Compliance Report
BigSky Tower Systems Inc. – Rapid Deployment Communications Tower

Report Version : 1.1

Report Issue Date: November 3rd, 2017

Contents

Revision History

Number	Date	Information	Initials
1.0	2017-11-03	Draft report to BigSky	DP
1.1	2017-11-03	JK/BigSky Revisions incorporated – Initial Report issue	DP

Executive Summary

TPM – Total Project Management Ltd was engaged by BigSky Tower Systems Inc (BigSky) to provide Standard Compliance Review of the structural and material specification aspects of their Rapid Deployment Communications Tower (RDCT) system in relation to the current version of CSA S37-13.

This review was carried out by their sister company SWP Projects Ltd, a Certificate of Authorization holder in good standing with Engineers Geoscientists Manitoba. The following report under seal has been prepared for BigSky for their express use in marketing their system to prospective clients.

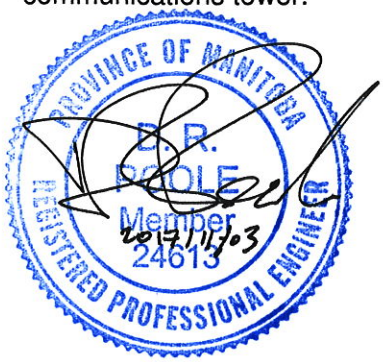
The RDCT system consists of a prefabricated, bolt together 100' tall gravity ballasted cable guyed steel lattice self contained communications tower complete with integral ladder that is erected on in a horizontal orientation connected a hinged plate and tripod base system.

Primary advantages of the system are as follows:

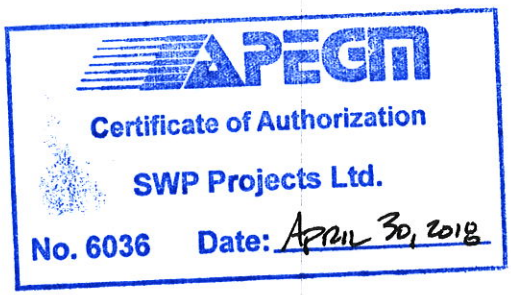
- Low shipping weight
- Ease of transport and mobilization of tower components of sub-assemblies through a variety of transportation options to remote locations.
- Erection by 3 person crews in 50-75 person-hours.
- No permanent cable stay anchors or tower base
- Low environmental impact
- Sites can be completely remediation or restoration after removal.

The RDCT system was found to be largely compliant with the CSA S37-13 standard with acceptable minor deviations that are related to constructability or the specific gravity ballasted base system employed. These minor modifications are found to follow the intent of the Standard and are admissible give the provisions of Clause 1.5 Other Design Approaches.

Site specific location information, climatic data and a specified antenna or antenna assembly configuration is required to provide opinion regarding the final Reliability Classification of a specific tower. However, in general the RDCT system and the engineering design approach being undertaken for site-specific tower designs can provide a Reliability Class I communications tower.



Seal



Certificate of Authorization

Introduction and Limitations of Compliance Review

The intent of this document is to analyze in general terms the material specifications and Structural Design aspects of the BigSky Tower Systems Inc. (BigSky) Rapid Deployment Communications Tower (RDCT) for compliance with the requirements of the following standard:

> **CSA S37-13 Antennas, towers and antenna-supporting structures with June 2017 Errata**

At the time of writing this report this referenced standard is the current governing Canadian standard for structural design of communications structures, normally consisting of lattice steel construction with principal applied loads of wind and ice.

CSA S37-13 (the Standard) provides governing criterion for the design and construction of every tower, antenna, and antenna-supporting structure and is intended to govern the requirements for new structures as well as existing structures which are undergoing a change in attached equipment. The Standard is also referenced under Part II of the Canadian Occupational and Health Regulations as it is recognized that the safety of persons who are required to climb a tower is as important of a consideration as the safety of the structure of the tower itself. Therefore, CSA S37-13 includes requirements for ladders, safety devices, platforms and cages.

This report is organized to provide commentary on a Section by Section basis with specific reference to CSA S37-13 clauses where applicable for ease of cross-reference. In general, the analysis is provided in written and/or tabular format with information provided on the basis of the following four categories:

> **COMP** - Compliance to Standard requirement – the system meets the base Standard requirement as written
>
> **ALT** - Alternate Compliance to Standard requirement – using good engineering judgment and analysis using acceptable methods or analysis in accordance with the Standards reference publications the system is deemed to meet the intent or letter of the Standard requirement. Generally, additional information including base assumptions and critical point of the analysis will be provided as justification for this finding.
>
> **NON** - Non-compliance – the system does not meet the Standard requirement
>
> **N/A** - Not Applicable – The Standard requirement does not apply to the specific system in question

Limitations of the Report

The intent of this document is to provide BigSky with an engineered report which outlines compliance with the requirements of CSA S37-13 with respect to their base RDCT design. This report is solely for the use of BigSky Tower Systems Inc, and has been prepared under specific scope of service and terms of reference agreement. This report is not transferrable to any designates or affiliates without the specific written permission of the original report author.

Furthermore, TPM - Total Project Management and SWP Projects Ltd. accept no duty or responsibility (including in negligence) to any party other than BigSky Tower Systems Inc. and disclaims all liability of any nature whatsoever to any such party in respect of this report. Any use or reliance of this report by a third party is done solely at the risk of the third party.

While this report provides a professional analysis and viewpoint regarding compliance with the requirements of the CSA S37-13 Standard it is not an explicit certification of the RDCT system under that standard. Furthermore, this opinion applies to the current version of the standard and its official errata as listed above. Further update or errata to the CSA S37-13 or its reference publications will require review and reissuance of this report.

Finally, CSA S37-13 includes a requirement for mandatory seismic checks for designated post-critical structures that must remain in service immediately after an earthquake. As this requires site specific geotechnical information and seismic site classification, such an analysis is beyond the scope of this generic report. Site specific engineering drawings should be commissioned and referenced for additional requirements (if any) to cover the specific attachment antenna or attachment antenna array configuration, specific tower requirements with regards to post-disaster classification and the impact (if any) of site specific geotechnical information on the following analysis.

General RDCT System Description

The BigSky RDCT system consists of a prefabricated, bolt together 100’ tall gravity ballasted cable guyed steel lattice communications tower constructed from 5 modular sections (3 lower 20’ sections, two upper 20’ sections) complete with integral ladder, central hinged tower to base coupler plate, a tripod base configuration with ballast receptacles, and an integrally mounted telecommunications cabinet.

The modular 20’ tower sections can be pre-assembled or shipped knock-down for assembly on site and are assembled in a horizontal orientation and affixed to the hinged coupler plate. Attachment antenna or antenna arrays can be rough mounted on the tower at ground level prior to final erection of the tower to the vertical position using a removable A-frame and winch system. Cable stayed guide wires are then terminated and tensioned using turnbuckles to the ballasted receptacles.

Final fine adjustment or alignment of the antennas may require climbing the completed structure.

Primary advantages of the system are as follows:

> Low shipping weight allows for ease of transport and mobilization of tower components of sub-assemblies through a variety of transportation options, allowing for ease deployment of towers to remote locations.

Standardized construction of the base RDCT system allows for efficiency in assembly crews with completed towers being erected by 3 person crews in as little as 50-75 person-hours.

No permanent installations for cable stay anchors or tower base provide low environmental impact with tower sites being capable of complete remediation or restoration after tower removal.

Section 1- Scope

This section provided scope and exclusion criteria for the S37-13 standard. In general, the BigSky RDCT system is found to be compliant with this Section with specific attention brought to the following clauses which inform the scope of the subsequent review:

Clause	Finding	Commentary / Rationale
1.2 a)	COMP	Standard does not apply to attachment antennas and arrays or assemblies of such antennas, this report is therefore focused on the specific base tower system including 5 modular tower sections, hinged base plate, tripod base, and ballasted basket assemblies
1.2. b)	COMP	Towers extend greater than 15m above grade and are assumed to be ground mounted (not mounted on another structure)
1.5	COMP	Allows for "A *rational design based on theory, analysis, and engineering practice, acceptable to the owner and regulatory authority, may be used in lieu of the design procedures or materials described in this Standard. In such cases, the design should be prepared by an engineer qualified in the specific method and knowledgeable about the materials to be used, and should provide a level of safety and performance that is not less than that implicit in this Standard"*

Section 2 - Reference Publications

This section provides reference to specific publications which may govern portions of the design or analysis. Exhaustive review of the reference publications is beyond the scope of this compliance review. Specific attention is brought to the following reference publications for use in the site-specific engineering analysis of specific towers.

CSA A23.1-09/A23.2-09 Concrete materials and methods of construction / Methods of test for concrete

CAN/CSA A23.3-94 (R2010) Design of concrete structures for buildings

C22.1-12 Canadian Electrical Code, Part 1

CAN/CSA-G12-92 (R2012) Zinc coated steel wire strand

CSA G40.20/G40.21-13 General requirements for rolled or welded structural quality steel / Structural quality steel

O86-09 Engineering design in wood

S16-09 Design of steel structures

S136-12 North American Specification for the design of cold formed steel structural members

S136.1-12 Commentary on North American Specification for the design of cold formed steel structural members

W59-13 Welded steel construction (Metal arc welding)

Canadian Geotechnical Society – Canadian Foundation Engineering Manual, 4th Edition, February 2007

CISC (Canadian Institute for Steel Construction) – Handbook of Steel Construction, 9th Edition, September 2008

Government of Canada – Canada Labour Code – Part II, Regulations respecting occupational safety and health made under Part II of the Canadian Labour Code

National Research Council of Canada - National Building Code of Canada, 2010

National Research Council of Canada – User's Guide – NBCC 2010 Structural Commentaries (Part 4 of Division B)

Section 3 – Definitions and Symbols

This section provides standardized definitions and symbols for use throughout the Standard. Where possible this compliance report attempts to use the same standardized definitions and symbols for ease of cross-reference.

Section 4 – Design Requirements

This Section lays out requirements for the Engineering analysis, design, drawings and inspections and maintenance of existing structures. Compliance information is provided in tabular format below:

Clause	Finding	Commentary / Rationale
4.1	COMP	This clause is a common basic tenant of structural design and the responsibility of the sealing engineer. Provision of site specific sealed drawings for the tower provide this assurance as well as professional liability for the design of the structure
4.2, 4.3	COMP	Analysis has been carried out using Limit States Design methods in accordance with Standard and NBCC 2010
4.4.1	COMP	Site specific engineering drawings for each tower should be provided
4.4.2	N/A	BigSky RDCT system is designed for deployment at grade level adjacent to existing structures, not for mounting or support on top of another structure
4.4.3	COMP	TPM-Total Project Management and SWP Projects Ltd. have been engaged to provide standard drawings which will comply with Annex

		A requirements. These are provided for use as the basis of site specific engineering drawings as per Clause 4.4.1
4.5.1	N/A	BigSky RDCT system is designed for new structure implementations. Inspection and maintenance of the new towers shall be the responsibility of the tower purchaser and/or BigSky depending on the terms of the Sales and Service agreements put in place at the time of purchase
4.5.2	N/A	New installation only for one antenna configuration. Should the antenna configuration be modified or the antenna be relocated new site-specific engineering drawings should be provided

Section 5 – Loads

This section of the Standard provides information regarding the Loads for application to the tower during engineering review using Limit States Design practices. The following section outlines design assumptions central to the design of the BigSky RDCT system as carried out by TPM – Total Project Management and SWP Projects Ltd. Should independent analysis of the system be performed by another engineering firm, the following Section should be reviewed and consistent assumptions applied by the independent firm to ensure consistency in the analysis and design of the system across jurisdictions.

Clause	Finding	Commentary / Rationale
5,1	COMP	Dead loads used in site specific analysis shall include the weight of the tower and all attachments
5.2	COMP	Ice loads used in the site-specific analysis shall include glaze ice with a density of 900 kg / cubic meter deposited radially on the exposed surface of the structure, guys and attachments to a minimum thickness in accordance with Figure 1 – Ice Map. In general, analysis of the BigSky RDCT system will use an ice thickness of 20 mm which is sufficient for all locations inside Manitoba with the exception of locations adjacent to Hudson Bay and in the environs of Churchill. It should be noted that this thickness is a conservative value that would also apply to all locations across Saskatchewan, Alberta and British Columbia with the exception of the Abbotsford-Chilliwack valley and in the environs of Prince Rupert. This assumption is consistent with the anticipated range of tower deployments under consideration at the time of the report Ice thickness will be escalated with height in accordance with Clause 5.2.3

5.2.4	COMP	Ice on guy cables shall be determined at mid-height and applied for the full cable length
5.3.1	COMP	Site specific analysis shall use Design Wind Pressure P= qCeCgCa in accordance with 5.3.1 q - Values for reference velocity q shall be taken from Climatic Data Tables in NBCC 2010 Ce - Given the nature of the tower and its overall height a Ce factor for Open exposure conditions shall be used Cg – as per Clause 5.6 Ca – shall be taken as 1.0 as per Clause 5.7 since towers are ground mounted
5.3.2	COMP	Escalation of wind with height is provided with the use of Ce and Open exposure
5.3.3	N/A	Towers deployed at ground level
5.4	COMP	Values for reference velocity q50 shall be taken from NBCC 2010 Climatic Design Tables or Annex E (specifically Table E.1) of the Standard. In the case of a discrepancy the more stringent value shall be used In no case shall q50 be less than 0.32 kPa
5.5.1	COMP	Value for Ce shall be determined from Clause 5.5.1 a) Open Terrain
5.5.2	COMP	Design shall consider wind bands of 6m in height using qh at mid-height of the wind band across the full band height
5.5.3	COMP	Value of qh for guy cables shall be calculated at mid-height of the cable and applied along the full cable length
5.5.4	COMP	Value of qh for antenna attachments shall be determined at the centroid of the projected area of the attachment
5.6.1 a)	COMP	Cg = 2.0 shall be used
5.6.2	N/A	BigSky RDCT is not a pole structure
5.6.3	N/A	Tower are less than 250 m tall
5.7.1	COMP	Ca = 1.0 wind speed up factor
5.7.2	N/A	Towers are ground mounted, not erected on roofs.
5.8.1	COMP	Limit State Design Wind load shall be calculated as per 5.8.1 using P value per Clause 5.3.1, projected area of the members and Cd (drag factor) in accordance with Clause 5.9.1 a) ii)
5.8.2	N/A	BigSky RDCT is not a pole structure

5.8.3	COMP	Wind on attachments shall be calculated in accordance with Clause 5.8.3 including increase to the projected area to account for radial ice as per Clause 5.8.1 Effects of shielding from the main structure shall generally be neglected.
5.9.1	COMP	Drag factor shall be determined using Clause 5.9.1 a) ii) Flat members Triangular tower shape Cdf = 3.4 (Rs)^2 – 4.7 Rs + 3.4 where Rs is solidity ratio for the panel under design.
5.9.2	N/A	BigSky RDCT is not a pole structure
5.9.3	COMP	Cd for use with wind on guys shall be 1.2
5.9.4.1	COMP	Cd for antennas shall be based on published data from antenna manufacturer (if available) or from Table 2 in the absence of published data Reduction factor Ka shall be used only if full attachment is located within the exclusion zone extending a distance of 300mm (1'-0") from the exterior face of the triangular main tower structure
5.9.4.2	N/A	Antennas for use with the BigSky RDCT are not typically linear attachments
5.9.4.3	COMP	Antennas for use with the BigSky RDCT are not typically Special Antenna Assemblies. **This condition shall be verified during the site-specific engineering review based on the actual antenna assemblies to be mounted. Specific information required includes antenna dimensions and weight, azimuth, mounting height and Survey grade GPS coordinates for final tower location.**
5.9.4.4.	COMP	Total antenna load shall be considered as the sum of the wind load on each antenna using the projected area for direction of wind under consideration
5.9.4.5	COMP	Effective Projected Area (EPA) shall be calculated in accordance with Clause 5.9.4.5 with wind direction varying from 0 to 90 degrees relative to the azimuth of the attachment
5.9.4.6	N/A	Antennas for use with the BigSky RDCT are not typically linear attachments
5.9.4.7	COMP	Wind on tower shall be limited to a maximum value as per Clause 5.9.4.7
5.9.4.8.	N/A	BigSky RDCT sections are generally considered as rectangular sections.

5.10	COMP	Given the small member section sizes of the RDCT system effects of shielding are generally neglected. This assumption will lead to conservative design / analysis of the tower
5.10.1	COMP	Shielding of leeward antennas by windward antennas may be possible and should be verified during site specific engineering review based on the mounted antenna assembly configuration. Generic analysis for basic RDCT configurations will neglect antenna shielding completely. This assumption will lead to conservative design / analysis of the tower
5.11	COMP	Temperature effects shall be included in Limit States Design load cases that include Ice.
5.12	N/A	Earthquake loading is contingent on two items as follows: Identification / classification of the tower as post-critical which is dependent on the specific tower, its function and equipment and should be reviewed during preparation of site specific engineering drawings. Location of the tower in a medium to high seismicity zone. This requires specific knowledge of the tower location which is beyond the general scope of this report and should be reviewed during preparation of site specific engineering drawings. NOTE: NBCC 2010 Climatic Data Tables provide Sa(0.2) values for locations across Canada. **Locations within Manitoba are considered to be located within a zone of low seismicity and are therefore applicable for Exclusion under Clause 5.12.2. This is due to Manitoba Building Code (Building and Mobile Homes Act B93-R.M. 31/2011) clause 2(39) which sets Sa(0.2) values for all locations with the Province as equal to zero.** 5.12.3 through 5.12.5.5 are therefore N/A to Manitoba sites

Section 6 – Analysis

This section of the Standard stipulates Analysis conditions for the tower system. Again, as the actual applied loads are dependant on the specific antenna assemblies, icing and wind conditions for the specific tower locations this section is largely addressed by the provision of site specific engineered drawings under seal. The following section outlines design assumptions central to the analysis of the BigSky RDCT system as carried out by TPM – Total Project Management and SWP Projects Ltd. Should independent analysis of the system be performed by another engineering firm, the following Section should be reviewed and consistent assumptions applied by the independent firm to ensure consistency in the analysis and design of the system across jurisdictions.

Clause	Finding	Commentary / Rationale
6.1	COMP	Initial condition for analysis shall be as per Clause 6.1
6.2	COMP	Load combinations shall be in accordance with Clause 6.2
6.3	COMP	Ultimate Limit States Design load combinations, importance factors, load combination factors shall be in accordance with Clause 6.3 **Specifically, Importance factor shall be taken as 1.0 in accordance with a Reliability Class I classification in Table 3.**
6.4	COMP	Serviceability Limit States Design load combinations, importance factors, load combination factors shall be in accordance with Clause 6.4 Values for reference velocity q10 shall be taken from NBCC 2010 Climatic Design Tables or Annex E (specifically Table E.1) of the Standard. In the case of a discrepancy the more stringent value shall be used **Specifically, Serviceability factor, τ shall be taken as 1.0 unless otherwise specified by the Owner** Clause 6.4.4 is not applicable to Manitoba locations, see commentary on Clause 5.12 in Section 5 of this report.
6.5	COMP	Wind directions shall be in accordance with Clause 6.5 ULS wind directions shall be at a minimum considered parallel to and acting at an angle of 30, 60 and 90 degrees to the face under consideration
6.6	COMP	Not applicable for Manitoba locations, see commentary on Clause 5.12 in Section 5 of this report.
6.7	COMP	Mast shall be analyzed as a beam column on elastic supports
6.8	COMP	Cantilever factor shall be applied in accordance with 6.8 b) when KL/r equals or exceeds 120

Section 7 – Structural Steel

This section covers significant technical assumptions regarding material specifications, framing eccentricity, and geometric conditions related to a wide variety of towers. Rather than providing a detailed clause by clause summary the following summary indicates specific clauses applicable to the BigSky RDCT system.

Clause	Finding	Commentary / Rationale
7.1	COMP	Members used in the tower system are governed by CSA S136 for Haydon Strut sections and the appropriate clauses for CSA S16 for all remaining components Member connection plates shall have a minimum thickness of 5 mm Tubular structures shall have minimum thickness of 4 mm Framing eccentricities shall be determined as per the following Leg Members – Clause 7.1.7.2 a) or 7.1.7.2 c) Bracing Members – Clause 7.1.7.3 Secondary Bracing Members – ladder rungs can be considered as secondary bracing members as required in accordance with Clause 7.1.8.2 Material resistance reduction factor φ shall be 0.90
7.2	COMP	Unbraced length and slenderness ratios shall be calculated in accordance with requirements of Clause 7.2.1 Rotational restraint for diagonal braces with single bolted connections is neglected in accordance with Clause 7.2.1.4. Effective slenderness ratios KL/r for compression members about the axis under consideration are limited as per Clause 7.2.1.5 as follows: 120 for leg members 200 for diagonal bracing 240 for ladder rungs (if acting as secondary braces) Member section properties shall be calculated in accordance with S16 or S136, or determined using manufacturers published values where available Factored compressive resistance shall be calculated in accordance with Clause 7.2.6 using effective yield stress in accordance with Clause 7.2.5.1
7.3	COMP	Tensile resistance of members shall be considered using net area of section perpendicular to the tension at bolt hole locations with holes 2mm larger than specified diameter in accordance with Clause 7.3.3.2 unless holes are drilled. Tensile resistance shall be calculated in accordance with Clause 7.3.5 and Clause 7.3.6
7.4	COMP	Tower sections are considered as idealized pinned truss sections and have no flexural members.

		W-sections in tripod base will use published Moment resistance values from CSA S16-09 Design of steel structures for unsupported length and consider effects of combined axial and flexural forces in accordance with Clause 7.4.4 as required.
7.5	COMP	Bolts used shall comply to requirements of Clause 7.5.1 Bolted connection capacities shall be calculated in accordance with Clause 7.5.2 Clause 7.5.3 Not applicable – no anchor rods Splice connections shall conform to Clause 7.5.6
7.6	COMP	Welding in tripod base and ballasted basket sections shall conform to requirements of Clause 7.6.1. Clause 7.6.2 is not applicable
7.7	N/A	BigSky RDCT is not a pole structure

Section 8 – Corrosion Protection

This Section deals with specification of corrosion coatings / protection to ensure appropriate tower service life and ensure tower stability is not degraded significantly over time as a result of member area loss to corrosion effects.

Clause	Finding	Commentary / Rationale
8.1	COMP	Information clause only
8.2.1	COMP	Haydon strut sections used for main vertical legs, diagonal bracing and ladder rung sections are compliant with ASTM A123 when provided with HDG surface coating from the manufacturer. Fabricated metal components of the tower (connection plates) are provided with a 0.005” yellow zinc coating in the base system. This coating thickness can be increased upon Owner request.
8.2.2	COMP	Open sections are used to ensure minimization of entrapped moisture through the base tower design.
8.2.3	COMP	No permanently sealed surfaces
8.3.1	COMP	Guy wires, fittings and attachments used are provided with zinc coating.
8.3.2	COMP	Guy wires, fittings and attachments used are provided with zinc coating.

		Additional information regarding zinc coating is available from the guy wire manufacturer upon request.
8.3.3	N/A	No non-ferrous components used in the Guy assembly
8.4	COMP	Bolts used are zinc coated
8.5.1	COMP	Exposed anchorage items such as turnbuckles are hot dip galvanized.
8.5.2	N/A	No below grade steel
8.6	N/A	Refer to BigSky installation and repair requirements for repair of damaged coatings

Section 9 – Other Structural Materials

This section is not applicable to the BigSky RDCT system.

Section 10 – Guy Assemblies

This section provides additional requirements for Guy assemblies

Clause	Finding	Commentary / Rationale
10.1.1	COMP	Information clause only
10.1.2	COMP	All guy wires are locally manufactured by a third party with their own internal QA/QC process and come fabricated as a single un-spliced unit to the correct length with wire thimbles and machine swaged fittings on each end. All other components in the assembly (quick links, turnbuckles, and shackles) are purchased, come hot dip galvanized or zinc coated and have listed ratings
10.1.3	COMP	Information can be solicited from the third-party vendors upon Owner request.
10.1.4	COMP	
10.2.1	COMP	Galvanized wire rope conforming to CSA G4
10.2.2	COMP	All guy wires are locally manufactured by a third party and come tagged with size, length and working capacities. Additional information regarding manufacturing can be solicited from the third-party vendor upon Owner request.
10.2.3	COMP	Guys are fabricated as single un-spliced unit to the correct length
10.2.4	N/A	No guys greater than 29 mm in diameter used in the RDCT system

10.3.1	N/A	Ends secured with machine swaged fittings.
10.3.2	N/A	Ends secured with machine swaged fittings.
10.3.3	N/A	Machine swaged (cold pressed) fittings are used
10.3.4	N/A	No sockets are used in the assembly
10.3.5	COMP	Wire rope thimbles are used at the end of guy wires
10.3.6	COMP	Shackles are used during lift / erection of the tower to a vertical state only and are removed once permanent guy assemblies including quick link connectors, guy wires and turnbuckles have been installed and tensioned
10.3.7	COMP	Additional information regarding Turnbuckle heat treatment and material specifications are available from the third-party vendor on Owner request
10.3.8	N/A	No guy link plates
10.3.9	COMP	Tags are provided
10.4.1	COMP	Guy assemblies are designed to resist the maximum factored guy forces in accordance with Clause 6
10.4.2	COMP	Guy breaking strength shall be calculated using the Efficiency factors from 10.4.2.2
10.4.3	COMP	Design effective resistance shall be limited as per Clause 10.4.3 and other components sized for minimum 90% of the manufacturers rated breaking strength of the cable.
10.4.4	COMP	Resistance factor $\emptyset$=0.6 shall be used
10.4.5	COMP	Initial tension is set using turnbuckles located at the anchorage to the gravity ballasted bucket assembly to specification and tolerances as laid out Clause 10.4.5
10.4.6	COMP	Full articulation is provided at both ends of guy assembly
10.4.7	ALT	Turnbuckles are provided Minimum available adjustment length is less than specified amount. This deviation is considered acceptable due to greater tolerances achievable as the guy, tower, connection plates and anchor point (gravity ballasted bucket) are all part of one manufactured assembly and greater tolerance is therefore achievable (ie – less adjustment required to account for constructability error in placement of site installed anchorages).

		Alternative turnbuckles with specified adjustable lengths can be provided upon Owner request.
10.4.8	N/A	No non-metallic material used in guy assembly

Section 11 – Foundations and Anchorages

This Section deals with foundation and anchorage design for support of the tower system under the applied loading conditions. The BigSky RDCT system is a non-penetrating mount system in accordance with Clause 11.6.

Clause	Finding	Commentary / Rationale
11.1	ALT	As the BigSky RDCT system is an unanchored self ballasted system the foundation capacity is solely dependent on frictional resistance between the ballasted baskets and the ground surface for resistance to translational forces, and on bearing resistance between the ballasted baskets and the ground surface for vertical and rotational or tipping resistance. Analysis of foundation capacities is based on principles from Canadian Foundation Engineering Manual and NBCC 2010 Assumption is that the existing ground surface will be prepared as follows: - Remove existing softened and organic surface material to competent subgrade level and to provide positive drainage away from the tower ballast basket locations. - Proof roll or static load test the subgrade to prove an allowable bearing capacity of at least 1500 psf (72 kPa) - Install granular material in maximum 6” (150 mm) lifts with compaction to a minimum of 98% standard proctor density to provide a competent level bearing pad to place the tower on. - Geotextile fabric can be placed between the sub-grade and granular pad if required
11.2.1	ALT	Refer to Clause 11.1 explanation above. Where possible a site specific geotechnical report prepared by a competent geotechnical engineer registered in the project Province is always highly preferred. In the case of conflict between such a report and the explanatory material provided for Clause 11.1 above, the site-specific report requirements shall govern.
11.2.2	COMP	Soil density used in design shall not exceed 1600 kg/cubic meters. Concrete density used in design shall not exceed 2300 kg/cubic meters
11.2.3	N/A	BigSky RDCT is not suitable for submerged conditions

11.2.4.	COMP	Ultimate Foundation resistance shall be designed to resist all factored loads in accordance with Clause 6
11.2.5	COMP	Resistance factors from Clause 11.2.5 shall be used
11.3.1	COMP	This clause is considered for the interface between the prepared pad location and the existing subgrade. Compaction effort and material required for the pad itself shall be specified by the Engineer
11.3.2	N/A	Base of foundation will not extend below frost line or into permafrost
11.4	N/A	No rock anchors used as part of the system
11.5	N/A	Towers are ground mounted, not erected on roofs.
11.6	COMP	

Section 12 – Tower and Pole Installation

Installation procedures are beyond the scope of this code compliance review and should be carefully planned for specific site between BigSky Tower Systems Inc and the Owner on a site by site basis. Installation and erection of the tower should be done by BigSky Tower Systems directly or by installers Certified by BigSky Tower Systems under their in-house training program.

Section 13 – Obstruction Marking

Obstruction marking requirements are site dependent and as such are beyond the scope of this Standard compliance review. They should be done in accordance with CARs 621.19 and requirements of the local Authority Having Jurisdiction when the structures pose a hazard to aircraft navigation.

Section 14 – Bonding and Grounding

Electrical connections, bonding, grounding, insulation and insulators are beyond the scope of this Standard compliance review. As a result, this section has not been considered in detail.

Section 15 – Insulators and Insulation

Electrical connections, bonding, grounding, insulation and insulators are beyond the scope of this Standard compliance review. As a result, this section has not been considered in detail.

Section 16 – Ladders, Safety Devices, Platforms and Cages

This section prescribes requirements for provisions of safe conditions for persons climbing and working on structures covered by the Standard.

Due to the small size and 100' maximum height of the BigSky Tower Systems RDCT a number of the clauses required under this section are either not applicable, not practically achievable, or accommodated to the fullest extent possible in the inclusion of the integral ladder on one face of the main tower frame.

Clause	Finding	Commentary / Rationale
16.1.1	COMP	Information clause only
16.1.2	COMP	ULS load factor of 1.5 shall be used for climbing loads in the engineering analysis / design of the tower
16.1.3	ALT	Clause is applicable as the tower exceeds 3m in height. Please refer to commentary for Clause 16.1.6 for further information
16.1.4	NON	The climbing face of the tower is an integral part of the tower structure, therefore under CSA S37-13 it does NOT classify as a Ladder under Clause 16.2.1.1 A fixed climbing facility is provided on one tower face (refer to Clause 16.2.1.2) however it is NOT equipped with fall arresting devices, cages or hoops so does not qualify for compliance of 16.1.4
16.1.5	NON	Although the tower height exceeds a distance of 18 m (approximately 59 feet) rest platforms are not provided in accordance with 16.1.5 a) (Refer to 16.3 commentary) Work platforms are not provided in accordance with 16.1.5 b) (Refer to 16.3 commentary) Interchange platforms in accordance with 16.1.5. c) are not required due to the geometry of the tower system Provision of rest and work platforms given the small size of the main tower structure is impractical with this system. Non-compliance with this Clause is allowed, see commentary for Clause 16.1.6 below
16.1.6	COMP	BigSky Tower Systems Inc. RDCT should only be climbed by qualified persons. In particular, they should only be climbed by Certified Rescue Climbers Warning signs and climbing shield shall be provided at the base of the ladder in accordance with the requirements of Clause 16.1.9

16.2.1.1	N/A	No ladder provided
16.2.1.2	COMP	Loads for design of the climbing face of the tower are compliant with Clause 16.2.1.2
16.2.2.2	N/A	Portable ladders are not required
16.2.3.	COMP	Climbing Facility conforms to the requirements of 16.2.3.3
16.2.4.1	COMP	Interior dimensions of the tower do not meet 16.2.3.1 j) so system is installed on the outside of the tower.
16.2.4.2	N/A	Portable ladders are not required
16.3	N/A	No platforms provided. Refer to commentary for Clause 16.1.6, 16.10 and 16.9
16.4	N/A	No fall arresting devices provided. Refer to commentary for Clause 16.1.6, 16.10 and 16.9
16.5	N/A	No ladder cages or hoops are provided. Refer to commentary for Clause 16.1.6, 16.10 and 16.9
16.6	N/A	Mud grating does not form an integral part of the tower system. **Owner should provide a mud grate in accordance with Clause 16.6 where required.**
16.7	COMP	Stabilizer bars for guy wire attachments allow for safe access through the obstruction.
16.8	N/A	Towers are new construction to the Standard.
16.9	COMP	Anti-climb shields equipped with Warning signs that clearly identify the potential risk to welfare, the required Certifications and Personal Safety equipment (body harness, shock absorbing lanyards, etc.) shall be provided. Consideration should be given to provision of multilingual signs in areas where English and French are not the predominant languages
16.10	COMP	Certification as a Rescue Climber is a posted requirement Towers should not be climbed by any person without current required certifications.