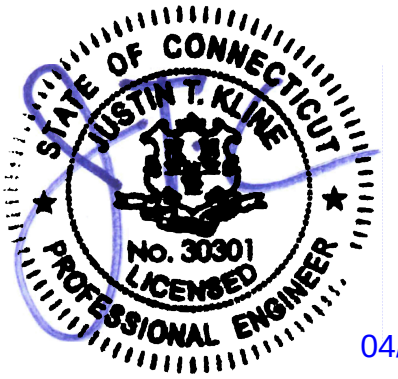
The proposed wood pole and its foundation referenced in this report shall be installed in accordance with the recommendations listed within this report for the determined available structural capacity to be effective.

We at Paul J. Ford and Company appreciate the opportunity of providing our continuing professional services to you and On Air Engineering, LLC. If you have any questions or need further assistance on this or any other projects, please give us a call.

Respectfully Submitted by:
Paul J. Ford and Company

Nathan C. Miller

Nathan C. Miller, P.E.
Project Engineer
nmiller@pauljford.com



04/11/2022

TABLE OF CONTENTS

1) INTRODUCTION

This tower is a proposed 38.5 ft Wood Monopole tower.

2) ANALYSIS CRITERIA

TIA-222 Revision:	TIA-222-H
Risk Category:	II
Wind Speed:	120 mph
Exposure Category:	C
Topographic Factor:	1
Ice Thickness:	1 in
Wind Speed with Ice:	50 mph
Service Wind Speed:	60 mph

Table 1 - Proposed Equipment Configuration

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)
37.0	37.0	1	pole mounts	Mount Collar	12	7/8
		3	samsung	MT6407-77A		
34.0	34.0	3	pole mounts	2.5" OD x 12' Mount Pipe	---	---
		3	samsung	CBRS RT4401-48A		
		3	samsung	XXDWMM-12.5-65-8T-RRH w/ RT4401-48A w/ mount pipe		
30.0	30.0	1	pole mounts	Mount Collar	---	---
		3	jma wireless	XGU-MB-134 w/ Pipe Mount		
27.0	27.0	1	raycap	RHSDC-6627-PF-48	1	1-5/8

3) ANALYSIS PROCEDURE

Table 2 - Documents Provided

Document	Remarks	Reference	Source
RFDS	Verizon Wireless, 11/15/2021	FUZE: 2054637	On Air Engineering, LLC
Zoning Drawings	On Air Engineering, LLC, 12/29/2019	Durham Fair 2 CT	
Mount Analysis	Paul J. Ford and Company, 12/15/2021	A42920-0009.002.7190	PJF

3.1) Analysis Method

tnxTower (version 8.1.1.0), a commercially available analysis software package, was used to create a three-dimensional model of the tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

3.2) Assumptions

1) Tower and structures were maintained in accordance with the TIA-222 Standard.
2) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
3) At the time of analysis, a site-specific geotechnical report was not available. See the recommendations section for further information.
4) The wood structure was analyzed in tnxTower for obtaining the reactions at critical elevations in the structure. This analysis should be considered as an approximation of the pole behavior since the pole is wood and tnxTower is intended for steel poles.
5) The new pole wood species is assumed to be Southern Pine with an allowable bending stress (Fb) of 1950psi, but alternatives that meet or exceed this allowable bending stress would be acceptable.

This analysis may be affected if any assumptions are not valid or have been made in error. Paul J. Ford and Company should be notified to determine the effect on the structural integrity of the tower.

4) ANALYSIS RESULTS

Table 3 - Section Capacity (Summary)

Section No.	Elevation (ft)	Description	% Capacity	Pass / Fail
L1	38.5 - 35	Round Wooden Pole	2.4	Pass
L2	35 - 30	Round Wooden Pole	14.7	Pass
L3	30 - 25	Round Wooden Pole	30.4	Pass
L4	25 - 20	Round Wooden Pole	45.1	Pass
L5	20 - 15	Round Wooden Pole	58.3	Pass
L6	15 - 10	Round Wooden Pole	70.1	Pass
L7	10 - 5	Round Wooden Pole	80.6	Pass
L8	5 - 0	Round Wooden Pole	89.2	Pass
			Summary	
		Pole (L8)	89.2	Pass
		Rating =	89.2	Pass

Table 4 - Tower Component Stresses vs. Capacity

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Base Foundation (Structure)	0	93.2	Pass
1	Base Foundation (Soil Interaction)	0	81.1	Pass

Structure Rating (max from all components) =	93.2%

Notes:
1) See additional documentation in “Appendix C – Additional Calculations” for calculations supporting the % capacity consumed.

4.1) Recommendations

The tower and its foundation have sufficient capacity to carry the proposed load configuration. In order for the results of this analysis to be considered valid, the following must be completed:

- Geotechnical observation and testing to confirm the site soil values meet or exceed the values assumed as part of this design.
- Coax shall be flush mounted to the pole as shown in Appendix B- Base Level Drawing.

STANDARD CONDITIONS FOR FURNISHING OF PROFESSIONAL ENGINEERING SERVICES ON EXISTING STRUCTURES BY PAUL J. FORD AND COMPANY

1) Paul J. Ford and Company has not made a field inspection to verify the monopole dimensions or the antenna/coax loading. If the existing conditions are not as represented on these sketches, we should be contacted immediately to reevaluate any conclusions stated in this report.

2) No allowance was made for any damaged, missing, or rusted material. The analysis of this monopole assumes that no physical deterioration has occurred in any of the structural components of the monopole and that all the structural members have the same load carrying capacity as the day the monopole was erected.

3) It is not possible to have all the detailed information to perform a thorough analysis of every structural sub-component of an existing monopole. The structural analysis provided by Paul J. Ford and Company verifies the adequacy of the main structural members of the monopole. Paul J. Ford and Company provides a limited scope of service in that we cannot verify the adequacy of every weld, plate, connection detail, etc.

4) The structural integrity of the existing tower foundation can only be verified if exact foundation sizes and soil conditions are known. Paul J. Ford and Company will not accept any responsibility for the adequacy of the existing foundations unless the foundation sizes and a soils report are provided.

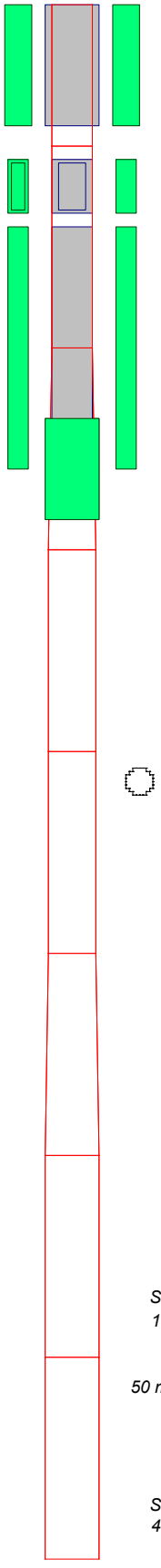
5) The monopole has been analyzed according to the minimum basic design wind velocity recommended by the Telecommunications Industry Association Standard ANSI/TIA-222-H. If the owner or local or state agencies require a higher design wind velocity, Paul J. Ford and Company should be made aware of this requirement.

APPENDIX A

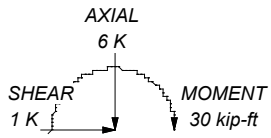
TNXTOWER OUTPUT

Section	1	2	3	4	5	6	7	8
Length (ft)	3.5000	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000
Number of Sides	1	1	1	1	1	1	1	1
Thickness (in)	6.2050	6.4950	6.7850	7.0800	7.3700	7.6600	7.9500	8.2450
Top Dia (in)	12.0000	12.4100	12.9900	13.5700	14.1600	14.7400	15.3200	15.9000
Bot Dia (in)	12.4100	12.9900	13.5700	14.1600	14.7400	15.3200	15.9000	16.4900
Grade	Southern Pine							
Weight (K)	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3

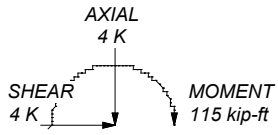
38.5 ft
35.0 ft
30.0 ft
25.0 ft
20.0 ft
15.0 ft
10.0 ft
5.0 ft
0.0 ft
1.9



ALL REACTIONS ARE FACTORED



TORQUE 0 kip-ft
50 mph WIND - 1.0000 in ICE



TORQUE 0 kip-ft
REACTIONS - 120 mph WIND

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
Southern Pine	3 ksi	4 ksi			

TOWER DESIGN NOTES

1. Tower is located in Middlesex County, Connecticut.
2. Tower designed for Exposure C to the TIA-222-H Standard.
3. Tower designed for a 120 mph basic wind in accordance with the TIA-222-H Standard.
4. Tower is also designed for a 50 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Risk Category II.
7. Topographic Category 1 with Crest Height of 0.0000 ft

Paul J. Ford & Company
250 East Broad Street, Suite 600
Columbus, OH 43215
Phone: 614.221.6679
FAX:

Job:	***38.5' Wood Monopole | Durham Fair 2 CT***		
Project:	***42920-0009***		
Client: On Air Engineering, LLC		Drawn by: tdehnke	App'd:
Code: TIA-222-H		Date: 04/08/22	Scale: NTS
Path:			Dwg No. E-1

Tower Input Data

This tower is designed using the TIA-222-H standard.
The following design criteria apply:

- Tower is located in Middlesex County, Connecticut.
- Tower base elevation above sea level: 187.5600 ft.
- Basic wind speed of 120 mph.
- Risk Category II.
- Exposure Category C.
- Simplified Topographic Factor Procedure for wind speed-up calculations is used.
- Topographic Category: 1.
- Crest Height: 0.0000 ft.
- Nominal ice thickness of 1.0000 in.
- Ice thickness is considered to increase with height.
- Ice density of 56.00 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 pole design is 1.05.
- Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

	Consider Moments - Legs		Distribute Leg Loads As Uniform		Use ASCE 10 X-Brace Ly Rules
	Consider Moments - Horizontals		Assume Legs Pinned		Calculate Redundant Bracing Forces
	Consider Moments - Diagonals	√	Assume Rigid Index Plate		Ignore Redundant Members in FEA
	Use Moment Magnification	√	Use Clear Spans For Wind Area		SR Leg Bolts Resist Compression
	Use Code Stress Ratios		Use Clear Spans For KL/r		All Leg Panels Have Same Allowable
√	Use Code Safety Factors - Guys		Retension Guys To Initial Tension		Offset Girt At Foundation
	Escalate Ice	√	Bypass Mast Stability Checks	√	Consider Feed Line Torque
	Always Use Max Kz	√	Use Azimuth Dish Coefficients		Include Angle Block Shear Check
	Use Special Wind Profile	√	Project Wind Area of Appurt.		Use TIA-222-H Bracing Resist. Exemption
	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Use TIA-222-H Tension Splice Exemption
	Leg Bolts Are At Top Of Section		Add IBC .6D+W Combination		Poles
	Secondary Horizontal Braces Leg		Sort Capacity Reports By Component	√	Include Shear-Torsion Interaction
	Use Diamond Inner Bracing (4 Sided)		Triangulate Diamond Inner Bracing		Always Use Sub-Critical Flow
	SR Members Have Cut Ends		Treat Feed Line Bundles As Cylinder		Use Top Mounted Sockets
	SR Members Are Concentric		Ignore KL/ry For 60 Deg. Angle Legs		Pole Without Linear Attachments
					Pole With Shroud Or No Appurtenances
					Outside and Inside Corner Radii Are Known

Tapered Pole Section Geometry

Section	*Elevation*	*Section Length*	*Splice Length*	*Number of Sides*	*Top Diameter*	*Bottom Diameter*	*Wall Thickness*	*Bend Radius*	*Pole Grade*
	ft	*ft*	*ft*		*in*	*in*	*in*	*in*	
L1	38.5000-35.0000	3.5000	0.00	Round	12.0000	12.4100	6.2050		Southern Pine (3 ksi)
L2	35.0000-30.0000	5.0000	0.00	Round	12.4100	12.9900	6.4950		Southern Pine (3 ksi)
L3	30.0000-25.0000	5.0000	0.00	Round	12.9900	13.5700	6.7850		Southern Pine (3 ksi)
L4	25.0000-20.0000	5.0000	0.00	Round	13.5700	14.1600	7.0800		Southern Pine (3 ksi)
L5	20.0000-15.0000	5.0000	0.00	Round	14.1600	14.7400	7.3700		Southern Pine (3 ksi)
L6	15.0000-10.0000	5.0000	0.00	Round	14.7400	15.3200	7.6600		Southern Pine (3 ksi)
L7	10.0000-5.0000	5.0000	0.00	Round	15.3200	15.9000	7.9500		Southern Pine (3 ksi)
L8	5.0000-0.0000	5.0000		Round	15.9000	16.4900	8.2450		Southern Pine (3 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	12.0000	112.9653	1017.8746	3.0018	6.0000	169.6458	2035.7493	56.4489	0.0000	0
	12.4100	120.9577	1164.2789	3.1025	6.2050	187.6356	2328.5578	60.4427	0.0000	0
L2	12.4100	120.6935	1164.2733	3.1059	6.2050	187.6347	2328.5467	60.3107	0.0000	0
	12.9900	132.5282	1397.6760	3.2475	6.4950	215.1926	2795.3520	66.2245	0.0000	0
L3	12.9900	132.2640	1397.6704	3.2507	6.4950	215.1918	2795.3409	66.0925	0.0000	0
	13.5700	144.6271	1664.5210	3.3925	6.7850	245.3237	3329.0421	72.2704	0.0000	0
L4	13.5700	144.3537	1664.5151	3.3957	6.7850	245.3228	3329.0302	72.1338	0.0000	0
	14.1600	157.4767	1973.4354	3.5400	7.0800	278.7338	3946.8708	78.6914	0.0000	0
L5	14.1600	157.2125	1973.4298	3.5430	7.0800	278.7330	3946.8597	78.5593	0.0000	0
	14.7400	170.6416	2317.1803	3.6850	7.3700	314.4071	4634.3607	85.2699	0.0000	0
L6	14.7400	170.3774	2317.1748	3.6879	7.3700	314.4063	4634.3495	85.1378	0.0000	0
	15.3200	184.3348	2703.9892	3.8300	7.6600	353.0012	5407.9785	92.1124	0.0000	0
L7	15.3200	184.0706	2703.9837	3.8327	7.6600	353.0005	5407.9674	91.9804	0.0000	0
	15.9000	198.5565	3137.3170	3.9750	7.9500	394.6311	6274.6339	99.2190	0.0000	0
L8	15.9000	198.2831	3137.3110	3.9777	7.9500	394.6303	6274.6220	99.0824	0.0000	0
	16.4900	213.5655	3629.5478	4.1225	8.2450	440.2120	7259.0956	106.7190	0.0000	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Sector	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	Number Per Row	Start/End Position	Width or Diameter in	Perimeter in	Weight klf
LDF5-50A (7/8" foam)	C	No	Surface Ar (CaAa)	37.0000 - 0.0000	12	6	0.000 0.000	1.0900		0.00
LDF7-50A (1 5/8" foam)	C	No	Surface Ar (CaAa)	37.0000 - 0.0000	1	1	0.000 0.000	0.0000		0.00

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
MT6407-77A	A	From Leg	1.0000 0.00 0.00	0.0000	37.0000	No Ice 1/2" Ice 1" Ice	4.6922 4.9799 5.2750	1.8402 2.0626 2.2920	0.08 0.11 0.14
MT6407-77A	B	From Leg	1.0000 0.00 0.00	0.0000	37.0000	No Ice 1/2" Ice 1" Ice	4.6922 4.9799 5.2750	1.8402 2.0626 2.2920	0.08 0.11 0.14
MT6407-77A	C	From Leg	1.0000 0.00 0.00	0.0000	37.0000	No Ice 1/2" Ice 1" Ice	4.6922 4.9799 5.2750	1.8402 2.0626 2.2920	0.08 0.11 0.14
Mount Collar	C	None		0.0000	37.0000	No Ice 1/2" Ice 1" Ice	5.0000 7.0000 9.0000	5.0000 7.0000 9.0000	0.12 0.20 0.28
***									
XXDWMM-12.5-65-8T-RRH w/ RT4401-48A w/ mount pipe	A	From Leg	1.0000 0.00 0.00	0.0000	34.0000	No Ice 1/2" Ice 1" Ice	3.1184 3.9638 4.6875	9.3925 10.6227 11.7049	0.06 0.14 0.23
XXDWMM-12.5-65-8T-RRH w/ RT4401-48A w/ mount pipe	B	From Leg	1.0000 0.00 0.00	0.0000	34.0000	No Ice 1/2" Ice 1" Ice	3.1184 3.9638 4.6875	9.3925 10.6227 11.7049	0.06 0.14 0.23
XXDWMM-12.5-65-8T-RRH w/ RT4401-48A w/ mount pipe	C	From Leg	1.0000 0.00 0.00	0.0000	34.0000	No Ice 1/2" Ice 1" Ice	3.1184 3.9638 4.6875	9.3925 10.6227 11.7049	0.06 0.14 0.23
CBRS RT4401-48A	A	From Leg	1.0000	0.0000	34.0000	No Ice	0.9911	0.4962	0.02

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.00			1/2" Ice	1.1196	0.5965	0.03
			0.00			1" Ice	1.2555	0.7038	0.04
CBRS RT4401-48A	B	From Leg	1.0000	0.0000	34.0000	No Ice	0.9911	0.4962	0.02
			0.00			1/2" Ice	1.1196	0.5965	0.03
			0.00			1" Ice	1.2555	0.7038	0.04
CBRS RT4401-48A	C	From Leg	1.0000	0.0000	34.0000	No Ice	0.9911	0.4962	0.02
			0.00			1/2" Ice	1.1196	0.5965	0.03
			0.00			1" Ice	1.2555	0.7038	0.04
2.5" OD x 12' Mount Pipe	A	From Leg	1.0000	0.0000	34.0000	No Ice	3.0000	3.0000	0.06
			0.00			1/2" Ice	4.2350	3.5292	0.08
			0.00			1" Ice	5.4900	4.5750	0.10
2.5" OD x 12' Mount Pipe	B	From Leg	1.0000	0.0000	34.0000	No Ice	3.0000	3.0000	0.06
			0.00			1/2" Ice	4.2350	3.5292	0.08
			0.00			1" Ice	5.4900	4.5750	0.10
2.5" OD x 12' Mount Pipe	C	From Leg	1.0000	0.0000	34.0000	No Ice	3.0000	3.0000	0.06
			0.00			1/2" Ice	4.2350	3.5292	0.08
			0.00			1" Ice	5.4900	4.5750	0.10
***									
XGU-MB-134 w/ Pipe Mount	A	From Leg	1.0000	0.0000	30.0000	No Ice	3.0912	1.2078	0.02
			0.00			1/2" Ice	3.3620	1.4621	0.05
			0.00			1" Ice	3.6438	1.7331	0.08
XGU-MB-134 w/ Pipe Mount	B	From Leg	1.0000	0.0000	30.0000	No Ice	3.0912	1.2078	0.02
			0.00			1/2" Ice	3.3620	1.4621	0.05
			0.00			1" Ice	3.6438	1.7331	0.08
XGU-MB-134 w/ Pipe Mount	C	From Leg	1.0000	0.0000	30.0000	No Ice	3.0912	1.2078	0.02
			0.00			1/2" Ice	3.3620	1.4621	0.05
			0.00			1" Ice	3.6438	1.7331	0.08
Mount Collar	C	None		0.0000	30.0000	No Ice	5.0000	5.0000	0.12
						1/2" Ice	7.0000	7.0000	0.20
						1" Ice	9.0000	9.0000	0.28
***									
RHSDC-6627-PF-48	C	None		0.0000	27.0000	No Ice	4.0563	3.0975	0.03
						1/2" Ice	4.3155	3.3351	0.07
						1" Ice	4.5822	3.5801	0.11

Tower Pressures - No Ice

$G_H = 1.100$

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
L1 38.5000-35.0000	36.7402	1.025	0.036	3.560	A	0.000	3.560	3.560	100.00	0.000	0.000
					B	0.000	3.560		100.00	0.000	0.000
					C	0.000	3.560		100.00	1.308	0.000
L2 35.0000-30.0000	32.4810	0.999	0.035	5.292	A	0.000	5.292	5.292	100.00	0.000	0.000
					B	0.000	5.292		100.00	0.000	0.000
					C	0.000	5.292		100.00	3.270	0.000
L3 30.0000-25.0000	27.4818	0.964	0.034	5.533	A	0.000	5.533	5.533	100.00	0.000	0.000
					B	0.000	5.533		100.00	0.000	0.000
					C	0.000	5.533		100.00	3.270	0.000
L4 25.0000-20.0000	22.4823	0.924	0.032	5.777	A	0.000	5.777	5.777	100.00	0.000	0.000
					B	0.000	5.777		100.00	0.000	0.000
					C	0.000	5.777		100.00	3.270	0.000
L5 20.0000-15.0000	17.4833	0.877	0.030	6.021	A	0.000	6.021	6.021	100.00	0.000	0.000
					B	0.000	6.021		100.00	0.000	0.000
					C	0.000	6.021		100.00	3.270	0.000

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
L6 15.0000-10.0000	12.4839	0.85	0.030	6.263	A	0.000	6.263	6.263	100.00	0.000	0.000
					B	0.000	6.263		100.00	0.000	0.000
					C	0.000	6.263		100.00	3.270	0.000
L7 10.0000-5.0000	7.4845	0.85	0.030	6.504	A	0.000	6.504	6.504	100.00	0.000	0.000
					B	0.000	6.504		100.00	0.000	0.000
					C	0.000	6.504		100.00	3.270	0.000
L8 5.0000-0.0000	2.4848	0.85	0.030	6.748	A	0.000	6.748	6.748	100.00	0.000	0.000
					B	0.000	6.748		100.00	0.000	0.000
					C	0.000	6.748		100.00	3.270	0.000

Tower Pressure - With Ice

G_H = 1.100

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
L1 38.5000-35.0000	36.7402	1.025	0.006	1.0108	4.149	A	0.000	4.149	4.149	100.00	0.000	0.000
						B	0.000	4.149		100.00	0.000	0.000
						C	0.000	4.149		100.00	2.545	0.000
L2 35.0000-30.0000	32.4810	0.999	0.006	0.9984	6.124	A	0.000	6.124	6.124	100.00	0.000	0.000
						B	0.000	6.124		100.00	0.000	0.000
						C	0.000	6.124		100.00	6.334	0.000
L3 30.0000-25.0000	27.4818	0.964	0.006	0.9819	6.352	A	0.000	6.352	6.352	100.00	0.000	0.000
						B	0.000	6.352		100.00	0.000	0.000
						C	0.000	6.352		100.00	6.297	0.000
L4 25.0000-20.0000	22.4823	0.924	0.006	0.9623	6.579	A	0.000	6.579	6.579	100.00	0.000	0.000
						B	0.000	6.579		100.00	0.000	0.000
						C	0.000	6.579		100.00	6.253	0.000
L5 20.0000-15.0000	17.4833	0.877	0.005	0.9384	6.803	A	0.000	6.803	6.803	100.00	0.000	0.000
						B	0.000	6.803		100.00	0.000	0.000
						C	0.000	6.803		100.00	6.199	0.000
L6 15.0000-10.0000	12.4839	0.85	0.005	0.9074	7.019	A	0.000	7.019	7.019	100.00	0.000	0.000
						B	0.000	7.019		100.00	0.000	0.000
						C	0.000	7.019		100.00	6.129	0.000
L7 10.0000-5.0000	7.4845	0.85	0.005	0.8621	7.223	A	0.000	7.223	7.223	100.00	0.000	0.000
						B	0.000	7.223		100.00	0.000	0.000
						C	0.000	7.223		100.00	6.027	0.000
L8 5.0000-0.0000	2.4848	0.85	0.005	0.7721	7.391	A	0.000	7.391	7.391	100.00	0.000	0.000
						B	0.000	7.391		100.00	0.000	0.000
						C	0.000	7.391		100.00	5.825	0.000

Tower Pressure - Service

G_H = 1.100

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
L1 38.5000-35.0000	36.7402	1.025	0.008	3.560	A	0.000	3.560	3.560	100.00	0.000	0.000
					B	0.000	3.560		100.00	0.000	0.000
					C	0.000	3.560		100.00	1.308	0.000
L2 35.0000-30.0000	32.4810	0.999	0.008	5.292	A	0.000	5.292	5.292	100.00	0.000	0.000
					B	0.000	5.292		100.00	0.000	0.000
					C	0.000	5.292		100.00	3.270	0.000
L3 30.0000-25.0000	27.4818	0.964	0.008	5.533	A	0.000	5.533	5.533	100.00	0.000	0.000
					B	0.000	5.533		100.00	0.000	0.000
					C	0.000	5.533		100.00	3.270	0.000

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
L4 25.0000-20.0000	22.4823	0.924	0.007	5.777	A	0.000	5.777	5.777	100.00	0.000	0.000
					B	0.000	5.777		100.00	0.000	0.000
					C	0.000	5.777		100.00	3.270	0.000
L5 20.0000-15.0000	17.4833	0.877	0.007	6.021	A	0.000	6.021	6.021	100.00	0.000	0.000
					B	0.000	6.021		100.00	0.000	0.000
					C	0.000	6.021		100.00	3.270	0.000
L6 15.0000-10.0000	12.4839	0.85	0.007	6.263	A	0.000	6.263	6.263	100.00	0.000	0.000
					B	0.000	6.263		100.00	0.000	0.000
					C	0.000	6.263		100.00	3.270	0.000
L7 10.0000-5.0000	7.4845	0.85	0.007	6.504	A	0.000	6.504	6.504	100.00	0.000	0.000
					B	0.000	6.504		100.00	0.000	0.000
					C	0.000	6.504		100.00	3.270	0.000
L8 5.0000-0.0000	2.4848	0.85	0.007	6.748	A	0.000	6.748	6.748	100.00	0.000	0.000
					B	0.000	6.748		100.00	0.000	0.000
					C	0.000	6.748		100.00	3.270	0.000

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.0 Wind 0 deg - No Ice
3	0.9 Dead+1.0 Wind 0 deg - No Ice
4	1.2 Dead+1.0 Wind 30 deg - No Ice
5	0.9 Dead+1.0 Wind 30 deg - No Ice
6	1.2 Dead+1.0 Wind 60 deg - No Ice
7	0.9 Dead+1.0 Wind 60 deg - No Ice
8	1.2 Dead+1.0 Wind 90 deg - No Ice
9	0.9 Dead+1.0 Wind 90 deg - No Ice
10	1.2 Dead+1.0 Wind 120 deg - No Ice
11	0.9 Dead+1.0 Wind 120 deg - No Ice
12	1.2 Dead+1.0 Wind 150 deg - No Ice
13	0.9 Dead+1.0 Wind 150 deg - No Ice
14	1.2 Dead+1.0 Wind 180 deg - No Ice
15	0.9 Dead+1.0 Wind 180 deg - No Ice
16	1.2 Dead+1.0 Wind 210 deg - No Ice
17	0.9 Dead+1.0 Wind 210 deg - No Ice
18	1.2 Dead+1.0 Wind 240 deg - No Ice
19	0.9 Dead+1.0 Wind 240 deg - No Ice
20	1.2 Dead+1.0 Wind 270 deg - No Ice
21	0.9 Dead+1.0 Wind 270 deg - No Ice
22	1.2 Dead+1.0 Wind 300 deg - No Ice
23	0.9 Dead+1.0 Wind 300 deg - No Ice
24	1.2 Dead+1.0 Wind 330 deg - No Ice
25	0.9 Dead+1.0 Wind 330 deg - No Ice
26	1.2 Dead+1.0 Ice+1.0 Temp
27	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
28	1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp
29	1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp
30	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp
31	1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp
32	1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp
33	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
34	1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp
35	1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp
36	1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp
37	1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp
38	1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp
39	Dead+Wind 0 deg - Service
40	Dead+Wind 30 deg - Service
41	Dead+Wind 60 deg - Service
42	Dead+Wind 90 deg - Service

Comb. No.	Description
43	Dead+Wind 120 deg - Service
44	Dead+Wind 150 deg - Service
45	Dead+Wind 180 deg - Service
46	Dead+Wind 210 deg - Service
47	Dead+Wind 240 deg - Service
48	Dead+Wind 270 deg - Service
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 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
L1	38.5 - 35	Pole	Max Tension	33	0.00	0.00	0.00
			Max. Compression	26	-1.04	0.00	-0.03
			Max. Mx	8	-0.55	-1.33	-0.01
			Max. My	14	-0.56	0.00	-1.30
			Max. Vy	8	0.68	-1.33	-0.01
			Max. Vx	14	0.66	0.00	-1.30
			Max. Torque	10			-0.00
L2	35 - 30	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-2.64	0.00	-0.09
			Max. Mx	8	-1.23	-9.69	-0.04
			Max. My	14	-1.26	0.00	-9.06
			Max. Vy	8	2.05	-9.69	-0.04
			Max. Vx	14	1.82	0.00	-9.06
			Max. Torque	9			-0.05
L3	30 - 25	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-3.75	0.00	-0.16
			Max. Mx	8	-1.72	-23.02	-0.08
			Max. My	14	-1.78	0.00	-20.77
			Max. Vy	8	2.92	-23.02	-0.08
			Max. Vx	14	2.50	0.00	-20.77
			Max. Torque	9			-0.10
L4	25 - 20	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-4.22	0.00	-0.23
			Max. Mx	8	-2.04	-38.43	-0.11
			Max. My	14	-2.10	0.00	-33.57
			Max. Vy	8	3.24	-38.43	-0.11
			Max. Vx	14	2.62	0.00	-33.57
			Max. Torque	9			-0.15
L5	20 - 15	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-4.71	0.00	-0.30
			Max. Mx	8	-2.40	-55.40	-0.14
			Max. My	14	-2.46	0.00	-46.96
			Max. Vy	8	3.55	-55.40	-0.14
			Max. Vx	14	2.73	0.00	-46.96
			Max. Torque	9			-0.20
L6	15 - 10	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-5.22	0.00	-0.37
			Max. Mx	8	-2.80	-73.85	-0.15
			Max. My	14	-2.85	0.00	-60.89
			Max. Vy	8	3.84	-73.85	-0.15
			Max. Vx	14	2.84	0.00	-60.89
			Max. Torque	9			-0.25
L7	10 - 5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-5.75	0.00	-0.44
			Max. Mx	8	-3.24	-93.73	-0.16
			Max. My	14	-3.27	0.00	-75.33
			Max. Vy	8	4.12	-93.73	-0.16
			Max. Vx	14	2.93	0.00	-75.33
			Max. Torque	9			-0.30
L8	5 - 0	Pole	Max Tension	1	0.00	0.00	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Compression	26	-6.30	0.00	-0.50
			Max. Mx	8	-3.72	-115.02	-0.16
			Max. My	14	-3.72	0.00	-90.24
			Max. Vy	8	4.40	-115.02	-0.16
			Max. Vx	14	3.03	0.00	-90.24
			Max. Torque	9			-0.36

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	38.5 - 35	4.92	42	0.9163	0.0242
L2	35 - 30	4.25	42	0.9147	0.0242
L3	30 - 25	3.30	42	0.8893	0.0233
L4	25 - 20	2.40	42	0.8197	0.0209
L5	20 - 15	1.60	42	0.7084	0.0175
L6	15 - 10	0.93	42	0.5640	0.0136
L7	10 - 5	0.42	42	0.3939	0.0092
L8	5 - 0	0.11	42	0.2041	0.0047

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
37.0000	MT6407-77A	42	4.63	0.9164	0.0242	14827
34.0000	XXDWMM-12.5-65-8T-RRH w/ RT4401-48A w/ mount pipe	42	4.05	0.9124	0.0241	14827
30.0000	XGU-MB-134 w/ Pipe Mount	42	3.30	0.8893	0.0233	6086
27.0000	RHSDC-6627-PF-48	42	2.75	0.8530	0.0220	3879

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	38.5 - 35	21.86	8	4.0729	0.1065
L2	35 - 30	18.87	8	4.0657	0.1065
L3	30 - 25	14.66	8	3.9541	0.1024
L4	25 - 20	10.67	8	3.6460	0.0919
L5	20 - 15	7.10	8	3.1518	0.0771
L6	15 - 10	4.12	8	2.5098	0.0596
L7	10 - 5	1.88	8	1.7529	0.0406
L8	5 - 0	0.48	8	0.9085	0.0205

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
37.0000	MT6407-77A	8	20.58	4.0731	0.1066	3403
34.0000	XXDWMM-12.5-65-8T-RRH w/ RT4401-48A w/ mount pipe	8	18.02	4.0559	0.1062	3403
30.0000	XGU-MB-134 w/ Pipe Mount	8	14.66	3.9541	0.1024	1389
27.0000	RHSDC-6627-PF-48	8	12.23	3.7936	0.0968	883

Pole Design Data

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u
	ft		ft	ft		in^2	K
L1	38.5 - 35 (1)	TP12.41x12x6.205	3.5000	0.0000	0.0	120.9580	-0.55
L2	35 - 30 (2)	TP12.99x12.41x6.495	5.0000	0.0000	0.0	132.5280	-1.23
L3	30 - 25 (3)	TP13.57x12.99x6.785	5.0000	0.0000	0.0	144.6270	-1.72
L4	25 - 20 (4)	TP14.16x13.57x7.08	5.0000	0.0000	0.0	157.4770	-2.04
L5	20 - 15 (5)	TP14.74x14.16x7.37	5.0000	0.0000	0.0	170.6420	-2.40
L6	15 - 10 (6)	TP15.32x14.74x7.66	5.0000	0.0000	0.0	184.3350	-2.80
L7	10 - 5 (7)	TP15.9x15.32x7.95	5.0000	0.0000	0.0	198.5570	-3.24
L8	5 - 0 (8)	TP16.49x15.9x8.245	5.0000	0.0000	0.0	213.5660	-3.72

Pole Bending Design Data

Section No.	Elevation	Size	M_{ux}
	ft		kip-ft
L1	38.5 - 35 (1)	TP12.41x12x6.205	1.33
L2	35 - 30 (2)	TP12.99x12.41x6.495	9.69
L3	30 - 25 (3)	TP13.57x12.99x6.785	23.02
L4	25 - 20 (4)	TP14.16x13.57x7.08	38.43
L5	20 - 15 (5)	TP14.74x14.16x7.37	55.40
L6	15 - 10 (6)	TP15.32x14.74x7.66	73.85
L7	10 - 5 (7)	TP15.9x15.32x7.95	93.73
L8	5 - 0 (8)	TP16.49x15.9x8.245	115.00

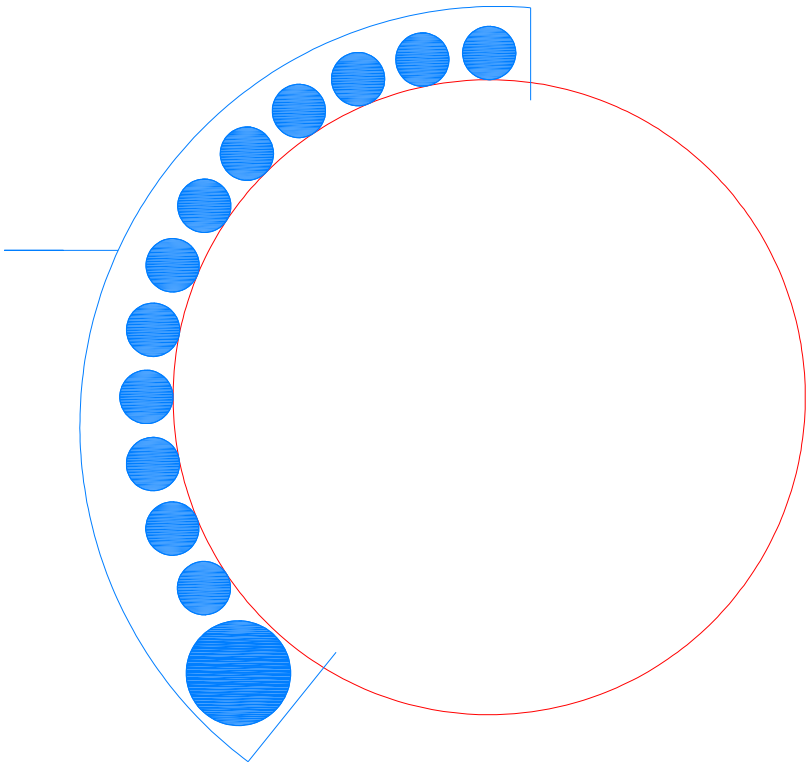
Pole Shear Design Data

Section No.	Elevation	Size	Actual V_u
	ft		K
L1	38.5 - 35 (1)	TP12.41x12x6.205	0.68
L2	35 - 30 (2)	TP12.99x12.41x6.495	2.05
L3	30 - 25 (3)	TP13.57x12.99x6.785	2.92
L4	25 - 20 (4)	TP14.16x13.57x7.08	3.24
L5	20 - 15 (5)	TP14.74x14.16x7.37	3.55
L6	15 - 10 (6)	TP15.32x14.74x7.66	3.84
L7	10 - 5 (7)	TP15.9x15.32x7.95	4.12
L8	5 - 0 (8)	TP16.49x15.9x8.245	4.40

APPENDIX B

Base Level Drawing

PROPOSED
(12) 7/8"Ø COAX
(1) 1-5/8"Ø COAX



APPENDIX C

ADDITIONAL CALCULATIONS

PAUL J. FORD & COMPANY
250 E Broad St, Ste 600 • Columbus, OH 43215
Phone 614.221.6679 www.pauljford.com

Version: v0.5 **Effective:** 7/31/2019

Job Number:	42920-0009.001.7805
By:	NCM
Date:	4/6/2022
Site Number:	0
Site Name:	DURHAM FAIR 2 CT

SOLID ROUND TIMBER POLE CALCUATIONS (35 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	35.00	ft
Critical Diameter	12.41	in.
Critrical Cross Sectional Area	120.91	$in.^2$
Critical Section Modulus	187.53	$in.^3$
Critical Moment of Inertia	1163.44	$in.^4$

Code

2012 NDS (LRFD)

Maximum Capacity Ratio

100%

Applied Loading (From TnxTower)

Moment (kip*ft	1.33
Shear (kips)	0.68
Axial (kips)	0.55

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = 462.00

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	1.00			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4194.4	psi
Adjusted F_v	345.6	psi
Adjusted F_c	154.2	psi

Calculated Capacities (35 ft)

Applied Compression Stress (fc)	4.55	psi
Adjusted Allowable Stress (F'c)	154.24	psi
fb1	85.10	psi
Fb1'	4194.45	psi
Fce1	155.64	psi
1 - fc / Fce1	0.97	
% Capacity	2.2%	

[2012 NDS Section 3.9.2]

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Version: v0.5 **Effective:** 7/31/2019

Job Number:	42920-0009.001.7805
By:	NCM
Date:	4/6/2022
Site Number:	0
Site Name:	DURHAM FAIR 2 CT

SOLID ROUND TIMBER POLE CALCUATIONS (30 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	30.00	ft
Critical Diameter	12.99	in.
Critrical Cross Sectional Area	132.53	$in.^2$
Critical Section Modulus	215.21	$in.^3$
Critical Moment of Inertia	1397.80	$in.^4$

Code

2012 NDS (LRFD)

Maximum Capacity Ratio

100%

Applied Loading (From TnxTower)

Moment (kip*ft	9.69
Shear (kips)	2.05
Axial (kips)	1.22

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = **462.00**

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	0.99			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4173.1	psi
Adjusted F_v	345.6	psi
Adjusted F_c	154.2	psi

Calculated Capacities (30 ft)

Applied Compression Stress (fc)	9.21	psi
Adjusted Allowable Stress (F'c)	154.24	psi
fb1	540.32	psi
Fb1'	4173.12	psi
Fce1	155.64	psi
1 - fc / Fce1	0.94	
% Capacity	14.1%	

[2012 NDS Section 3.9.2]

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Site Name:	DURHAM FAIR 2 CT

SOLID ROUND TIMBER POLE CALCUATIONS (25 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	25.00	ft
Critical Diameter	13.57	in.
Critrical Cross Sectional Area	144.69	$in.^2$
Critical Section Modulus	245.48	$in.^3$
Critical Moment of Inertia	1665.90	$in.^4$

Code

2012 NDS (LRFD)

Maximum Capacity Ratio

100%

Applied Loading (From TnxTower)

Moment (kip*ft	23.01
Shear (kips)	2.92
Axial (kips)	1.71

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = 462.00

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	1.00			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4208.9	psi
Adjusted F_v	345.6	psi
Adjusted F_c	154.2	psi

Calculated Capacities (25 ft)

Applied Compression Stress (fc)	11.82	psi
Adjusted Allowable Stress (F'c)	154.24	psi
fb1	1124.83	psi
Fb1'	4208.94	psi
Fce1	155.64	psi
1 - fc / Fce1	0.92	
% Capacity	29.5%	

[2012 NDS Section 3.9.2]

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Site Number:	0
Site Name:	DURHAM FAIR 2 CT

SOLID ROUND TIMBER POLE CALCUATIONS (20 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	20.00	ft
Critical Diameter	14.16	in.
Critrical Cross Sectional Area	157.37	$in.^2$
Critical Section Modulus	278.46	$in.^3$
Critical Moment of Inertia	1970.84	$in.^4$

Code

2012 NDS (LRFD)

Maximum Capacity Ratio

100%

Applied Loading (From TnxTower)

Moment (kip*ft	38.42
Shear (kips)	3.24
Axial (kips)	2.02

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = 462.00

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	1.00			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4189.3	psi
Adjusted F_v	345.6	psi
Adjusted F_c	154.2	psi

Calculated Capacities (20 ft)

Applied Compression Stress (fc)	12.84	psi
Adjusted Allowable Stress (F'c)	154.24	psi
fb1	1655.69	psi
Fb1'	4189.33	psi
Fce1	155.64	psi
1 - fc / Fce1	0.92	
% Capacity	43.8%	

[2012 NDS Section 3.9.2]

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Site Name:	DURHAM FAIR 2 CT

SOLID ROUND TIMBER POLE CALCUATIONS (15 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	15.00	ft
Critical Diameter	14.74	in.
Critrical Cross Sectional Area	170.59	$in.^2$
Critical Section Modulus	314.27	$in.^3$
Critical Moment of Inertia	2315.84	$in.^4$

Code: 2012 NDS (LRFD)

Maximum Capacity Ratio: 100%

Applied Loading (From TnxTower)

Moment (kip*ft	55.38
Shear (kips)	3.55
Axial (kips)	2.38

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = 462.00

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	0.99			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4170.6	psi
Adjusted F_v	345.6	psi
Adjusted F_c	154.2	psi

Calculated Capacities (15 ft)

Applied Compression Stress (fc)	13.95	psi
Adjusted Allowable Stress (F'c)	154.24	psi
fb1	2114.61	psi
Fb1'	4170.60	psi
Fce1	155.64	psi
1 - fc / Fce1	0.91	
% Capacity	56.5%	

[2012 NDS Section 3.9.2]

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SOLID ROUND TIMBER POLE CALCUATIONS (10 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	10.00	ft
Critical Diameter	15.32	in.
Critrical Cross Sectional Area	184.34	$in.^2$
Critical Section Modulus	353.03	$in.^3$
Critical Moment of Inertia	2704.26	$in.^4$

Code

2012 NDS (LRFD)

Maximum Capacity Ratio

100%

Applied Loading (From TnxTower)

Moment (kip*ft	73.83
Shear (kips)	3.84
Axial (kips)	2.77

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = 462.00

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	0.99			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4152.7	psi
Adjusted F_v	345.6	psi
Adjusted F_c	154.2	psi

Calculated Capacities (10 ft)

Applied Compression Stress (fc)	15.03	psi
Adjusted Allowable Stress (F'c)	154.24	psi
fb1	2509.60	psi
Fb1'	4152.68	psi
Fce1	155.64	psi
1 - fc / Fce1	0.90	
% Capacity	67.8%	

[2012 NDS Section 3.9.2]

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By:	NCM
Date:	4/6/2022
Site Number:	0
Site Name:	DURHAM FAIR 2 CT

SOLID ROUND TIMBER POLE CALCUATIONS (5 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	5.00	ft
Critical Diameter	15.90	in.
Critrical Cross Sectional Area	198.63	$in.^2$
Critical Section Modulus	394.85	$in.^3$
Critical Moment of Inertia	3139.62	$in.^4$

Code: 2012 NDS (LRFD)

Maximum Capacity Ratio: 100%

Applied Loading (From TnxTower)

Moment (kip*ft	93.71
Shear (kips)	4.12
Axial (kips)	3.20

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = 462.00

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	0.98			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4135.5	psi
Adjusted F_v	345.6	psi
Adjusted F_c	154.2	psi

Calculated Capacities (5 ft)

Applied Compression Stress (fc)	16.11	psi
Adjusted Allowable Stress (F'c)	154.24	psi
fb1	2847.98	psi
Fb1'	4135.49	psi
Fce1	155.64	psi
1 - fc / Fce1	0.90	
% Capacity	77.9%	

[2012 NDS Section 3.9.2]

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Site Number:	0
Site Name:	DURHAM FAIR 2 CT

SOLID ROUND TIMBER POLE CALCUATIONS (0 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	0.00	ft
Critical Diameter	16.49	in.
Critrical Cross Sectional Area	213.45	$in.^2$
Critical Section Modulus	439.85	$in.^3$
Critical Moment of Inertia	3625.53	$in.^4$

Code

2012 NDS (LRFD)

Maximum Capacity Ratio

100%

Applied Loading (From TnxTower)

Moment (kip*ft	115.00
Shear (kips)	4.40
Axial (kips)	3.67

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = 462.00

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	0.98			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4119.0	psi
Adjusted F_v	345.6	psi
Adjusted F_c	165.7	psi

Calculated Capacities (0 ft)

Applied Compression Stress (fc)	17.19	psi
Adjusted Allowable Stress (F'c)	165.69	psi
fb1	3137.46	psi
Fb1'	4118.99	psi
Fce1	167.31	psi
1 - fc / Fce1	0.90	
% Capacity	86.0%	

[2012 NDS Section 3.9.2]

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Job Number:	42920-0009.001.7805	Page:	1
Site Number:		By:	NCM
Site Name:	Durham Fair 2 CT	Date:	4/6/2022

DIRECT EMBED SOIL AND STEEL ANALYSIS - TIA-222-G

Factored Base Reactions from RISA

	Comp. (+)	Tension (-)	
Moment, Mu =	115.0		k-ft
Shear, Vu =	4.4		kips
Axial Load, Pu =	3.7		kips (from 1.2D + 1.6W)*
OTMu =	115.0	0.0	k-ft @ Ground

Safety Factors / Load Factors / Φ Factors

Tower Type =	Monopole DE
ACI Code =	ACI 318-08
Seismic Design Category =	D
Reference Standard =	TIA-222-G
Utilize Shear-Friction Methodology?	Yes
Use 1.3 Load Factor?	No
Load Factor =	1.00

	Safety Factor	Φ Factor
Soil Lateral Resistance =	2.00	0.75
Skin Friction =	2.00	0.75
End Bearing =	2.00	0.75
Concrete Wt. Resist Uplift =	1.25	

Direct Embed Concrete / Gravel Parameters

Diameter =	3	ft
Height Above Grade =	0	ft, Assumed 0 ft for DE
Depth Below Grade =	13	ft
fc' =	3	ksi
εc =	0.003	in/in
L / D Ratio =	4.33	
Mat Ftdn. Cap Width =		ft
Mat Ftdn. Cap Length =		ft
Depth Below Grade =		ft

Load Combinations Checked per TIA-222-G

1. (0.75) Ult. Skin Friction + (0.75) Ult. End Bearing + (0.75) Effective Soil Wt. - (1.2) Buoyant Conc. Wt. ≥ Comp.
2. (0.75) Ult. Skin Friction + (0.9) Buoyant Conc. Wt. ≥ Uplift

Soil Parameters

Water Table Depth =	99.00	ft
Depth to Ignore Soil =	3.00	ft
Depth to Full Cohesion =	0	ft
Full Cohesion Starts at?*	Ground	

Above Full Cohesion Lateral Resistance = 4(Cohesion)(Dia)(H)
Below Full Cohesion Lateral Resistance = 8(Cohesion)(Dia)(H)

*Note: The drilled pier foundation was analyzed using the methodology in the software 'PLS-Caisson' (Version 8.10, or newer, by Power Line Systems, Inc.). Per the methods in PLS-Caisson, the soil reactions of cohesive soils are calculated using 8CD independent of the depth of the soil layer. The depth of soil to be ignored at the top of the drilled pier is based the recommendations of the site specific geotechnical report. In the absence of any recommendations, the frost depth at the site or one half of the drilled pier diameter (whichever is greater) shall be ignored.

Steel Parameters

	Rebar	Ties	
Number of Bars =			
Size =			
Fy =	60		ksi
MOE =	29000	29000	ksi
Side Clear Cover to Ties =			in
Top Clear Cover to Ties =			in
Tie Upper Spacing =			in
Tie Lower Spacing =			in
Upper Tie Spacing Depth:			ft Below Grade

Direct Embed Pole Shaft Parameters

Dia @ Grade =	16.49	in
Dia @ Depth Below Grade =	18	in
Number of Sides =	Round	
Thickness =	9	in
Fy =	1.95	ksi
Backfill Condition =	Gravel Exterior	

Maximum Capacity Ratios

Maximum Soil Ratio =	110.0%
Maximum Steel Ratio =	105.0%
Apply 1.05 Normalization =	

Define Soil Layers

Note: Cohesion = Undrained Shear Strengh = Unconfined Compressive Strength / 2

Layer	Thickness ft	Unit Weight pcf	Cohesion psf	Friction Angle degrees	Soil Type	Ultimate End Bearing psf	Comp. Ult. Skin Friction psf	Tension Ult. Skin Friction psf	Depth ft
1	13	110	0	30	Sand	4000	500		13
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

Soil Results: Overturning

Depth to COR =	9.70	ft, from Grade
Shear, Vu =	4.40	kips
Resisting Shear, ΦVn =	5.43	kips
Bending Moment, Mu =	157.68	k-ft, from COR
Resisting Moment, ΦMn =	194.47	k-ft, from COR

MOMENT/SHEAR RATIO = 81.1% OK

Soil Results: Uplift & Compression

*Comp Ratio based on dia used for overturning calculation.

Uplift, Tu =	0.00	kips
Uplift Capacity, ΦTn =	2.85	kips

UPLIFT RATIO = 0.0% OK

Compression, Cu =	3.67	kips
Comp. Capacity, ΦCn =	19.74	kips

COMPRESSION RATIO = 18.6% OK

Pole Capacity Results:

Axial Load, Pu =	4.32	kips @ 3.50 ft Below Grade
Shear, Vu =	2.99	kips @ 3.50 ft Below Grade
Moment, Mu =	130.06	k-ft @ 3.50 ft Below Grade

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Site Number:	0
Site Name:	DURHAM FAIR 2 CT

SOLID ROUND TIMBER POLE CALCUATIONS (-3.5 FT)

Wood Pole Geometry

Total Pole Length	51.50	ft (38.5 ft AGL)
Embedment	13.00	ft
Top Pole Diameter	12.00	in.
Btm Pole Diameter	18.00	in.
Elev. Of Critical Section	-3.50	ft
Critical Diameter	16.89	in.
Critrical Cross Sectional Area	224.14	$in.^2$
Critical Section Modulus	473.30	$in.^3$
Critical Moment of Inertia	3997.77	$in.^4$

Code

2012 NDS (LRFD)

Maximum Capacity Ratio

100%

Applied Loading (From TnxTower)

Moment (kip*ft	130.06
Shear (kips)	2.99
Axial (kips)	4.32

Wood Pole Information

Species	Southern Pine	
F_b	1950	psi
F_v	160	psi
F_c	1250	psi
E	1500000	psi
E_{min}	600000	psi

*Assumed pole has been Air Dried

*Lu (in) = 462.00

* Conservative: occurs further up the tower leg.

**Based on square section with equivalent area

Calculate the Adjusted Design Stesses (2012 NDS)

	Factor	Flexure	Shear	Axial	
(ASD)	C_d	1.00	1.00	1.00	(Load Duration Factor)
	C_t	1.00	1.00	1.00	(Temperature Factor)
	C_{ct}	1.00	1.00	1.00	(Condition Treatment Factor)
	C_F	0.98			(Size Factor)
	C_P			0.06	(Column Stability Factor)
	C_{cs}			1.00	(Critical Section Factor)
	C_b				(Bearing Area Factor)
	C_{ls}	1.00		1.00	(Loading Sharing Factor)
(LRFD)	K_F	2.54	2.88	2.40	(Format Converstion Factor)
(LRFD)	ϕ	0.85	0.75	0.90	(Resistance Factor)
(LRFD)	λ	1.00	1.00	1.00	(Time Effect Factor)

Adjusted F_b	4107.8	psi
Adjusted F_v	345.6	psi
Adjusted F_c	154.2	psi

Calculated Capacities (-3.5 ft)

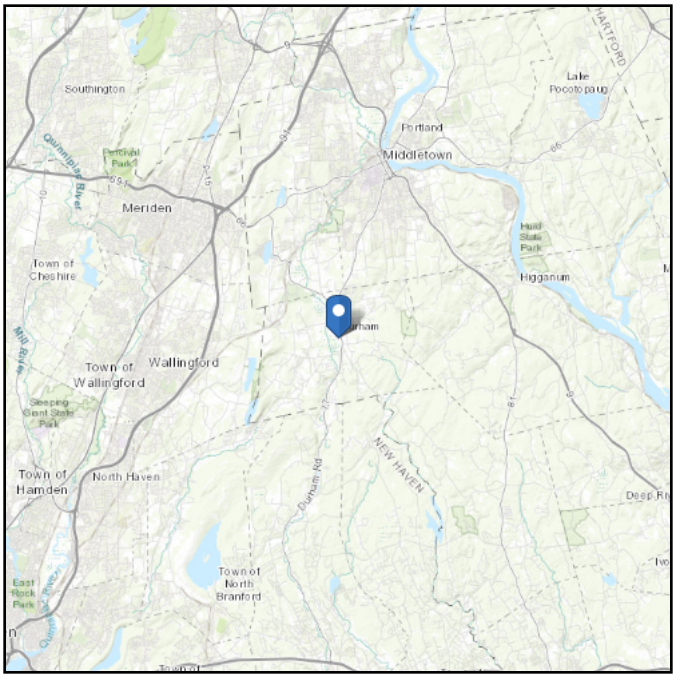
Applied Compression Stress (fc)	19.27	psi
Adjusted Allowable Stress (F'c)	154.24	psi
fb1	3297.53	psi
Fb1'	4107.83	psi
Fce1	155.64	psi
1 - fc / Fce1	0.88	
% Capacity	93.2%	

[2012 NDS Section 3.9.2]

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-16	**Elevation:**	187.56 ft (NAVD 88)
Risk Category:	II	**Latitude:**	41.468422
Soil Class:	D - Default (see Section 11.4.3)	**Longitude:**	-72.681983



Wind

Results:

Wind Speed:	120 Vmph
10-year MRI	75 Vmph
25-year MRI	85 Vmph
50-year MRI	92 Vmph
100-year MRI	99 Vmph

Data Source:	ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Tue Nov 09 2021

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

Site is in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2. Glazed openings need not be protected against wind-borne debris.

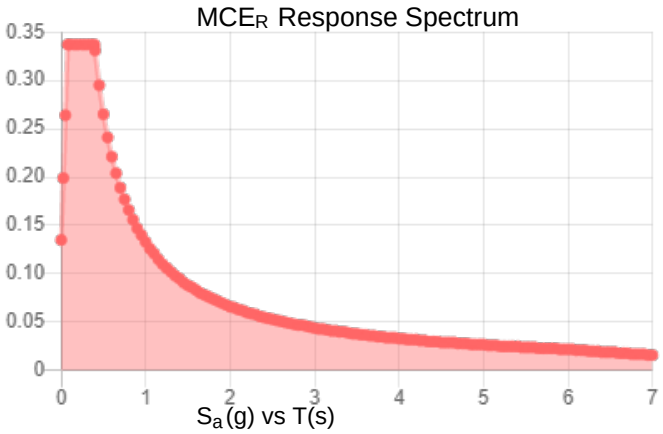
Seismic

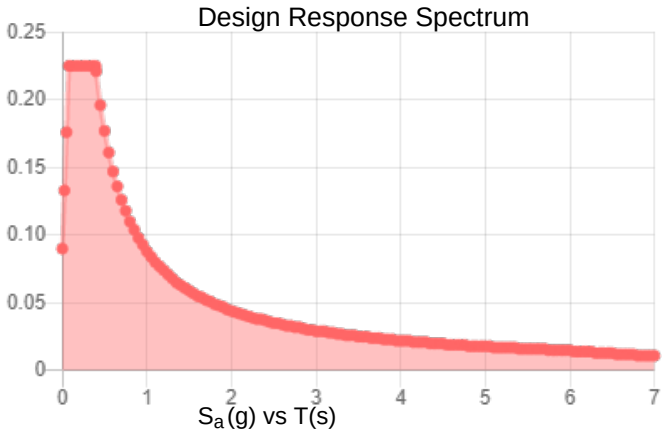
Site Soil Class: D - Default (see Section 11.4.3)

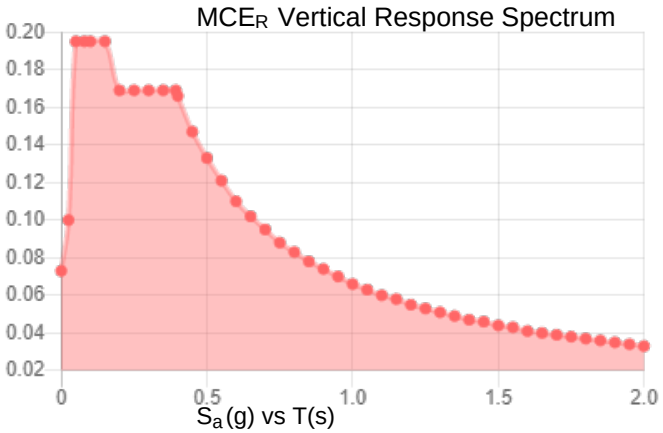
Results:

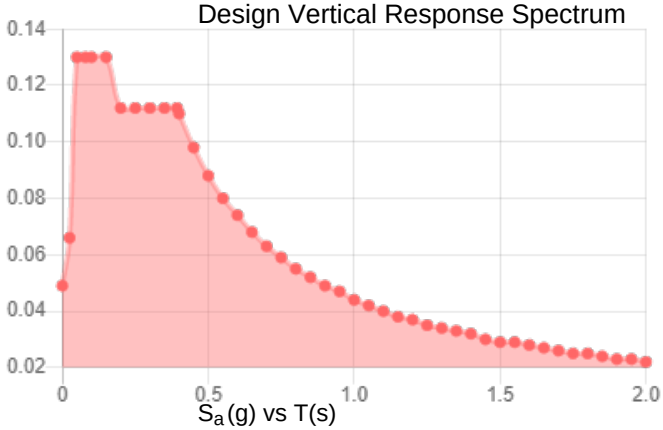
S_S :	0.211	S_{D1} :	0.088
S_1 :	0.055	T_L :	6
F_a :	1.6	PGA :	0.118
F_v :	2.4	PGA_M :	0.185
S_{MS} :	0.337	F_{PGA} :	1.564
S_{M1} :	0.133	I_e :	1
S_{DS} :	0.225	C_v :	0.722

Seismic Design Category B









Data Accessed: Tue Nov 09 2021

Date Source: USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

Ice

Results:

Ice Thickness:	1.00 in.
Concurrent Temperature:	15 F
Gust Speed:	50 mph
Data Source:	Standard ASCE/SEI 7-16, Figs. 10-2 through 10-8
Date Accessed:	Tue Nov 09 2021

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

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