NorthWest Tower Engineering

Coe Road, Rosalia, WA
SCT146
160-ft Self-Supporting Tower

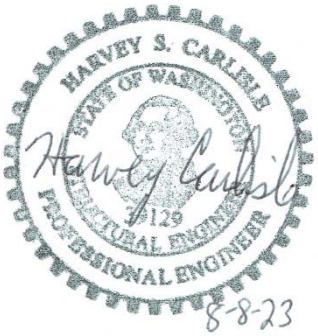
New J, LLC
Spokane Regional Emergency Communications System

Structural Analysis Report No. 231551.02
August 8, 2023

Analysis and Report by: Harvey Carlisle, S.E.

Checked by: Steven Diamond, P.E.

Approved by: Harvey Carlisle, S.E.



Introduction

NorthWest Tower Engineering (NWTE) has completed a structural analysis of the Spokane Regional Emergency Communications System (SRECS) 160-foot self-supporting tower on Coe Road near Rosalia, Washington. The analysis was performed at the request of New J, LLC to determine the ability of the tower to support proposed equipment.

Tower Information

NWTE visited the site on 09-09-15. The tower was designed and manufactured by Valmont / Microflect (Model No 108-L840-160, SO 155116-1). A Valmont stress analysis dated 06-22-11, Valmont foundation drawing (No. D-132231) dated 06-08-11, and an Adapt Engineering geotechnical report WA10-16819-GEO, dated 12-06-10 were provided.

Assessed Condition

This analysis was performed to determine the ability of the tower to support the following load conditions:

Existing Appurtenance Configuration

Elevation	Location	Appurtenance	Tx Line	Tx Line No.
35'	N Leg	Empty Standoff Mount	N/A	N/A
49'	SE Leg	6' HP MW Dish w/ Ice Shield above @ 55'	EW63	# 7
87'	SW Leg	6' HP MW Dish	EW63	# 6
120'	Internal	Internal Work Platform w/ Rails on all sides	N/A	N/A
150'	Internal	Internal Work Platform w/ Rails	N/A	N/A
150'	SE Leg	Empty Pipe Mount	N/A	N/A
152' 154'	N Leg	18' 8-Bay Sinclair Dipole 20'x 5" OD Omni Antenna Sinclair SC412-HF2LDF & TTA on 6' Double Standoff Mount.	7/8" Coax 7/8" Coax ½" Coax	# 4 # 1 # 2
154'	SE Leg	20' 4-Bay Sinclair Dipole RFI OA40-41-DIN 20'x 5" OD Omni Antenna Sinclair SC412-HF2LDF on 6' Double Standoff Mount	7/8" Coax 1-5/8" Coax	# 5 # 3
160'	SW Leg	Lightning Rod on Pipe Extension	N/A	N/A

Proposed Appurtenance Configuration

All existing appurtenances and the following:

Elev.	Location	Appurtenance	Tx Line	Tx Line No.
100'	SW Leg	Radiowaves HP3-11, 3' HP MW Dish (262°) Cambium Networks PTP 850C Radio	½" Hybrid	# 8
110'	N Leg	Radiowaves HP3-11, 3' HP MW Dish (23°) Cambium Networks PTP 850C Radio	½" Hybrid	# 9
110'	SW Leg	Radiowaves HP3-11, 3' HP MW Dish (271°) Cambium Networks PTP 850C Radio	½" Hybrid	# 10
120'	N, SE, SW Legs	(3) KP Performance Antennas KPP-3SX4-65, 30" Panel Antennas (3) Leax Arkivator Telecom LBS8529 Radios (3) Pipe Mounts	(3) ½" Hybrid	#11-13

Antenna center elevations are listed for microwave, yagi, and panel type antennas. Base elevations are listed for other antenna types.

Information on tower geometry and structural member sizes was taken from the Valmont Microflect drawings and confirmed on site. Information on existing antennas and feed lines was gathered during the site visit. Information on proposed antennas and feed lines was provided by New J in an appurtenance list and in emails dated 08-02-23.

Yield strengths for structural steel members are given by Valmont Microflect as follows:

- Pipe Legs 50 ksi
- Pipe Bracing 50 ksi
- Angle Bracing 36 ksi

The attached drawings show tower geometry, structural member sizes, existing and proposed antennas, feed lines, and other supported appurtenances.

Wind Load Specifications

A comprehensive structural analysis was performed using the provisions of TIA-222-H, "Structural Standard for Antenna Supporting Structures, Antennas, and Small Wind Turbine Support Structures." This standard is referenced in the 2018 International Building Code (IBC). The minimum basic wind speed of 114 mph as listed in the standard for Risk Category IV structures at this location was used. A basic wind speed of 40 mph in combination with a design ice thickness of 1" as listed in the standard was also considered. Exposure Category C (open terrain) and topographic category 1 (flat or rolling terrain) were considered. Tower base elevation above sea level of 2600' was used for the analysis.

Analysis Method

A three-dimensional finite element model of the tower was created using *tnxTower Version 8.1.1.0 (Tower Numerics, 2021)*. This computer software program calculates and distributes wind and ice loads in the model. It calculates the resulting forces (required strength) in all structural members and determines tower deflections and foundation loads. Required strength of each structural member is compared to each member's design strength determined using the TIA-222-H standard.

Analysis Results

The following ratios of required strength to design strength for the tower's structural members were found:

MEMBER DEMAND-CAPACITY RATIO

Elevation (ft)	Member	Existing Configuration Maximum % Capacity	Proposed Configuration Maximum % Capacity
160 - 0	Leg	32	35
	Diagonal	31	34
	Horizontal	13	14

The attached tables contain more detailed lists of member forces and capacities. Capacities of all structural members were found to be adequate.

Calculations confirmed the adequacy of the anchor bolts and the bolts in each leg splice and bracing connection. Welds, plates, and other elements of the connections are assumed to develop the full strengths of the members.

Each leg of the tower rests on a 3' diameter by 2'-6" long concrete pier. According to the foundation drawing, the piers are supported by a 30' square by 3' thick concrete mat, which has 2' of soil cover. Bottom of mat is 5' below grade. A comparison was made between the foundation design reactions, which were provided by Valmont Microflect, and the calculated reactions from this analysis. Valmont Microflect obtained the foundation design reactions from their tower structural analysis based on the TIA-222-G standard. The original design reactions were found to be significantly greater than the reactions from this analysis. Based on this comparison, the foundation is considered to be adequate.

Seismic calculations were performed using the equivalent lateral force procedure in accordance with the TIA-222-H standard. Seismic forces were distributed over the height of the tower in accordance with the TIA-222-H standard. Resulting values for shear forces in the tower were then calculated at multiple levels and compared with shear forces generated from wind loads. Wind load was found to govern over the full height of the structure.

The tower was found to fall within the Twist and Sway limitations for microwave antennas set forth in the TIA-222-H Standard for 3dB degradation in RF signal. Calculated twist and sway values at each microwave dish location for 60-mph wind were found to be within allowable limits. Operating frequencies of 6GHz & 11GHz were assumed.

Conclusion

The tower meets the requirements of the TIA-222-H standard for the antenna configurations considered. No structural modifications are required.

Conditions of Analysis

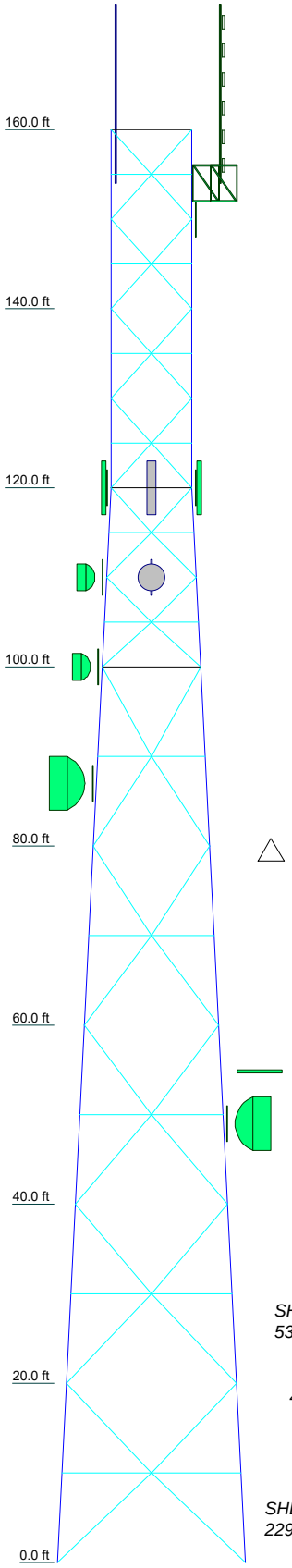
The analysis performed and the conclusions contained herein are based on the following assumptions:

- The tower has been properly installed and maintained.
- Steel grades for structural members are as listed above.
- No x-ray, subsurface excavation, or other similar examination of the tower, foundation system, or welded connections was conducted. For portions of the tower and foundation system that were not visually accessible, no determination regarding the condition or adequacy was made.
- All structural components of the tower including, but not limited to, structural members (legs, bracing, etc.), connection components (gusset plates, welds, bolts), and foundations are in good condition.
- Proposed microwave dishes will be installed with standard pipe mount and stabilizers as recommended by the manufacturer.
- Proposed panel antennas will be installed on new pipe mounts.
- Proposed feed lines will be placed as shown in the attached cross section.

Deviations to these assumptions may affect the analysis results.

Section	T1	T2	T3	T4	T5	T6	T7	T8
Legs		P4x.237		P4x.337	P6x.280	P8x.322	P10x.365	
Leg Grade		A572-50						
Diagonals		P1.5x.145			P3x.216		P3.5x.226	
Diagonal Grade		A572-50						
Top Girts	2L2x2x3/16x3/8	N.A.	2L2 1/2x2x3/16x3/8	2L2x2x1/8x3/8		N.A.		
Horizontals		2L2x2x1/8x3/8			2L2x2x3/16x3/8		2L2 1/2x2 1/2x3/16x3/8	
Inner Bracing			L2x2x1/8			L2 1/2x2 1/2x3/16		L3x3x3/16
Face Width (ft)	9			11	13	15	17	19
# Panels @ (ft)		12 @ 5				10 @ 10		
Weight (lb)	1485.4	1354.1	1551.4	2301.3	2574.8	3273.8	4404.6	4545.0

Total Weight (lb): 21490.3



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
6' Standoff Mount	154	LBS8529 Radio	120
20' Omni	154	Pipe Mount	120
6' Standoff Mount	154	KP Performance KPP-3SX4-65	120
6' Standoff Mount	154	LBS8529 Radio	120
20' 4-Bay Dipole Antenna	154	Cambium Networks PTP 850C Radio	110
6' Standoff Mount	154	Dish Mount	110
20' Omni	154	Cambium Networks PTP 850C Radio	110
Work Platform w/Handrails	152	Dish Mount	110
Work Platform w/Handrails	152	3' MW HP	110
Work Platform w/Handrails	152	3' MW HP	110
18' 8-Bay Dipole Antenna	152	Cambium Networks PTP 850C Radio	100
Pipe Mount (empty)	150	3' MW HP	100
Work Platform w/Handrails	122	Dish Mount	100
Work Platform w/Handrails	122	6' MW HP	87
Work Platform w/Handrails	122	Dish Mount	87
Pipe Mount	120	Ice Shield	55
KP Performance KPP-3SX4-65	120	6' MW HP	49
LBS8529 Radio	120	Dish Mount	49
Pipe Mount	120	Standoff Mount (empty)	35
KP Performance KPP-3SX4-65	120		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi			

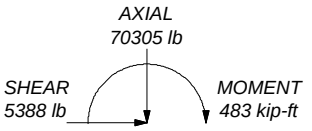
TOWER DESIGN NOTES

1. Tower designed for Exposure C to the TIA-222-H Standard.
2. Tower designed for a 114 mph basic wind in accordance with the TIA-222-H Standard.
3. Tower is also designed for a 40 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 60 mph wind.
5. Tower Risk Category IV.
6. Topographic Category 1 with Crest Height of 0'
7. TOWER RATING: 34.8%

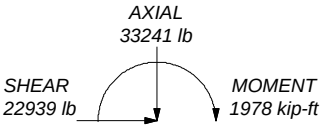
ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 119867 lb
SHEAR: 15152 lb

UPLIFT: -98817 lb
SHEAR: 12937 lb



TORQUE 2 kip-ft
40 mph WIND - 1.0000 in ICE



TORQUE 9 kip-ft
REACTIONS - 114 mph WIND

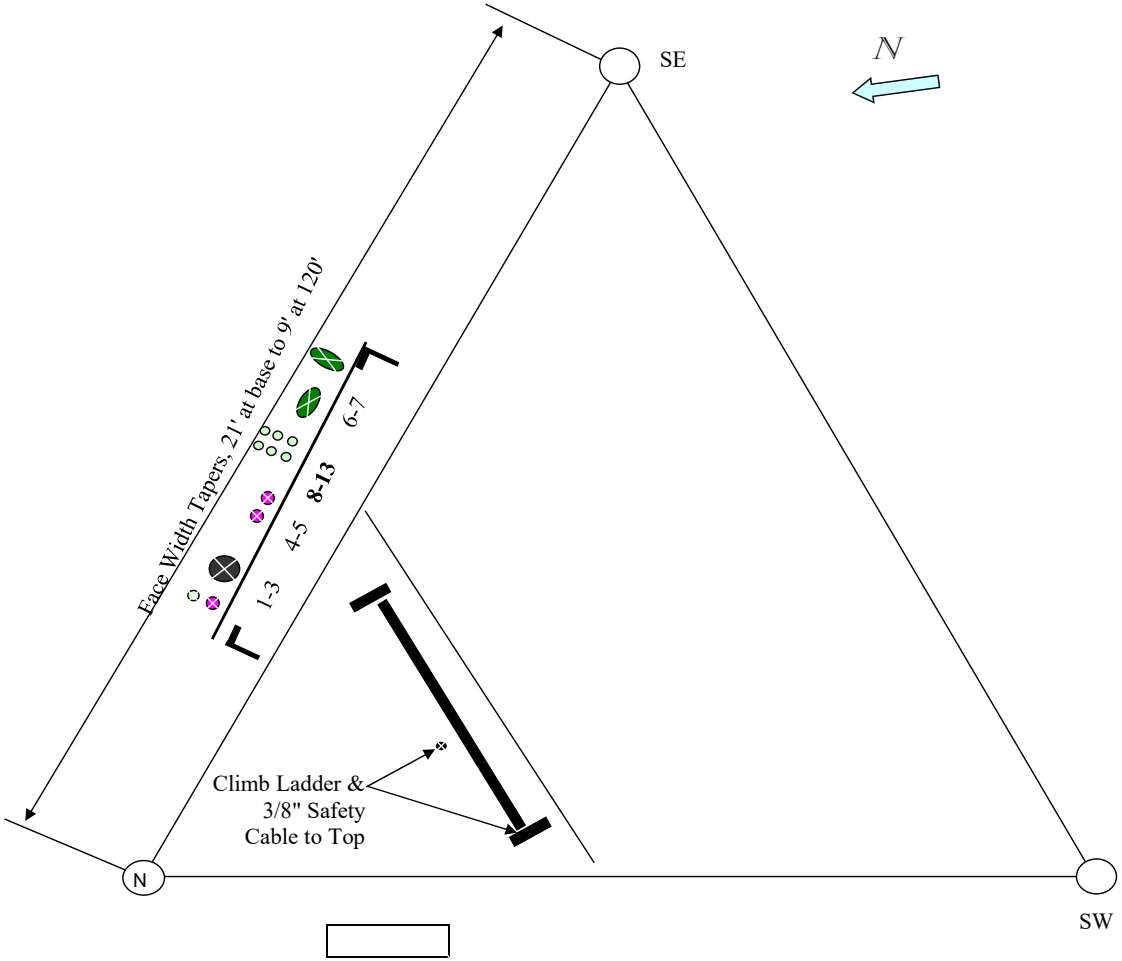
NorthWest Tower Engineering
3426 Broadway Suite 302
Everett, WA 98201
NWTE
Phone: 425 258 4248
FAX: 425 258 4289

Job:	***231551.02 160' SS Coe Rd, Rosalia, WA***		
Project:	***Proposed, Vult=114 mph, 40 mph with 1" Ice***		
Client: New J / SRECS	Drawn by: Steven Diamond	App'd:	
Code: TIA-222-H	Date: 08/08/23	Scale: NTS	
Path:		Dwg No. E-1	

NorthWest Tower Engineering
3426 Broadway Suite 302
Everett, WA 98201
Phone: 425-258-4248
Fax: 425-258-4289

Job Name:	160' SS Coe Road - Rosalia, WA	Page:	A-1
Project Number:	231551.02	Date:	8/4/2023
Client Name:	New J / SRECS	By:	ES/SD/HC

EXISTING FEEDLINES			
Coax Number	**Coax Description**	**Termination Elevation**	**Coax Key**
1	1/2" Coax	154'	
2	7/8" Coax	154'	
3	1-5/8" Coax	154'	
4	7/8" Coax	152'	
5	7/8" Coax	154'	
6	EW63	87'	
7	EW63	49'	
PROPOSED FEEDLINES			
8	1/2" Hybrid	100'	
9	1/2" Hybrid	110'	
10	1/2" Hybrid	110'	
11-13	(3) 1/2" Hybrid	120'	



Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	$øP_{allow}$ lb	% Capacity	Pass Fail
T1	160 - 140	Leg	P4x.237	2	-5783.01	127250.00	4.5	Pass
		Diagonal	P1.5x.145	11	-2349.37	11698.70	20.1	Pass
		Horizontal	2L2x2x1/8x3/8	28	-869.30	19920.60	4.4	Pass
							9.7 (b)	
		Top Girt	2L2x2x3/16x3/8	5	-100.43	14545.30	0.7	Pass
		Inner Bracing	L2x2x1/8	36	-2.35	7513.78	0.4	Pass
T2	140 - 120	Leg	P4x.237	44	-17646.70	127250.00	13.9	Pass
		Diagonal	P1.5x.145	50	-3440.53	11698.70	29.4	Pass
		Horizontal	2L2x2x1/8x3/8	46	-305.65	19920.60	1.5	Pass
							3.4 (b)	
		Inner Bracing	L2x2x1/8	55	-1.02	7513.78	0.4	Pass
T3	120 - 100	Leg	P4x.237	83	-30833.60	127201.00	24.2	Pass
		Diagonal	P1.5x.145	93	-2926.97	9427.84	31.0	Pass
		Horizontal	2L2x2x1/8x3/8	88	-534.72	18952.40	2.8	Pass
							5.9 (b)	
		Top Girt	2L2 1/2x2x3/16x3/8	85	-534.72	27219.40	2.0	Pass
		Inner Bracing	L2x2x1/8	97	-4.65	5520.33	0.5	Pass
T4	100 - 80	Leg	P4x.337	124	-39472.10	122179.00	32.3	Pass
		Diagonal	P3x.216	135	-5140.78	35258.80	14.6	Pass
							15.1 (b)	
		Horizontal	2L2x2x1/8x3/8	136	-847.29	17796.00	4.8	Pass
							9.3 (b)	
		Top Girt	2L2x2x1/8x3/8	129	-847.29	6623.65	12.8	Pass
		Inner Bracing	L2x2x1/8	141	-9.89	4226.50	0.6	Pass
T5	80 - 60	Leg	P6x.280	148	-56247.10	203686.00	27.6	Pass
		Diagonal	P3x.216	153	-4607.47	32634.10	14.1	Pass
		Horizontal	2L2x2x3/16x3/8	157	-975.44	23932.70	4.1	Pass
		Inner Bracing	L2x2x1/8	160	-10.38	3105.19	0.6	Pass
T6	60 - 40	Leg	P8x.322	169	-68852.50	334421.00	20.6	Pass
		Diagonal	P3x.216	173	-6427.43	29943.80	21.5	Pass
		Horizontal	2L2x2x3/16x3/8	178	-1194.05	18534.60	6.4	Pass
		Inner Bracing	L2 1/2x2 1/2x3/16	181	-11.31	6863.92	0.5	Pass
T7	40 - 20	Leg	P10x.365	190	-86775.40	495532.00	17.5	Pass
		Diagonal	P3.5x.226	194	-6049.80	43463.20	13.9	Pass
		Horizontal	2L2 1/2x2 1/2x3/16x3/8	199	-1504.87	29609.00	5.1	Pass
							5.2 (b)	
		Inner Bracing	L2 1/2x2 1/2x3/16	203	-13.42	5423.34	0.5	Pass
T8	20 - 0	Leg	P10x.365	211	-101349.00	495532.00	20.5	Pass
		Diagonal	P3.5x.226	215	-7002.98	38962.80	18.0	Pass
		Horizontal	2L2 1/2x2 1/2x3/16x3/8	220	-1757.61	23734.00	7.4	Pass
		Inner Bracing	L3x3x3/16	223	-13.83	7695.81	0.5	Pass
							Summary	
						Leg (T4)	32.3	Pass
						Diagonal (T3)	31.0	Pass
						Horizontal (T1)	9.7	Pass
						Top Girt (T4)	12.8	Pass
						Inner Bracing (T5)	0.6	Pass
						Bolt Checks	20.7	Pass
						RATING =	**32.3**	**Pass**

Section Capacity Table

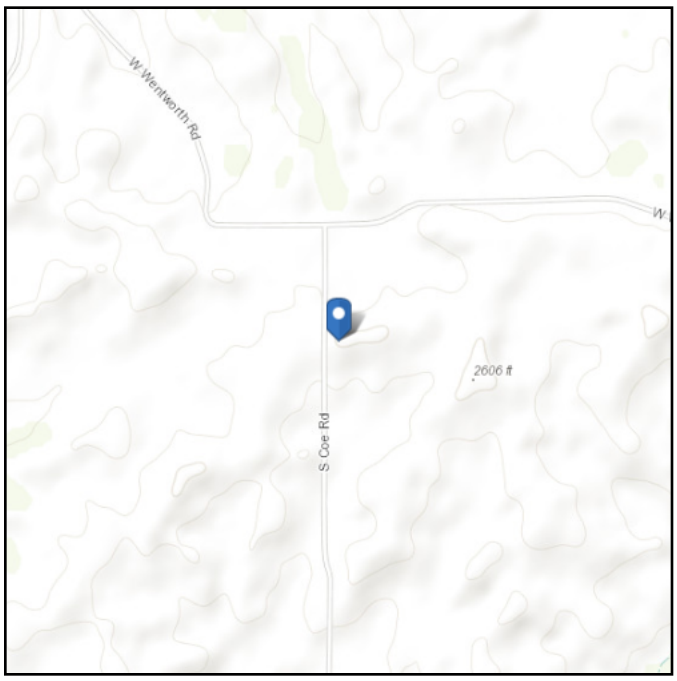
Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	$øP_{allow}$ lb	% Capacity	Pass Fail
T1	160 - 140	Leg	P4x.237	2	-5782.76	127250.00	4.5	Pass
		Diagonal	P1.5x.145	11	-2349.92	11698.70	20.1	Pass
		Horizontal	2L2x2x1/8x3/8	28	-869.26	19920.60	4.4 9.7 (b)	Pass
		Top Girt	2L2x2x3/16x3/8	5	-100.68	14545.30	0.7	Pass
		Inner Bracing	L2x2x1/8	36	-2.38	7513.78	0.4	Pass
T2	140 - 120	Leg	P4x.237	44	-17647.70	127250.00	13.9	Pass
		Diagonal	P1.5x.145	50	-3445.76	11698.70	29.5	Pass
		Horizontal	2L2x2x1/8x3/8	64	-305.67	19920.60	1.5 3.4 (b)	Pass
		Inner Bracing	L2x2x1/8	55	-1.04	7513.78	0.4	Pass
T3	120 - 100	Leg	P4x.237	84	-32052.90	127201.00	25.2	Pass
		Diagonal	P1.5x.145	92	-3190.72	9427.84	33.8	Pass
		Horizontal	2L2x2x1/8x3/8	91	-555.87	18952.40	2.9 6.1 (b)	Pass
		Top Girt	2L2 1/2x2x3/16x3/8	86	-555.87	27219.40	2.0	Pass
		Inner Bracing	L2x2x1/8	97	-4.68	5520.33	0.5	Pass
T4	100 - 80	Leg	P4x.337	124	-42549.80	122179.00	34.8	Pass
		Diagonal	P3x.216	131	-5574.42	35258.80	15.8 16.2 (b)	Pass
		Horizontal	2L2x2x1/8x3/8	136	-913.36	17796.00	5.1 10.0 (b)	Pass
		Top Girt	2L2x2x1/8x3/8	129	-913.36	6623.65	13.8	Pass
		Inner Bracing	L2x2x1/8	141	-9.91	4226.50	0.6	Pass
T5	80 - 60	Leg	P6x.280	148	-61268.60	203686.00	30.1	Pass
		Diagonal	P3x.216	153	-5234.92	32634.10	16.0	Pass
		Horizontal	2L2x2x3/16x3/8	157	-1062.53	23932.70	4.4	Pass
		Inner Bracing	L2x2x1/8	160	-10.40	3105.19	0.6	Pass
T6	60 - 40	Leg	P8x.322	169	-75179.80	334421.00	22.5	Pass
		Diagonal	P3x.216	173	-6915.54	29943.80	23.1	Pass
		Horizontal	2L2x2x3/16x3/8	178	-1303.78	18534.60	7.0	Pass
		Inner Bracing	L2 1/2x2 1/2x3/16	181	-11.32	6863.92	0.5	Pass
T7	40 - 20	Leg	P10x.365	190	-94531.00	495532.00	19.1	Pass
		Diagonal	P3.5x.226	194	-6514.11	43463.20	15.0	Pass
		Horizontal	2L2 1/2x2 1/2x3/16x3/8	199	-1639.37	29609.00	5.5 5.7 (b)	Pass
		Inner Bracing	L2 1/2x2 1/2x3/16	203	-13.43	5423.34	0.5	Pass
T8	20 - 0	Leg	P10x.365	211	-110091.00	495532.00	22.2	Pass
		Diagonal	P3.5x.226	215	-7459.80	38962.80	19.1	Pass
		Horizontal	2L2 1/2x2 1/2x3/16x3/8	220	-1909.21	23734.00	8.0	Pass
		Inner Bracing	L3x3x3/16	223	-13.85	7695.81	0.5	Pass
							Summary	
						Leg (T4)	34.8	Pass
						Diagonal (T3)	33.8	Pass
						Horizontal (T4)	10.0	Pass
						Top Girt (T4)	13.8	Pass
						Inner Bracing (T5)	0.6	Pass
						Bolt Checks	22.0	Pass
						RATING =	**34.8**	**Pass**

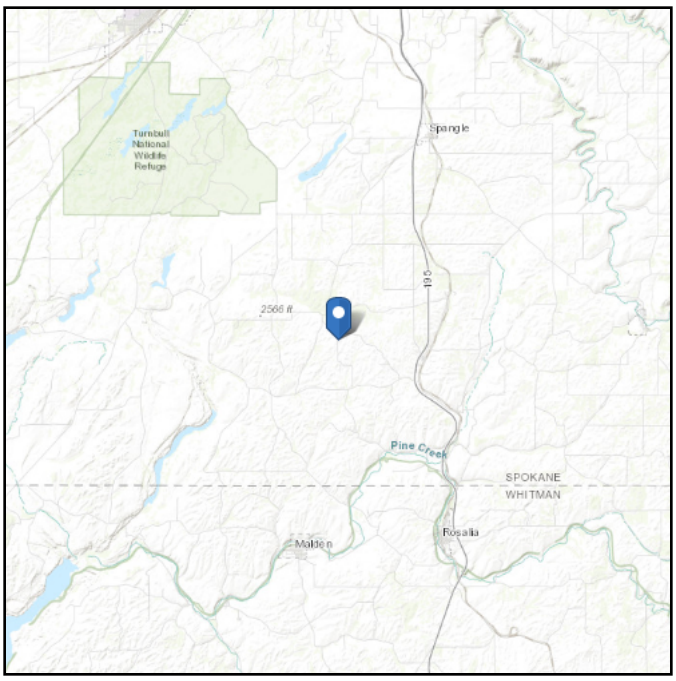
ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: IV
Soil Class: D - Stiff Soil

Latitude: 47.329656
Longitude: -117.444919
Elevation: 2604.1861739179444 ft (NAVD 88)





Wind

Results:

Wind Speed	114 Vmph
10-year MRI	71 Vmph
25-year MRI	77 Vmph
50-year MRI	82 Vmph
100-year MRI	87 Vmph

Data Source:	ASCE/SEI 7-16, Fig. 26.5-1D and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Fri Aug 04 2023

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 1.6% probability of exceedance in 50 years (annual exceedance probability = 0.00033, MRI = 3,000 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

Ice

Results:

Ice Thickness:	1.00 in.
Concurrent Temperature:	15 F
Gust Speed	40 mph
Data Source:	Standard ASCE/SEI 7-16, Figs. 10-2 through 10-8
Date Accessed:	Fri Aug 04 2023

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.

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