STRUCTURAL ANALYSIS

OF

30.4m 12-SIDED MONOPOLE

AT MT. DOUGLAS

WesTower Job#: 10-18696

FOR:

DISTRICT OF SAANICH

CARRIER INFORMATION

OWNER: District of Saanich	Mt. Douglas
2nd CARRIER: BC Hydro	MTD Mt. Douglas
3rd CARRIER: Rogers	W0199 Mt. Douglas
4th Carrier: Telus	BC0207 M. Douglas

Location: Mt. Douglas, BC

(Date of Picture: 2021-10-28)

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FOR:

DISTRICT OF SAANICH

Attention:

Janet Racz
Land Agent
Building, Bylaw, Licensing and Legal Service Department
District of Saanich
770 Vernon Ave.
Victoria BC
V8X 2W7

Prepared by:

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February 11, 2022

Contents

1.0 Introduction:

We have completed the structural analysis of the existing 30.4m 12-sided monopole located at Mt. Douglas, BC. The tower was originally designed by Nova Pole International Inc. for LeBlanc & Royle Telecom Inc. in 1990. The purpose of the analysis was to determine the structural adequacy of the existing tower for a revised antenna load. The analysis was based on requirements and information provided by the District of Saanich and by WesTower. We are pleased to submit our report for your attention.

ANTENNA LOADING

ID No.	Technology or Frequency/Band	Equipment Type (Model Number)	Qty	Elevation [1]		Azimuth (°)	TX - Line	Qty	Status	Antenna Owner
				(m)	(ft)		Type/Size			
1	-	210C4	1	31.9	104.8	275	LDF6	1	EXISTING	-
2	-	210C2	1	25.9	85.1	250	LDF6	1	EXISTING	-
3	-	OMNI ANTENNA (Ø100 x L2700)	1	25.9	85.1	OMNI	-	-	EXISTING	-
4	-	OMNI ANTENNA (Ø100 x L2700)	1	25.9	85.1	OMNI	LDF5	1	EXISTING	-
5	-	OMNI ANTENNA (Ø64 x L2500)	1	25.6	84.1	OMNI	LDF5	1	EXISTING	-
6	-	310C4 EQUIVALENT	1	25.2	82.6	265	LDF6	1	EXISTING	-
7	-	840 10511 XPOL	1	25.0	81.9	OMNI	LDF4	2	EXISTING	-
8	-	TMA (L230 x W130 x D100)	1	24.4	80.0	-	LDF4	2	EXISTING	-
9	-	TX LINES	-	23.9	78.5	-	LDF6	1	EXISTING	-
10	-	TX LINES	-	23.9	78.5	-	LDF5	4	EXISTING	-
11	-	GPS	1	21.4	70.1	OMNI	Ø10.0mm	1	EXISTING	-
12	-	RVVPX305 10RXM	3	19.6	64.3	85, 155, 300	-	-	EXISTING	-

13	-	Diplexer	2	19.3	63.4	-	LDF5-50	2	EXISTING	-
14	-	Diplexer	2	18.9	62.0	-	LDF5-50	2	EXISTING	-
15	-	Diplexer	2	18.7	61.4	-	LDF5-50	2	EXISTING	-
16	-	PANEL ANTENNA (L1300 x W270 x D145)	3	17.9	58.6	10, 155, 280	LDF5-50	6	EXISTING	-
17	-	80010764v01	3	15.0	49.1	0, 140, 280	LDF4-50	12	EXISTING	-
18	-	VHLP2-15-CR4B	1	12.2	40.0	0	-	-	EXISTING	-
19	-	RAU	1	12.2	40.0	-	Ø10.0mm	1	EXISTING	-
20	-	TA-2408	1	11.4	37.4	150	LDF4-50	1	EXISTING	-
21	-	PANEL ANTENNA (L1120 x W310 x D140)	2	10.0	32.9	215, 345	LDF4-50	4	EXISTING	-
22	-	GPS	2	8.3	27.1	OMNI	Ø10.0mm	2	EXISTING	-
23	-	GPS	2	8.2	26.7	OMNI	Ø10.0mm	2	EXISTING	-
24	-	RSPP 2933	1	8.1	26.6	OMNI	Ø11.0mm	1	EXISTING	-
25	-	GPS	1	7.8	25.4	OMNI	Ø10.0mm	1	EXISTING	-
26	-	GPS	1	7.7	25.1	OMNI	Ø10.0mm	1	EXISTING	-
27	-	RAU	2	7.6	24.9	-	LDF2-50	2	EXISTING	-
28	-	MT375002/BD	1	7.5	24.6	300	-	-	EXISTING	-
29	-	GPS	2	7.5	24.6	OMNI	Ø10.0mm	2	EXISTING	-
30	-	VHLP2	1	7.4	24.1	205	-	-	EXISTING	-
31	-	GPS	1	7.4	24.1	OMNI	Ø10.0mm	1	EXISTING	-

32	-	WIN5137-5-AC	1	7.2	23.5	-	Ø6.0mm	2	EXISTING	-
33	-	PANEL ANTENNA (L300 x W160 x D75)	1	7.2	23.5	340	LDF4-50	1	EXISTING	-
34	-	2' Dish	1	6.9	22.7	210	Ø10.0mm	1	EXISTING	-
35	-	VHLP2-15-CR4B	1	6.9	22.6	175	-	-	EXISTING	-
36	-	RAU	1	6.9	22.6	-	Ø10.0mm	1	EXISTING	-
37	-	RAU	2	6.9	22.6	-	LDF2-50	2	EXISTING	-
38	-	GPS	1	6.7	22.0	OMNI	Ø10.0mm	1	EXISTING	-
39	-	GPS	1	6.6	21.5	OMNI	Ø10.0mm	1	EXISTING	-
40	-	GPS	1	6.4	20.8	OMNI	Ø10.0mm	1	EXISTING	-
41	-	2' Dish	1	6.2	20.2	185	-	-	EXISTING	-
42	-	RAU	2	6.2	20.2	-	LDF2-50	2	EXISTING	-
43	-	VHLP2-15-CR4B	1	6.2	20.2	155	-	-	EXISTING	-
44	-	RAU	1	6.2	20.2	-	Ø10.0mm	1	EXISTING	-
45	-	RRU (L640 x W270 x D150)	1	6.1	19.9	-	Ø11.0mm FB, Ø12.0mm DC, LDF4-50	2, 2, 2	EXISTING	-
46	-	VHLP2-23-HR1	1	6.0	19.5	210	-	-	EXISTING	-
47	-	RAU	2	6.0	19.5	-	LDF2-50	2	EXISTING	-
48	-	GPS	1	5.9	19.2	OMNI	Ø10.0mm	1	EXISTING	-
49	-	TA-2304	1	5.8	19.1	135	Ø10.0mm	1	EXISTING	-

50	-	GPS	1	5.7	18.5	OMNI	Ø10.0mm	1	EXISTING	-
51	-	VHLP2-15-CR4B	1	5.3	17.2	275	Ø10.0mm	1	EXISTING	-

(1) Elevations are physical centers of appurtenances
(2) Azimuths are assumed if not provided in the RF or Real Estate documents
(3) Symbols (,#,$) denote lines shared by particular antennas*
(4) Jumper size & length if known

2.0 Terms of Reference:

The following documents and drawings were referenced/examined:

Tower Profile:	Nova Pole International Inc. Drawing # 2-110-627 Rev. B dated April 27, 1990
Tower Foundations:	Fraser Engineering Ltd. Drawing # 203-1 dated March 26, 1992
Soil Report:	Ryzuk Geotechnical Report, File # 8-112-4, Dated November 15, 2017
Damping Report:	WesTower FDM # 10-18696, Sealed January 11, 2021
Antenna Inventory:	WesTower TAC # 10-18696, Dated January 11, 2021
Client documents:	District of Saanich "Request for Quote No Q 27/21"

3.0 Design Parameters:

1)	Standard:	CSA-S37-18
2)	Wind (ULS – 1/50yr):	Qh = 1030 Pa @ 10.0m (ECCC DATED: July 6, 2017)
3)	Wind (SLS – 1/10yr):	Qh = 796 Pa @ 10.0m (ECCC DATED: July 6, 2017)
4)	Radial Ice Thickness:	10 mm Glaze (CSA S37-18)
5)	Importance Factor:	1.0
6)	Serviceability Factor:	1.0
7)	Gust Factor:	2.0
8)	Load Combination Factor	0.5 (Modify only as instructed in Source document
9)	Damping Ratio	0.0052 (WesTower FDM # 10-18696)
10)	Seismic Performance Level	Seismicity is high Sa(0.2) > 0.35g @ 1.283

4.0 Assumptions:

1) This existing tower is assumed, for the purpose of this analysis, to have been properly maintained in accordance with the CSA-S37-18 Standard and/or its original manufacturer and to be in good condition with no structural defects and with no deterioration to its member capacities ('as-new' condition).
2) All prior structural modifications are assumed to be as per the data supplied/available, and to have been properly installed and to be fully effective.
3) The antenna configuration is as supplied and/or as stated in the analysis section. It is assumed to be complete and accurate. All antennas, mounts, coax and waveguides are assumed to be properly installed and supported as per manufacturer requirements.
4) Some assumptions were made regarding antenna and mount sizes; their projected areas are based on the best interpretation of supplied data and industry knowledge.
5) The existing as per references and changes to transmission line loading are as shown in the TX arrangement drawing in Appendix A.

If any of these assumptions are not met, the results of this study may not be valid. In this case, contact the engineer to review the results.

4.1 Tower Loading:

Appendix A shows the tower profile, along with the transmission lines and ancillary loading considered in this analysis.

5.0 Analysis Results:

The existing structure was analyzed using 'TSTOWER' software version 6.0.1 developed by TowerSoft Inc. Graphical results are presented in Appendix B. Complete computer output is on file at WesTower Communications Ltd. Typically, forces in members exceeding their rated capacities by 5% or more are considered inadequate.

5.1 Strength Results:

SHELL SECTIONS:

Elevation (m)		ULTIMATE Rated Capacity (%)	FATIGUE Rated Capacity (%)	ASSESSMENT
0.0	11.6	66	**179(2)**	**Un-Satisfactory**
11.6	23.0	53	11	Satisfactory
23.0	30.0	52(3)	13(4)	Satisfactory

(1) Monopole steel grade not confirmed. Assumed steel grade of 44W
(2) Monopole base flange stiffeners do not meet CSA S37-18 Annex N.3 Fatigue. (Detail category 5.1 considered instead of 6.2)
(3) Splice overlap length does not meet CSA S37-18 Standard.
(4) Splice overlap length does not meet CSA S37-18 Annex N.3 Fatigue. Half of the fatigue detail category B is considered (55 MPa vs 110MPa)

SPLICE ELEVATIONS:

Elevation (m)	ULTIMATE Rated Capacity (%)	FATIGUE Rated Capacity (%)	ASSESSMENT
0.0	89(1)	46(1)	Satisfactory
11.6	-(2)	-(2)	Satisfactory
23.0	-(2)	-(2)	Satisfactory

(1) Anchor rods are 2" ASI 4140
(2) Telescopic splice, refer to Shell Section table

PINWHEEL:

ELEVATION	TYPE (1)	Rated Capacity		ASSESSMENT
		Environmental (%)	Fall arrest (2) (Pass/Fail)	
23.9	4.9m BOOM	100	**FAIL**	Satisfactory
18.9	Ø1.0m PW	71	PASS	Satisfactory
6.1	Ø0.7m PW	40	PASS	Satisfactory

(1) The distance provided is c/c of antenna pipes for a particular sector
(2) The Pinwheel arm and connections were checked for a factored 12.0kN Fall arrest point load as per CSA Z259.16-15, and where Tees extend further than 1.2m from the main arm they are also checked.

FOUNDATIONS:

	Description	Rated Capacity (%)	ASSESSMENT
Global Foundation Loads	Moment	79	Satisfactory
	Shear		
	Vertical		

(1) Based on overturning capacity

5.2 Antenna Displacements:

In conformity with CSA-S37-18, an analysis using service loads was carried out in order to obtain the maximum deflection of the tower at antenna elevations. This analysis was performed using an un-factored wind pressure profile corresponding to a 10-year return period combined with a serviceability factor of 1.0.

Elevation		Dish Type	Azimuth (◦)	Owner	Status	Calculated Rotation [1] (◦)
(m)	(ft)					
12.2	40.0	VHLP2-15-CR4B	280	-	EXISTING	0.5
7.4	24.1	VHLP2	210	-	EXISTING	0.3
6.9	22.7	2' Dish	210	-	EXISTING	0.2
6.9	22.6	VHLP2-15-CR4B	195	-	EXISTING	0.2
6.2	20.2	2' Dish	195	-	EXISTING	0.2
6.2	20.2	VHLP2-15-CR4B	175	-	EXISTING	0.2
6.0	19.5	VHLP2-23-HR1	210	-	EXISTING	0.2
5.3	17.2	VHLP2-15-CR4B	290	-	EXISTING	0.2

(1) To be reviewed by RF Engineer of the respective carrier

6.0 Conclusions & Recommendations:

In accordance with Annex N of the CSA S37-18 Standard, based on the measured damping ratio of 0.005, the shell section from 0.0m to 11.6m is overstressed in fatigue by 79%.

The existing pinwheel at 23.9m is structurally inadequate for a specified fall arrest load of 12.0kN. A reinforcing scheme can be developed for fall arrest overstress if specifically requested. Alternatively, in lieu of reinforcing a Safe Work Procedure could be reviewed by a contractors Engineer to permit safe access.

The foundation for the existing 30.4m 12-sided monopole located at Mt. Douglas, BC, for the design parameters with the antenna loading and transmission lines outlined in this report does satisfy the requirements of the Standard CSA S37-18. However, the monopole is not compliant.

For the design and implementation of reinforcing and/or auxiliary dampener, damping ratios of 0.017 would be required to eliminate the fatigue overstresses. Alternatively, in lieu of adding an appurtenance near the top of the pole a consideration could be made to weld S37 compliant stiffener extensions around base.

Should any additional clarification be required, please do not hesitate to contact the undersigned.

WesTower Communications Ltd.

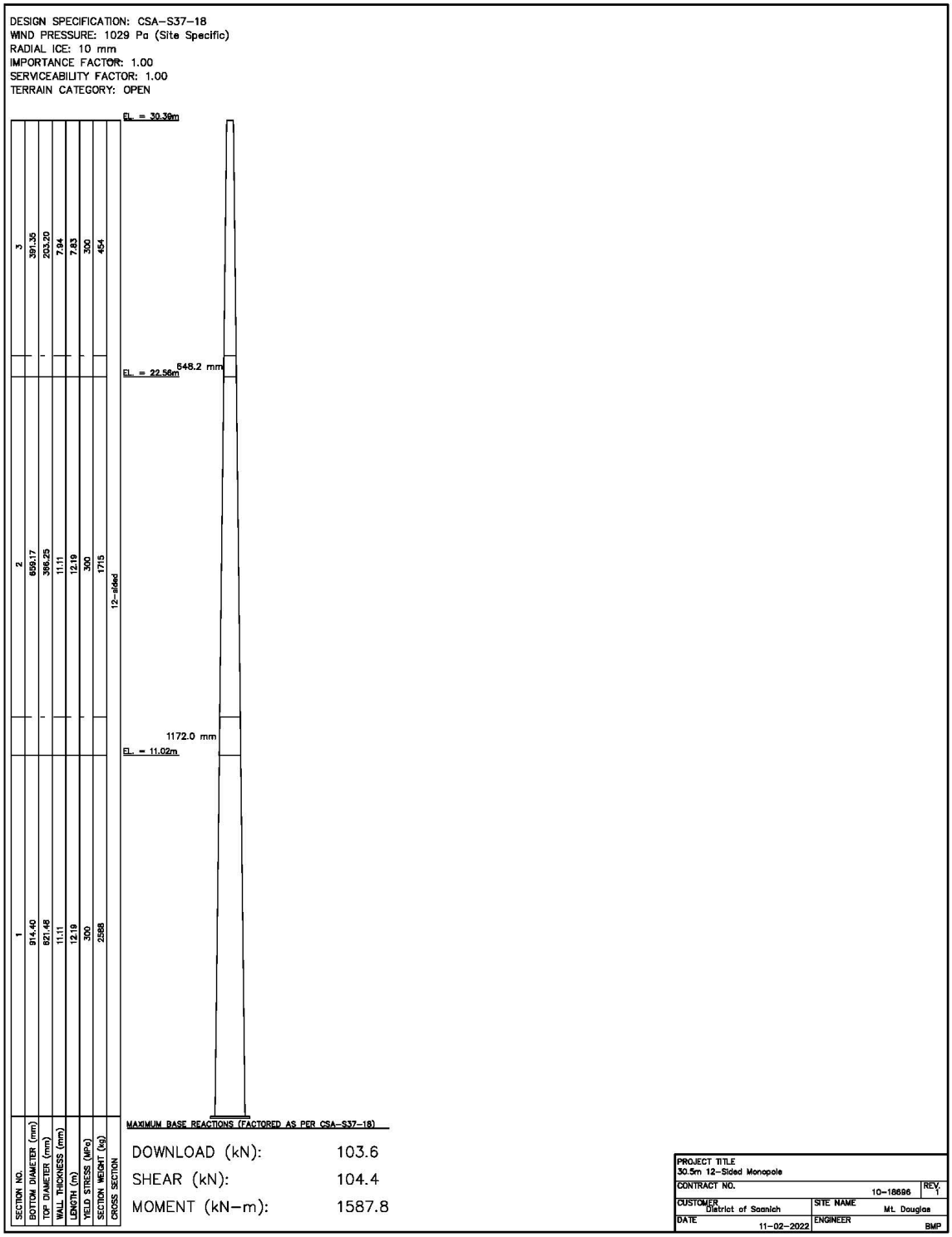
PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. B. BITTNER
39026
2022 Feb 11

Brayden Perry E.I.T
Engineer-In-Training

Blair Bittner, P.Eng.
Manager, Engineering

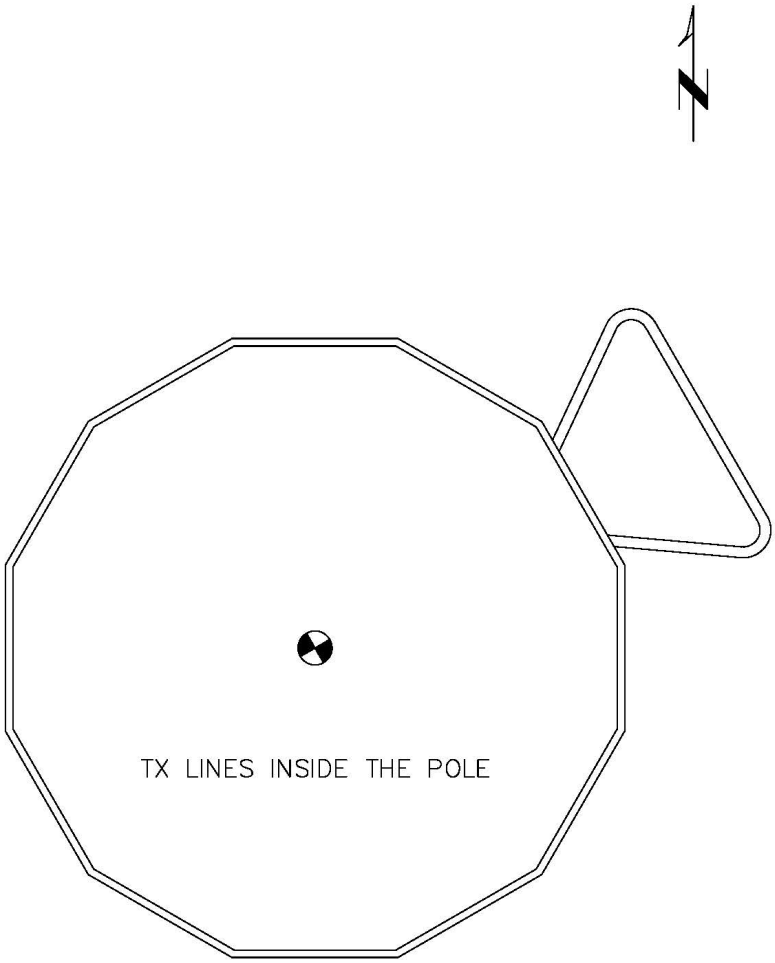
APPENDIX A - Tower Profile and Transmission Line Layout

Tower Profile(s)



Transmission Line Layout (not to scale)

(Based on noted references and assumptions)



ENGINEERING DRAFT N.T.S

J#10–18696
DISTRICT OF SAANICH
MT. DOUGLAS (–)

LINE LAYOUT

APPENDIX B - Graphical Results of Analysis

Monopole Bending Moment Diagram

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TSTower - v 6.0.0 Tower Analysis Program                    Licensed to: Westower
(c) 1997-2021 TowerSoft www.TSTower.com                     SK
-------------------------------------------------------------------------------
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Contract: 10-18696                                          Revision: 1
Project: 30.5m 12-Sided Monopole                            Site: Mt. Douglas
Date and Time: 2/11/2022 12:30:04 PM                        Engineer: BMP
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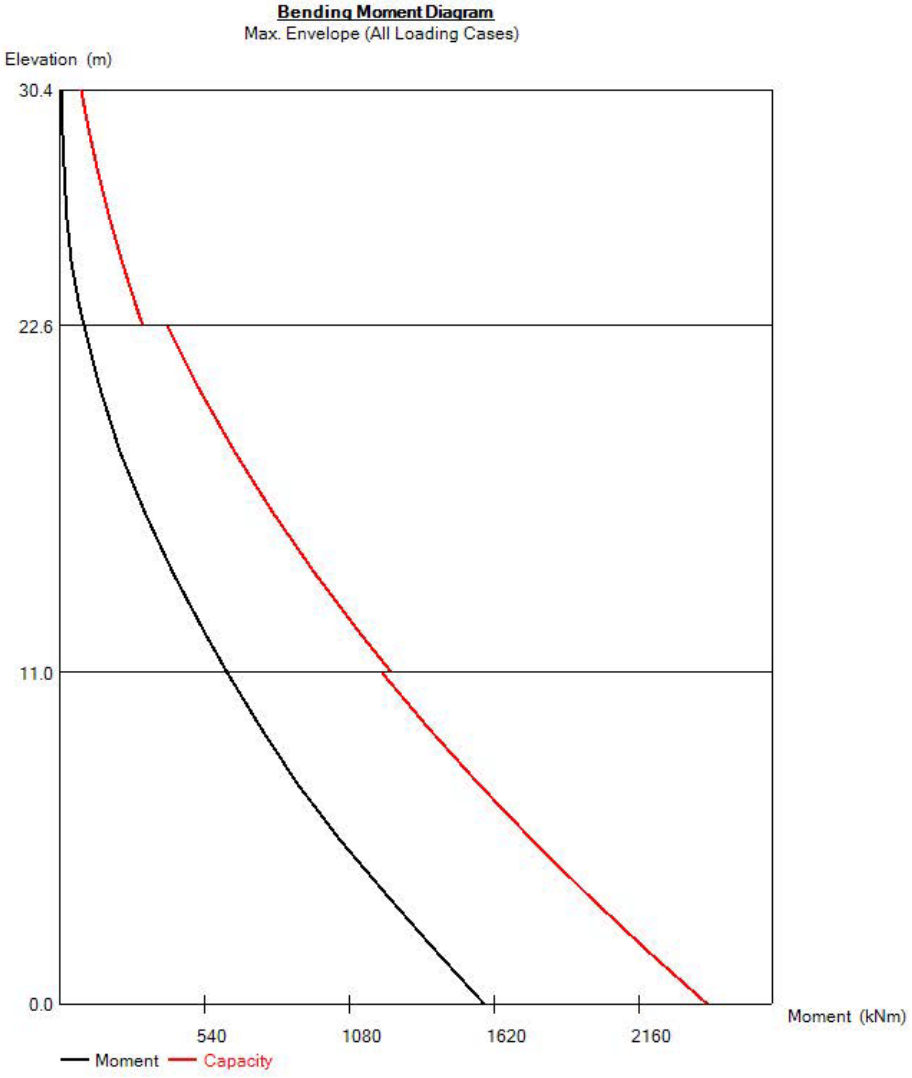

Appendix 3

Resultant Deflections

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TSTower - v 6.0.0 Tower Analysis Program                    Licensed to: Westower
(c) 1997-2021 TowerSoft www.TSTower.com                     SK

File: C:\Users\bmperry\OneDrive - WesTower Canada\Job Files\10SUR\10-18696 - MT DOUGLAS\MODELS\10-
Contract: 10-18696                                          Revision: 1
Project: 30.5m 12-Sided Monopole                            Site: Mt. Douglas
Date and Time: 2/11/2022 12:30:04 PM                        Engineer: BMP
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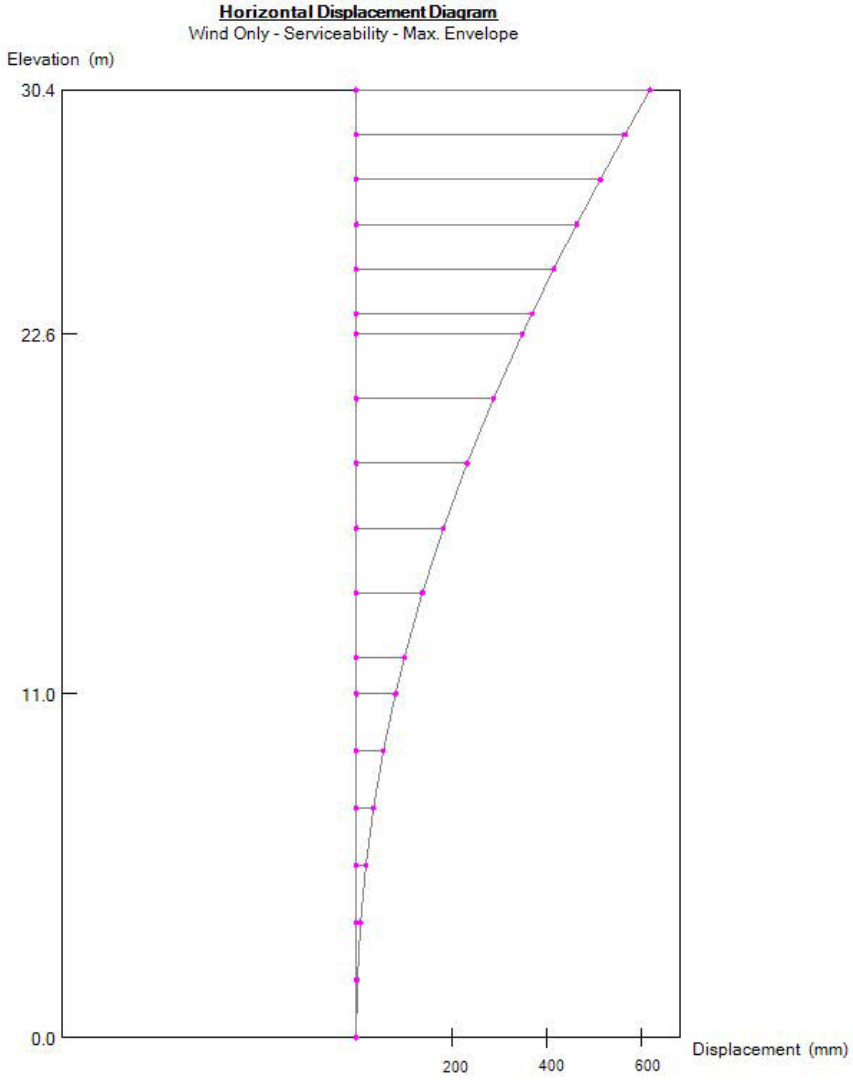

Appendix 2

Foundations

TSTower - v 6.0.0 Tower Analysis Program
(c) 1997-2021 TowerSoft www.TSTower.com

Licensed to: Westower
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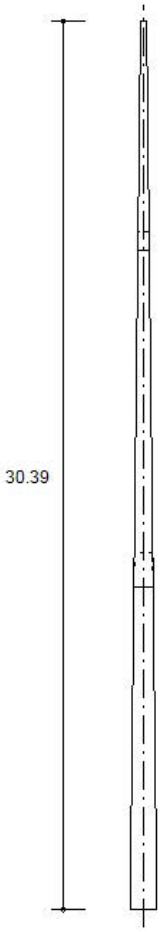
File: C:\Users\bmperry\OneDrive - WesTower Canada\Job Files\10SUR\10-18696 - MT DOUGLAS\MODELS\10-
Contract: 10-18696
Project: 30.5m 12-Sided Monopole
Date and Time: 2/11/2022 12:30:04 PM

Revision: 1
Site: Mt. Douglas
Engineer: BMP

DESIGN SPECIFICATION

Design Standard: CSA - S37 - 18
Wind pressure = 1029.00 (Pa) (Site Specific)
Ice thickness = 10.00 (mm)
Roughness of the surrounding terrain: Open Terrain

Sct.	Length (m)	Overlap (m)	Top Dia. (mm)	Bot Dia. (mm)	Thick. (mm)
3	7.83	0.00	203.2	391.4	7.940
2	12.19	0.65	366.3	659.2	11.113
1	12.19	1.17	621.5	914.4	11.113



MAXIMUM BASE REACTIONS

Download (kN)	103.6
Shear (kN)	104.4
Moment (kNm)	1587.8

Appendix 1

APPENDIX C - Environmental Data

Mount Douglas Summit, Saanich, BC 36m Tower

Site-Specific 10-yr. Wind Pressure Report (V2.1 2016-01-04 Format)

Site Information:

Name: Mount Douglas Summit, Saanich, BC
Latitude: 48° 29' 32.38" N
Longitude: 123° 20' 42.01" W
Tower Height (m): 36
Elevation MSL (m): 225

Results:

Note: Following direction from the S37 Committee, Qe can no longer be provided.

Q_{nbc} (Pa):	340	$Q_{nbc} = 340(Z/10)^{0.2}$	V_{nbc} = 51.3 mph
Icing:	As per CAN/CSA S37-13		
Q_{Min} (Pa)	250	$Q_{Min} = 250(Z/10)^{0.2}$	V_{Min} = 43.99 mph

Wind Pressure Formula (for z in metres and result in Pa):

For Z ≤ 33 metres: $Q_h = 0.12919\ \{[0.8000\ e^{(-0.0123\,z)} + 0.6173\ ln(z/0.0500) / ln(z/0.6000)]\ 41.97\}^2\ (z/10)^{0.296}$

For Z > 33 metres: $Q_h = 0.12919\ \{[1 + 0.8000\ e^{(-0.0123\,z)}]\ 41.97\}^2\ (z/10)^{0.296}$

Profile Formula General Form:

$$Q_h = 0.12919\ \{[a_1\ e^{(-a2\,z)} + a_3\ ln(z/z_h) / ln(z/z_{01})]\ v_{01}\}^2\ (z/10)^{0.296}$$

Site Values of Coefficients:

For Z ≤ 33 metres: $a_1 = 0.8000,\ a_2 = 0.0123,\ a_3 = 0.6173,\ z_h = 0.0500,\ z_{01} = 0.6000,\ v_{01} = 41.97$ mph

For Z > 33 metres: $a_1 = 0.8000,\ a_2 = 0.0123,\ a_3 = 1.0000,\ z_h = 0.6000,\ z_{01} = 0.6000,\ v_{01} = 41.97$ mph

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $^2/_{10}$ power law.
Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^2/_{10}$ power law as per Section 5.4.1 of S37-13.

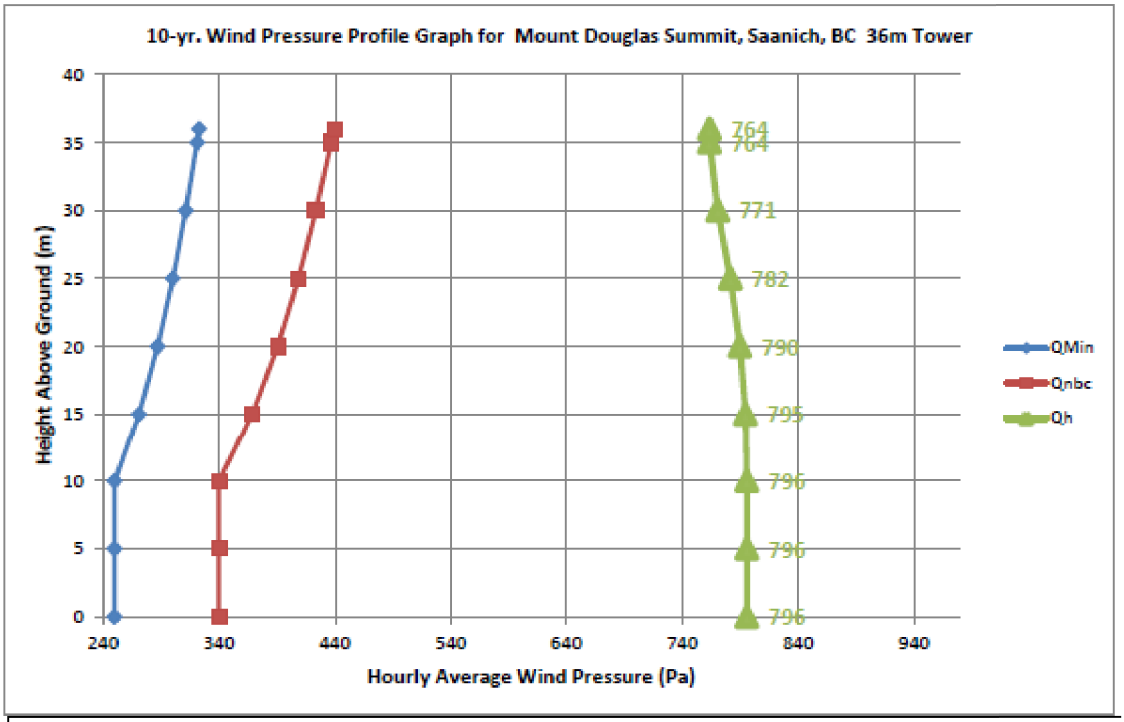
Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-13, 5.3.1)
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

July 06, 2017

Mount Douglas Summit, Saanich, BC 38m Tower



Q_{nbc} Profile: Regionally representative reference wind profiled with the $^2/_{10}$ power law.
Q_{Min} Profile: Minimum site-specific wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^2/_{10}$ power law.
Q_h Profile: The site-specific wind pressure profile directly from the Taylor and Lee (1984) simple guidelines.

Explanatory notes regarding the new report format and changes to calculation methods.

1. The most significant change from the previous versions of the reports is that the exponent used in the Q_h equation is no longer fixed at 0.2. The exponent now varies continuously from 0.2 for open terrain to 0.32 for closed terrain.
2. A new Q_{min} profile has been added to the graphs and it represents the minimum acceptable reference wind pressure profile. It starts with the minimum 10-metre reference wind pressure of 320 Pa for a 50-year return period as per section 5.4.1 of S37-13 and then uses the same $^2/_{10}$ power law formulation as the Q_{NBC} profile to generate the curve. The corresponding 10-metre reference wind pressures for the 10-year and 30-year return periods are 250 Pa and 300 Pa respectively.
3. Q_h will always be plotted even when they are less than Q_{Min}. This will allow designers to see how Q_h varies over the height of the tower. Also, in rough terrain and for taller towers, the Q_h profile might cross the Q_{Min} profile.
4. The coefficients for the Q_h equation will now always be given regardless of the Q_{NBC} or Q_{Min} values.
5. The wind speeds will be given for each of the 4 equations (Q_h, Q_{NBC}, or Q_{Min}) too.

July 06, 2017

Mount Douglas Summit, Saanich, BC 36m Tower

Site-Specific 50-yr. Wind Pressure Report (V2.1 2016-01-04 Format)

Site Information:

Name: Mount Douglas Summit, Saanich, BC
Latitude: 48° 29' 32.38" N
Longitude: 123° 20' 42.01" W
Tower Height (m): 36
Elevation MSL (m): 225

Results:

Note: Following direction from the S37 Committee, Qe can no longer be provided.

Q_{nbc} (Pa):	440	$Q_{nbc} = 440(Z/10)^{0.2}$	V_{nbc} = 58.36 mph
Icing:	As per CAN/CSA S37-13		
Q_{Mln} (Pa)	320	$Q_{Mln} = 320(Z/10)^{0.2}$	V_{Mln} = 49.77 mph

Wind Pressure Formula (for z in metres and result in Pa):

For Z ≤ 33 metres: $Q_h = 0.12919\ \{[0.8000\ e^{(-0.0123\,z)} + 0.6173\ ln(z/0.0500) / ln(z/0.6000)]\ 47.75\}^2\ (z/10)^{0.296}$

For Z > 33 metres: $Q_h = 0.12919\ \{[1 + 0.8000\ e^{(-0.0123\,z)}]\ 47.75\}^2\ (z/10)^{0.296}$

Profile Formula General Form:

$$Q_h = 0.12919\ \{[a_1\ e^{(-a2\,z)} + a_3\ ln(z/z_h) / ln(z/z_{01})]\ v_{01}\}^2\ (z/10)^{0.296}$$

Site Values of Coefficients:

For Z ≤ 33 metres: $a_1 = 0.8000,\ a_2 = 0.0123,\ a_3 = 0.6173,\ z_h = 0.0500,\ z_{01} = 0.6000,\ v_{01} = 47.75$ mph

For Z > 33 metres: $a_1 = 0.8000,\ a_2 = 0.0123,\ a_3 = 1.0000,\ z_h = 0.6000,\ z_{01} = 0.6000,\ v_{01} = 47.75$ mph

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $^2/_{10}$ power law.
Q_{Mln}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^2/_{10}$ power law as per Section 5.4.1 of S37-13.

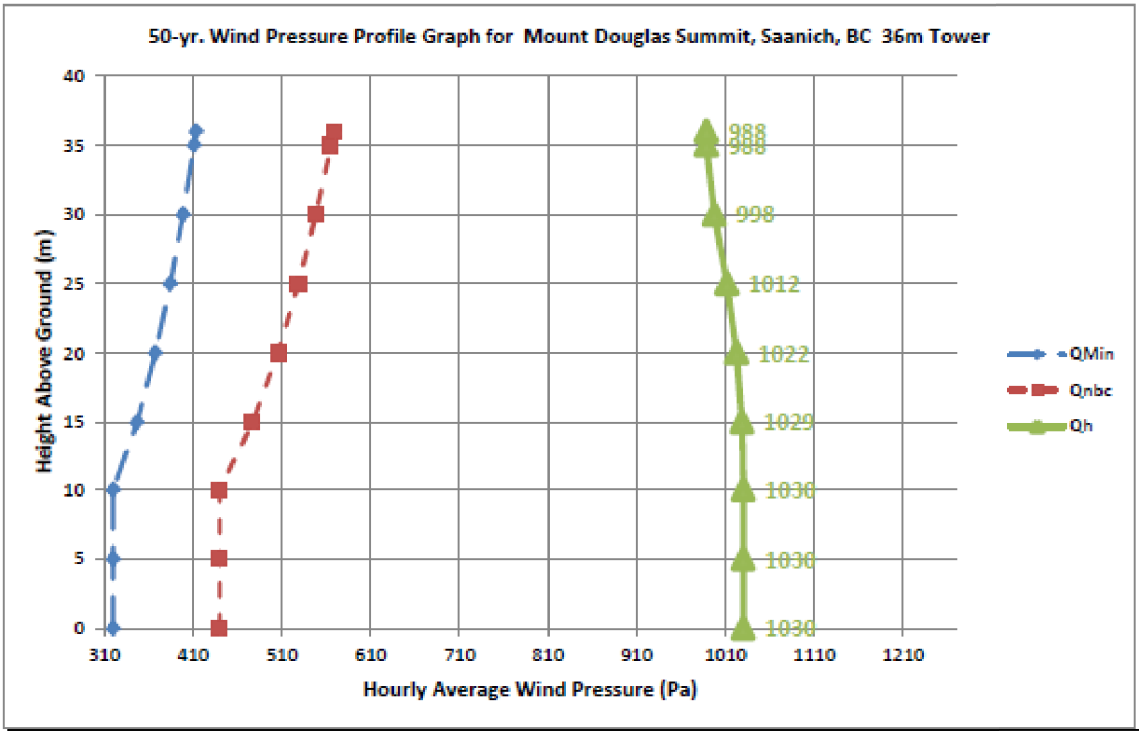
Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-13, 5.3.1)
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

July 06, 2017

Mount Douglas Summit, Saanich, BC 36m Tower



Q_{nbc} Profile: Regionally representative reference wind profiled with the $^2/_{10}$ power law.
Q_{Min} Profile: Minimum site-specific wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^2/_{10}$ power law.
Q_h Profile: The site-specific wind pressure profile directly from the Taylor and Lee (1984) simple guidelines.

Explanatory notes regarding the new report format and changes to calculation methods.

1. The most significant change from the previous versions of the reports is that the exponent used in the Q_h equation is no longer fixed at 0.2. The exponent now varies continuously from 0.2 for open terrain to 0.32 for closed terrain.
2. A new Q_{min} profile has been added to the graphs and it represents the minimum acceptable reference wind pressure profile. It starts with the minimum 10-metre reference wind pressure of 320 Pa for a 50-year return period as per section 5.4.1 of S37-13 and then uses the same $^2/_{10}$ power law formulation as the Q_{NBC} profile to generate the curve. The corresponding 10-metre reference wind pressures for the 10-year and 30-year return periods are 250 Pa and 300 Pa respectively.
3. Q_h will always be plotted even when they are less than Q_{Min}. This will allow designers to see how Q_h varies over the height of the tower. Also, in rough terrain and for taller towers, the Q_h profile might cross the Q_{Min} profile.
4. The coefficients for the Q_h equation will now always be given regardless of the Q_{NBC} or Q_{Min} values.
5. The wind speeds will be given for each of the 4 equations (Q_h, Q_{NBC}, or Q_{Min}) too.

July 06, 2017

APPENDIX D - Seismic Data

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 48.492N 123.345W **User File Reference:** Mount Douglas 2021-12-09 19:49 UT

Requested by: District of Saanich

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.702	0.501	0.367	0.165
Sa (0.1)	1.069	0.772	0.565	0.253
Sa (0.2)	1.283	0.927	0.685	0.308
Sa (0.3)	1.281	0.927	0.683	0.304
Sa (0.5)	1.134	0.812	0.589	0.249
Sa (1.0)	0.657	0.447	0.309	0.118
Sa (2.0)	0.384	0.254	0.169	0.061
Sa (5.0)	0.120	0.069	0.038	0.012
Sa (10.0)	0.042	0.024	0.012	0.004
PGA (g)	0.570	0.412	0.303	0.134
PGV (m/s)	0.816	0.560	0.390	0.149

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

Natural Resources Canada Ressources naturelles Canada

Canada

STANDARD CONDITIONS FOR THE PROVISION OF PROFESSIONAL ENGINEERING SERVICES FOR EXISTING STRUCTURES BY WesTower Communications Ltd.

All engineering services are performed on the basis that the information used is current and correct. This information may consist of, but is not necessarily limited to:

1. Information supplied by the client regarding the structure and its components, foundations, soil conditions, antenna and feed line loading on the structure, and other site-specific information.

2. Information from quality documents and/or drawings in the possession of WesTower or acquired from field inspections.

It is the responsibility of the client to ensure that the information provided to WesTower and used in the performance of our engineering services is correct and complete. In the absence of information to the contrary, we assume that all structures were constructed in accordance with the drawings and specifications provided and are in non-corroded condition and have not deteriorated. Therefore, we assume that the member capacities have not changed from the “as new” condition.

All services will be performed to meet the codes specified by the client, and we do not imply to meet any other codes or requirements unless explicitly agreed to in writing. If wind and ice loads or other relevant parameters are to be different than the minimum values recommended by the standards, the client shall specify the requirement. Otherwise, all work will be performed to meet the requirements of the latest revision of CSA standard S37.

All services are performed in accordance with generally accepted engineering principles and practices. WesTower is not responsible for the conclusions, opinions and recommendations made by others based on the information we supply.