STRUCTURAL ANALYSIS REPORT

For

CT2139

BROOKLYN H2O

50 Tiffany Street
Brooklyn, CT 06234

Antennas Mounted on Water Tank Lid

Prepared for:

smartlink at&t

Dated: February 4, 2022

Prepared by:

HUDSON Design Group LLC

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STATE OF CONNECTICUT
DANIEL HAMM
24178
LICENSED
PROFESSIONAL ENGINEER

HUDSON Design Group LLC

SCOPE OF WORK:

Hudson Design Group LLC (HDG) has been authorized by AT&T to conduct a structural evaluation of the structure supporting the proposed AT&T equipment located in the areas depicted in the latest HDG construction drawings.

This report represents this office's findings, conclusions and recommendations pertaining to the support of AT&T's proposed equipment.

This office's subconsultant, Provertic LLC, conducted a mount mapping of the above area on November 9, 2021.

The following documents were used for our reference:

- Previous HDG Structural Analysis Report dated April 7, 2009.
- Mount Mapping Report prepared by Provertic LLC, dated November 18, 2021.

CONCLUSION SUMMARY:

Based on our evaluation, we have determined that the existing structure **IS CAPABLE** of supporting the proposed equipment loading.

	Controlling Load Case	Stress Ratio	Pass/Fail
Water Tank Lid	Bending	46%	**PASS**

Based on our evaluation, we have determined that the proposed antenna mounts **ARE CAPABLE** of supporting the proposed equipment loading.

	Member	Controlling Load Case	Stress Ratio	Pass/Fail
Antenna Mount	1	LC1	85%	**PASS**

Previous HDG Structural Analysis Reports recommended that rust removal be performed on the existing tank as well as new paint to maintain its structural integrity. HDG recommends that a third party conduct a conditions assessment on the existing water tank prior to the installation of any appurtenances. The existing water tank exhibits a significant amount of surface rust and peeled paint. HDG recommends periodic inspections of the existing tower in accordance with the ANSI/TIA-G section 14.0 and Annex J. A localized lid bending check was performed at the location of the proposed installations.

*Reference documents attached.

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APPURTENANCE CONFIGURATION (BASED ON RFDS DATED 1/12/2022):

Appurtenances	Dimensions	Weight	**Elevation	Mount
(3) 7770 Antennas	55.0"x11.0"x5.0"	35 lbs	131'	Tripod Ballast
(6) LGP21401 TMA's	14.4"x9.0"x2.7"	19 lbs	-	Tripod Ballast
(3) TPA65R-BU8DA Antennas	96.0"x20.7"x7.7"	88 lbs	131'	Tripod Ballast
(3) DMP65R-BU8DA Antennas	96.0"x20.7"x7.7"	119 lbs	131'	Tripod Ballast
(3) B14 4478 RRH's	18.1"x13.4"x8.3"	60 lbs	-	Tripod Ballast
(3) B2/B66A 8843 RRH's	14.9"x13.2"x10.9"	72 lbs	-	Tripod Ballast
(3) B5/B12 4449 RRH's	17.9"x13.2"x9.4"	73 lbs	-	Tripod Ballast
(3) 4415 B30 RRH's	16.5"x13.4"x5.9"	46 lbs	-	Tripod Ballast
(3) DC6-48-60-18 Surge Arrestors	31.4"x10.2"Ø	29 lbs	**-**	Tripod Ballast

** Proposed equipment shown in bold.*
*** Elevation to antenna centerline.*

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DESIGN CRITERIA:

International Building Code (IBC) 2015 with 2018 Connecticut State Building Code Amendments, and ASCE 7-10 (Minimum Design Loads for Buildings and Other Structures).		
Wind		
Reference Wind Speed:	140 mph	(2018 CSBC Appendix N)
Exposure Category:	B	(ASCE 7-10 Chapter 26)
Risk Category:	IV	(ASCE 7-10 Table 1.5-1)
Snow		
Ground Snow, P_g:	35	(2018 CSBC Appendix N)
Importance Factor (I_s):	1.2	(ASCE 7-10 Table 1.5-2)
Exposure Factor (C_e):	0.9	(Fully Exposed, Table 7-2)
Thermal Factor (C_t):	1.0	(ASCE 7-10 Table 7-3)
Flat Roof Snow Load:	26 psf	(ASCE 7-10 Equation 7.3-1)
Min. Flat Roof Snow Load:	30 psf	
EIA/TIA-222-H Structural Standards for Steel Antenna Towers and Antenna Supporting Structures		
Wind		
City/Town:	Brooklyn	
County:	Windham	
Wind Load:	140 mph	(TIA-222-H Figure B-2)
Ice		
Design Ice Thickness (t_i):	1.0 in	(TIA-222-H Figure B-9)
Structure Class:	IV	(TIA-222-H Table 2-1)
Importance Factor (I_I):	1.25	(TIA-222-H Table 2-3)
Factored Thickness of Radial Ice (t_{iz}):	1.43 in	(TIA-222-H Sec. 2.6.10)

ANTENNA/RRH/SURGE ARRESTOR SUPPORT RECOMMENDATIONS:

The new antennas and RRH's are proposed to be mounted on proposed pipe masts installed on existing tripod ballast frames welded to the existing water tank lid.

Limitations and assumptions:

1. Reference the latest HDG construction drawings for all the equipment locations and details.
2. All structural members and their connections are assumed to be in good condition and are free from defects with no deterioration to its member capacities.
3. All antennas, coax cables and waveguide cables are assumed to be properly installed and supported as per the manufacturer requirements.
4. HDG is not responsible for any modifications completed prior to and hereafter which HDG was not directly involved.
5. If field conditions differ from what is assumed in this report, then the engineer of record is to be notified as soon as possible.
6. A condition assessment on the existing water tank was not part of the scope of work.

FIELD PHOTOS:

Photo 1: Sample photo illustrating the existing antennas and RRH's.

Photo 2: Sample photo illustrating the existing antennas and RRH's.

FIELD PHOTOS (CONT'D.):

Photo 3: Sample photo illustrating the existing antenna mount.

Photo 4: Sample photo illustrating the existing welded connection.

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Wind and Ice
Calculations

Date: 2/2/2022
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Project No.: CT2139
Designed By: LBW **Checked By:** MSC

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2.6.5.2 Velocity Pressure Coeff:

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

z=	131	(ft)
z_g=	1200	(ft)
α=	7.0	

K_z= 1.067

Kzmin ≤ Kz ≤ 2.01

Table 2-4

Exposure	Z_g	α	K_{zmin}	K_c
B	1200 ft	7.0	0.70	0.9
C	900 ft	9.5	0.85	1.0
D	700 ft	11.5	1.03	1.1

2.6.6.2 Topographic Factor:

Table 2-5

Topo. Category	K_t	f
2	0.43	1.25
3	0.53	2.0
4	0.72	1.5

$K_{zt} = [1+(K_c\ K_t/K_h)]^2$

$K_h = e^{(f*z/H)}$

K_{zt}= 1

(If Category 1 then K_{zt} =1.0)

Category=	1	

K_h=	1	
K_c=	0.9	(from Table 2-4)
K_t=	0	(from Table 2-5)
f=	0	(from Table 2-5)
z=	131	
z_s=	177	(Mean elevation of base of structure above sea level)
H=	0	(Ht. of the crest above surrounding terrain)
K_{zt}=	1.00	(from 2.6.6.2.1)
K_e=	0.99	(from 2.6.8)

2.6.10 Design Ice Thickness

Max Ice Thickness =	t_i =	1.00	in
Importance Factor =	I=	1.25	(from Table 2-3)
	K_{iz} =	1.15	(from Sec. 2.6.10)

$t_{iz} = t_i * I * K_{iz} * (K_{zt})^{0.35}$

t_{iz} = 1.43 in

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2.6.9 Gust Effect Factor

2.6.9.1 Self Supporting Lattice Structures

G_h = 1.0 Latticed Structures > 600 ft

G_h = 0.85 Latticed Structures 450 ft or less

G_h = 0.85 + 0.15 [h/150 - 3.0] h= ht. of structure

h=	130	G_h=	0.85

2.6.9.2 Guyed Masts G_h= 0.85

2.6.9.3 Pole Structures G_h= 1.1

2.6.9 Appurtenances G_h= 1.0

2.6.9.4 Structures Supported on Other Structures
(Cantilivered tubular or latticed spines, pole, structures on buildings (ht. : width ratio > 5)

G_h=	1.35	**Gh=**	**1.00**

2.6.11.2 Design Wind Force on Appurtenances

F= q_z*G_h*$(EPA)_A$

q_z= 0.00256*K_z*K_{zt}*K_s*K_e*K_d*V_{max}^2

		K_z=	1.067	(from 2.6.5.2)
		K_{zt}=	1.0	(from 2.6.6.2.1)
		K_s=	1.0	(from 2.6.7)
q_z=	**50.56**	K_e=	0.99	(from 2.6.8)
$q_{z\ (ice)}$=	**6.45**	K_d=	0.95	(from Table 2-2)
$q_{z\ (30)}$=	**2.32**	V_{max}=	140	mph (Ultimate Wind Speed)
		$V_{max\ (ice)}$=	50	mph
		V_{30}=	30	mph

Table 2-2

Structure Type	Wind Direction Probability Factor, Kd
Latticed structures with triangular, square or rectangular cross sections	0.85
Tubular pole structures, latticed structures with other cross sections, appurtenances	0.95
Tubular pole structures supporting antennas enclosed within a cylindrical shroud	1.00

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Determine Ca:

Table 2-9

Force Coefficients (Ca) for Appurtenances				
Member Type		**Aspect Ratio ≤ 2.5**	**Aspect Ratio = 7**	**Aspect Ratio ≥ 25**
		Ca	**Ca**	**Ca**
Flat		1.2	1.4	2.0
Square/Rectangular HSS		$1.2 - 2.8(r_s) \geq 0.85$	$1.4 - 4.0(r_s) \geq 0.90$	$2.0 - 6.0(r_s) \geq 1.25$
Round	**C < 39** (Subcritical)	0.7	0.8	1.2
	39 ≤ C ≤ 78 (Transitional)	$4.14/(C^{0.485})$	$3.66/(C^{0.415})$	$46.8/(C^{-1.0})$
	C > 78 (Supercritical)	0.5	0.6	0.6

Aspect Ratio is the overall length/width ratio in the plane normal to the wind direction.
(Aspect ratio is independent of the spacing between support points of a linear appurtenance,

Note: Linear interpolation may be used for aspect ratios other than those shown.

Ice Thickness = **1.43** in | **Angle = 0 (deg)** | **Equivalent Angle = 180 (deg)**

Appurtenances	Height	Width	Depth	Flat Area	Aspect Ratio	Ca	Force (lbs)	Force (lbs) (w/ Ice)	Force (lbs) (30 mph)
7770 Antenna	55.0	11.0	5.0	4.20	5.00	1.31	**279**	**47**	**13**
TPA65R-BU8DA Antenna	96.0	20.7	7.7	13.80	4.64	1.30	**904**	**135**	**41**
TPA65R-BU8DA Antenna (Side)	96.0	7.7	20.7	5.13	12.47	1.58	**411**	**74**	**19**
DMP65R-BU8DA Antenna	96.0	20.7	7.7	13.80	4.64	1.30	**904**	**135**	**41**
DMP65R-BU8DA Antenna (Side)	96.0	7.7	20.7	5.13	12.47	1.58	**411**	**74**	**19**
B14 4478 RRH	18.1	13.4	8.3	1.68	1.35	1.20	**102**	**18**	**5**
B14 4478 RRH (Side)	18.1	8.3	13.4	1.04	2.18	1.20	**63**	**13**	**3**
B14 4478 RRH (Shielded)	18.1	4.2	13.4	0.52	4.36	1.28	**34**	**8**	**2**
B2/B66A 8843 RRH	14.9	13.2	10.9	1.37	1.13	1.20	**83**	**15**	**4**
B2/B66A 8843 RRH (Side)	14.9	10.9	13.2	1.13	1.37	1.20	**68**	**13**	**3**
B2/B66A 8843 RRH (Shielded)	14.9	5.5	13.2	0.56	2.73	1.21	**35**	**8**	**2**
B5/B12 4449 RRH	17.9	13.2	9.4	1.64	1.36	1.20	**100**	**18**	**5**
B5/B12 4449 RRH (Side)	17.9	9.4	13.2	1.17	1.90	1.20	**71**	**14**	**3**
B5/B12 4449 RRH (Shielded)	17.9	4.7	13.2	0.58	3.81	1.26	**37**	**9**	**2**
4415 B30 RRH	16.5	13.4	5.9	1.54	1.23	1.20	**93**	**17**	**4**
4415 B30 RRH (Side)	16.5	5.9	13.4	0.68	2.80	1.21	**41**	**9**	**2**
4415 B30 RRH (Shielded)	16.5	3.0	13.4	0.34	5.59	1.34	**23**	**7**	**1**
LGP21401 TMA	14.4	2.7	9.0	0.27	5.33	1.33	**18**	**6**	**1**
Surge Arrestor	24.0	9.7	9.7	1.62	2.47	0.70	**57**	**11**	**3**
2" Pipe	2.4	12.0		0.20	0.20	1.20	**12**		
2-1/2x2-1/2 Angle	2.5	12.0		0.21	0.21	2.00	**21**		

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ICE WEIGHT CALCULATIONS

Thickness of ice:	1.43	in.
Density of ice:	56	pcf

7770 Antenna

Weight of ice based on total radial SF area:		
Height (in):	55.0	
Width (in):	11.0	
Depth (in):	5.0	
Total weight of ice on object:	108	lbs
Weight of object:	35.0	lbs
Combined weight of ice and object:	143	lbs

TPA65R-BU8DA Antenna

Weight of ice based on total radial SF area:		
Height (in):	96.0	
Width (in):	20.7	
Depth (in):	7.7	
Total weight of ice on object:	329	lbs
Weight of object:	87.0	lbs
Combined weight of ice and object:	416	lbs

DMP65R-BU8DA Antenna

Weight of ice based on total radial SF area:		
Height (in):	96.0	
Width (in):	20.7	
Depth (in):	7.7	
Total weight of ice on object:	329	lbs
Weight of object:	96.0	lbs
Combined weight of ice and object:	425	lbs

B14 4478 RRH

Weight of ice based on total radial SF area:		
Height (in):	18.1	
Width (in):	13.4	
Depth (in):	8.3	
Total weight of ice on object:	45	lbs
Weight of object:	60.0	lbs
Combined weight of ice and object:	105	lbs

B2/B66A 8843 RRH

Weight of ice based on total radial SF area:		
Height (in):	14.9	
Width (in):	13.2	
Depth (in):	10.9	
Total weight of ice on object:	40	lbs
Weight of object:	72.0	lbs
Combined weight of ice and object:	112	lbs

B5/B12 4449 RRH

Weight of ice based on total radial SF area:		
Height (in):	17.9	
Width (in):	13.2	
Depth (in):	9.4	
Total weight of ice on object:	46	lbs
Weight of object:	73.0	lbs
Combined weight of ice and object:	119	lbs

4415 B30 RRH

Weight of ice based on total radial SF area:		
Height (in):	16.5	
Width (in):	13.4	
Depth (in):	5.9	
Total weight of ice on object:	39	lbs
Weight of object:	46.0	lbs
Combined weight of ice and object:	85	lbs

LGP21401 TMA

Weight of ice based on total radial SF area:		
Height (in):	14.4	
Width (in):	2.7	
Depth (in):	9.0	
Total weight of ice on object:	23	lbs
Weight of object:	19.0	lbs
Combined weight of ice and object:	42	lbs

Squid Surge Arrestor

Weight of ice based on total radial SF area:		
Depth (in):	24.0	
Diameter(in):	9.7	
Total weight of ice on object:	39	lbs
Weight of object:	33	lbs
Combined weight of ice and object:	72	lbs

2" pipe

Per foot weight of ice:		
diameter (in):	2.38	
Per foot weight of ice on object:	7	plf

L 2-1/2x2-1/2 Angles

Weight of ice based on total radial SF area:		
Height (in):	2.5	
Width (in):	2.5	
Per foot weight of ice on object:	9	plf

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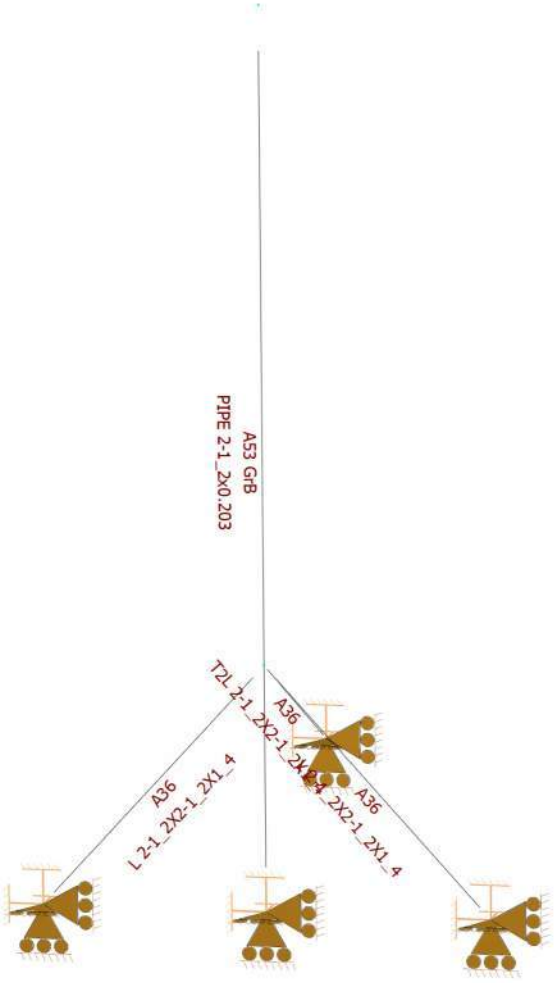
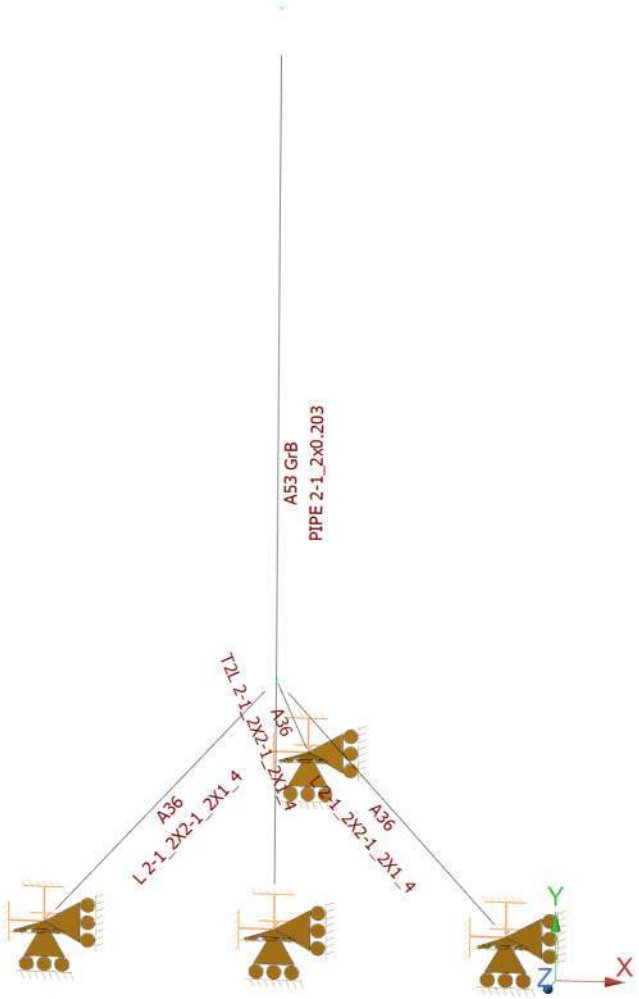
Antenna Mount
Calculations

Y
X
Z


A53 GrB
PIPE 2-1_2x0.203
T2L 2-1_2X2-1_2X1_4
A36
L 2-1_2X2-1_2X1_4
A36
A36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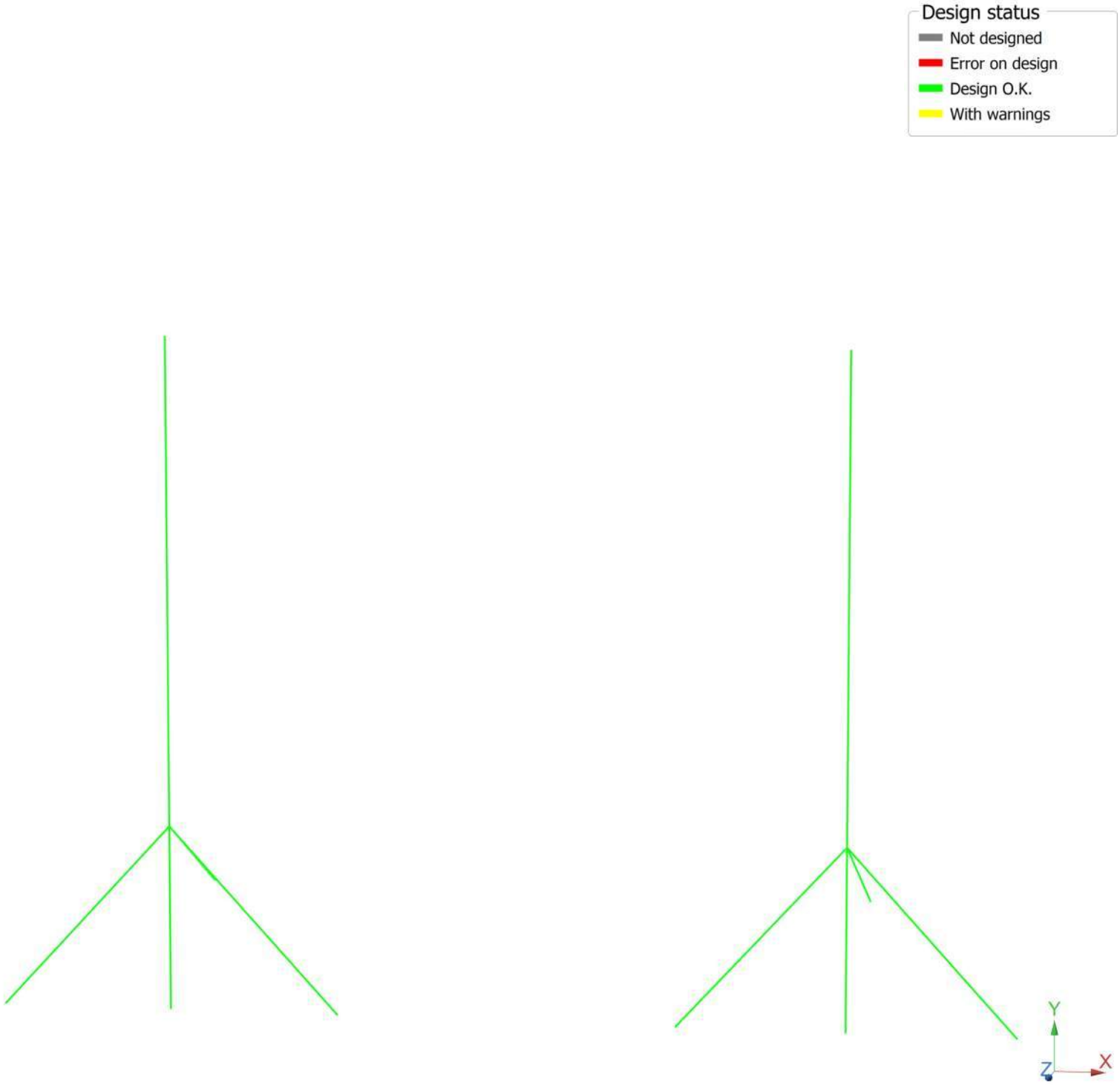
A36
Y
Z
X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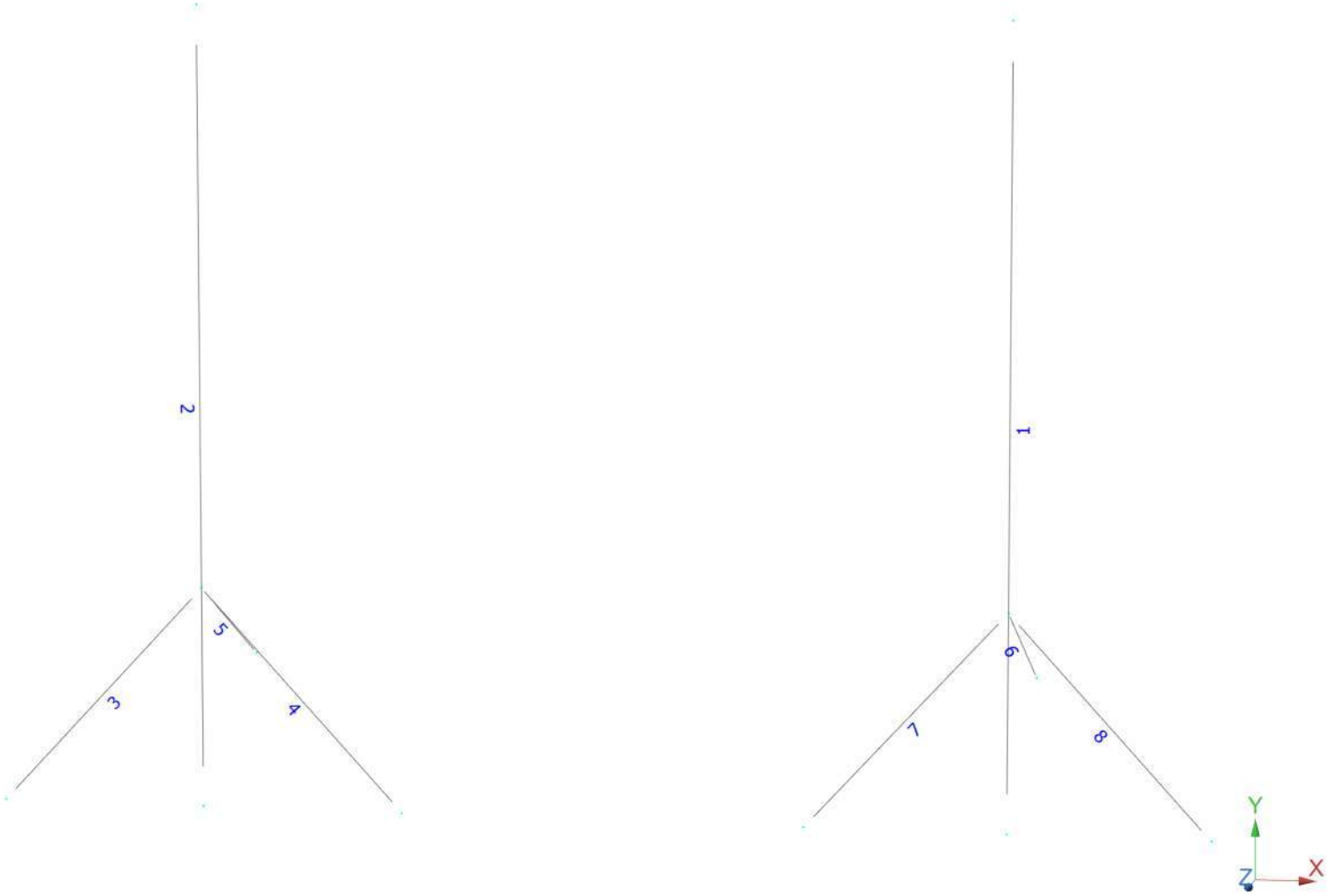
Not designed
Error on design
Design O.K.
With warnings
Y
X
Z


1
6
7
8
Y
Z
X
2
5
3
4

Current Date: 2/2/2022 12:35 PM
Units system: English

Load data

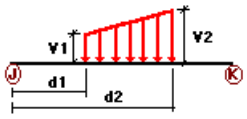
GLOSSARY

Comb : Indicates if load condition is a load combination

Load Conditions

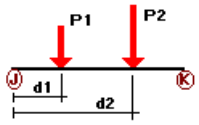
Condition	Description	Comb.	Category
DL	Dead Load	No	DL
Wf	Wind Load (FRONT)	No	WIND
Ws	Wind Load (SIDE)	No	WIND
Wfice	Wind ICE (FRONT)	No	WIND
Wsice	Wind ICE (SIDE)	No	WIND
Di	Ice Load	No	LL

Distributed force on members



Condition	Member	Dir1	Val1 [Kip/ft]	Val2 [Kip/ft]	Dist1 [ft]	%	Dist2 [ft]	%
Wf	3	z	-0.021	0.00	0.00	No	0.00	No
	4	z	-0.021	0.00	0.00	No	0.00	No
	5	z	-0.021	0.00	0.00	No	0.00	No
	6	z	-0.021	0.00	0.00	No	0.00	No
	7	z	-0.021	0.00	0.00	No	0.00	No
	8	z	-0.021	0.00	0.00	No	0.00	No
Ws	1	x	-0.012	0.00	0.00	No	0.00	No
	2	x	-0.012	0.00	0.00	No	0.00	No
	3	x	-0.021	0.00	0.00	No	0.00	No
	4	x	-0.021	0.00	0.00	No	0.00	No
	5	x	-0.021	0.00	0.00	No	0.00	No
	6	x	-0.021	0.00	0.00	No	0.00	No
	7	x	-0.021	0.00	0.00	No	0.00	No
	8	x	-0.021	0.00	0.00	No	0.00	No
Di	1	y	-0.007	0.00	0.00	No	0.00	No
	2	y	-0.007	0.00	0.00	No	0.00	No
	3	y	-0.009	0.00	0.00	No	0.00	No
	4	y	-0.009	0.00	0.00	No	0.00	No
	5	y	-0.009	0.00	0.00	No	0.00	No
	6	y	-0.009	0.00	0.00	No	0.00	No
	7	y	-0.009	0.00	0.00	No	0.00	No
	8	y	-0.009	0.00	0.00	No	0.00	No

Concentrated forces on members



Condition	Member	Dir1	Value1 [Kip]	Dist1 [ft]	%
DL	1	y	-0.044	1.00	No
		y	-0.044	8.00	No
		y	-0.06	4.50	No
		y	-0.072	4.50	No
	2	y	-0.048	1.00	No
		y	-0.048	8.00	No
		y	-0.073	4.50	No
		y	-0.046	4.50	No
Wf	1	z	-0.452	1.00	No
		z	-0.452	8.00	No
		z	-0.034	4.50	No
		z	-0.035	4.50	No
	2	z	-0.452	1.00	No
		z	-0.452	8.00	No
		z	-0.037	4.50	No
		z	-0.023	4.50	No
Ws	1	x	-0.206	1.50	No
		x	-0.206	8.50	No
		x	-0.102	4.50	No
	2	x	-0.206	1.50	No
		x	-0.206	8.50	No
		x	-0.10	4.50	No
Wfice	1	z	-0.068	1.50	No
		z	-0.068	8.50	No
		z	-0.008	4.50	No
		z	-0.008	4.50	No
	2	z	-0.068	1.50	No
		z	-0.068	8.50	No
		z	-0.009	4.50	No
		z	-0.007	4.50	No
Wsice	1	x	-0.038	1.50	No
		x	-0.038	8.50	No
		x	-0.018	4.50	No
	2	x	-0.038	1.50	No
		x	-0.038	8.50	No
		x	-0.018	4.50	No
Di	1	y	-0.164	1.00	No
		y	-0.164	8.00	No
		y	-0.045	4.50	No
		y	-0.04	4.50	No
	2	y	-0.164	1.00	No
		y	-0.164	8.00	No
		y	-0.046	4.50	No
		y	-0.039	4.50	No

Self weight multipliers for load conditions

Condition	Description	Self weight multiplier			
		Comb.	MultX	MultY	MultZ
DL	Dead Load	No	0.00	-1.00	0.00
Wf	Wind Load (FRONT)	No	0.00	0.00	0.00
Ws	Wind Load (SIDE)	No	0.00	0.00	0.00
Wfice	Wind ICE (FRONT)	No	0.00	0.00	0.00
Wsice	Wind ICE (SIDE)	No	0.00	0.00	0.00
Di	Ice Load	No	0.00	0.00	0.00

Earthquake (Dynamic analysis only)

Condition	a/g	Ang. [Deg]	Damp. [%]
DL	0.00	0.00	0.00
Wf	0.00	0.00	0.00
Ws	0.00	0.00	0.00
Wfice	0.00	0.00	0.00
Wsice	0.00	0.00	0.00
Di	0.00	0.00	0.00

Current Date: 2/2/2022 12:35 PM
Units system: English

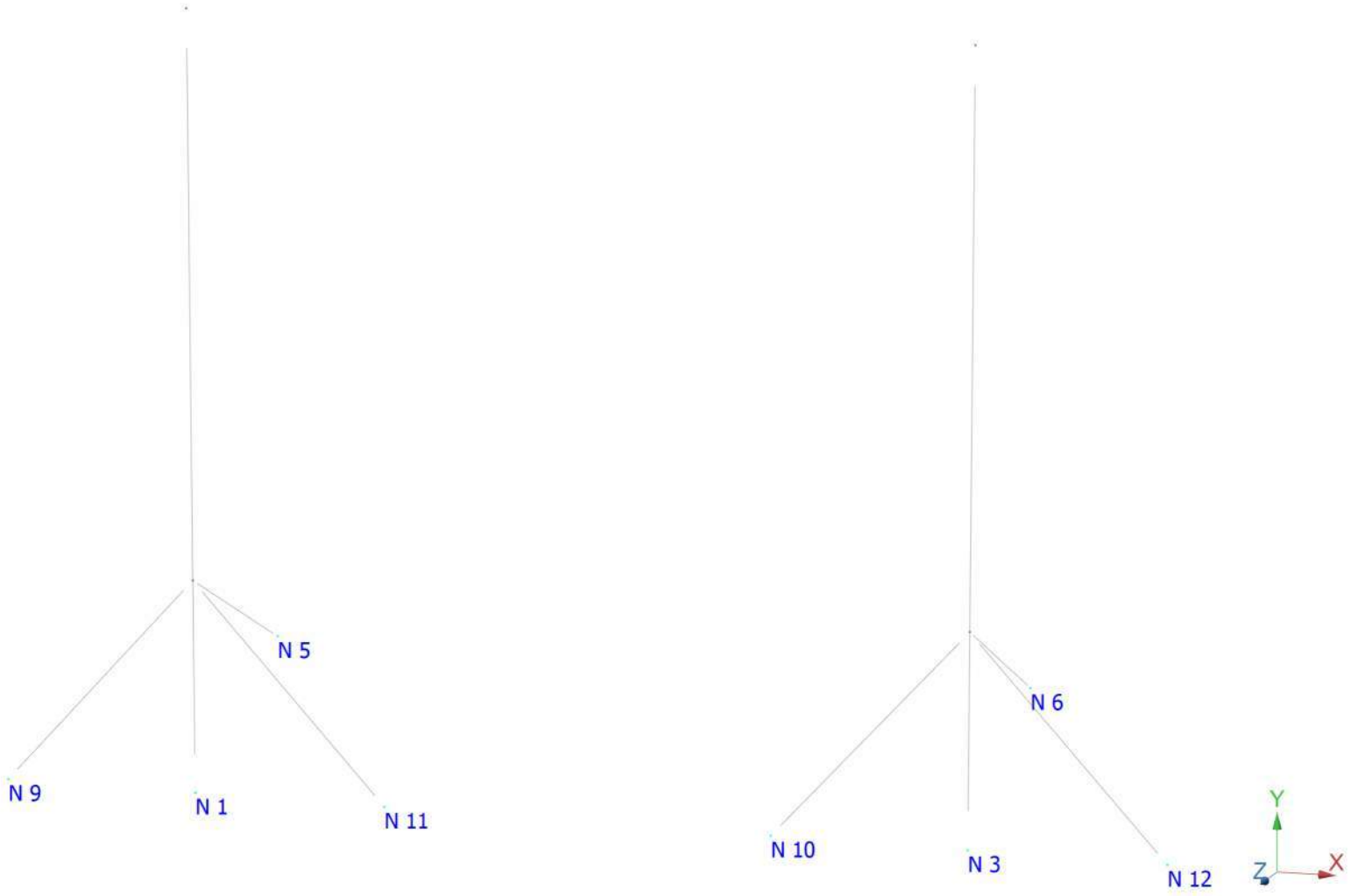
Steel Code Check

Report: Summary - Group by member

Load conditions to be included in design :

LC1=1.2DL+Wf
LC2=1.2DL+Ws
LC3=0.9DL+Wf
LC4=0.9DL+Ws
LC5=1.2DL+Wfice+Di
LC6=1.2DL+Wsice+Di
LC7=1.4DL
LC8=0.9DL

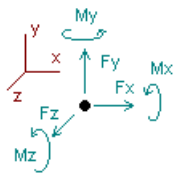
Description	Section	Member	Ctrl Eq.	Ratio	Status	Reference
	L 2-1_2X2-1_2X1_4	**3**	LC1 at 100.00%	0.38	OK	
		4	LC1 at 0.00%	0.38	OK	
		7	LC1 at 100.00%	**0.38**	**OK**	
		8	LC1 at 0.00%	0.38	OK	
	PIPE 2-1_2x0.203	**1**	LC1 at 71.88%	**0.85**	**OK**	
		2	LC1 at 71.88%	0.84	OK	
	T2L 2-1_2X2-1_2X1_4	**5**	LC1 at 0.00%	0.38	OK	
		6	LC1 at 0.00%	**0.39**	**OK**	


N 5
N 9
N 1
N 11
N 6
N 10
N 3
N 12
Y
Z
X

Current Date: 2/2/2022 12:36 PM
Units system: English

Analysis result

Reactions



Direction of positive forces and moments

Node	Forces [Kip] FX	FY	FZ	Moments [Kip*ft] MX	MY	MZ
Condition **LC1=1.2DL+Wf**						
5	0.00000	1.16373	1.75798	0.00000	0.00000	0.00000
1	0.00000	-0.35276	-0.42717	-0.38671	0.00000	0.00000
9	-0.10998	-0.22033	-0.08961	0.00136	0.00150	0.00000
11	0.10998	-0.22033	-0.08961	0.00136	-0.00150	0.00000
3	0.00000	-0.35523	-0.43184	-0.39088	0.00000	0.00000
10	-0.11000	-0.22133	-0.09070	0.00138	0.00151	0.00000
12	0.11000	-0.22133	-0.09070	0.00138	-0.00151	0.00000
6	0.00000	1.17419	1.77383	0.00000	0.00000	0.00000
SUM	0.00000	0.74660	2.31219	-0.77211	0.00000	0.00000
Condition **LC2=1.2DL+Ws**						
5	0.06606	0.01722	0.00386	0.00000	-0.00243	-0.00540
1	-0.35514	0.18261	-0.00305	-0.00297	-0.08811	0.33849
9	0.62908	0.84537	0.03647	-0.00069	-0.00076	0.00000
11	0.48420	-0.67490	-0.03728	0.00071	-0.00078	0.00000
3	-0.35679	0.18502	-0.00306	-0.00298	-0.08842	0.33996
10	0.63248	0.84973	0.03661	-0.00069	-0.00076	0.00000
12	0.48433	-0.67567	-0.03741	0.00071	-0.00078	0.00000
6	0.06617	0.01722	0.00386	0.00000	-0.00244	-0.00542
SUM	1.65039	0.74660	0.00000	-0.00593	-0.18449	0.66763
Condition **LC3=0.9DL+Wf**						
5	0.00000	1.15629	1.75361	0.00000	0.00000	0.00000
1	0.00000	-0.39694	-0.42414	-0.38391	0.00000	0.00000
9	-0.12758	-0.24081	-0.08894	0.00136	0.00149	0.00000
11	0.12758	-0.24081	-0.08894	0.00136	-0.00149	0.00000
3	0.00000	-0.39998	-0.42877	-0.38802	0.00000	0.00000
10	-0.12801	-0.24224	-0.09002	0.00137	0.00150	0.00000
12	0.12801	-0.24224	-0.09002	0.00137	-0.00150	0.00000
6	0.00000	1.16668	1.76940	0.00000	0.00000	0.00000
SUM	0.00000	0.55995	2.31219	-0.76648	0.00000	0.00000
Condition **LC4=0.9DL+Ws**						
5	0.06593	0.01294	0.00287	0.00000	-0.00242	-0.00538
1	-0.35315	0.13704	-0.00234	-0.00227	-0.08774	0.33667
9	0.61018	0.82227	0.03644	-0.00069	-0.00076	0.00000
11	0.50124	-0.69452	-0.03697	0.00070	-0.00077	0.00000
3	-0.35476	0.13885	-0.00234	-0.00228	-0.08804	0.33811
10	0.61315	0.82614	0.03657	-0.00069	-0.00076	0.00000
12	0.50177	-0.69570	-0.03710	0.00070	-0.00077	0.00000
6	0.06603	0.01294	0.00287	0.00000	-0.00243	-0.00539
SUM	1.65039	0.55995	0.00000	-0.00453	-0.18370	0.66401

Condition **LC5=1.2DL+Wfice+Di**

5	0.00000	0.19317	0.24320	0.00000	0.00000	0.00000
1	0.00000	0.36043	-0.05323	-0.05319	0.00000	0.00000
9	0.13992	0.15233	-0.01899	0.00022	0.00024	0.00000
11	-0.13992	0.15233	-0.01899	0.00022	-0.00024	0.00000
3	0.00000	0.36283	-0.05325	-0.05322	0.00000	0.00000
10	0.14155	0.15412	-0.01899	0.00022	0.00024	0.00000
12	-0.14155	0.15412	-0.01899	0.00022	-0.00024	0.00000
6	0.00000	0.19320	0.24323	0.00000	0.00000	0.00000
SUM	0.00000	1.72254	0.30400	-0.10554	0.00000	0.00000

Condition **LC6=1.2DL+Wsice+Di**

5	0.00478	0.03163	0.00733	0.00000	-0.00038	-0.00085
1	-0.05627	0.43526	-0.00536	-0.00534	-0.01354	0.05302
9	0.23746	0.30291	0.00503	-0.00010	-0.00011	0.00000
11	-0.09197	0.08847	-0.00700	0.00012	-0.00013	0.00000
3	-0.05629	0.43767	-0.00536	-0.00535	-0.01354	0.05303
10	0.23909	0.30472	0.00503	-0.00010	-0.00011	0.00000
12	-0.09359	0.09024	-0.00700	0.00012	-0.00013	0.00000
6	0.00478	0.03163	0.00733	0.00000	-0.00038	-0.00085
SUM	0.18800	1.72254	0.00000	-0.01065	-0.02831	0.10436

Condition **LC7=1.4DL**

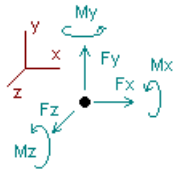
5	0.00000	0.01998	0.00462	0.00000	0.00000	0.00000
1	0.00000	0.21266	-0.00333	-0.00326	0.00000	0.00000
9	0.08387	0.09969	-0.00064	0.00001	0.00001	0.00000
11	-0.08387	0.09969	-0.00064	0.00001	-0.00001	0.00000
3	0.00000	0.21547	-0.00334	-0.00327	0.00000	0.00000
10	0.08577	0.10178	-0.00064	0.00001	0.00001	0.00000
12	-0.08577	0.10178	-0.00064	0.00001	-0.00001	0.00000
6	0.00000	0.01999	0.00463	0.00000	0.00000	0.00000
SUM	0.00000	0.87103	0.00000	-0.00651	0.00000	0.00000

Condition **LC8=0.9DL**

5	0.00000	0.01285	0.00297	0.00000	0.00000	0.00000
1	0.00000	0.13671	-0.00214	-0.00210	0.00000	0.00000
9	0.05392	0.06409	-0.00041	0.00000	0.00001	0.00000
11	-0.05392	0.06409	-0.00041	0.00000	-0.00001	0.00000
3	0.00000	0.13852	-0.00215	-0.00210	0.00000	0.00000
10	0.05514	0.06543	-0.00041	0.00000	0.00001	0.00000
12	-0.05514	0.06543	-0.00041	0.00000	-0.00001	0.00000
6	0.00000	0.01285	0.00297	0.00000	0.00000	0.00000
SUM	0.00000	0.55995	0.00000	-0.00418	0.00000	0.00000

Envelope for nodal reactions

Note.- **Ic** is the controlling load condition



Direction of positive forces and moments

Envelope of nodal reactions for :

LC1=1.2DL+Wf
LC2=1.2DL+Ws
LC3=0.9DL+Wf
LC4=0.9DL+Ws
LC5=1.2DL+Wfice+Di
LC6=1.2DL+Wsice+Di
LC7=1.4DL
LC8=0.9DL

		Forces						Moments					
Node		**Fx** [Kip]	**lc**	**Fy** [Kip]	**lc**	**Fz** [Kip]	**lc**	**Mx** [Kip*ft]	**lc**	**My** [Kip*ft]	**lc**	**Mz** [Kip*ft]	**lc**
5	Max	0.066	LC2	1.164	LC1	1.758	LC1	0.00000	LC1	0.00000	LC1	0.00000	LC1
	Min	0.000	LC1	0.013	LC8	0.003	LC4	0.00000	LC1	-0.00243	LC2	-0.00540	LC2
1	Max	0.000	LC1	0.435	LC6	-0.002	LC8	-0.00210	LC8	0.00000	LC1	0.33849	LC2
	Min	-0.355	LC2	-0.397	LC3	-0.427	LC1	-0.38671	LC1	-0.08811	LC2	0.00000	LC1
9	Max	0.629	LC2	0.845	LC2	0.036	LC2	0.00136	LC1	0.00150	LC1	0.00000	LC1
	Min	-0.128	LC3	-0.241	LC3	-0.090	LC1	-0.00069	LC2	-0.00076	LC2	0.00000	LC1
11	Max	0.501	LC4	0.152	LC5	0.000	LC8	0.00136	LC1	-0.00001	LC8	0.00000	LC1
	Min	-0.140	LC5	-0.695	LC4	-0.090	LC1	0.00000	LC8	-0.00150	LC1	0.00000	LC1
3	Max	0.000	LC1	0.438	LC6	-0.002	LC8	-0.00210	LC8	0.00000	LC1	0.33996	LC2
	Min	-0.357	LC2	-0.400	LC3	-0.432	LC1	-0.39088	LC1	-0.08842	LC2	0.00000	LC1
10	Max	0.632	LC2	0.850	LC2	0.037	LC2	0.00138	LC1	0.00151	LC1	0.00000	LC1
	Min	-0.128	LC3	-0.242	LC3	-0.091	LC1	-0.00069	LC2	-0.00076	LC2	0.00000	LC1
12	Max	0.502	LC4	0.154	LC5	0.000	LC8	0.00138	LC1	-0.00001	LC8	0.00000	LC1
	Min	-0.142	LC5	-0.696	LC4	-0.091	LC1	0.00000	LC8	-0.00151	LC1	0.00000	LC1
6	Max	0.066	LC2	1.174	LC1	1.774	LC1	0.00000	LC1	0.00000	LC1	0.00000	LC1
	Min	0.000	LC1	0.013	LC8	0.003	LC4	0.00000	LC1	-0.00244	LC2	-0.00542	LC2

HUDSON
Design Group LLC

Water Tank Lid
Calculations

Date: 2/2/2022
Project Name: BROOKLYN H2O
Project No.: CT2139
Designed By: LBW **Checked By:** MSC

HUDSON Design Group LLC

CHECK BENDING ON THE WATER TANK:

*Water tank plans were not available. ProVertic conducted an on-site survey and mapping of the existing AT&T antenna mounts on November 9, 2021.

Lid Thickness, t_l	0.280667	in.	
Assumed Effective Width, b	12	in.	
Span, L	12	in.	
Horizontal Reaction, P	1174	lbs.	(See Bentley Output)

M_u = PL/4

= **3522.00 lb-in**

S = $(b \times t_l 2)/6$

= 0.158 in^3

Z = $(b \times t_l 2)/4$

= 0.236 in^3

ϕMn_Z = 0.9 x 36000 psi x Z

= **7656.81 lb-in**

ϕMn_S = 36000 psi x 1.6 x S

= **8167.27 lb-in**

ϕMn_Z > M_{max}

7656.81	**lb-in**	**>**	**3522.00**	**lb-in**	**OK !**

Conclusion

The water tank lid is capable of supporting the proposed loads.