

Date: April 1, 2022

Tank Comparative Analysis Report

Project Information:

Carrier: T-Mobile
Site Name: NY10152A
Site ID: NY10152A
Site Address: 50 Evan Rd, Warwick, Orange County, NY 10990
Latitude 41° 18' 5.69", Longitude -74° 17' 38.89"
Site Type: 104 ft Water Tank

Tectonic Project Number: 11072.NY10152A

Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C. is pleased to submit this **"Tank Comparative Analysis Report"** to determine the structural integrity of the above-mentioned water tank telecommunication site.

The purpose of the analysis is to determine the acceptability of the stress level of the existing water tank. Based on our analysis we have determined the stress levels to be as follows:

Water Tank:

Sufficient

This analysis has been performed in accordance with the 2020 New York State Uniform Code (2018 IBC) based upon a 3-second gust wind speed of 90 mph as required for use per the AWWA D100-11 "Welded Carbon Steel Tanks for Water Storage". Exposure Category C and an Importance Factor of 1.15 were used in this analysis.

We appreciate the opportunity of providing our continuing professional services to you and T-Mobile. If you have any questions or need further assistance on this or any other projects, please give us a call.

Structural analysis prepared by/reviewed by: John-Fritz Julien / Ian Marinaccio

Respectfully submitted by:

Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C.,



Edward N. Iamiceli, P.E.
Managing Director - Structural



Project Contact Info

1279 Route 300 | Newburgh, NY 12550
845.567.6656 Tel | 845.567.8703 Fax

tectonicengineering.com
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Tank Comparative Analysis

1) INTRODUCTION/PURPOSE

Comparative analysis of the existing water tank and its supporting structure due to the loading of the proposed antennas, equipment and related appurtenances.

2) ANALYSIS CRITERIA

AWWA Revision:	D100-11 (ASCE 7-05)
Risk Category:	III
Importance Factor:	1.15
Wind Speed:	90 mph
Exposure Category:	C
Topographic Factor:	1.0

Table 1 – Proposed Equipment Loading Information

Mounting Level (ft)	Carrier Designation	Quantity	Equipment Manufacturer	Equipment Model	Number of Feed Lines	Feed Line Size (in)	Note
88.83	T-Mobile	4	RFS	APXVAALL24_43-U-NA20	4	6x24 HCS	1
		4	CommScope	VV-65A-R1			
		4	Ericsson	RRUS 4480			
		4	Ericsson	RRUS 4460			

Note:

- 1) Proposed equipment to be installed on new proposed pipe mounts.

3) ANALYSIS PROCEDURE

Table 2 - Documents Provided

Document	Prepared By	Dated
Water Tank Design Drawings	CBI	08/25/88
Field Notes	Tectonic	12/16/21
Lease Exhibit	Tectonic	01/14/22
RFDS	T-Mobile	01/14/22
Mount Analysis Report	Tectonic	04/01/22

3.1) Analysis Method

A tool internally developed, using Microsoft Excel, was used to calculate loading on all equipment, appurtenances and members for various load cases. Selected input from the analysis is included in Appendix A.

3.2) Assumptions

- 1) All tank structural elements were properly fabricated, installed, and maintained in good condition in accordance with its original design, standards, and/or manufacturer's specifications.
- 2) The configuration of equipment and other appurtenances are as specified in Table 1.

This analysis may be affected if any assumptions are not valid or have been made in error. Tectonic should be notified to determine the effect on the structural integrity of the tank.

4) ANALYSIS RESULTS

Based on our analysis, the percentage increase in the lateral force and the moment at the base exceeded 5%. As such, the existing anchors were analyzed to check its adequacy to resist the uplift.

Table 3 - Adequacy

Notes	Component	% Capacity	Pass / Fail
1	Anchor Bolts	19	Pass

Note:

- 1) See additional documentation in Appendix A for analysis output calculations supporting the % capacity utilized.

4.1) Results/Conclusions

The existing water tank anchors have sufficient capacity to support the proposed T-Mobile load configurations. Therefore, we believe that the water tank structure and supporting foundation are adequate. No modification is required at this time.

Contractor shall field verify existing conditions and recommendations as noted on the construction drawings and notify the design engineer of any discrepancies prior to construction. Any further changes to the antenna and/or appurtenance configuration should be reviewed with respect to their effect on structural loads prior to implementation.

APPENDIX A
TANK COMPARATIVE ANALYSIS

AWWA STANDARD - Existing Appurtenances Loads

Wind Velocity, V:	90	[per AWWA]	Exposure Category:	C	(AWWA Sec 3.1.4.2)
Force Coefficient, Cf (Flat Surface):	1		Gust Effect Factor, G:	1.00	(AWWA Sec 3.1.4)
Force Coefficient, Cf (Cylindrical Surface):	0.6		Importance Factor, I:	1.15	(AWWA Sec 3.1.4)
Force Coefficient, Cf (Double Curved):	0.5				

Antenna Loads

Antennas	Quantity	Length or Diameter (in)	Width (in)	Depth (in)	Shape	Weight (ea, lb)	Total Weight (total, lb)	Elevation (ft)	Kz (Per Table 3)	qz (psf)	Wind Pressure (psf)	Projected Area (ea, ft ²)	Net Wind Load (ea, lb)	Total Wind Load (total, lb)	Moment (kip-ft)
Proposed T-Mobile															
(P) APXVAALL24_43-U-NA20	4	95.88	24.00	8.50	F	149.90	600	88.83	1,230	29.33	29.33	15.98	469	1256	112
(P) VV-65A-R1	4	60.12	15.91	10.95	F	41.89	168	88.83	1,230	29.33	29.33	6.64	195	522	46
(P) RRUS 4460	4	19.60	15.70	12.10	F	109.00	436	88.83	1,230	29.33	29.33	2.14	63	168	15
(P) RRUS 4480	4	21.80	15.70	7.50	F	84.00	336	88.83	1,230	29.33	29.33	2.38	70	187	17
+5% misc, brackets, & etc							77								
Existing Verizon Wireless															
QS8656-5	6	96.00	12.00	9.60	F	98.00	588	88.83	1,230	29.33	29.33	8.00	235	943	84
700/850 Dual Band RRH	3	21.40	12.00	7.20	F	51.00	153	88.83	1,230	29.33	29.33	1.78	52	105	9
AW5/PCS Dual Band RRH	3	31.50	12.00	8.70	F	70.00	210	88.83	1,230	29.33	29.33	2.63	77	155	14
Raycap 3315 OVP	3	19.18	15.73	10.25	F	32.00	96	88.83	1,230	29.33	29.33	2.10	61	123	11
+5% misc, brackets, & etc							52								
Proposed T-Mobile:															189
Totals:															307

Cable Loads

Cables	Quantity	Quantity in Wind	Cable Diameter (in)	Shape	Cable Length (ft)	CL Elevation (ft)	Projected Area (ft ²)	Weight (ea, lb/ft)	Kz (Per Table 3)	qz (psf)	Wind Pressure (psf)	Total Weight (ea, lbs)	Wind Load (total, lbs)	Moment (kip-ft)
(P) 6x24 Hybrid	4	0	1.98	C	89	44.42	14.66	2.65	1.090	25.99	15.60	941.60	0.00	0
(P) Cable Tray	1	1	28	F	92	46.00	214.67	5.00	1.090	25.99	29.89	460.00	6416.70	295
(E) Cable Tray	1	1	28	F	92	46.00	214.67	5.00	1.090	25.99	29.89	460.00	6416.70	295
(E) Verizon - 1-1/4" Hybniflex	3	0	1.54	C	89	44.415	11.40	1.51	1.090	25.99	15.60	402.40	0.00	0
Proposed T-Mobile: 1402														
Assumed	Totals:													295
														590

Assumed
Provided

AWWA STANDARD - Existing Appurtenances Mount Loads

Wind Velocity, V: 90															Exposure Category: C (AWWA Sec 3.1.4.2)														
Force Coefficient, Cf (Flat Surface): 1															Gust Effect Factor, G: 1.00 (AWWA Sec 3.1.4)														
Force Coefficient, Cf (Cylindrical Surface): 0.6															Importance Factor, I: 1.15 (AWWA Sec 3.1.4)														
Force Coefficient, Cf (Double Curved): 0.5																													
Proposed T-Mobile Mount																													
Mount Elements					Quantity	Length or Diameter (in)	Width (in)	Depth (in)	Shape	Weight (ea, lb)	Total Weight (total, lb)	Elevation (ft)	Kz Per Table 3	qz (psf)	Wind Pressure (psf)	Projected Area (ea, ft^2)	Net Wind Load (ea, lb)	Total Wind Load (total, lb)	Moment (kip-ft)										
(P) Pipe Mounts					12	132.00	2.88	2.88	C	63.72	765	88.83	1.230	29.33	17.60	2.64	46	373	33										
(P) Face Brace					16	48.00	2.38	2.38	C	15.41	247	88.83	1.230	29.33	17.60	0.79	14	149	13										
(P) Standoff Horizontals					24	6.00	3.00	3.00	F	4.41	106	88.83	1.230	29.33	29.33	0.13	4	59	5										
Misc (Add 10%)											112							58	5										
Existing Verizon Mount																													
(E) Antenna Mount Pipe					12	96.00	2.88	2.88	C	46.34	556	88.83	1.230	29.33	17.60	1.92	34	271	24										
Misc (Add 10%)											56							27	2										
Proposed T-Mobile Loads :															Proposed T-Mobile Loads :														
Total Loads :															Total Loads :														
1229															639														
1840															937														
57															83														

Weight of the Tank

Element	Shape	Height (ft)	Width (ft)	Surface Area (ft^2)	Thickness (in)	Volume (ft^3)	Density (lbs/ft^3)	Empty Wt (lbs)
Dome	Hemisphere	8	42	1741.5	0.250	36.28	490.00	17778.15
	Cylinder	8.46	42	1116.0	0.188	17.44	490.00	8544.73
Shaft	Cylinder	8.46	42	1116.0	0.188	17.44	490.00	8544.73
	Cylinder	8.46	42	1116.0	0.188	17.44	490.00	8544.73
	Cylinder	8.45	42	1114.7	0.206	19.14	490.00	9376.27
	Cylinder	8.40	42	1107.8	0.209	19.29	490.00	9454.15
	Cylinder	8.40	42	1107.8	0.248	22.89	490.00	11218.32
	Cylinder	8.40	42	1107.8	0.288	26.59	490.00	13027.72
	Cylinder	8.40	42	1107.8	0.327	30.19	490.00	14791.90
	Cylinder	8.40	42	1107.8	0.366	33.79	490.00	16556.07
	Cylinder	8.40	42	1107.8	0.405	37.39	490.00	18320.24
	Cylinder	8.40	42	1107.8	0.445	41.08	490.00	20129.64
Total:							156286.6 lbs	
							156.3 kips	
Add 10% for Misc:							15.6 kips	
Total:							171.9 kips	

Notes:

1. Tank is assumed to be empty for this analysis (worse case loading when combined with wind).
2. Tank shaft thickness is based on the Original Tank Drawings by CBI, dated August of 1988.

AWWA STANDARD

Tank Loads

Wind Velocity, V:	90	mph	Exposure Category:	C	(AWWA Sec 3.1.4.2)
Force Coefficient, Cf (Flat Surface) :	1		Gust Effect Factor, G:	1	(AWWA Sec 3.1.4)
Force Coefficient, Cf (Cylindrical Surface):	0.6		Importance Factor, I:	1.15	(AWWA Sec 3.1.4)
Force Coefficient, Cf (Double Curved):	0.5				

Tank Loads

Tank Elements	Length or Diameter (ft)	Width (ft)	Depth (ft)	Shape	Area (ft ²)	C/L Elevation (ft)	Velocity Exposure Coeff, Kz	qz (psf)	Wind Pressure (psf)	Net Wind Load (total, lb)	Moment (kip-ft)
Tank Dome	8.00	42.00	42.00	DC	1446.64	96.59	1.26	29.99	15.00	21694	2096
Tank Shaft	92.59	42.00	42.00	C	3888.92	46.30	1.09	25.99	15.60	60650	2808
10% Misc.										2169	210
										84514	5113

Components	Total Load
Estimated Lateral Load	17230 lbs
Estimated Base Moment	981 k-ft
Therefore,	
% Increase in the lateral Force on the Tank	20%
% Increase in the Moment of the Tank	19%

Total Moment:	6094	K-ft
Total Shear:	102	Kips
Total Weight:	179	Kips

Weight assumes tank empty condition.

Since the increase in lateral force and moment at the base of the tank is greater than 5%, check the capacity of the existing anchors.

ANCHOR BOLT GROUP ANALYSIS			
No grout used under base plate. No prying action included.			
Anchor Bolt Circle Dia:	42.63 ft	Applied Moment:	6094 k-ft
Quantity of Anchor Bolts:	44	Applied Shear:	102 k
Anchor Bolt Diameter:	2.00 in	Applied Vertical Load:	179 k
Allow Stress Incr Factor:	1.33	Note: For conservative approach, the anchors are analyzed for empty tank condition.	
Per ANSI/AWWA D100-11			
Maximum Tension per Bolt		Max Tension = $4(M/Nd)-(W/N)$ (Eq.3-41)	
8.9 kips			
Allowable Tension per Bolt		ASTM A36 Anchors ¹ Allowable Tension = 15000 psi * 1.33 * Minimum Root Area	
45.9 kips			
Percentage Stress(%)	19%		
Based on our analysis, the existing anchor bolts have adequate capacity to support the proposed T-Mobile load configurations and appurtenances loads currently installed to the tank under 'Empty Tank' condition.			
Note ¹ : Based on confirmation from the tank manufacturer, the existing anchor rods are ASTM A36. Per AWWA D100-11 - Table 5, the allowable unit stress is 15000 psi.			

Search Information

Coordinates: 41.30158, -74.294135
Elevation: 721 ft
Timestamp: 2022-04-01T21:49:20.049Z
Hazard Type: Wind



ASCE 7-16

MRI 10-Year	74 mph
MRI 25-Year	82 mph
MRI 50-Year	87 mph
MRI 100-Year	93 mph
Risk Category I	103 mph
Risk Category II	111 mph
Risk Category III	120 mph
Risk Category IV	125 mph

ASCE 7-10

MRI 10-Year	76 mph
MRI 25-Year	84 mph
MRI 50-Year	90 mph
MRI 100-Year	96 mph
Risk Category I	105 mph
Risk Category II	115 mph
Risk Category III-IV	120 mph

ASCE 7-05

ASCE 7-05 Wind Speed 90 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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