A BRIEF HISTORY & OVERVIEW OF CSA STANDARD S37

by

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ABSTRACT

A brief history of the evolution of CSA Standard S37 is presented, along with the general philosophy of the Technical Committee in preparing the current versions. It is hoped this will provide the user with a better understanding of the purpose of the contents.

INTRODUCTION

CSA Standard S37 Antennas, Towers, and Antenna-Supporting Structures (Design) serves as the control document for the design, manufacture, installation and maintenance of towers in Canada. They may be described collectively as Communication Structures. Like all CSA Standards it is not a legal document in itself, but may become one when it is referenced by a Code, Government Regulation, other legal statue or contractual specification.

Since the broadcast and telecommunications tower industry in Canada is relatively small compared to other types of structures, there is no formal industry association as there are in other sectors. Consequently the Technical Committee has become the focus of questions and is looked to, to provide leadership beyond its primary role of producing a design standard. This is illustrated by the expansion of topics and commentary Appendices, which do not relate to just design.

The purpose of this paper is to review the history of the development of the standard during the past 50 years and to set out the general philosophy of the Technical Committee as it tries to serve the needs of the very changing broadcasting and telecommunications industries.

A BRIEF HISTORY OF THE STANDARD

The first version, published in 1954, was actually part of the Canadian Electrical Code, in PART IV RADIO. Panel 7 of this code was responsible for the development of standards dealing with radio installations. It reflects the major use of towers for the broadcast industry at that time. The standard was quite basic in nature, setting out the wind loads in two classes (A & B) and ½" ice. A third class, C, was reserved for special loading which may occur at exposed areas on the east coast and in the arctic. The design requirements were typical for that period and the guy cable factors were quite conservative.

In 1958, a new Sectional Committee on Radio was organized, and the tower committee placed under it's jurisdiction. However, in 1964 the Radio Sectional Committee was disbanded and the Committee on Antennas and Towers transferred to the Sectional Committee on Structures.

The next version was expanded and issued in 1965. The Class A & B wind loads were increased in magnitude and in height and three ice loading zones were added, but ice loading was not required on guy cables. Maps for both the wind & ice loading zones were presented. More guidance on the design of steel tower members and components was provided.

In the late sixties and early seventies there were a number of guyed tower failures, mostly due do to ice buildup on the guy cables and the Technical Committee felt corrective action was required. Other issues also arouse which required attention.

Therefore the next version, issued in 1976, was substantially different both philosophically and technically. A more rational approach was adopted with regard to applied loads and allowable member capacities. Wind loads were based on the National Building Code of Canada 1975 and Ice Loads on information from Environment Canada and other sources. Two loading combinations were now required (a) full wind with no ice and (b) half wind pressure with specified ice including ice on the guy cables. Extensive reference was made to CSA standards S16, S157 and A23.3. Several failures of guy turnbuckles raised concern about this product. Fortunately non of these mishaps caused a tower failure. Investigation and studies determined that the turnbuckles should be heat treated to provide better brittle fracture characteristics and that guy cables should be articulated so that the turnbuckles will always be in tension and not have any bending.

In the seventies the structural design community saw the change to metric units and the

introduction of Limit States Design procedures. The Technical Committee responded to these developments with the issuing of the M1981 version. Apart from these significant developments, only editorial changes were made from the 1976 version as the two were to coexist, to allow a gradual change over.
There was little use of this version as tower designers preferred using the 1976 version. The few efforts and studies to use the standard revealed difficulties. Interpretation of the ice load factors were uncertain and in a number cases computer results were inconsistent. The Technical Committee started studies to correct these difficulties. At the same time the Steering Committee on Design was pressuring for the elimination of the Allowable Stress Design standard, this the TC committee was reluctant to do until it could resolve the inconsistences, particularly the one of icing.

With the consent of the Steering Committee a pseudo Limit States Design Standard the M86 version was produced. This required the tower to be analyzed for the given loads then multiplying the resulting member forces by the appropriate load factor (1.5 in most cases) . This allowed reference to the design requirements of the other structural standards such as S16.1 , A23.3, etc..

In addition other significant changes were introduced. In the earlier versions reference to the design of antennas was excluded from the scope of S37. However it was found that there was a need to have a standard to cover these products, particularly larger broadcast antennas and satellite antennas. In many cases they were being brought in from out of country and not being designed and manufactured for the required loading conditions. Their failure could endanger the structure and/or surrounding buildings. The concept of a Structural Antenna was introduced to cover antennas which are an integral component of the structure or any antenna larger than 1.4 m^2 A new method for calculating wind loads on the structure was adopted. This involves calculating the drag factor based on the solidity of the tower and the configuration rather than on the sum of the individual members. This method is in accordance with other international tower standards. Several failures of steel anchor shafts lead to increasing the corrosion resistance requirements

Following the issue of the 86 version, the Technical Committee set to work to produce a complete Limit States Design standard. In addition, a complete review of the entire standard was undertaken to ensure it reflected the current state of communications tower design and to addressed new areas which were required for the future. The following are the some of the significant additions to the standard:

a) Pole type structures
b) Nonpenetrating roof mounts
c) Serviceability factors for tilt and twist.
d) Revised wind and ice load maps based on upgraded AES data,
e) Design of angle members based on effective slenderness ratios,
f) Safety requirements for climbing facilities.
g) Application of Importance Factors to new as well as existing towers,
i) Guidelines for the use of Patch Loading Methods for dynamic wind conditions for special cases.

Details of these changes are provided in a commentary to the standard yet to be published.

GENERAL PHILOSOPHY

The general philosophy of the Technical Committee is to incorporate the current knowledge of tower design and supply into the standard following an evaluation of the data for appropriateness to Canadian conditions. The standard follows the practices of the current CSA standards for steel, concrete, wood and aluminium as they relate to towers. In some instantances such as lattice steel angle members, it has found these standards are overly conservative. In these cases it has introduced appropriate criteria. Where data has not been available, the committee has had research and studies carried out to confirm the correctness of this criteria.

In accordance with CSA policy, the committee must be mindful of the economic consequences any changes may have on both new and existing structures, while it must always ensure the safety of the public and the personnel who work on and around them.

Because of the dynamic and ever changing nature of the telecommunications industry and hence the equipment to be mounted on these structures, it is frequently necessary to reanalyse and evaluate. While it is not mandatory to check a tower when a new version is issued, it is necessary to verify a structure to the current standard when any there is a change to any equipment , either added or subtracted, on the tower. When there has been a change in the wind and/or ice loads for the site where a tower is located , then it is recommended that the owner have it checked for the new conditions. Since these situations may require extensive modifications for older towers and cause some economic hardship, the standard provides an Importance Factor which allows the owner and the Engineer of Record to evaluate it for a lower factor, where the risk to the public, personnel and service is acceptable. These are significant decisions and requires knowledge and an understanding between the owner and engineer. The purpose is to give the owner the opportunity to select the most economic structure which will safely perform to all the requirements.

CONCLUSION

This standard, like most standards, is constantly changing. Already the Technical Committee is at work looking at revisions to make it clearer and to provide more data and guidance to the tower design engineer. It also hopes to produce a Commentary to the standard to provide a greater understanding and source of the requirements.

Table 1 Past Versions of the Standard

1954	CSA C22.4 No. 111-1954	Canadian Electrical Code PART IV Radio Specification for Antenna Towers and Antenna Supporting Structures (FIRST EDITION) 13 pages
1965	CSA STANDARD S37-1965	Antenna Towers and Antenna Supporting Structures 33 pages
1976	CSA STANDARD S37-1976	Antenna Towers and Antenna Supporting Structures 53 pages
1981	CSA STANDARD S37-M1981	Antenna Towers and Antenna Supporting Structures 65 pages
1986	CAN/CSA-S37-M86	Antennas, Towers, and Antenna-Supporting Structures 73 pages
1995	CSA S37-94	Antennas, Towers, and Antenna-Supporting Structures *Structures (Design)* 105 pages

APPENDIX C Members of Technical Committees

CSA C22.4 No. 111- 1954 Canadian Electrical Code Part IV

J. Carlisle (chairman)	Canadian Broadcasting Corp. Montreal Que.
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CSA Standard S37-1965

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G. M. Robinson	Dominion Steel & Coal Corp. Ltd., Canadian Bridge Co. Ltd., Walkerville, Ont.

In addition, the following made valuable contribution to the development of this standard in their capacities as noted.

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CSA S37-1976

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In addition to the members of the committee, the following individuals made valuable contrition to the development of this Standard.

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