ABSTRACT

THE IMPORTANCE OF STANDARDS AND CODES IN CONSTRUCTION SPECIFICATIONS

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The intent of this report is to give specification writers and users: engineers, inspectors and others who work with specifications, an insight into the subject of standards and codes in construction specification.

First, a critical view of the standards situation, past and present, in the U.S. and Canada is presented.

Then, international standards are touched upon in order to show the effect that they will most likely have on specifications in the future and also nuclear standards, as examples of the rapid evolution taking place in the standards field.

The distinction between legally adopted codes and non-mandatory codes of practice or recommendations is clarified along with the principle of "Reference to Standards". The importance of quality assurance in standards is emphasized. Company standardization, the standards engineer and management in the standards development process and their possible effect on specifications are examined. Finally suggested ways of treating standards and codes in specifications forming part of the contract documents are presented.

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CHAPTER 1

INTRODUCTION

This report has been prepared with a view of providing an insight into the subject of standards and codes and their role in construction specifications with the specification writers and others who use or work with construction specifications in mind. The writer has very much benefited from the research, the contacts and points of view of people closely associated with the preparation and development of national standards.

Recently published material, from technical journals on the subject of standards, codes and specifications has been relied upon in order to present an up-to-date point of view which should have more immediacy than other publications because of the rapidly changing situation in the standards codes and specifications fields.

One has only to pick up any construction specifications and see the number of standards that are referenced to realize how the development and production, quality and timing, the revision of existing standards and new standards can definitely affect specifications and at the very least render them less voluminous.

The basis for standards then is that as documents, they provide solutions to repetitive problems arrived at usually by consensus, use a clear and consistent format, are of high technical quality and have an authority based on the reputation of the association responsible for their development.

What is covered in the succeeding chapters is that first of all, definitions of a standard and specifications are presented which have somewhat narrower but more precise meanings than the usual ones.

Then the U.S. and Canadian standards scenes are examined, international standards, to show how these standards will most likely affect specifications in the future and nuclear standards as examples of the rapid evolution taking place.

Examples of codes are given and how they are also affected by standards is shown. The principle of reference to standards and quality assurance provisions in specifications are examined. Development of company standards and the role that they play in specifications are studied. The standards engineer and management, how they can also affect the development and production of standards is brought out.

Finally, the ways standards can be handled in contracts and in specifications are investigated.

It is believed that the compressing and synthesizing of the excellent material on this broad subject, should serve to provide an overview of the whole field, indicate not only the role but the importance that standards and codes have now, and will have in the future in specifications and some of the implications for national interests.

CHAPTER 11

DEFINITIONS

It is felt that the importance of being on one's guard against several overlapping meanings of the terms, standards, specifications and codes, cannot be over-emphasized. For example Mr. J.J. Riordan [1] in ASTM Standardization News states:

> Standards and Specifications - Even the most casual review of these efforts, indicates that there is little agreement on exactly what these words mean and how one differs from the other.

In spite of this lack of agreement, two broad definitions of the International Organization for Standardization (ISO) have received wide acceptance and are presented here as a basis to arrive at specialized definitions of these terms as applied to construction specifications. According to ISO a standard is:

> The result of a particular standardization effort, approved by recognized authority. It may take the form of:
>
> 1) A document containing a set of conditions to be fulfilled (In French "norme").
>
> 2) A fundamental unit or physical constant, for example, ampere, metre, absolute zero (Kelvin) (In French "etalon").

And a specification is:

A concise statement of a set of requirements to be satisfied by a product, a material or a process indicating, whenever appropriate, the procedure by means of which it may be determined whether the requirements given are satisfied.

Notes (ISO)

1. A specification may be a standard, a part of a standard or independent of a standard.
2. As far as practicable, it is desirable that the requirements be expressed numerically in terms of appropriate units together with their limits.

In the context of this report, the meaning of a standard leans on the first form of the ISO definition, which would be a document specifying in detail a required test method, product quality, code of practice or a recommended practice that is standardized by the act of publishing such a document by a recognized international, national, industry or company body prepared by specialists in particular fields but, reflecting a balance of special interests arrived at by consensus.

The consensus principle (2) implies the largest possible agreement among all the interests concerned which is different from the concept of a simple majority. The need for a standard is often established in that it brings a generally acceptable solution to a repetitive problem. A further definition concerning company standards will be presented in Chapter IX. Suffice to say at this point that some standards are called standard specifications to differentiate them from other standards on test methods, recommended practices, classifications and definitions.

The terms construction specifications, have a more specialized definition than the ISO definition of specification, and are that part of the tender or contract documents, specifying materials, products and equipment, assembling instructions and other conditions governing the execution of the work.

Construction specifications would normally exclude the general conditions and special conditions but, include the technical specifications, describing solely the technical aspects of the work, and sometimes designer's standard specifications. Thus, construction or contract specifications are in fact usually the technical specifications part of the contract documents but may include the standard specifications, special conditions and in some cases the general conditions.

AFNOR, the French Standardization Society, resolve the dilemma between standards and specifications by naming all its standardization documents, standards without repeating in the text that they are standard specifications, test methods or standardized products.

The point being that in a standard everything included in the document is standardized without having to repeat this fact in the text.

The word "standardization" itself, can be a semantic trap. In the context used here, it will mean not only uniformity but the act of developing a standard (as a document). However, standards as documents do result in uniformity by limiting the multiplicity of practices, products or materials.

The Department of Commerce, "Metric Study on Engineering Standards" (3) prepared for the U.S. Congress in 1971, brings out very dramatically the important concept of agreements, consensus or joint decisions necessary in the development of standards, by tracing the existence of this concept, which limits the multiplicity of practices, products or materials, to one or a certain number, as follows:

> If these agreements, consensus or joint decisions relate to social behavior they are called laws, regulations or legally adopted codes; to religion they are called canons; to manufacturing, testing properties and performance of materials or practices, they are called variously standard specifications, or standards of practice (often called codes of practice) which are grouped under technical or engineering standards.

Thus, to the specification writers and users of specifications, in spite of J.J. Riordan's statement of the lack of agreement, the meaning of a standard (as a document) and of construction specifications (as part of the contract documents) and a legally adopted code (as a regulation) should not be confused with other more general meanings of these terms.

In Canada and in the U.S., the application of standards is generally voluntary but may be made mandatory by being incorporated into contract specifications or into legally adopted codes, such as the Quebec and Ontario building codes and other provincial or municipal codes.

In France, with its government controlled standardization body, some standards are issued which are mandatory. In the U.S. and Canada, only a few standards mostly in the area of safety are mandatory.

It should be noted that a distinction has been made here between legally adopted codes adopted by a government and codes that are really standards, since in the nomenclature of standards, many standards are called codes or codes of practice, but they are not mandatory in themselves.

CHAPTER III

OVERVIEW - U.S. AND CANADIAN STANDARDS

U.S. standards will be considered first in this Chapter in order to appreciate better the Canadian situation in view of Canadian dependence and use of U.S. standards.

In the U.S., the situation appears to be one of proliferation of standards. Mr. E.J. Struglia, in his definitive work on "Standards and Specifications Information Sources" (4) published in 1965, listed as many as 250 associations engaged in making standards.

His work as reviewed by Mr. R.E. Gay, the managing director of the American Standards Association, now the American National Standards Institute, saw the proliferation of standards and of standards-development associations as the result of the free enterprise system. Mr. Struglia, on the other hand, because of this proliferation resulting in overlapping, and duplication, envisioned the standards situation in the U.S. then as a "jungle enshrouded in a light mist". He foresaw the need for a rational system of standards, that is to say a system that coordinated their development under a single authority and the need for an understanding of the role and importance of standards by the public.

What is the present situation in standards? Although there have been improvements, Mr. Struglia views still appear to be valid. A recent "Metric Study of Engineering Standards" (3), mentioned in chapter II, which was submitted to the U.S. Congress in 1971,

brings out the following important points:

1- Engineering standards are voluntary and their effectiveness depends on the extent that they are included in Government contracts.

2- There is not and has never been as yet a single organization covering the entire field of engineering standards in the U.S.

3- Standardization activities have grown without coordination and have been fragmented among more than 400 standardizing groups (includes non-engineering standards).

4- Only a small portion of national standards issued by about 40 member organizations are coordinated by the American National Standards Institute (ANSI). Food, drugs and other biological materials are not included in the scope of ANSI.

5- Fragmentation and lack of central responsibility have led to duplication of effort and confusion.

6- It is stated that there are 20,000 national standards in the U.S. (including standards of all kinds, as well as those concerned with food and clothing).

7- Standards development is costly because of laboratory work, investigative and committee work required to support the standards.

More recently, Mr. W.H. Rockwell, director of certification and resident counsel of the American National Standards Institute (ANSI), declared in the June 1974 issue of Standards Engineering that: (5)

"The proliferation of individual standards and guides both in

government and private sectors have now reached unmanageable proportions".

W. McAdams [10] in the January 1973 issue of ASTM'S Standardization News, really comes to grip with the problems of standards in the U.S. when he contends that the American National Standards Institute (ANSI), which is supposed to be a strong coordinating force in standardization, is not, even if ANSI member bodies like the American Society of Mechanical Engineers (ASME) and that ASTM say it is so. It seems that the reason is, that ANSI does not have the power to decide which standards developing body should write a standard to avoid duplication of efforts. In 1974, Dr. F. LaQue, [7] a former president of the International Organization for Standardization (ISO) expressed much the same idea when he maintained that there is a need for some form of official recognition of the responsibility of ANSI to serve as the national standards body of the U.S. Also that, there is a lack of a single set of national standards in the U.S. contrary to the situation in many other countries, where only one or a few organizations produce national standards. Over and above those approved by ANSI, there are ASME, ASTM, National Fire Protection Association (NFPA), Society of Automative Engineers (SAE) and many others. Therefore, it is hard to explain why a good ASTM standard is not an ANSI standard because nobody got around to including that standard into ANSI.

A quick inspection has been made of the U.S. standards system. It can be seen that some work remains if the U.S. is to have a truly effective national standards system able to act decisively on the national and international scene.

The Standards Council of Canada is the Canadian counterpart of ANSI but with the very important difference that it was created by act of Parliament and as such represents Canada. It coordinates standardization through what the Council calls, autonomous "standards-writing organizations", to form the national standards system at the national level.

In 1964, the Canadian Government began to realize the importance of international standardization and Canada's participation in the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) along with the question of metric conversion which was coming into the picture. At that time, there existed the Canadian Standards Association (CSA) a private non-profit organization created in 1919, having produced about 1200 standards, mainly in the electrical field with some mechanical and civil standards. There was the Canadian Gas Association concerned with gas fired appliance standards which were then published by CSA. There was the Canadian Government Specifications Board (CGSB) which produced standards for the Canadian Government departments to facilitate purchasing, but which were used by the private sector as voluntary stan-

dards. A few other organizations, such as the Underwriter's Laboratory of Canada (ULC) operated test laboratories on fire safety. In the background were the ASTM, ASME, SAE and other U.S. standards being used in Canada. Hence to bring all this together and to be able to speak with one voice at the international level, the Standards Council of Canada was created by act of Parliament in 1970 (8).

The Standards Council has been considering adopting (9) some ASTM or even British Standards Institution (BSI) standards as approved Canadian standards. Although CSA itself has adopted a few standards in this way to put this into practice might present difficulties in that foreign standards are made up at least in the case of ASTM, by interested parties in the U.S. and not always from within Canada. Using this approach could lead to dependence on the subsequent revisions and the decisions of the committees that produced the standards. The laws, contracts and safety regulations are different from those in this country and appear in the contractual clauses of U.S. standards, also other referenced standards and even codes within the standards can be less applicable in that they may refer to U.S. practices and regulatory codes.

Furthermore there is no question here about voluntary standards arrived at by a consensus of the interested parties since they have been adopted and issued outside of Canada. But might not the same argument be advanced for the host of ASTM standards that are used

as such in Canada without of course being adopted as national standards? The answer is yes. Another point is that they are good technical documents which have a lot of prestige, but some are being questioned and thus they could be better. An interesting possibility is that contracting parties do not often go to court over these standards where the fine points would be examined and no doubt, in many cases, contradictions, would become apparent, since as mentioned before, many safety regulations and other referenced U.S. codes are simply not applicable in Canada.

As we have seen, the American National Standards Institute (ANSI) which has as its aim, the promotion and coordination of the standards effort, in the U.S. has no real authority over all national standards, and because of this it is not quite the same system as has been established in Canada under the Standards Council. In fact it does not represent the U.S. Government when dealing with international standards.

While the U.S. has not obtained so far the system that Mr. Struglia foresaw, Canada has attained at least the framework of such a system and the "jungle" is much smaller than in the U.S. In fact, the Standards Council of Canada was created to establish the national standards system consisting of several accredited standards-developing (or standards-writing) bodies. At the international level the Standards Council represents Canada and speaks with one voice for all of the accredited standards-development organizations in Canada.

CHAPTER IV

INTERNATIONAL STANDARDS

The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) are the important names in international standards.[16] They have issued together 3,000 international standards. They have also acted in concert, for example, in the important code of principles of "Reference to Standards" discussed in Chapter VII, published as a joint statement by the two societies.

A few words should be said here about IEC because, it was the first international society involved in standardization work about the turn of the century which had a great impact on the whole field of electrical engineering. As Dr. G. Palandri, the incumbent president of IEC (1974) has stated:[9]

> The electrical trade in electrical goods could not have occured without some centralization body for worldwide norms and that body is the IEC.

IEC standards cover electronic components and assemblies in radio, television, communications, where recently a major breakthrough has been taking place in the area of internationally accepted quality assurance programs, standard test methods and materials in electrical engineering. Its standards also cover performance, safety, reliability on the application of electrical power and control in buildings, ships, trains, etc...and in process control, welding,

heating, refrigeration and air conditioning.

The U.S. point of view at IEC is expressed through delegates to the IEC technical committees from a National Committee which as in other countries is an official member body comprising producers, users, government bodies, and the scientific community. In the U.S. the National Committee is affiliated with the American National Standards Institute (ANSI) on a cooperative basis. All correspondance is handled from IEC head quarters in Geneva.

As for quality assurance at the international level, IEC is presently looking only at electronic compon nts. This is to become a product certification system. Twelve countries were reported participating in 1974 (10) including Japan. It seems that the input in this certification scheme will be the BSI standard 9,000 by the British Standards Institution and the MIL Specifications of the U.S. Military. At this point it is not known whether CSA will provide some Canadian input through the Standards Council.

France is fully aware that its national standardization system under AFNOR publishes standards that reflect national interest and policy. Mr. W.McAdams (10) an expert on international standards has promoted the idea that the U.S., to improve its export position, must meet world standards in order to sell, and to insure this he claims that the U.S. must be at the conference table. If one is not at the conference table to present one's case, then standards are conceived, which for a non-participating country can be difficult, costly or impossible to meet, once the standards are established.

Mr. W.McAdams, (10) also contended in an article on the "Four Worlds of Standards" that little use of international standards is made in the United States (1973), and that many countries within Western Europe, believe that new standardization should take place at the international level first.

Supporting this idea and parallel to it, is an organization called the Pan-American Standards Commission (COPANT) of which Mr. Felix Von Ranke, (11) feels that COPANT acts as a unifying standards body in North America with the stated objective of "the implementation of standardization on the American Continent". It has been active also through the Organization of American States of promoting training courses on standards work with representatives from seventeen Latin American countries. COPANT has a direct "liaison" with ASTM committees, for example, ASTM- B-5 on Copper. The point is, that this is a standards organization that is in its own right represented on U.S. Standards Committees of ASTM. It comes therefore to ASTM not as an individual, but as an organization. Hence one can only suppose that its representation must be stronger than that of an individual.

Mr. R. Hennesy, executive director of the Standards Council, (12) in considering the question of adopting of ISO Standards by Canada, indicated that perhaps we should go to the international level and bring back a standard to which we contributed and use it nationally, which is presently what Denmark is doing.

At the international level Canada recognizes also the implication of participating and being able to influence the content of international standards, as indicated by Mr. M.J. MacKerrow, director of the International Standards Programs for the Standards Council of Canada, who stated in the May 1974 issue of Consensus: (13)

> Any effective standard whether national or international contains in some degree the basic elements of definitions and terminology, product description, acceptable performance criteria and test methods and procedures. To be able to influence content of any one of these elements in an international standard is to preserve the opportunity to compete.

While on the subject of the content of standards, a word should be said about the European Standards Coordinating Committee (CEN). As soon as the European Common Market was launched in Rome in 1958, a Committee was formed in 1960 for the coordination of standards within the common market countries. Mr. Samuel F. Etris (14) indicated in an editorial in ASTM Standardization News, October 1974, that the regional system represented by CEN, now exerts a dominant influence on standards produced by ISO. It would appear from what Mr. Etris said in his editorial that the U.S. is getting outright opposition from the European members of ISO.

As several articles on ISO infer, (16) secretariats and technical committees are where the influence of the participating country can be brought to bear. And it was still true in 1974 that the majority of technical

committee secretariats were held by West European Countries at ISO. This position appears to be subtantiated by the important metric study report of the U.S. Department of Commerce [3], which actually goes further in saying that not only representation on technical committees is required, but that task groups of those committees developing the initial draft have the greatest influence in selecting the particular practice that is to be a standard. Furthermore the report (1971) concluded that a critical decade is ahead for the U.S. in the international standards fields.

Another important point is that ISO has produced about 2,500 international standards. It is th largest international organization in standardization and hence in technical and commercial cooperation. There are eight ISO meetings taking place each working day of the year somewhere on the earth. This is good enough reason to give ISO due consideration in this report. It is thought that a few more figures might help to give some perspective of what is believed could be very soon a bigger role for ISO. In the world there are at least 200,000 national standards in existence. The ISO central secretariat maintains however that there is a need for 10,000 ISO standards of importance to world trade of which 2,500 are published and an additional 3,000 are being processed or planned with a rate of production of 500 per year, but with a time lag of three or five years from first discussion to final standard.

ISO controversial objective is the preparation of product standards with the avowed purpose of removing technical trade barriers.

It is significant that the representative from Australia at ISO, Mr. W.I.Stewart, views the situation in this light: (17)

> We see the need for international standardization more immediately and more clearly than most other countries of the world.

The Australian industry has been obliged to furnish raw materials, semi-finished products, to standards imposed by overseas principals. Unfortunately, it has been difficult to make extensive use of ISO standards because of the lack of recognition by ISO of the U.S. practices and expertise which have influenced Australian practice.

The numerical distribution of ISO secretariats, technical committees, sub-committees and working groups, as of December 1973, was 1,062 Europeans and 207 others which included the U.S., Canada, India, Australia and Japan. A criticism of ISO is that the secretariats combined with a numerical majority, can pretty much influence the processing and content of a standard.

The reason for the lack of North-American influence it seems has been the failure of American Industry and Government to take an interest in ISO and also the lack of Government support for ANSI.

While one can understand that people in ASTM maintain that many ASTM standards are accepted practically as international standards, it is difficult to imagine how an ASTM standard can become directly an ISO standard without change in format for the same reasons put forward elsewhere in this report when examining the possibility of Canada itself adopting ASTM standards. However, this in no way prevents the use of ASTM

standards as a basis for an ISO standards and the use of the technical content. This is precisely what is being done by the Technical Committee ISO/TC 28 on petroleum products where ASTM test methods are being used.

A new development which seems to give support to the point of view advanced by many regarding the increasing importance of international standards, is that the General Agreement of Tariffs and Trade (GATT) through its treaty organization is in the process of hammering out a "Code of Conduct for Preventing Technical Barriers to Trade" which will probably provide for adoption, (use and enforcement with quality assurance systems) of what will be mandatory international standards and the promotion of voluntary international standards by member countries.

On the other hand, it would seem logical to initiate outright adoption at this time of international standards as a national standards rather than wait on the GATT agreement. This is precisely the way chosen by some European countries, including Denmark. Mr. R. Henessy [12] again on this subject, reported in ASTM standardization news, October 1974, that in Britain while so far, there was not outright adoption but international standards were given preeminence of place over national standards. In Canada, it is not known what the situation is exactly, but it is possible only a few international standards are being used at this time which include two IEC standards for testing hydroelectric equipment. It appears that the Standards Council of Canada has a policy of encouraging the adoption by the standards - developing organization of international standards wherever Canadian practices and conditions will permit.

Therefore as has been indicated there appears to be growing support for international standards and increasing importance of ISO and IEC, as mentioned previously, the development by GATT of a "Code of Conduct for Preventing Technical Barriers" to trade which when and if generally accepted, will bring pressure to bear on the almost obligatory use of international standards. Therefore, countries like Canada involved in world trade undoubtedly will be stepping up there representation at ISO and IEC.

CHAPTER V

NUCLEAR STANDARDS

If one examines the U.S. nuclear standards scene, it is immediately apparent that there is a great demand for new standards. Dr. John C. Green [18] mentioned in Standards Engineering, August 1974, that the former Atomic Energy Commission (AEC) reported that of the 1,200 existing standards applicable to nuclear work, 600 new standards were being developed and an additional 1,500 new or revised standards were needed. The program for the development of new standards was being managed by ANSI. About 10,000 people were involved and the program was reported to cost $300,000,000. with 80% of this supported by industry.

In 1972, the Canadian Nuclear Association (CNA) published a report by Mr. G. Hake, [19] of the Atomic Energy of Canada Limited (AECL) on "Engineering Codes and Standards for the Nuclear Industry". Mr. Hake emphasized the importance of standards needed for the Canadian nuclear program. The nuclear standards scene was reviewed in the United States as it existed at that time, before addressing himself to the Canadian situation then. General points are worth mentioning here. Nuclear standards development was insufficient to meet the needs of the industry and a sufficient number of competent people were not available for developing standards. Here one can appreciate the impact of standards engineers on the standards development machinery when or if called upon to

help in line with what will be discussed at some length in the Chapter X. It appears that, there was a need also for strong management support. It was mentioned that investigations had shown that only a few companies made highly qualified people available for "standards writing". It is believed that here again, we have a question of semantics, in that "standards writing" doubtless means the development and production of a document which is the standard itself.

At that time when AEC was in existence it looked to industry to produce standards, that is through ANSI. Industry ended up supplying and paying for the voluntary work required on committees.

Looking at the Canadian nuclear industry at that time with its reactors of the CANDU type, differing from those of the U.S., the question was put forward "Should not a nuclear code or standard applied in the U.S. have an equal applicability in Canada?" This seemed reasonable, since the Canadian program was smaller, more compact because of the decision made to go CANDU using natural uranium. But we were selling on the world markets and to use Mr. Hake's words: "We are in direct confrontation with the U.S.".

It seems our safety position was weak because our few codes, standards, and the little Canadian publicity that had been given to the CANDU project. The U.S. position on the other hand, was reinforced by what was claimed as "the almost global acceptance of the ASME prepared codes for nuclear pressure system components". A warning note was sounded however about "adopting U.S. standards for the Canadian nuclear industry unless they were appropriate and satisfactory". It is not certain whether the work "adopting" meant, referenced in construction specifications or

adopted as national standards.

It could be argued that the Standards Council of Canada itself should adopt as nuclear standards certain ASME standards in the national standards format, where these are needed, with whatever modifications are necessary to certain articles or terms in the preface of the new standards but not of course in the ASME standards themselves. However, such an approach might present too many problems when one considers the lack of significant Canadian representation present during the development of most ASME standards.

Mr. Hake also touched on the question of welding standards and foresaw modifications to the present CSA certification scheme, and the use of Canadian Government Specifications Board (CGSB) specifications for non-destructive testing, maintaining that provincial and Federal jurisdiction would be required in these areas. It is felt that these are important points. It does seem possible that in the case of welding standards, applicable to all kinds of structures under CSA wherein certification of welding companies and welders is performed by one of its subsidiaries the Canadian Welding Bureau, which alone administer welding standard CSA W 47.1, that the whole certification scheme for reasons of safety and control could come eventually under the various provincial jurisdictions. In the Province of Quebec, it is possible that welding certification standards could come soon under Quebec jurisdiction because the pressure vessel welding standards are already under its control.

Since 1975, the standards and codes situation has improved in the nuclear field. Three nuclear CSA standards, No. 287.1, 287.4 and 287.6 have

been published, also No. 289, on seismic design plus a fourth standard on quality assurance, applicable to nuclear construction.

Regarding the regulatory applications of these standards, it is not immediately clear how they are approved, since it was reported at the Canadian Nuclear Association (CNA) annual conference [20] held in Montreal, that the Atomic Energy Control Board and other parties having jurisdiction, presumably Federal and provincial, by being represented on the CSA committees would, "by doing so have given formal recognition to the codes and standards work as part of the licensing process".

Be that as it may, it would seem reasonable to suppose that licensing would involve formal acceptance of standards before referencing in the licensing regulations and specifications. Having licensing people on the committees however should make it easier to obtain a standard which would more easily meet with regulatory approval once the standard was published.

Mr. A.J.O'Connor, president of CNA (1974) [20] touched on the non-destructive testing examination for personnel under existing CGSB standards (the 48-GP series), the attemps to establish reciprocal arrangements with the U.S. and other countries, and the difficulties of attaining reciprocity (meaning presumably the use and acceptance of one another's code) between ASME codes and the American Society for Non-Destructive Testing. It was mentioned that a group representing provincial authorities and AECL were looking at a possible qualifying procedure for manufacturers, similar to the ASME "U" and "N" stamping

of equipment which would be an aid in accepting equipement in conformity with construction specifications and standards.

The CNA expressed the hope of using CSA standard Z 299, on Quality Assurance for use in purchasing specifications for electrical equipment. Purely, nuclear equipment would be covered by the CSA N 285 series.

It was emphasized by Mr. O'Connor that in selling CANDU reactors, the need for Canadian codes and standards was urgent.

Here the use of the word "codes" could cause confusion (it is understood however that the format would usually be in code form ready for legal adoption). For example, in the preliminary nuclear standard on concrete containment structures N 287.11 - 1975 it is stated that "this standard is the first in a series which together will form a code". Again the word "code" gives the impression of being by itself regulatory or mandatory. In another nuclear standard CSA N 285-4 , 1975, in connection with the inspection of nuclear power plant components, great pains are taken in the Foreword, to indicate that it is not legally adopted, which is true of all voluntary standards, namely: "That it should be understood that this document does not have force of law until adopted officially by the authority having jurisdiction". And a further warning: "also that the authority, even though having adopted it should be consulted as to the extent of such adoption; as the standard may have been adopted with exemptions or additional requirements".

CHAPTER VI

CODES

Basically, there are two kinds of codes: one kind being a legally adopted code such as a building code, or a safety code; the other kind is really a compendium of recommended practices. Such codes of recommended practices are actually voluntary standards. Looking at the Canadian Standards Association (CSA) catalogue of publications, it is immediately apparent that there are great number of codes which are really CSA standards and hence are non-mandatory. One exception in the building codes is the National Building Code of Canada, although in a format ready for adoption is not a legally adopted code, until adopted by a province or a municipality in Canada. Thus provinces and municipalities may have their own building codes based on the national code, with or without modifications.

In spite of the fact that the national code has not been legally adopted on a national basis throughout Canada except individually by various provinces, doubtless because of provincial jurisdiction in the area of building construction, it serves an extremely useful purpose in creating uniformity in the building codes throughout the country. In spite of its non-mandatory minimum requirements it is often referenced in construction specifications forming part of a contract which then make its specified requirements binding on the affected parties. It has over the years obtained considerable recognition and authority in the

building field due to its high technical quality.

The concept of the National Building Code as a recommended document, in promoting code uniformity throughout the country is different from that in the U.S. where there are at least four major building codes, such as the Uniform, Basic, National and the Southern Building Codes. There are also many other codes in use within each state which create disparities and high costs.(21)

Once a comprehensive building code is adopted by a province there is not much choice as far as the building specifications are concerned. They must be in line with code requirements. Hence it is not usually necessary to refer continuously to the code in construction specifications inasmuch as the necessity of meeting code requirements is usually covered in the general conditions of the contract documents.

The National Building Code, the different provincial and municipal codes, reference standards which would become binding, once the codes have been legally adopted. The City of Montreal as discussed in Chapter VII, keeps on hand copies of all standards referred to in its By-Law 1900.(22) This is most likely to make it clear that these standards are very much part of its building code.

Building codes usually will reference other codes such as plumbing or heating and air-conditioning codes, which if not legally adopted i.e. voluntary standards, would be made binding by being referenced in a building code.

It has not been possible to determine if their exist jurisprudence on the legality of referencing standards in legally adopted codes and contract documents. In view of the stand taken by the Standards Council, it is believed to be the case or at least to have general acceptance. The principle of reference to standards when adopted by the Federal and provincial governments should however normalize this situation as outlined in Chapter VII.

A distinction has been made between codes of recommended practices and legally adopted codes. Several types of codes will now be considered in more detail with a view of showing the effect they may have on design and specifications.

Design and Construction Codes

The National Building Code of Canada and the provincial codes including the Quebec Building Code, using the national code as a basis, have minimum requirements for health and safety as regards permissible types of construction, fire protection, quality of materials, mechanical, electrical and plumbing services and other equipment. Structural design, including snow, wind and seismic considerations, wall cladding and roofing are also considered. It is published by the National Research Council under the direction of an "Associate Committee" which is composed of twenty-four members acting as individuals. The object is discussing some of the design and construction codes in detail is to give some background on their good points and limitations, when one should use them, and when one is not obliged to use them. For example, the impression seems to exist that the ASME Boiler and Pressure Vessel Code should be used to design hydraulic penstocks which can

result in very conservative designs. The objective of this section then is to bring out important points of interest to specifications work in that these codes while non-mandatory in themselves even though well recognized and have great authority, it may not be absolutely necessary to use them to their full extent as long as one knows what one is doing.

On the other hand, when a standard is directly applicable to a project, for example CSA S 6 on the design of highway bridges, while not mandatory in Canada or the Province of Quebec, it is a highly regarded authority and its application would be necessary.

Concrete structural design is covered in the national code by referring to national standards for concrete such as, the Canadian Standards Association (CSA) standard A 23.3-1973 and others. In the U.S., the building code of the American Concrete Institute (ACI) standard ACI 318-71 is used extensively and although it is a voluntary standard, its format makes it ready for adoption into a legally adopted general building code. Thus in the U.S., the concrete design part of the building code doubtless has attained uniformity across the country through the efforts of ACI. The 1971 ACI code emphasizes a number of points that are worth noting. It takes precedence over the rest of the general building code in matters of design and construction. Structural drawings are to bear the seal of a licenced (by the state) engineer or architect. Concrete construction is to be inspected by the engineer or architect responsible for the design. A general requirement is made

regarding all standards referred to in the code declaring them: "to be a part of this code the same as if fully set forth elsewhere herein". About forty standards specifications are listed as being referenced in the code. It is a question of semantics but it would have been more accurate to call them just standards, since test methods and definitions were also included in the list. As mentioned in Chapter II of this report it could be a move in the right direction just to use the word standard in describing a document standardizing something, such as a specification or a test method.

What then is the situation in Canada as far as concrete design requirements in the National Building Code and provincial building codes where CSA A 23.3 is referenced? The CSA special publication A 23.3.1-1974, which is a commentary on the code for the design of concrete structures gives an insight into the reason for a Canadian design code, which could also provide answers to the need for other Canadian standards. The standard ACI 318-71, was used as a working document in preparing CSA A.23.3, but there are differences in detail; for example CSA 23.3.-1973, uses ultimate strength design instead of working stress design in line with the practices of most other countries. Thus the ACI "Alternate Design Method" based on working stress, was not incorporated. A modified column design (so-called R method) used in ACI is not included. Canadian users, industry and experts are represented. CSA format, definitions, terminology, international notation system (also used in ACI in this case), compatibility with other CSA standards are part of the standard.

Furthermore the referenced standards for materials in the code are CSA standards as much as it has been possible to utilize them.

Structural steel is covered by the much used CSA standard S 16-1969 (working stress design) Steel Structures for Buildings and the recent S16.1 which is less used. There is no U.S. counterpart in ASTM or ASCE, except for the well known standard of the American Institute of Steel Construction (AISC) (a private organization) entitled: Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

The use of these CSA standards makes a lot of sense in that Canadian users, steel manufacturers and technical expertise are represented. Apparently, the 1969 Edition of S16 has been allowed to become out-of-date except for a 1975 "Supplement", the standard has not had a major revision because of its planned eventual removal and replacement by S16.1. For example, an appendix which is part of the standard, refers to the "Code of Standard Practice for Structural Steel for Buildings" and covers the erection of structural steel, published by the Canadian Institude of Steel Construction (CISC) which itself has been revised several times. The S16-1969 standard for structural steel has not to our knowledge been revised in the light of recent revisions of AISC bolt specifications called "Specification for Structural Joints using ASTM A-325 and A-490 Bolts".

Standards are also referenced in the building codes covering other structural materials such as aluminum and wood.

As for building services, provincial plumbing, electrical, and even construction safety codes do exist. In the National Building Code, the Canadian Plumbing Code and the CSA electrical code are referenced. For the first time, the 1975 national code makes reference for design and installation, to the Canadian Heating, Ventilating and Air-Conditioning Code - 1975, published by the National Research Council of Canada. On the surface this seems like a significant step since the national code in the past simply referred to good engineering practice and to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) hand books.

What has been done however, is to simply transfer these requirements after some modifications from the general part of the code (1970 code) to a separate one called the Canadian Heating, Ventilating and Air-Conditioning Code. Even though the new code leans heavily on the technical competence of ASHRAE, it is an important document just the same, and a logical development permitting special requirements for building services to stand on their own feet just like the electrical and plumbing codes. Perhaps provincial assertiveness may become necessary in this area if one thinks of conservation of energy, and provincial adoption of the electrical and plumbing codes.

It is believed that, the creation of a Canadian Heating, Ventilating and Air-Conditioning Code at the national level will be welcomed by specification writers, not because they like mandatory requirements, but this code, like the National Building Code itself, should bring about more uniformity in provincial requirements throughout Canada.

On the subject of conservation of energy, it is noted that the U.S. Engineering News Record of May 1, 1975, reported that the U.S. "Senate Passes Sweeping Energy Conservation Bill for Buildings" (23) which would force code changes affecting all new residential and commercial buildings if approved without modification. It seems local code writing authorities of which there are many, would have to change their codes to meet specifications written by the Federal Department of Housing and Urban Development (HUD).

The proposed legislation directs HUD to establish new standards composed of component performance standards for new residential construction including such elements as windows, walls and mechanical equipment and also performance standards for energy consumption in commercial buildings.

The Canadian Electrical Code, part 1, called "Safety Standards for Electrical Installations" prepared by the Canadian Standards Association (CSA) C-22.1-1975 is concerned with safety standards for the installation and maintenance of electrical equipment. It is stated that it is not intended as a design specification. While it is not the intention to use it, it is believed that in actual fact the design engineers use it as such continuously. While numerous people representing many interests such as manufacturers, suppliers, contractors, public utilities, municipal, provincial and Federal governments are well represented on the code committees, there is in fact little representation by the professional societies, such as the Canadian Council of Professional Engineers, other engineering societies or associa-

tions except the Association of Consulting Engineers of Canada, in the published list of the committees appearing in the 1975 edition of the code.

However it is noted that on the Main Committee, labor is represented by the International Brotherhood of Electrical Workers and rightly so.

It is believed that a case can be made for increased representation by the professional societies to make their views known which would have an influence on the electrical code. The titles of two sections from the code show the possible effects on design and building specifications; Appendix F-" Graphical Electric Symbols for Architectural Plans (p.443)" and Appendix G A Suggested Method for Air pressurizing Electric Wiring Systems and Equipment in class 1 Hazardous Location (p.447)". A further consideration in this code and for some of the others such as the elevator code and the boiler code, is that being CSA standards they are voluntary standards and have a fairly complete balanced representation of various interests on the committees. This has a good effect on the provincial mandatory codes preventing them from sinking into permanent rigidity because the revised standards become the revised codes.

Further evidence of the apparent exclusion of the design aspect of electrical installations seems to be supported by the National Building Code itself, 1975 edition, wherein it is indicated that the installation (the design is not mentioned) of electrical equipment is covered by the CSA standard C 22.1 1975.

Canadian Standards Association CSA B 51 1972, Code for the Cons-

truction and Inspection of Boiler and Pressure Vessels, is referenced in the National Building Code and in the provincial codes. It is based on the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code which is also an American National Standard (ANSI) in that the design, fabrication, installation testing and inspection of boilers, pressure vessels, piping and fittings are to conform to the applicable ASME code sections. One thing that has to be recognized is that provincial representation exists on the ASME Conference Committee and all the provinces of Canada and each state are represented. But little Canadian representation seems to exist on the Main Committee which sets policy and implements the action of its subcommittees.

As can be expected there is real effort on the part of ASME to harmonize ASME standards with ASTM standards and with the American Welding Society (AWS) Welding Code.

The stated purpose of the ASME Boiler and Pressure Vessel Committee is to initiate safety rules for the construction of steam boilers and other pressure vessels. Furthermore consideration is given to the views of the users, manufacturers and pressure vessel inspectors in code preparation.

The ASME has code symbols for making boilers, pressure vessels and nuclear power plant components issued on compliance with all its marking requirements. But it does not approve, certify, rate or endorse; only that products are built in accordance or meet the requirements of the code.

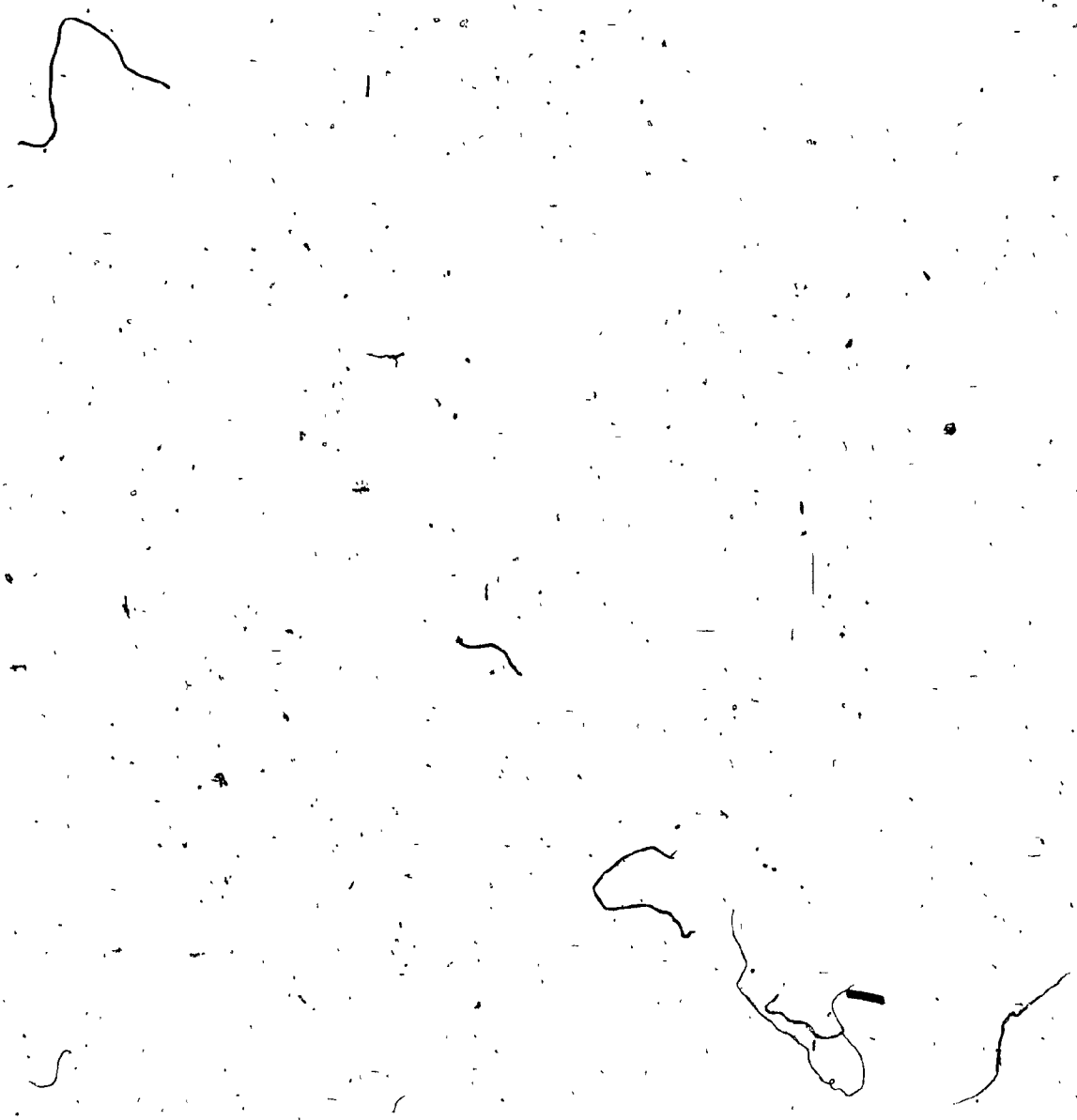
Another CSA code that is referenced in the National Building Code of Canada is the elevator code CSA B 44-1971, which is a standard of the Canadian Standards Association (CSA). This standard is used by provincial authorities as the basis for a provincial legally adopted code, as for example, the Quebec Elevator Code. Here as in other codes, the standard provides the necessary input for the code, including a document in a format easily adopted, by legislation as a legally adopted code.

In the case of the CSA standard B 44-1971, like most of the other codes it applys to the design, construction, installation and alterations of elevators, dumbwaiters and escalators. It is a complete code in itself, not a copy of an ASME Code or others.

On the other hand, the plumbing code of the National Building Code referenced as the Canadian Plumbing Code, is a code like the electrical code, where previously, design requirements were omitted and only construction, extension and alterations were included. However the 1975 code now incorporates design requirements which for high rise buildings, plumbing, including piping, can be complicated indeed. Quebec as well as other provinces have their own legally adopted plumbing code which does not seem to be based on the Canadian Plumbing Code.

A construction safety code actually referenced in the National Building Code is the Canadian Construction Safety Code 1975 which is concerned with safety and protection of the workers during construction,

excavation and demolition. Here also, at least in the case of the Province of Quebec, the legally adopted Quebec Construction Safety Code is not based or dependent on the Canadian Construction Safety Code.



CHAPTER VII

REFERENCE TO STANDARDS

The principle of "Reference to Standards" as published jointly by the International Electrotechnical Commission (IEC) and the International Organization for Standardization (ISO) appeared in Le Courrier de la normalisation, [24] in January 1974, and in BSI News of the British Standards Institution and in ASTM Standardization News, in October 1974. [25]

The promulgating of the principle jointly by the two international bodies, was an important step in rationalizing the principle of reference to standards in legal documents such as codes and other regulations. The use of the principle avoids the necessity of writing separate special technical specifications, already covered by standards.

The version which appeared in Le Courrier de la normalisation began by stating:

> The advantages of the principle of reference to standards in legislation and regulations are now well known among government agencies...

Briefly they are the advantages that accrue when technical requirements are expressed using standards in codes or in other regulatory documents which results in similar benefits as the use of standards in specifications. In the case of legislation, the work is simplified, speeded up, obstacles to commerce are reduced (if international standards are referenced) better up-to-date technical results are obtained.

In the text, ten additional "principles" were mentioned. Five were concerned with the development of international or national standards in response to the desire to use the principle of reference to standards. Five were concerned with the collaboration of the international societies with the national governments in the preparation of standards. Members of ISO and IEC, were asked to extend an invitation to their respective governments to accept these principles.

From readings in the Courrier de la normalisation, (26) the "Principle of Reference to Standards", appears to go back to about 1971 when a document was proposed for approval by ISO entitled "Application du principe de référence aux normes pour surmonter les barrières tarifaires au commerce".

In this document prepared by a Committee of ISO on certification, CERTICO, more complete explanations were given of the principle with a view of removing trade barriers. Some idea as to its origins was given, beginning from 1971, when it had just been adopted by the Western European Countries under the European Standards Coordinating Committee (CEN) and was to be discussed along with the General Agreement of Tariffs and Trade (GATT).

Basically the principle once adopted means that in legislative, regulatory procedure or control, a precise reference to a standard is made, which has been prepared as a voluntary international or national standard. The reference to standards means that all the interested parties, users, specialists and authorities, having jurisdiction have been consulted. The reference to standards assures that, technical

changes can be produced without revising the legislation, if reference is made in such a way that revisions to the standards are foreseen, which could be by referring to the latest edition of the standards or by some other mechanism.

What does all this mean as far as specifications are concerned? A great deal. For the first time the "Principle of Reference to Standards" will have legal support in many countries. It is believed that in North America, at least for all practical purposes, the idea behind it has been applied for a very long time, but not in formal way and perhaps without an awareness of its many implications.

In all kinds of specifications, within individual standards and in legally adopted codes, references in many ways are made to standards. It could be argued that the reference approach is only common sense. But, because it has not been thought out and embodied in a formal set of principles, there has been misuse due to lack of understanding in specifications and code writing. For example some specifications will mention that all applicable CSA standards are to govern the work without taking the trouble to identify the particular standards. Others, will specify a kind of or equal standard so that equipment built to say a British Standards Institution (BSI) standard may be acceptable in that a CSA and BSI standard are both referenced. This seems to be like writing two sets of specifications upon which a decision will be based once the bids are received. This brings up all kinds of possibilities, one which is that one of these standards may be less demanding than the other.

Mr. H.J. Rosen, [27] in his book "Construction Specifications Writing" 1973, covers the subject in this way: for example instead of describing ASTM C150 on cement in detail, he states that the specifier simply says that the cement shall meet the requirements of ASTM C150:

> By making reference to a standard, the standard becomes a part of the specification to the same degree as (if) descriptive or performance specification is used.

The Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC), gives some indication how standards are to be used and referenced in specifications in the CSI Manual of Practice and in their joint publication, the Uniform Construction Index. [28]

Mr. H.D. Hauf, [29] in his book "Building Contracts for Design and Construction" brings out this very point. "Referenced standards have the same status as they would have if reproduced in their entirety".

As discussed in Chapter XI, contract documents even in the general conditions rarely mention standards. No mention it seems is made that they form part of the contract documents along with the general conditions, special conditions, technical specifications and drawings. Therefore, it may be easy to say, as Mr. Rosen has done, that the standards are part of the specifications and this may be, but their status seems to be in a kind of limbo as far as the contract documents are concerned. Probably what has happened is that, rarely has the referencing of a national standard been questioned because of its authority based on user and other

acceptances and the high level of technical competence which it represents. However, the referencing of standards over the years and its unquestioned acceptance could change unless it is formalized in a principle which can be invoked when necessary. A case in point are the contract documents of a large engineering company, where it is stated in the general conditions, "that unless otherwise stipulated in the technical specifications the standards and codes are for information only".

In the case of another company, a clause of this nature in the general conditions of the contract documents has been revised. One reason that has been put forward for this situation is that standards, if incorrectly referenced can be put aside as not being applicable. Thus the onus is on the construction specification writer to state clearly that the referenced standards are requirements and not just information for the contractor to take it or leave it. The question arises which construction specifications would reference standards for information only? The answer is obviously none if one is looking for contractual obligations. Therefore, one can only conclude that the presentation of the principle of "reference to standards" and its eventual adoption by most countries will be timely indeed.[15] As far as Canada is concerned, recently the Standards Council of Canada,[31] encouraged all levels of government in Canada to adopt the principle. It is reported that an appropriate approach to implement it was to be developed during 1976-80 period.

CHAPTER VIII

QUALITY ASSURANCE

The subject of quality assurance invariably comes up in the preparation of standards and specifications. It is proposed to define some of the terms relating to quality assurance emphasizing the distinction to be made between it and quality control and identify some of the problems which can be encountered and possible solutions when preparing specifications. Quality assurance and its companion discipline , statistical methods are handled by a special guidance committee at ASTM constituted so that it can be called upon to assist the technical committees in these areas. For example, it is seen from the "Regulations Governing ASTM Technical Committees" (Sept. 1973) [30] that committee E-11, on statistical methods has as its primary purpose the role of advisor to ASTM Committees in connection with test methods, development, design of experiments and evaluation of statistical data.

In construction specifications, the use of statistical methods often has to be considered. At this point a distinction should be made between factory or production control (quality control) and acceptance control (quality assurance) of the product at the construction site or prior to delivery. With this in mind the following definitions are cited. The definitions are taken from the International Organization for Standardization (ISO) publication, "The Aims and Principles of Standardization" edited by Mr. T.R.B. Saunders: [32]

Quality Control

a) In the wider sense: the set of operations (programming, coordinating, carrying out) intended to maintain or to improve quality and to set up the production at the most economical level, which allows for customer satisfaction (which is rather long. Part (b) is more to the point).

b) In a more restricted sense: the verification of the conformity of a product to its definition or its specifications.

Statistical Quality Control

Quality control using statistical methods (such as control charts and sampling plans).

Quality Assurance

A system of activities whose purpose is to provide an assurance that the overall control of quality is in fact being carried out effectively at all stages.

Quality assurance includes the activities of inspection, sampling, testing, acceptance and rejection. Sampling as part of a quality assurance program is often called acceptance sampling as opposed to production sampling because more often than not, its aims are different being part of a production control program within plants, where for example, obtaining excessively high quality could be very costly, even though it might still satisfy the requirements of acceptance sampling.

Acceptance sampling then, if it is to stand up to close scrutiny should be based on probability theory so that valid conclusions can be drawn on as to the materials or products being sampled. Standards as documents concerned with quality assurance including those involving acceptance sampling are practical solutions which can be brought to bear on quality assurance problems in construction specifications. Standards on acceptance sampling describe the required preparations, precautions, selection and the number of samples needed to represent a lot of material or product.

At best quality assurance requirements and sampling requirements in specifications are difficult to prepare because they lead to the obligations of acceptance and rejection of materials and products. Specifying standards concerned with quality of materials, products and even of services should have a better chance of gaining the confidence of contractors as being fair and equitable than individual quality requirements made for each project.

Lists of standards dealing with quality have been published in the September 1976 edition of Quality Progress by the American Society for Quality Control (ASQC), which include standards by ASTM, ANSI ASME, ASQC, BSI and others[33]. AFNOR has also put out a list of the statistical control of quality in the November-December 1972 edition of the Courrier de la normalisation.[34]

Many of the standards in these two lists are concerned with production quality control in manufacturing plants, others are more general and are concerned with inspection and testing and the setting up of qua-

lity assurance programs within plants as required by construction specifications which will be dealt in more detail further on. A reading of these lists point out that, sampling standards are many and varied. Most of them are concerned with sampling for production quality control in plants and lean heavily on control charts for the acceptance and rejection of parts. Most of them no doubt, cannot be used for acceptance sampling as part of a quality assurance program.

A case in point is the well known military standard of the U.S. government MIL 105D, which utilizes sampling by attributes, a sampling method which uses as a basis good or bad, accept or reject situation, whereas another standard the MIL 414, sampling by variables uses as a basis actual test values or other variables. Both of these standards require the use of control charts and do not appear to be well adapted to acceptance sampling. In these two lists there are also specialty sampling standards, that is to say those dealing with bulk materials such as oil, gas, chemicals and cements and requiring standardized devices to draw the samples from tanks, silos and tank cars. Most of these specialty standards are designed for or can be used for acceptance sampling and hence as such, can be referenced in construction specifications. They do not for the most part make use of control charts but make use of sampling plans to determine the number of samples required, and use compositing of these samples to arrive at a final sample, which is taken to represent the lot of material in bulk. Some use the estimation of the mean of a determined number as sample values taken from the lot to represent the values of the lot itself. Finally in these

two lists on quality standards, there are a number of guide standards on the establishment of quality control and quality assurance programs.

A recent innovation in construction specifications has been to specify the setting up of quality control programs at different levels of sophistication depending on the importance or size of the project within the suppliers manufacturing plant by using quality control or quality assurance standards.

These standards have as their objective the implementation of quality control or quality assurance programs by suppliers according to certain fixed rules incorporated in the standards. These standards began with the standards of the military of the U.S. and Canadian governments, were adopted by Ontario Hydro as their QA-20 for use in the construction specifications of their nuclear installations. QA-20, was then subsequently adopted after modifications by CSA to become the four standards in the Z299 series, which are now being used in this new form by Ontario Hydro, Hydro-Quebec and other utilities and governments in their construction specifications.

These four standards permits the specifier of construction specifications to select varying degrees of control or assurance programs that the project requires from simple inspection programs to a complete quality control or quality assurance program. Once the program is set-up by the supplier as demanded by the standard specified in the construction specifications, the owner or his representative by predetermined checks ascertains that the program is being implemented and is functioning according to the standard.

In this connection Dr. A. Duncan [35] a statistician on Committee E-11 of ASTM indicated in the April 1974 issue of Standardization News, in an article on "Enforcement of Government Mandatory Product Standards", that the incorporation of a quality assurance program in a standard makes the monitoring procedure part of the standard instead of policing the requirements from outside the standard. While these are mandatory and product standards to be used in conjunction or referenced in the U.S. Consumer Product Safety Act., the same idea can be applied to the referencing of a quality program as a standard in construction specifications. Therefore, a quality assurance program can operate within mandatory standards in construction specifications, the enforcement agency or an owner need only check to see if the program is functioning normally as a main preoccupation, which is in fact the idea behind CSA Z 299 series of standards on quality control and quality assurance.

It is evident that the field of quality assurance is developing rapidly, standards bodies are looking closely at this field. For example CSA has indicated in its February-March 1977 Quarterly Review that, sampling criteria as part of a quality assurance program along with inspection, is being examined as to its role in their standards. It appears that there should be separation of sampling criteria, it is felt, from the specifications within standards. Undoubtly problems in specifying and implementing quality assurance can only be really settled in the long run by better quality assurance standards that can be referenced in construction specifications. Therefore, it seems evident that specifications on products and construction specifications are very much affected by standards on quality assurance or by the lack of these standard in certain

specialities. For example if a comparison is made with recent international standards it is quite evident that the paint sampling standards in Canada, do not provide enough detailed procedures to readily obtain a representative sample while in the U.S., ASTM has so far only a draft sampling paint standard which although more detailed as regards procedures it has so far not yet been published. Furthermore, possibly because of exaggerated practical considerations some standards have very rudimentary sampling plans.

The trend however, seems unmistakable, because to facilitate acceptance and rejection of products, materials and equipement on an equitable basis and for safety considerations which is especially true in the nuclear field, quality assurance standards including those elements concerned with inspection and sampling will be playing more and more a prominent role in construction specifications.

CHAPTER IX

COMPANY STANDARDIZATION

Company standards, including those prepared by public utilities and government departments, like national standards can be product or material standards, practices, recommendations, guides, standard specifications or standard drawings.

Furthermore, company standards also are documents, standardizing some product material etc., but prepared principally or exclusively for company use.

Another facet to company standardization is when certain parts of construction specifications are standardized and called standard specifications which may be the first step towards a company master specifications, i.e. a set of construction specifications adapted by editing the master to all company projects.

Here as with national standards the question of semantics is important. By the standardized specification will be meant a special kind of standard specifications in this chapter on Company Standards. It can be considered as being a standardized part of the construction or contract specifications which has in turn standardized the use of a product, such as certain classes of reinforcing steel or practices, such as methods of concreting, steel erection, painting or other work.

The establishment of company standards, including standardized specifications, is of some importance to specification writers because it reduces design time and costs [36] required to produce construction specifications which usually must be completed within a short time span.

Therefore, how well the company standards effort is organized to prepare standards, has a direct bearing on their availability and applicability for referencing which can expedite the work of preparing construction specifications.

Company standard specifications are the best solutions available, applied to repetitive problems using the company's best people. But is seems possible that the stumbling block in some companies is that management has not come to grips with the importance of standardization. Both Struglia [4] and AFNOR [37], whose books are referred to in this report, have foreseen this possibility. In fact Struglia quoting T.A. Marshall of ASTM says:

> A lack of proper understanding by management, and I mean high management, of the importance and significance of standardization...This lack of understanding affects every phase of standardization work.

The problem on the surface is deceptively simple. All that seems to be required is to issue directives or simply let the desires of different departments take their course.

One has only to think of the complexities on the national scenes in the U.S. & Canada, to appreciate the difficulties encountered by company management when it comes to dealing with uncoordinated standards development by departments often compounded by inter-departmental rivalries.

Perhaps management's difficulties, in part, exist because those

who prepare company standards are often an "unknown breed", to paraphrase Mr. R. Preston [38] in his talk given before the Standards Council of Canada in February 1975. He emphasized that support from the Standards Council in this regard could help the whole process of standardization within companies. Mr. Preston stated that the underlying problem was that "management generally haven't a clue of what standardization is all about". It seems possible that courses and seminars on standards could solve many of the problems with company standardization. In England, the British Standards Institution (BSI) has been offering courses to industrial standards engineers and management seminars on standardization for some time now. He felt that a national body such as the Standards Council of Canada should be in a better position through seminars to promote to management the cost saving potentials of standardization, than the standards engineer, whose work is discussed in more detail in Chapter X.

It is generally believed that the conversion to the International System of Units (SI) will stimulate interest and increase standardization within companies because of the need to examine and review existing standards, and produce new standards under the impetus of the conversion to SI units and the consequent changes to more rational dimensions in the new system. One thing seems certain, that the conversion to SI cannot proceed much faster at least in engineering and construction, than the technical standards, be they company or national. These must be converted before construction specifications can really be adapted to the SI standards of measurements.

Mr. Leo B. Moore [39] professor of management at the Massachusetts

Institute of Technology (MIT) writing in the February 1975 ASTM Standardization News "Tomorrow's Specifications" in speaking of managerial responsibility makes the point that companies would gain tremendously by an aggressive pursuit of standards and specifications at the managerial level. In the manufacturing context, which includes product specifications and product standards, he brings out another often forgotten facet to standards when he says:

> For many of us who have worked with problems of organization, the need has long been to have management recognize that, specifications and standards are the work of engineering, but the responsibility of the line (management).

He claims that it has been almost a thankless task, even though a strong argument can be made and demonstrated that the importance and attention paid by the line to the specifications and standards, job being well done, will add significantly to the effectiveness of the organization. This demonstrates the other side of standards, namely the support required for standardization by line management.

Again, in the same issue of the ASTM Standardization News, Dr. J.S. Foster [40] director of the U.S. Department of Defense, gives an insight into just how big the standardization problem is as regards standards:

> Standardization is not a dirty word. We must realize that there are significant barriers to its implementation, so we must organize for it, and we must insist on it. It must become institutional in order to be effective, not a one-shot or a one-service experiment.

Implementation will be difficult but the potential rewards of standardization, properly applied, demand greater efforts.

As the report states, these words echoing down the halls of the Pentagon, gave some impetus to the Department of Defense's revision of its Standardization Program which included the Army, Navy, Air Force and other services.

How does management's problem with standardization within companies affect specifications? Well, this situation it is felt creates confusion. Most technical people when faced with a repetitive problem want to standardize. However, it would seem that if the mechanics for implementing the desire to standardize are not in-place it is difficult if not impossible to obtain standards. For example, it is known that in one company department, several standard specifications on concreting, painting of special structures and others made about twenty year ago, have been used continuously on all major construction projects, but have rarely been revised and certainly no new worthwhile standards have been created simply because a permanent small standardization group able to devote a full time effort, was not available though the original group was well conceived. On the positive side, it is safe to say, and it speaks well for the proponents of company standardization, that the effect on the company's specifications and tendering documents taken over a twenty years span must have been enormous. Since it is known, from having consulted many of these documents over the years, that the standard specifications did not gather dust. Therefore, it can be appreciated that the mechanism for implementing the desire to standardize must be in place before standardization can take place

on a continuing basis.

This brings us to what could also be part of the problem the moment one speaks of standardizing, some division or department may feel that it alone can write-up standards, possibly from fear that it will lose some influence and reduce its freedom of action or choice if the standards are made up by some other department or division. Naturally standardization evokes a mental picture of something that is to become frozen hence rigid and difficult to change. Again a mechanism to develop standards properly set-up avoids this problem.

Suffice to say that the mechanism employed depends on the size of the company. One approach that could be followed, would be to introduce centralization company-wide for those standards that will have a company wide impact, and hence are company standards for large companies. There would be departmental standards which affect a department, but the format and quality should be under the control of a company-wide standardization group.

It is interesting to observe the philosophy of one of the multinational companies as regards the organizational structure required for producing standards.

Mr. R. de Gelder, [41] Standards Engineer with the Phillips group presented an in-depth expose in the Courrier de la Normalisation Np 237, V-Vl, 1974.

It was claimed that it was absolutely necessary to have a centralized system in order to organize, coordinate, inform and establish procedures for the work of standardization in a multinational company.

Mention is made of this facet of company standards and the organizational structure because of its influence on the production of company standards and the subsequent effects on specifications produced by the company. It was emphasized that standardization in a multi-national company has as its objective the implementing of the policy of top management to insure that the responsibilities and lines of communication relative to the standardization activity are clearly defined and to establish procedures and methods of executing the standardization work within the company.

Using as a basis a number of years of experience with committee work and writing standard specifications, it is thought that the slowness of the standards-writing process could be accelerated if recognition were given to the actual standards writing aspect which is often the stumbling clock of committees.

It would appear that at the national level, the Standards Council of Canada has given recognition to the importance of standards-writing by calling the standard developing societies, "Standards-writing organizations".

Company management should consider centralizing the standards effort just as the Standards Council has done for all Canada. The standards-writing organization say, in each company department could write standards for the various disciplines.

A condition which appears to occur in companies with branch plants, and this could merit consideration also for the centralized company, is that there may be a real need for a standard, but the number of users may be very

limited. Hence the standard may have a very limited distribution and obtaining a consensus may be a very simple process.

There is the possibility that a standard can be set up for the actual writing of standards. These do exist, for the guidance of committees and standardizers at the company and national levels.

It is certain that the national associations have the administrative know-how and other back-ups, to handle the standards writing process, companies could follow their example and adapt it to their needs.

CHAPTER X

THE STANDARDS ENGINEER AND MANAGEMENT

It may be wondered what connection the standards engineer has with the preparation of construction specifications. It is believed that, if greater recognition were given to the work at the national and company level of the standards engineers, standards officers or standardizer, as he is often called in Europe, would have a favorable impact on the development of standards for use in construction specifications.

He then would be in a position to identify acceptable (to management) areas where new standards are needed. The increased productivity of standards would be of help in design by limiting the selection of materials, products and practices to manageable proportions.

A standards engineer, Mr. R. Preston, [38] in his talk to the Standards Council mentioned in the previous Chapter brought out this very point that the standards engineer, needs more recognition, especially in industry, as "he was a prophet seldom recognized in his own country".

The purpose of giving some attention to this facet of standards is not to defend, in this paper at least, the cause of the standards engineer but to try to show that there is an unawareness of the importance of standards writing and other areas of the standards engineer's work, which contributes to the lack of direction in the preparation and production of standards, and in turn has its effect on specifications. As a result the specification writer does not have the referenced standards on hand

that he should have when preparing specifications.

It would appear that, in North America at least, judging from various publications on the subject, the standards engineer, standardizer, or the person who actually writes the draft and does the final editing, is more often than not nameless. He is the committee or perhaps the secretary of the committee. One is left with the impression that the only problem in standardizing is to get people on the committee to agree, after the members have been chosen to give a balanced representation of the interests involved, buyer, suppliers and others.

It would seem that the allied field of specification writing is in a similar situation. Mr. E.A. Abdun-Nur, [42] Consulting Engineer, stated in "Designing Specifications" based on his consulting work with the U.S. Bureau of Public Works, in the May 1975 American Society of Civil Engineer (ASCE) Proceedings, that there is a problem of recognition in specification writing judging from his remark;

> Until organizations realize that specifications designs (i.e. specification writing) is not a routine task to be delegated to anyone for whom there is nothing else to do, dynamic, useful and effective specifications will be lacking.

Furthermore, he felt compelled to say which may still be applicable today:

> Such an approach (i.e. designing specifications) offers challenges to qualified engineers at least equal to the demands to be found in the design of structures.

Others such as H.J. Rosen, [27] Construction Specifications Consultant, Merrick, N.Y, have said as much in articles and books on specifications writing also A.D. Boyd and A.H. Wilson, [43] in a recent Science Council of Canada Study, concerning the difficulties of transfering technical information in the construction industry.

There seems to exists a tendency to give less importance to the mechanics of preparing not only standards but even specifications. Not intentionally perhaps, but possibly because many other aspects are important in their own right and very demanding all through the standards development process, such as setting-up committees, meetings, reconciling different points of view. These aspects are very visible but the skills and expertise required to put all the results of this effort together, into a standard as a document involving often many people are hidden from view.

It has been observed that at standards development meetings conducted without benefit of well established procedures, the preparation of sections of the draft specifications by a voluntary group was a major stumbling block to the efficient production of important company standards. This view is amply supported by what may be a definitive work on the managerial principles and strategy in standards development by Mr. J.J. Riordan, [1] who is president of a Planning and Research Organization in standards and products assurance, McLean, Virginia. His paper was published in ASTM Standardization News and in Standards Engineering. He mentions that: "It is almost impossible for a committee to draft a standard", maintaining that this was the job of the project officer (standards officer).

It appears that in some organizations for example, the Canadian Government Specifications Board (CGSB), have standards officers whose function is to pilot the standards project from the initial steps to final publishing, acting not only as coordinators, but writing the drafts and editing the finished standards in line with the Board's policy and format for final approval and emission as CGSB standards.

No doubt similar procedures exist in industry for the preparation of industry or company standards. The subject of standards-writing has received recent attention, as reported in the Standards Section of Nuclear News, February 1975, [44] "Experimental Writing Formats Announced". It was indicated that the American National Standards Institute (ANSI) had instituted an experimental standards-writing program of which the result were to be evaluated on the basis of the time required and the quality obtained to produce and agreed upon draft of a standard by three committees constituted as follows:

1st: a paid chairman (probably a full time standardizer) using a previously prepared outline of the proposed standard.

2nd: a paid chairman using a previously prepared draft of the proposed standard.

3rd: an unpaid chairman but using a previously prepared draft of the proposed standard.

It is believed that, this program supports the view that the standards writer or standards engineer is often forgotten.

The reason why so much emphasis is being given to the writer of standard specifications for that matter, is that this lack of recognition contributes to management's dilemma regarding the proper place of standards in the organization. This situation is abetted by the fact that the production of standards requires that a long-range policy be established by management before the standards themselves can be produced which in turn contributes to this situation, since there is no one in place to ascertain and identify that standards are even required. Because of this, the problem is put aside until it comes up again.

Therefore, as has been indicated previously, the Standards Council of Canada could play an active role in promoting proper procedures for implementing standardization and the key role that these procedures should play in the standards developing process. The Standards Council (as the National Standards Coordinator) has a stake in the business of standards, in national standards, or even in company standards, since company standards can become national standards.

Standards engineers just like specification writers, may be in the lower echelons of the company's structure hence not able to contribute to company policy or at least with great difficulty. Hence,

standards are pushed aside, which of course has a direct effect on the company's technical effectiveness. Solutions to repetitive problems are not found and standardized. This makes specifications more voluminous with repetitive subject matter because, it is not formalized in an agreed upon standard even though reborrowed from previous specifications, it becomes the subject of endless internal discussions.

What is the situation in Europe as regards the standards engineer or the standardizer? A brief look should give some insight into its effects on the production of standards.

Before doing so, it should be mentioned from an examination of the recent available papers and articles presented in North America on the subject of standards, only one [45] gave importance to the role of the standards engineer, stating that 150 of them would be required to implement the International Organization for Standardization (ISO) program if a required annual production of 500 standards per year over the next few years would be needed to meet a target of 10,000 standards.

In Europe, recognition of standards work, is undoubtly well advanced, for example, France's Standardization Society (AFNOR) in its official publication, the Courrier de la normalisation [46] of May-June 1974 a complete issue is devoted solely to The International Federation for the Application of Standards, (IFAN) grouping the national associations of standardizers of ten countries recognized by the official standards body of the country of origin of which only two were non-European, namely

India and the United States, the latter being represented by the Standards Engineers Society. Since no strictly Canadian Standards Engineers group existed, Canada was not represented. However, a growing number of Canadians are members of the Standards Engineers Society who may decide to seek an increased Canadian identity in this or another organization furthering standardization and promoting the application of standards established by regularly constituted standardizing bodies.

To give an idea of how the Standards Engineer's role is better defined and better understood in Europe, the following is taken from AFNOR's introduction to its special edition mentioned previously, roughly translated, it mentions that: (46)

> A new specialization has taken place in thousands of companies throughout the world: that of the standards engineers, around which is then built-up the standards department of the company.

In the same vein Mr. Henri Durand, the high commissionner of standardization, speaking about the internal organization of AFNOR, standards committees, at the 1974 general meeting, (47) stated:

> The thousands of engineers and technicians who have come to us from industry who form the backbone of our committees, have the right to ask us to place at their disposal the structure and organization capable of fully and rapidly utilizing the results of their work.

This indicates ideally how management can be conscious of its role in the standardization process which can only result in more and better standards nationally or within a company.

In France, there is also a society called "L'Association des cadres de normalisation (ACANOR)" grouping management people involved in standardization. This is another example of the formal recognition given to the standardization function in France and for that matter in Europe.

This brief look of the European scene is not to suggest that many companies in Canada and the U.S. do not give importance to the standardization function. It seems possible however that increased Canadian identity in a standards society could help in getting recognition in Canada to the work of standards engineers. Courses on preparing standards are given in England and Europe. As mentioned previously, Mr. Preston, in his talk said that the Council can help and one way would be to publish a booklet on how to set-up a "Company Standards Department". The fact of Mr. Preston addressing the Council has provided a forum on the subject which may have had some impact on the technical community. This and other stimuli by the Standards Council similar to what AFNOR has been doing in France and Europe can only result in more and better standards in Canada which can be "referenced" in construction specifications.

It is thought pertinent to this chapter on the standards engineer to discuss further the nature of his position and how it affects standards, whether he is working at the company, national or international level.

The influence of the organizational structure and management atmosphere is all pervasive in the standards development process. Recent literature is replete with danger-signals of the realities and difficulties of the situation. To give credence to these assertions without taking up

too much space, a look at some of the U.S. Government Departments in Washington as reported by Dr. John G. Green, [18] Consultant for ASTM, ANSI and others, gives an insight to the complicated world of preparing standards. It seems that, government agencies operate "like semi-autonomous duchies, jealous of their sovereignties, hostile to incursions on their borders".

Standards development organizations have difficulty satisfying different agencies. In fact, the regulatory agencies, for example OSHA, the Occupational Safety and Hazards Agency, the Federal Trade Commission (FTC) and others do not want to use non-governmental standards because the private sector is too slow, too difficult because, it is dominated by industry and the public interest cannot be compromised by using consensus standards! Dr. Green maintains that, the reason for this attitude is that individual standards of the private sector were not made up with strong government input on committees.

Non-regulatory agencies however, such as National Bureau of Standards (NBS), General Services Administration (GSA), even the Department of Defense (DOD), are using national standards and working on the committees of ASTM (for example 340 NBS professionnal are working on ASTM Committees).

The point is that the standards engineers at the national level, as can be seen, have difficulties. It is safe to conclude that at the international level with different national interests things can be quite complicated and the wonder is that standards do get produced. At the company level the same situation can exist. The standard engineer's

task can be very difficult, as AFNOR and ACANOR have indicated in their publications [37] - [48] on the subject, unless the company is organized for standardization, and this usually means a standards department with standards engineer or standardizer reporting to top management.

Failing this the standards engineer is forced to tread in the area of company policy to get results expected of him and because management decides what this policy is to be his efforts are most likely doomed to failure until management identifies its need for standards and organizes to meet these needs.

CHAPTER XI

CONTRACTS, SPECIFICATIONS AND STANDARDS

Standard Contracts

Standard forms of construction contracts are prepared by organizations such as: the Canadian Construction Documents Committee and the American Institute of Architects. They do not touch upon the role of standards governing the work and acceptance of materials or mention them as being part of the contract documents. In some standard contracts, standards seem to be treated as poor cousins in that they are to be used for "information only, except if specified otherwise" in other parts of the contract documents. This seems to make little sense since, standards are usually mentioned in the specifications to avoid repeating what is already in the standard and in order to use a well tried, proven, generally recognized acceptable solution to a given problem. In fact, one engineering office insists that, when drawing up standard specifications, maximum use must be made of the national standards, which is what generally should be done in specification writing. Then what is in the standard with whatever modifications is required, should be a definite requirement and not for information only. A further possible complication is the order of precedence of the different contract documents. Clauses concerning precedence in the general conditions may oblige the specification writer to state clearly that in spite of what is said in the general conditions that the specifications require the application of reference standards as a definite requirement. This is especially true when the

general conditions as they usually do, take precedence over the other documents.

Some contracts do mention standards in the general conditions, but few if any include them as being part of the contract documents along with the special conditions, technical specifications and drawings.

On the surface standards would seem to have been half forgotten. This is somewhat astounding when one considers the contractual implications embodied in the standards in regard to acceptance or rejection of materials and large parts or even the entire work. One has only to think of concrete and steel standards and their effects on a large structure such as a bridge or a concrete dam to appreciate the implications.

A possible explanation for this state of affairs, since these contracts without making formal claim to appropriate standards as being part of the contract documents, is that they are being used all the time without too much trouble. It seems possible that because the standard of the Canadian Standards Association (CSA) and ASTM standards, for example, are generally well made, well recognized and accepted that no problem develops in enforcing their requirements. Possibly also, in the minds of many technical people, including engineers, they appear to be mandatory requirements in themselves without the necessity of formally making them part and parcel of the contract documents.

Similarity with codes

While legally adopted codes are not contract documents there exists a similarity in the use of standards in codes and contracts as legally binding documents. For example, the City of Montreal, in its Building Code By-Law 1900 mentionned previously in Chapter VI (22) provides in article 2-4 "Standard Specifications", that when CSA and ASTM standards are referenced in the text, actual certified copies with subsequent modifications, are available with the City clerk for consideration by the interested parties. Thus, it is made known that referenced standards form part of Montreal's building code.

Applying Standards

When preparing specifications, forming part of the contract documents, a good rule which deserves not to be broken is to obtain and look at each and every standard before putting the final touches to the specifications in order to make sure that there are no unanswered questions included in the standard nor that there exist clauses with which the specification writer and his company would be in disagreement, even though this should rarely be the case. Nevertheless prudence dictates a careful perusal of the standard and understanding its implications.

For example in the well known standard CSA S 16 "Steel Structures for Buildings" there are several appendices at the back of the standard which are part of the standard. A case in point is Appendix

"A" which refers to another standard, "Code of Standard Practice for Structural Steel for Buildings" by the Canadian Institute of Steel Construction (CISC) which group the major steel suppliers in Canada.

Now the contents of the "Code" (which are not mandatory in themselves) are fairly straight-forward but there are certain conditions of which it behooves the specification writer to take careful note. Among others, is an article concerned with the responsibility for design and articles on those items that are included in the contract price and those that are not. The question arises which issue of the CISC "Code" is applicable since it is not defined in the standard and thus one is tempted to accept the latest issue. However unless there has been continuing dialogue between the CSA Commitee on S 16, one can only conclude that the Committee which prepared the standard in 1969 could have no knowledge of succeeding revisions of the CISC Code.

Specifications

Mr. H.J. Rosen,[27] well known construction specifications consultant who was formerly with Skidmore, Owens & Merrill, of New York, classifies specifications under three headings:

1. Descriptive specifications in which the details of the material and workmanship required to construct something are described.

2. Performance specifications wherein the performance required is specified.

3. Reference specifications which is one that makes reference to a standard that has been established for either a material, test method or procedure.

By making reference to a standard, the standard becomes a part of the specification to the same degree as the descriptive or performance specification language used.

Further on Mr. Rosen points out that, where reference specifications are to be used and specified, the specifier must be thoroughly familiar with the standards that he incorporates in his specifications since, for one thing, standards can cover several types and grades, and the options to be used must be stated. For another, the wrong standard of course must not be used. This can happen because sometimes, there are several standards covering the same process, workmanship or material. A consideration which should be kept in mind is not to reference by name only standards dealing with recommended practices, but to reference them as being in conformity with or conforming to the recommended practices. In this way the standard becomes binding and not just a recommendation. Mr. Rosen indicates a very important aspect in the use of standards in specifications, in that certain standards must be modified by explaining certain provisions or by eliminating others but only in the text of the specifications. The standards themselves of course cannot be modified, except by the authority producing the standards.

What is an encouraging aspect of a very ambitious project in standardization called "Government of Canada Master Construction Specification" (GMS) [49] creating computerized specifications that can be adapted to just about any construction project, is the intention to make it available on a national basis. The "Master Specifications System" as it is called is now in actual use by the Federal Department of Public Works (DPW).

While appreciating the advantages of predetermined specifications for any project it is difficult to see their acceptance for some time yet throughout the construction insdustry as the overall specifications document. This is especially so, when one considers that a master specifications may have to include policies regarding the choice of standards that will be referenced, the precedence in referencing, for example, Federal standards or provincial standards, also the contractual clauses, purchasing policy, inspection, safety, provincial codes and many other considerations.

Nevertheless, this should in no way preclude the use of the "Master Construction Specification" as a model specification, a guide in preparing company construction specifications and even for engineering design.

CHAPTER XII

SUMMARY AND CONCLUSION

For those involved in the use of standards and codes, the specification writers and users of construction specifications, if what has been presented on the subject of standards and codes, on the national scene in the U.S. and in Canada, on international and nuclear standards, codes, referencing and quality assurance programs, examples of problems encountered in the development of standards, the standards engineer and management, and their use in contracts and specifications, has given an insight into the role of standards and codes in construction specifications, then this report has attained its objective.

A point which was brought out repeatedly, was that concerned interests were usually involved in the preparation of standards and under the consensus principle unless well balanced could have possible restrictive commercial effects in specifications. It was emphasized that it could not be over looked that national interests can be involved in standards at the national and international levels.

It was brought out also that, there was a real necessity for more Canadian standards, and that the specification writer will have to continue to use someone else's for some time to come, until there is increased Canadian participation in and adoption of international standards.

A problem touched upon in the report, of concern to the specification writer was that, with metrication, engineering or technical standards in Canada and in the U.S. must be brought into line with the

International System of Units (SI) before metrication in specifications can effectively be implemented. It was felt that this may cause delays since not only is conversion to SI units (which is now underway) and rationalization to preferred numbers required, but in many cases, a change in engineering practice involving not just units, but symbols, terminology and testing equipment would also be required.

Again it is hoped that the overview and sign posts on the road to the development of standards and the use of codes pointed out here, have provided an insight which may result in better specifications and perhaps more national and company standards.

June 1977.

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