Canada's National Model Construction Codes Development System

1.0 Introduction

1.1 Canadian Commission on Building and Fire Codes

Canada has one of the best standards of construction in the world and a high degree of uniformity in building construction and fire safety across the country. Canada's centralized system for model code development and maintenance began in the 1930s. The first edition of the National Building Code of Canada was published in 1941. Subsequent adoption of the National Building, Plumbing, and Fire Codes and partnership with the provinces and territories has resulted in a progressive system that is responsive to new construction products and techniques.

The Canadian Commission on Building and Fire Codes (CCBFC), an independent committee of volunteers established by the National Research Council of Canada (NRC), is responsible for developing and updating the National Model Construction Codes. It oversees the work of eleven committees and several task groups involving as many as 300 members. The system is structured such that it is the members of the committees who establish the content of the model codes. Member expertise from industry, the regulatory community and general interest groups is balanced to ensure that all relevant sectors and geographical areas of the country are represented. These committees are administratively and technically supported by the Canadian Codes Centre (CCC) of the NRC Institute for Research in Construction (NRC-IRC).

1.2 National Model Construction Codes

On behalf of the CCBFC, the NRC publishes six National Model Construction Codes, in English and in French, which must be adopted by a regulatory authority in order to come into effect. In some cases, the Codes are amended and/or supplemented to suit regional needs, and then published as provincial codes. The six codes are:

- The National Building Code of Canada (NBC) addresses the design and construction of new buildings and the substantial renovation of existing buildings.
- The National Fire Code of Canada (NFC) provides minimum fire safety requirements for buildings, structures and areas where hazardous materials are used, and addresses fire protection and fire prevention in the ongoing operation of buildings and facilities.
- The National Plumbing Code (NPC) covers the design and installation of plumbing systems in buildings and facilities.
- The National Farm Building Code (NFBC) provides relaxations of the requirements in the NBC to address the particular needs of farm buildings.
- The National Energy Code of Canada for Buildings (NECB) and the National Energy Code of Canada for Houses (NECH) provide technical requirements for the construction of energy-efficient buildings and houses.

To assist in the application of the codes, explanatory material is published in the form of user's guides. Descriptions of all the published documents and ordering information are available at www.nrc-cnrc.gc.ca/eng/ibp/irc/publications/index.html.

2.0 Historical Background

2.1 Evolution of the Code Development System

Under the British North America Act and its successor, the Constitution Act, responsibility for building regulation in Canada rests with the provinces and territories. This responsibility was generally delegated to municipalities, which, not surprisingly, resulted in a multiplicity of regulations being developed over time as each municipality tried to deal with its own needs. These variations from one municipality to the next made it very difficult for designers, product manufacturers and contractors to conduct business in more than one region. It was also very difficult for national programs supporting housing and other construction work to be implemented. Thus, in 1937, the federal Department of Finance asked the NRC to develop a model building regulation that could be adopted by all municipalities in Canada. The result of that initiative was the publication of the first edition of the NBC in 1941.

The post-war construction boom fuelled the demand for a revised NBC, particularly one that did not require houses and small buildings to be designed by architects and engineers. To respond to the needs of an industry that was rapidly expanding, NRC established the Division of Building Research (DBR), which became the NRC-IRC in 1986. One of DBR's original mandates was to provide research support for the NBC. Then in 1948, NRC created the Associate Committee on the National Building Code whose mandate was to update and maintain the NBC on an ongoing basis and provide for broad input. The Associate Committee revised the NBC in 1953 and has subsequently published new versions about every five years. The NBC 2005 is the 12th edition.

In 1956, NRC created the Associate Committee on the National Fire Code, which produced the first edition of the NFC in 1963.

In October 1991, the two Associate Committees were replaced by the CCBFC.

2.2 Changes to the System

A number of economic realities—increasing globalization, free trade, harmonization of standards, demands for better quality and performance, and a major shift from new construction to rehabilitation—created the need to make the codes more dynamic, more responsive, and better able to accommodate innovation. The CCBFC 1995-2000 Strategic Plan addressed this need by identifying opportunities to improve the code development system in several significant ways. Two key initiatives were subsequently undertaken: one to establish a coordinated provincial/territorial/national code development system, the other to convert the National Model Construction Codes into objective-based codes.

- **Core Codes**
  To facilitate provincial and territorial adoption of the National Model Construction Codes, with few or no amendments, new editions now only address issues agreed upon by all provinces and territories. Technical differences between provincial and National Model Construction Codes requirements are examined with a view to harmonizing as many as possible.

  Issues falling outside the scope of the core codes are now dealt with in separate documents published by that province or territory. If several provinces and territories wish to address the same issue, the CCBFC will consider developing a separate code on that issue. The two energy codes and the NFBC are examples of such non-core documents.

- **Provincial/Territorial Participation**
  The provinces and territories may now examine proposed changes to the National Model Construction Codes at every stage of the code development cycle. Their concerns are addressed by the CCBFC so that standing committees do not waste time developing changes that are unacceptable to the authorities having jurisdiction. The aim is to reduce the number of amendments that are required before provincial or territorial adoption thus allowing for faster adoption.

- **Coordinated Public Reviews**
  Public reviews of proposed changes to the National Model Construction Codes are now coordinated such that code users are consulted once annually, usually in the fall. Fixed dates for public reviews allow code users to plan their provision of input into the review process. Provinces and territories are invited to coordinate the review of changes to their codes with the national public review; they also advertise the national public review and encourage participation in their jurisdiction. Thus, the input of all code users—even from code users in provinces having their own codes—is made available to the national process.

- **Improved Policy Input**
  The Provincial/Territorial Policy Advisory Committee on Codes (PTPACC), a committee made up of senior representatives appointed by provincial and territorial deputy ministers, provides policy advice to the CCBFC.

- **Equitable Sharing of Code Development Costs**
  Revenue from code sales continues to be the principal source of funding for the development and production of the model codes. Arrangements have been put in place so that even provinces that publish and sell their own codes can make equitable contributions to the national code development system. The NRC is the other funding partner of the national code development system.

- **Objective-Based Codes**
  Previous editions of the NBC, NFC and NPC had equivalency provisions that permitted the use of materials, equipment, systems, methods of design or construction procedures not specifically prescribed. When something new was proposed, however, it had to be demonstrated that it provided the level of performance required by the codes. This “equivalency” approach was retained in the 2005 objective-based codes and converted into the “alternative solution” compliance path to the codes. Code users now have the choice of using the “acceptable solutions” prescribed in the codes or demonstrating that a proposed “alternative solution” provides at least an equivalent performance. Converting these codes to an objective-based format has made them more accommodating to innovation by clarifying their scope as well as the intent behind their requirements. Each code provision is now supplemented by clearly stated objectives, functional statements and intents.

  As a result, the 2005 objective-based codes provide additional information that helps proponents and regulators determine what minimum performance must be achieved, thereby facilitating the evaluation of new products and construction techniques. Thus proponents and regulators who assess code conformance now have a better common understanding of the minimum performance expected by the codes.

2.3 CCBFC Review of Priorities in 2008

In 2008, the CCBFC Executive Committee held a strategic session to review the implementation of changes to the national code development system since their introduction in 1995. The session also provided an opportunity to review the role of the CCBFC, its mission, and the environment in which it operated. Major elements of this reflection by the CCBFC included new goals and objectives as well action plans to achieve the strategic objectives. The action plans address four near-term priorities: communications and marketing, timeliness and responsiveness to change, harmonization of provincial/territorial and national codes, and sensing of emerging issues.

2.4 Policies and Procedures Updated

The CCBFC also developed and adopted new policies and procedures in early 2009 that better reflect the changes made in recent years to the national code development system, as well as the closer ties with PTPACC. The new policies and procedures contain the operating procedures of the national code development system, terms of reference for the CCBFC and its committees, and a description of the supporting role of the NRC-IRC.

2.5 Protocol for Adding New Objectives

Following requests to add energy efficiency and water use efficiency requirements in the core codes, it was determined that these did not fit within the National Model Construction Codes' four existing objectives (safety, health, accessibility, fire and structural protection of buildings). The matter was discussed with the provinces and territories, and a joint CCBFC/PTPACC task group was established to develop a protocol for considering the addition of new objectives. Adopted by the CCBFC in early 2009, the six-step protocol is being used to develop a new energy efficiency objective that can form the basis for energy efficiency requirements in the National Model Construction Codes. A water use efficiency objective is also being considered through application of the protocol.

3.0 Codes and Standards

3.1 Scope and Application of the National Model Construction Codes

The NBC is concerned with health, safety, accessibility and the protection of buildings from fire or structural damage. It applies to the construction of new buildings and to the demolition or relocation of existing ones. It also applies when a building's use changes or when it is significantly renovated or altered. Some provincial building codes also address energy conservation.

The NFC applies to buildings and facilities already in use and regulate activities that create fire hazards. It contains requirements regarding the maintenance of fire safety equipment and egress facilities, and provides direction on the safe use of combustible materials and dangerous goods in both new and existing buildings or facilities. It also requires fire safety plans in anticipation of emergencies. In sum, the NFC aims to reduce the likelihood of fires, particularly those that may present a hazard to the community, and to limit the potential damage caused by fires and by the handling and storage of hazardous materials.

In Canada, building and fire codes are developed cooperatively with the goal of achieving compatibility. Generally, when a new building code is adopted, it is not applied retroactively: existing buildings that comply with the code in effect at the time of their construction are generally not required to be upgraded so that they comply with the new code. Unlike building codes, however, fire codes may contain retroactive requirements that apply to all buildings, regardless of when they were built.

The NPC is concerned with health, safety, and the protection of buildings or facilities from water and sewage damage. It covers the design and installation of plumbing systems in buildings and facilities. It applies to the construction of new buildings and to the demolition or relocation of existing ones and also applies when a building's use changes or when it is significantly renovated or altered.

The NFBC addresses the special nature of the occupancies of non-residential farm buildings. Farm buildings that do not qualify under specific criteria are required to conform to the NBC in all respects.

The NECB and NECH were designed to complement the building codes. They set out minimum requirements for energy efficiency that may be adopted in whole or in part into provincial or territorial legislation and codes or, alternatively, that may be used as guidelines for the construction of energy-efficient new buildings.

3.2 Differences Between a Code and a Standard

National Model Construction Codes and standards are developed through similar consensus-based committee processes and extensive public review. There is no precise and universally recognized definition of the differences between a code and a standard.

Generally, a code–
- is broad in scope, i.e. it covers a wide range of issues, and
- is intended to be given the force of law through adoption by a provincial, territorial or municipal authority.

In the construction context, generally a standard–
- is narrow in scope, i.e. it covers a limited range of issues, and
- is intended to be given the force of law by being referenced in a code adopted by a provincial, territorial or municipal authority or by being referenced directly by a provincial, territorial or municipal regulation.

Some standards do not become legal requirements but are simply used by a specific industry or trade as the recognized articulation of "good practice."

A code will often reference several standards, thus giving them the force of law in jurisdictions where that code is adopted. For example, the NBC references more than 200 standards.

3.3 Standards Development Organizations

Standards development organizations are major contributors to construction regulation in Canada. Hundreds of standards are used by the construction industry. The NBC references almost 200 documents directly (and many more indirectly) that are largely prepared by Canadian standards development organizations accredited by the Standards Council of Canada, such as:
- the Canadian General Standards Board (CGSB)
- the Canadian Standards Association (CSA)
- Underwriters Laboratories of Canada (ULC), and
- the Bureau de normalisation du Québec (BNQ).

Standards from American organizations, such as the American Society for Testing and Materials and the National Fire Protection Association, are also referenced.

4.0 Code Development: Roles and Responsibilities

4.1 Role of the Canadian Commission on Building and Fire Codes

The CCBFC is a decision-making body established by the NRC to provide direction and oversight on the development of the National Model Construction Codes and encourage uniformity of building and facility regulations throughout Canada. It is made up of voting and non-voting members from across Canada who are appointed by NRC on the recommendation of the CCBFC Selection Committee. Voting members are volunteers who are chosen for their individual interests and expertise.

The Commission normally meets once a year in February and meetings are open to the public. Guidelines for visitors attending meetings are available at www.nationalcodes.ca

The CCBFC Chair reports annually, or as requested, to the NRC through the Vice-President responsible for the NRC-IRC. Through PTPACC, the CCBFC receives advice from and informs provincial and territorial authorities of issues, priorities, requests and decisions on matters relating to the National Model Construction Codes.

The CCBFC develops Canada's National Model Construction Codes through a committee-based process and formally approves all Code documents and technical revisions prior to publication by the NRC. The CCBFC also establishes the following committees and oversees their work (see Figure 1 at the end of the document):

- Executive Committee (acts as a standing committee on Divisions A and C of the Codes)
- Standing Committee on Building and Plumbing Services
- Standing Committee on Earthquake Design
- Standing Committee on Energy Efficiency in Buildings
- Standing Committee on Environmental Separation
- Standing Committee on Fire Protection
- Standing Committee on Hazardous Materials and Activities
- Standing Committee on Housing and Small Buildings
- Standing Committee on Structural Design
- Standing Committee on Use and Egress
- CCBFC Technical Translation Verification Committee

The CCBFC may approve the creation of short-term task groups, working groups and advisory groups to study specific issues and make recommendations to either itself or the applicable standing committee.

The CCBFC Technical Translation Verification Committee is responsible for verifying the technical accuracy of the translations of all Codes published in French.

4.2 Role of the Executive Committee

The Executive Committee looks after CCBFC business between CCBFC meetings by undertaking specific tasks assigned to it by the CCBFC, addressing policy or coordination problems that may arise and responding to requests for review of procedural actions taken by any subcommittees. It also recommends proposed changes to Divisions A and C of the core codes and similar content for non-core codes.

The Committee meets at the call of the CCBFC Chair and may hold joint meetings with PTPACC, as the need arises. Its Chair is the CCBFC Chair and its membership includes at least four voting CCBFC members. Meetings are held in camera, except those portions that deal with changes to Divisions A and C of the core codes and similar parts of non-core codes.

4.3 Role of the Standing Committees

Each CCBFC standing committee is responsible for a code or sections of a code and related documents, such as user's guides, and advises the CCBFC on technical issues and recommended changes. Meetings are normally held twice annually in spring and fall, unless otherwise authorized. Annual work plans balancing the number of requests and priorities against time constraints, capacities and resources are prepared by each standing committee in the fall for approval by the CCBFC.

Members are appointed by the CCBFC chair on the recommendation of the CCBFC Nomination Committee. The membership of each standing committee conforms to a matrix that provides for regulatory, industry, and general interest categories as well as equitable geographical representation. Non-members are welcome to observe the committee meetings or to address the committees on specific agenda items. Meetings are often held outside Ottawa to facilitate regional involvement. Guidelines for visitors attending meetings are available at www.nationalcodes.ca.

4.4 Role of the NRC-IRC

NRC-IRC is involved in every aspect of the development of the National Model Construction Codes. Committee work is supported by the latest technical information and expertise available within the NRC-IRC. Correspondingly, the committees refer many of the technical problems relating to code requirements to the NRC-IRC for study and possible inclusion in its research programs. This two-way flow of information has proven mutually beneficial.

The essential link between the standing committees and NRC-IRC research staff is provided through the CCC and the research advisors appointed as non-voting members to the standing committees.

When the committees need more information to make informed decisions, studies are performed to provide the missing data. These studies are not only performed by NRC-IRC but also by provinces, manufacturing groups and various consortia having similar interests. For more information on the NRC-IRC, see www.nrc.gc.ca/irc.

4.5 Role of the Canadian Codes Centre

NRC-IRC houses the Canadian Codes Centre (CCC). The CCC's technical advisors, who are mostly architects or engineers, provide technical support to the CCBFC committees and task groups as well as administrative support, including the organization of meetings, the preparation and distribution of agenda packages, and the preparation of minutes.

Technical advisors receive code change requests, review and evaluate them, and advise the appropriate committees on their implications. They are often required to prepare technical studies or committee papers that provide additional information and background data to the committees to assist them in their decisions. They also facilitate access to research resources.

Technical advisors help regulatory officials and other code users understand the codes' requirements; however, final interpretation of the codes rests with the authorities having jurisdiction.

Most technical advisors also perform a coordinating function as members of various standards development committees.

Despite the involvement of CCC staff in the work of the standing committees, they do not have voting status. It is the volunteer committee members who decide what code changes should be recommended to the CCBFC, which in turn makes the final decisions.

More information about the CCC is available at www.nrc.gc.ca/ccc.

4.6 Role of Other Groups at NRC-IRC

The Codes and Evaluation Production and Marketing Group is responsible for the editing, translation, and production of codes and related documents, including some provincial codes.

NRC-IRC's Client Services unit is responsible for sales and distribution of the products. More information is available at www.nrc-cnrc.gc.ca/eng/ibp/irc/publications/index.html.

4.7 Role of the Provinces, Territories and Municipalities

Canada's constitution gives the ten provinces and three territories jurisdiction over construction. Some cities also have this authority through a special relationship with their provincial authority. To enact building and fire regulations, the provinces, territories, and municipalities pass legislation that references the relevant National Model Construction Codes or provincial code.

The provincial and territorial authorities having jurisdiction are responsible for:

- adopting and enforcing laws and regulations
- providing interpretation of such laws and regulations
- providing training and education in such laws and regulations
- establishing roles and responsibilities of trades people and professionals.

In 2001, as part of the improvements to the code development system, the Provincial/Territorial Policy Advisory Committee on Codes (PTPACC) was formed to provide policy advice to the CCBFC. Three PTPACC sub-committees were also set up to deal with each code individually.

5.0 Process for Developing the National Model Construction Codes

Codes are continuously evolving to accommodate new technologies, materials, construction practices, research, social policy, and the changing needs of Canadian society. Globalization and free trade, for example, have led to the harmonization of some North American standards and increased use of international standards.

Development of code content is a consensus-based process that relies on the voluntary contributions of standing committee and task group members, and the public. A common process—from the initial proposing and consideration of code change requests to the publication of approved changes—is followed for all codes. An important feature of the code development and maintenance process is the extent of public involvement. Canada's code-writing process has one of the most extensive public review procedures in the world.

5.1 Proposed Changes

1. Submission
   Code change requests can be submitted to the CCC by regulatory officials, design and safety professionals, manufacturers and suppliers, contractors, building managers or owners, consumers, and other public and private sector stakeholders—in fact, by anyone with an interest in the codes. CCBFC standing committee members and NRC-IRC staff may also propose changes.

2. Work Plan
   Each code change request is reviewed by the appropriate standing committee. After this initial review the standing committee determines if it wishes to work on it and to include it in its work plan for CCBFC approval and priority setting. Work plan approval and priority setting by the CCBFC ensures that code development work focuses on issues of importance to the provinces and territories as well as stakeholders.

3. Review
   Once authorized by the CCBFC the appropriate standing committee undertakes a detailed review of the code change request. If the proposed change is complex and requires significant analysis, a task group may be established to study it and make recommendations. When a change has implications for a part of a code that is the responsibility of other committees, all affected committees review the change. For example, a proposed change to NBC Part 9, Housing and Small Buildings, may need to be reviewed by the committees responsible for Parts 3, 4, or 6, and may also lead to a corresponding change in one of those parts.

   A standing committee may reject a proposal, amend the wording, defer it pending receipt of more information or research, or approve the proposed change.

4. Pre-public Review
   The provinces and territories have the opportunity to review draft proposed changes. If any of them has serious policy or administrative concerns about the inclusion of a certain proposed change for public review, the proposed change can be withdrawn or deferred for further discussion prior to public review.

5. Public Review
   All proposed changes approved by the standing committees are made available for public review annually, in the fall, for two months. Additional public review periods may be called, when necessary, at other times of the year. This allows those most affected by a proposed change to provide feedback and increases the range of expertise available on any subject. Provinces and territories are invited to coordinate their public review activities with the national public review periods.

   The availability of the public review documents is announced in Construction Innovation (NRC-IRC's quarterly newsletter, which is posted at www.nrc-cnrc.gc.ca/eng/ibp/irc/ci/current-issue.html) and on the National Code Documents Web site at www.nationalcodes.ca. The Internet is the primary format for distribution of public review information and receipt of comments.

6. Post-public Review
   Following the public review period, the standing committees review the submitted comments. A proposed change moves forward only once all comments have been taken into consideration. Some proposed changes may be deferred or withdrawn at this point. The provinces and territories then review the final version of the proposed changes from a policy perspective and identify their concerns before the changes are submitted to the CCBFC for final approval.

7. CCBFC Approval
   Following review of the proposed changes by the provinces and territories, the recommended changes are submitted to the CCBFC, and then, if approved, they are published in the next edition of the codes.

8. Translation
   The approved changes are translated into French. The translation is reviewed by the Technical Translation Verification Committee to ensure accuracy, enforceability and consistency within the French documents.

6.0 Evaluation of New Technology and Systems

The evaluation of building products, materials, or systems as to their conformance to codes and standards is a difficult and time-consuming activity. A number of organizations, such as the Canadian Standards Association and Underwriter's Laboratories of Canada, provide full third-party certification for safety- related products or systems for which standards exist. The National Model Construction Codes do not require such certification, only that the product or system meets the minimum performance required by the standard. Code enforcement officials, however, often rely on certification as evidence that such is the case.

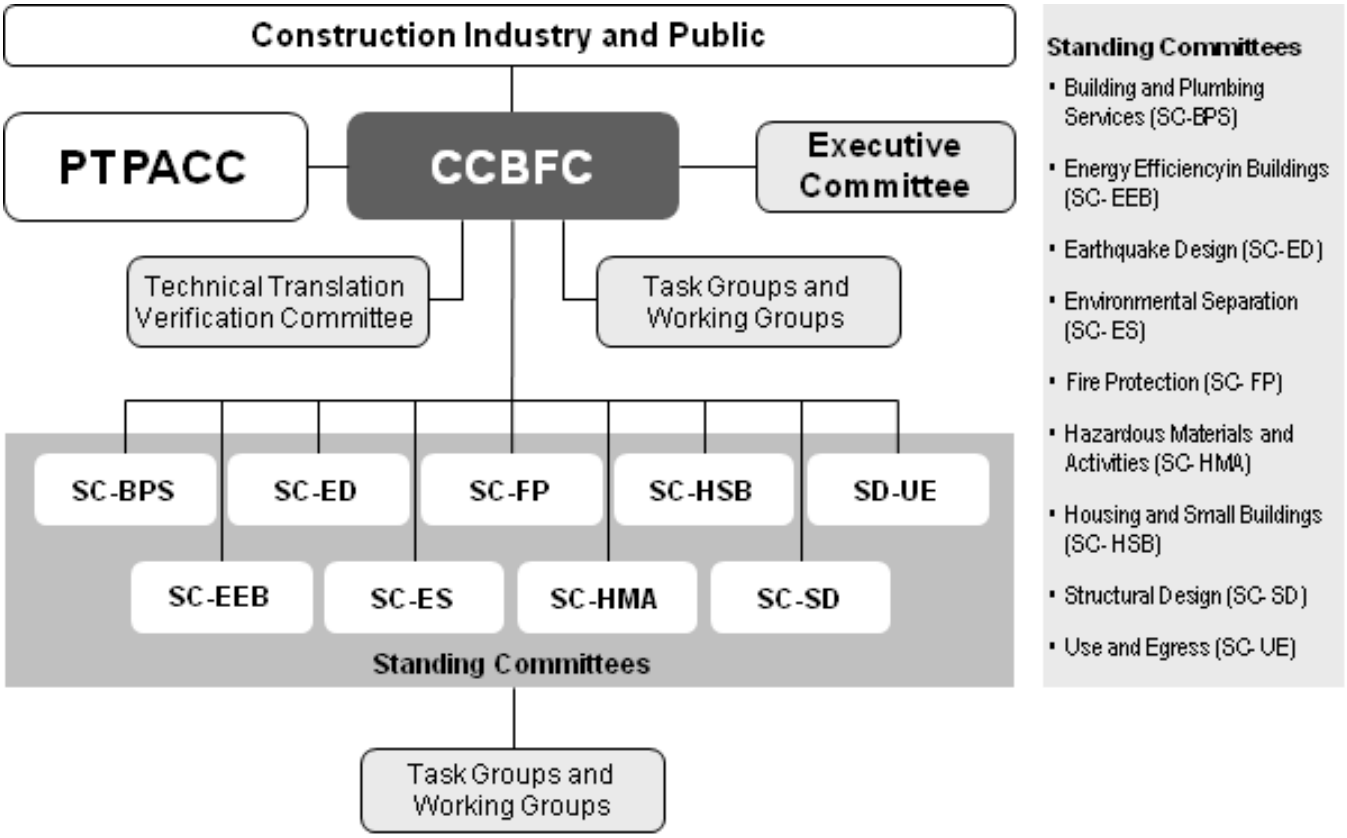
To provide the construction industry with a national evaluation service for innovative materials, products and systems, NRC in 1988 created the Canadian Construction Materials Centre (CCMC) at the NRC-IRC. This service includes the evaluation of new and innovative products for which no standards exist, and of products for which standards exist but for which no third-party certification program has been established. Most provinces, territories and municipalities use CCMC's evaluation reports as a basis for determining compliance of new products to codes. See www.nrc.gc.ca/ccmc for more information.

7.0 Summary

The National Model Construction Codes are developed and maintained using a broad-based consensus process. Individuals from all segments of the Canadian construction industry have the opportunity to contribute to the development of the codes, either directly, through committee membership, or indirectly, by submitting or commenting on proposed changes.

The improvements to the code development system for the 21st century are innovative, at the leading edge, and uniquely Canadian. They ensure openness and transparency, and minimize disruption to the design and construction industries, while responding to the realities and opportunities of the modern global economy.

Figure 1: Structure of the Canadian Commission on Building and Fire Codes



THE ORIGIN AND DEVELOPMENT OF CANADA'S OBJECTIVE-BASED CODES CONCEPT

INTRODUCTION

The first National Building Code of Canada was published in 1941. As preparations were underway for publication of the 1995 National Code Documents—National Building Code (NBC), National Fire Code (NFC) and National Plumbing Code (NPC)—the Canadian Commission on Building and Fire Codes (CCBFC)[1] decided that, after more than fifty years of evolution of Canada's code development and maintenance system, it would be good to step back and examine its current state and where it was headed. A task group was formed to develop a strategic plan[i] to guide the next ten years of the Commission's work. That task group heard submissions from Code users throughout the country on how the Codes themselves and the system could be improved. Although the overall consensus was that Canada's National Code Documents and the system for their development and maintenance were in pretty good shape, there were several opportunities for improvement. Some of these suggestions related to the code development system and have resulted in major changes to that system. However, this paper addresses the suggestions related to the Codes themselves and how they have been addressed.

In the suggestions received regarding needed improvements to the Codes, four themes emerged:

- The scope of the Codes needs to be clearer.
- The intent behind code requirements should be clearer.
- The Codes should be more accommodating to innovation.
- The Codes should be easier to apply to renovation.

One often hears Canada's current Codes described as prescriptive codes. But that is not accurate. They are really mixtures of prescriptive and performance requirements.

For example, a requirement for a swing-type door in a fire separation to have a latch is purely prescriptive. It tells you exactly what must be done, in physical terms, to satisfy the Code.

On the other hand, a requirement for an exit to not contain more than one percent of contaminated air in a fire situation is a performance requirement: it tells you what must be achieved to satisfy the Code, not how to do it.

It is perceived that prescriptive requirements inhibit innovation whereas performance requirements are much more accommodating to innovation. Therefore, staff of the Canadian Codes Centre (CCC) began to investigate the feasibility of converting the National Code Documents to a performance-based format.

EVOLUTION OF THE OBJECTIVE-BASED CODES CONCEPT

The CCC played a pivotal role in the creation of CIB Task Group 11, Performance-Based Building Codes[ii], which brought together representatives of countries that had adopted performance-based codes or were contemplating doing so. CCC staff were also instrumental in the creation of the Inter-jurisdictional Regulatory Collaboration Committee (IRCC)[iii], which has a similar function but is restricted to representatives of national governments. Participation in these groups permitted CCC staff to learn and pass on to the CCBFC the good and bad experiences of those countries that had adopted performance-based codes. This convinced the CCBFC that rapid conversion of the National Code Documents to a performance-based format similar to that adopted in the UK, Australia and New Zealand would be extremely disruptive to the Canadian construction industry and regulatory community. A more evolutionary approach that would still achieve the benefits of performance-based codes was sought.

The approach that was settled on was to retain the existing mixture of performance and prescriptive code provisions but to tie each provision to at least one explicitly stated Code objective. The objectives of the Codes had never been explicitly stated, although they were alluded to in the prefaces.

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[1] The CCBFC is a committee of 40 +/- volunteers from across Canada and from all segments of the community affected by the National Code Documents—consumer representatives, architects, engineers, building officials, fire officials, plumbing officials, material suppliers, builders, etc. The CCBFC makes all the decisions regarding the content of the National Code Documents.

Thus, in order for this objective-based approach to work, it was necessary to define these objectives quite precisely. The CCBFC was determined that the exercise of defining the objectives and linking Code provisions to them should not inadvertently expand or contract the scopes of the National Code Documents—scopes that had evolved from more than 50 years of public consensus.

A number of initiatives were started and new theories proposed. As this concept of objective-based codes was entirely new, many course corrections and new starts turned out to be necessary:

Top-Down and Bottom-Up Analysis

It was planned to conduct both top-down and bottom-up analysis of the Codes –

- A Task Group on Implementation of Objective-Based Codes would consider from first principles which objectives each Code should and should not address.
- The standing committees[2] with technical responsibility for the various parts of the Codes would analyze each provision to identify what overall objective(s) they seemed to be addressing.

However, early in the process, top-down analysis was abandoned when it identified objectives the Codes should not address, only to have the bottom-up analysis reveal several pages of provisions that seemed to address those objectives.

Thus, the objectives that were eventually declared to be the objectives of the National Code Documents were derived from a synthesis of the bottom-up analysis of all the provisions of the three 1995 National Code Documents—some 6000 sentences in all.

Rigour of Analysis of New Acceptable Solutions

Early on, it was decided that the existing performance-based and prescriptive Code provisions would be included in the new format as "acceptable solutions," a term used in the performance-based codes in other countries. It was initially reasoned that, whereas the existing Code provisions had only been included in the Codes after rigorous analysis by the standing committees with technical responsibility for the various parts of the Codes, in evaluating proposed new acceptable solutions, the standing committees would only be assessing what one **could do** as opposed to what one **must do**; therefore a less rigorous analysis would be needed. However, it was soon realized that Canadian society would expect that any solution deemed "acceptable" in the Codes would be just as safe and create as little risk to health as the existing Code provisions. Therefore no relaxation in the rigour of the analysis could be expected.

Role of Cost/Benefit Analysis in the Evaluation of New Acceptable Solutions

Again, it was initially reasoned that, whereas the standing committees had always considered cost/benefit issues in evaluating the existing Code provisions, in evaluating proposed new acceptable solutions, the standing committees would only be assessing what one **could do** as opposed to what one **must do**; therefore cost/benefit issues need not be considered. However, it was realized that each acceptable solution would include a number of sub-requirements that must be satisfied for the overall solution to work acceptably and that cost/benefit issues would have to be considered in determining the stringency of these sub-requirements.

OBJECTIVE-BASED CODES CONCEPT AND KEY COMPONENTS

Concept

The fundamental concept behind the 2005 objective-based codes in Canada is the recognition that the acceptable solutions represent an implicit expression of the levels of building performance that are acceptable to society. Objective-based codes are articulated around acceptable solutions, which play two important roles:

1. In objective-based codes, acceptable solutions are maintained and represent one of the two compliance options. Following the technical specifications of the acceptable solutions is deemed to meet the objectives and performance expectations of the Codes. Acceptable solutions consist of

[2] Although the CCBFC makes final decisions regarding the content of the National Code Documents, it is assisted by standing committees responsible for the development and updating of all technical aspects of the codes. Like the CCBFC, standing committees consist of volunteers from all segments of the construction community but have more specific technical expertise based on their respective areas of responsibility.

provisions—either prescriptive or performance-based—that have been developed over time under the code development system in place before the introduction of objective-based codes. Acceptable solutions will continue to be developed and updated under objective-based codes and will continue to offer to Code users a straightforward way of complying with the Codes.

2. The second compliance option under objective-based codes is through the use of alternative solutions, i.e. innovative solutions that differ from the specifications of the acceptable solutions. To be acceptable, an alternative solution must provide a level of performance at least equivalent to that of the acceptable solution(s) it is replacing. This very important feature aims at preventing an unintentional reduction or increase in the level of performance and quality of construction that could result from the introduction of objective-based codes. This is a clear statement that the acceptable solutions (specifications developed over the years) do set out the level of performance deemed to be acceptable to society and that objective-based codes shall not inadvertently facilitate the use of building solutions with a lower performance level. In preparation for the development of objective-based codes, the standing committees responsible for the development and updating of acceptable solutions have examined each and every Code specification with the mandate of determining their intents and application. In objective-based codes, each specification of the acceptable solutions is tied to well defined objectives and functional statements and is supplemented with detailed intent and application statements. When evaluating innovative solutions for compliance, the areas of performance to be examined are clearly identified by the objectives and functional statements attributed to each specification of the acceptable solutions. Innovative solutions are not limited to "prescriptive" solutions. Both prescriptive and performance design options are permitted but their common denominator is that an alternative solution must provide a level of performance at least equivalent to the acceptable solutions it replaces.

Structure and Format

The existing structure of the Codes did not permit the incorporation of the new information provided with objective-based codes—objectives, functional statement and intent and application statements. While retaining the structure and format of current technical provisions, the Codes have been restructured around 3 divisions. The Divisions are:

Division A – Compliance, Objectives and Functional Statements
Division B – Acceptable Solutions
Division C – Administrative Provisions

Division A. Most of the information in Division A was not in the existing Codes and has been developed during the preparation of the objective-based codes. Division A contains the following:

- the conditions necessary to achieve compliance with the Codes,
- the objectives and functional statements, and
- the limitations on the application of certain objectives and functional statements (not all objectives and functional statements apply to all buildings).

Because the objectives and functional statements will rarely change, it is expected that Division A will not require updating with each new edition of the Codes.

Division B. Division B contains most of the existing Codes' technical requirements, which are now referred to as acceptable solutions. It also references the objectives and functional statements that each acceptable solution is deemed to satisfy (an acceptable solution may address more than one objective and more than one functional statement). In an objective-based code, every acceptable solution is linked to at least one of the Codes' objectives and one of its functional statements. Unlike Division A, Division B will be updated on a regular basis as part of the ongoing development and review processes (more information under Future of Objective-Based Codes).

Division C. Division C contains the administrative provisions currently found in Parts 1 and 2 of the national Codes. Provinces and territories may have different administrative provisions following from the legislative context in which they adopt codes. Placing this material in a separate division facilitates its replacement by province- or territory-specific administrative provisions.

Key Components

It is important to have a good understanding of the terminology used in Canada's objective-based codes. The key terms with which we should be familiar are listed below, and this section provides examples of how they will be applied under the new objective-based code format. The key terms are:

- Objectives
- Functional Statements
- Acceptable Solutions
- Intent Statements
- Application Statements

Objectives. Objectives state what the Codes aim to achieve. The objectives define the Codes and provide the rationale behind the acceptable solutions. In light of the bottom-up analysis of the Codes and the feedback received in the two consultations[iv] [v] on objective-based codes, the CCBFC has identified the objectives of the Codes to be:

- Safety
- Health
- Accessibility (NBC)
- Fire and Structural Protection of Buildings (NBC)
- Protection of Buildings and Facilities from Water and Sewage Damage (NPC)
- Fire Protection of Buildings and Facilities (NFC)

The objectives are found in Division A of the objective-based codes. Sub-objectives (second-level and third-level objectives) provide even more detailed information about what the Codes are trying to accomplish. The NBC objective Safety has 5 second-level objectives: Fire Safety, Structural Safety, Safety in Use, Resistance to Unwanted Entry, and Safety at Construction and Demolition Sites.

The following shows the NBC objective Safety and its sub-objective Structural Safety:

> **OS Safety**
> An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury.
>
> **OS2 Structural Safety**
> An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to structural failure. The risks of injury due to structural failure addressed in this Code are those caused by-
>
> **OS2.1** loads bearing on the *building* elements that exceed their load-bearing capacity
> **OS2.2** loads bearing on the *building* that exceed the load-bearing properties of the supporting medium
> **OS2.3** damage to or deterioration of *building* elements
> **OS2.4** vibration or deflection of *building* elements
> **OS2.5** instability of the *building* or part thereof
> **OS2.6** collapse of the excavation

Functional Statements. The functional statements translate objectives into operational terms. They describe the general conditions to be achieved. A functional statement

- is expressed in qualitative terms, and
- describes the outcome required, but not how to achieve that outcome.

Any one objective can be related to one or more functional statements, and vice versa. Functional statements are likely to be useful in the evaluation process of proposed alternative solutions. The functional statements are found in Division A.

The following shows functional statements that are normally related to the NBC sub-objective Structural Safety:

3.2.1.1. Functional Statements

1) The objectives of this Code are achieved by measures, such as those described in the acceptable solutions in Division B, that are intended to allow the building or its elements to perform the following functions:

...

F20 To support and withstand expected loads and forces.

F21 To limit or accommodate dimensional change.

F22 To limit movement under expected loads and forces.

F23 To maintain equipment in place during structural movement.

Acceptable Solutions. The term "acceptable solution" designates a Code provision or a set of Code provisions. In the objective-based codes, the prescriptive and performance requirements of the existing Codes become "acceptable solutions," a term that reflects their position as one of the many possible solutions afforded under the objective-based code format. Following the technical specifications of acceptable solutions represents one way of achieving compliance with the Codes. Acceptable solutions can also be used as a benchmark against which other means of meeting the Codes' objectives and performance expectations will be assessed or compared (more information under The Concept and How Objective-Based Codes are Intended to be Used). In an objective-based code, every acceptable solution is linked to at least one of the Codes' objectives and functional statements**.** The acceptable solutions are found in Division B of the objective-based codes.

The following is an example of an NBC acceptable solution that, although linked to other objectives, is linked to at least the NBC sub-objective Structural Safety and to some of the functional statements that are normally related to it:

9.23.10.2. Bracing and Lateral Support

1) … each exterior wall in each *storey* shall be braced with at least one diagonal brace conforming to Sentence (3).

. . .

3) Where bracing is required, it shall

a) consist of not less than 19 mm by 89 mm wood members,
b) be applied to the studs at an angle of approximately 45° to the horizontal, and
c) extend the full height of the wall on each *storey*.

The following is an excerpt from a table that will be in Division B of the printed version of the objective-based NBC that shows the objectives and functional statements attributed to this acceptable solution. Although this paper discusses only the portion of the analysis that is linked to the NBC sub-objective Structural Safety, this excerpt illustrates that this acceptable solution is also linked to other objectives.

Acceptable Solutions	Objectives and Functional Statements
9.23.10.2. Bracing and Lateral Support	
(3)	[F20-OS2.1,OS2.3,OS2.5] [F22-OS2.3,OS2.5] [F20-OP2.1,OP2.3,OP2.5] [F22-OP2.3,OP2.4,OP2.5]
	[F20,F22-OH1.1,OH1.2,OH1.3] Applies to studs in an environmental separator or that support an environmental separator.
	[F22-OS3.1] [F22-OH4] Applies to studs in walls supporting floors.
	[F20,F22-OS1.2] Applies to studs in assemblies that are required to provide fire resistance.

Intent Statements. The intent statements describe in simple terms what the acceptable solutions in Division B aim to achieve and explain the link between an acceptable solution and its attributed objective(s) and functional statement(s). This explanatory information will help Code users evaluate alternative solutions and will most likely contribute to a more consistent application of the acceptable solutions.

The intent statements are not an integral part of the Codes**,** but do constitute useful reference material, similar to appendix notes or information normally contained in Users' Guides or Handbooks. They will be accessible on the CD-ROM versions of the Codes as hyperlinks from each acceptable solution. Due to the sheer volume of intent statements, it is impossible to include them in the printed versions of the Codes.

The following is the intent statement that has linked the above example of an NBC acceptable solution—NBC 9.23.10.2.(3)—to NBC sub-objective Structural Safety and the related functional statements:

> **9.23.10.2.(3)**
> **Intent Statement.** To limit the probability of inadequate dimensions, inappropriate installation angles or inadequate lengths, which could lead to an inability to resist expected gravity and lateral loads, which could lead to excessive racking.
> This is to limit the probability of:
> - in all instances, structural collapse, or
> - for studs in an environmental separator or that support an environmental separator, the excessive deflection, deformation, displacement or failure of required environmental separation elements, which could lead to further compromised structural integrity of environmental separators, which could lead to condensation or precipitation ingress, which could lead to deterioration.
>
> This is to limit the probability of harm to persons.

Application Statements. The application statements describe the situations to which each Code provision applies and does not apply. Like the intent statements, the application statements are not an integral part of the Codes**,** but do constitute useful reference material. The application statements will be accessible on the CD-ROM version of the Codes as hyperlinks from each acceptable solution. Due to the sheer volume of application statements, it is impossible to include them in the printed versions of the Codes.

The following is the application statement for the above example of an NBC acceptable solution—NBC 9.23.10.2.(3):

> **9.23.10.2.(3)**
> **Application Statement.** Minimum dimensions, materials, orientation and extent of bracing required by Sentence 9.23.10.2.(1), in exterior walls, in wood-frame constructions to which Section 9.23. applies [see Sentence 9.23.1.1.(1) for application of Section 9.23.].

HOW OBJECTIVE-BASED CODES ARE INTENDED TO BE USED

This section presents the only two methods for assessing compliance with the 2005 Objective-Based Codes.

Typical Code Use

Code users who will rely on the acceptable solutions outlined in Division B, which includes the technical provisions of the existing Codes, should experience little change from the way they use the Codes today. Preparing a set of drawings or design specifications that comply with the acceptable solutions in Division B, or taking the necessary measures to satisfy the relevant acceptable solutions, will constitute full compliance with the Code in question and be sufficient to obtain approval from a regulatory official. Likewise, Code users who demonstrate compliance with the relevant provisions of a referenced standard will be deemed to have met the intent of the part of the Code in question. In these cases, a builder, designer or property owner will not likely need to reference or rely on the additional information that the objectives and functional statements provide.

However, in situations where Code users are unsure of how to apply a particular Code provision, the objectives and functional statements attributed to the applicable provisions will increase their understanding. Users of the CD-ROM version of the Codes will also be able to refer to detailed intent and application statements for more information on the relevant provisions.

Alternative Solutions

Under objective-based codes, a material, system or design that differs from the acceptable solutions in Division B will be treated as an alternative solution. The additional information provided in the objective-based codes will prove most useful to those persons proposing or evaluating alternative solutions, and thus needing to know what that alternative solution must accomplish to comply with the Code in question.

The process used to evaluate alternative solutions will be very similar to that used to establish equivalency in the current Codes. The objective-based codes' objectives and functional statements are

intended to make the evaluation process much easier, for both the proponent and the regulatory official. Other explanatory information, including intent and application statements, and appendix notes, is also available.

Performance. Objectives and functional statements provide qualitative performance criteria only: they do not provide quantitative performance criteria that can be used in assessing the compliance of a proposed alternative solution. It is the acceptable solutions in Division B that provide the benchmark for quantitative performance against which to compare a proposed alternative solution. Assessing compliance cannot be based on the objectives and functional statements alone.

Many acceptable solutions in Division B are not framed in precise measurable terms, with specific methods for evaluating building performance. Proponents will nevertheless be required to demonstrate that their alternative solution will perform as well as the applicable acceptable solution(s) it is replacing: not "well enough" but "as well as." An alternative solution must meet, as a minimum, the quantitative and qualitative performance levels of the acceptable solution(s) it is replacing.

Level of Performance. When Division B offers a choice between several possible designs, it is likely that these designs do not all provide exactly the same level of performance. Therefore, the lowest of these levels of performance is the benchmark (i.e. the minimum acceptable level of performance) against which to evaluate a proposed alternative solution. It is up to the regulatory official, in dialogue with the proponent, to identify that minimum acceptable benchmark.

In many cases, establishing an overall level of performance may not be straightforward due to the fact that individual acceptable solutions have differing functionalities. In these cases, a more practical approach would be to establish that the alternative solution meets or exceeds the level of performance of the individual solutions it is intended to replace.

BENEFITS OF OBJECTIVE-BASED CODES

In gauging the effectiveness of the objective-based codes, Code users will appreciate the following benefits:

- For most projects, Code users will likely rely upon the acceptable solutions in Division B—which remains essentially today's Codes—because they are familiar and satisfied with the acceptable solutions that have been in effect and proven to work for many years. The additional information—objectives, functional statements and intent and application statements—should however help Code users understand the reasons for following the acceptable solutions and contribute to a more uniform application and interpretation of the Codes.
- While many Code users may consider it is easier to keep working with the acceptable solutions, others will want to propose alternative solutions. Regulatory officials and proponents alike will now have access to information regarding the intents and applications of acceptable solutions and to the objectives and functional statements that proposed alternative solutions must satisfy.
- Generic (i.e. non-proprietary) alternative solutions that could be used across Canada will continue to be reviewed by the CCBFC's standing committees, submitted to public review, and potentially added to the applicable National Code Document as acceptable solutions. As was the case for the current acceptable solutions, intent and application statements will be developed for the new acceptable solutions, and objectives and functional statements will be attributed to them.
- Because the objectives and functional statements will rarely change, it is expected that Division A will not require updating with each new edition of the Codes. The consistency of the fundamental precepts upon which the Codes' technical requirements are based is one of the benefits of the objective-based format. In Division A, the Codes' objectives are fully articulated for the first time in the Codes' history. Division A therefore constitutes a very thorough and precise statement of the Codes' scope.

TRANSITION TO OBJECTIVE-BASED CODES

Training for Objective-Based Codes

In Canada, training on Codes is normally the domain of the provinces and territories and the CCBFC plays no role. However, it was realized that all jurisdictions would have common training needs related to the introduction of objective-based codes, so it was agreed that the transition training materials should be developed jointly under the aegis of a new committee under the CCBFC called the National Steering Committee on Training and Education for Objective-Based Codes. This training will introduce the new structure of the Codes and the new terminology, and provide guidance on dealing with alternative solutions.

Decision-Making and Fire Risk Assessment Tools

FiRECAM™[vi] and FIERAsystem[vii] are computer-based fire risk assessment tools that can be used to evaluate fire protection options and costs for office, apartment and light-industrial buildings. FiRECAM™ and FIERAsystem are developed by the Fire Risk Management group at the Institute for Research in Construction (IRC) of the National Research Council Canada. These tools do not establish the level of performance in absolute terms but allow the benchmarking of current Codes and can be used to determine if different fire protection options would have an impact (reduction or increase) - and the relative importance of the impact – on the overall level of fire safety performance of a building. These are decision-making tools that can be used to compare the impact of such features as sprinkler systems or smoke detectors on life safety and property preservation. FiRECAM™ and FIERAsystem are examples of the research that IRC is conducting to support Canada's move from a prescriptive to an objective-based system of construction codes. IRC is planning to extend its modeling capabilities to evaluate fire protection systems in other types of buildings, such as industrial plants, arenas and shopping malls.

FUTURE OF OBJECTIVE-BASED CODES

Objectives

In an objective-based code, every acceptable solution is linked to at least one of the Codes' objectives and functional statements**.** Therefore, a proposal to add an acceptable solution that cannot be linked to one of the established objectives would require the creation of a new objective. While these objectives are not necessarily fixed for all time, the CCBFC will only add an objective after very careful consideration, and extensive consultation with the Code community and its major stakeholders.

Level of Performance

New acceptable solutions beyond those in the current Codes will be added over time through the regular updating process. A reduction or increase in the acceptable level of performance over time is possible under objective-based codes and can be achieved by the introduction or revision of acceptable solutions against which alternatives will be compared.

Performance-Based Codes

Some stakeholders may perceive objective-based codes as a transitional approach towards the introduction of fully performance-based building regulations. This is not necessarily the case since some parts of the Codes might logically be left in prescriptive format and some parts of the code-using community might prefer it that way. Nevertheless, there is a general trend towards performance-based codes and objective-based codes can help guide the way along that path.

The implicit level of performance embedded in the acceptable solutions can be viewed as representing society's expectations of building performance. Converting this implicit level of performance into quantitative terms is a critical first step in the development of measurable and verifiable performance criteria that closely reflect society's expectations—the performance criteria that are essential to true performance-based codes. This is an area where research is needed to develop tools and methods, such as FIRECAM™ and FIERAsystem, that allow the quantification of the implicit level of performance of acceptable solutions. As more knowledge becomes available, more areas of the Codes may be developed into a performance path with quantitative, measurable and verifiable performance criteria, including their verification methods.

National Repository of Alternative Solutions

A national repository of alternative solutions previously accepted by local authorities, or by an individual province or territory, is being contemplated. Such a repository would make additional well-considered information available on-line, result in less "reinventing of the wheel," and speed up the evaluation of other alternative solutions. Proponents and authorities having jurisdiction could more easily investigate what has been accepted by other jurisdictions and under what limitations. However, there are many issues to be addressed before such a repository can become a reality: liability of the listing authority, obligation or pressure imposed on other authorities, disclosure of proprietary information, etc.

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Making it Happen – The Transition to a Sustainable Society

Case Study

The Transformation of the National Building Code of Canada: from Prescriptions to Objectives

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Preface

This case study is about the transformation of a very fundamental but not widely appreciated regulatory instrument, the Model National Building Code, into a more flexible and adaptable framework. The intent of that transformation was to clarify objectives and intents of decades of prescriptive regulations and, among other things, allow for more innovation, including innovations that would lead to a sustainable society. The transformation ensures both the policy and technical dimensions are clear. This case study is included here because it illustrates dramatically the process of how bureaucratic and administrative tools need to be adapted and harmonized if we are to remove obstacles to change.

The case study describes some of the steps over the 10 year period during which the National Building Code of Canada, the fundamental regulatory framework that shapes how we build and renovate buildings, was transformed from a prescriptive-based system, to a more flexible objective-based framework. It describes the huge challenge and complexity involved in this makeover. Removing obstacles to change, especially administrative and institutional barriers, is not a trivial pursuit.

This case study was funded by the Institute for Research in Construction at the National Research Council of Canada. The views expressed in this case study are those of the authors, and do not represent the NRC. More information on the National Building Code of Canada and the national model construction codes development system can be found at www.nationalcodes.ca

This Case Study is part of a larger project, Making it Happen, that examines the barriers and obstacles to deploying sustainable technologies. (See http://makingithappen.ca)

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There are approximately $70 billion worth of new construction projects in Canada every year. All of them, whether commercial or residential, require building permits before they can proceed. Those permits, in turn, depend on the National Building Code published by the National Research Council of Canada, which specifies minimum standards for how buildings should be designed and erected. As the “Bible” of Canada’s construction industry, the building code is the foundation of a national system of regulations, practices and enforcement. This is the story of how it underwent a major recent transformation to meet the evolving needs of Canadians.

What is the building code?

The National Building Code sets out minimum provisions for design and construction with goal of providing an *acceptable level of safety, health, accessibility and building protection*. As one architect said, "a building has to satisfy the requirements of the code or you simply cannot build it.” *Minimum provision* in this case means that every building has to satisfy at least these requirements: it does not prevent a builder from exceeding them.

Under the Canadian Constitution, responsibility for building regulation rests with the provinces and territories. In earlier times, however, regulating buildings was the responsibility of municipalities and even today some cities still retain this right in their charter. As a result, a multiplicity of municipal building regulations arose across the country, making it very difficult for architects, providers of materials or contractors to do business in more than one centre. If they wanted to do business in different cities or regions, material manufacturers would have to become very familiar with the codes in each area, obtain different code documents and in some cases even hire a separate expert to deal with specific local requirements.

In order to rationalize this proliferation of local standards, three model codes were developed by NRC between the 1940s and 1960s as national standards that could serve as a common reference point for local regulation: the National Building Code of Canada (NBC), the National Fire Code of Canada (NFC) and the National Plumbing Code of Canada (NPC). The first sets out minimum requirements addressing safety, health, accessibility and building protection for new buildings; the second addresses fire safety during the operation of facilities and buildings; and the third deals with safe installation of potable water systems in new buildings and the removal of wastewater to municipal or private sewage systems.

The National Building Code has gained acceptance over the years by governments, regulatory authorities and industry, and is used today as a model set of minimum standards for virtually all regulations in Canada that apply to the construction, renovation or alteration of all buildings. Safety, health, accessibility and building protection are its four primary objectives. Divided into nine parts and organized using a convenient decimal numbering system, the NBC first defines words, terms and phrases. It then spells out minimum requirements for:

- Fire protection, occupant safety and accessibility (Part 3)
- Structural design (Part 4)
- Environmental separation (Part 5)
- Heating, ventilating and air-conditioning (Part 6).
- Plumbing services (Part 7)
- Safety measures at construction and demolition sites (Part 8)
- Housing and small buildings (Part 9).

The development and promotion of these codes is carried out under the direction of the Canadian Commission on Building and Fire Codes (CCBFC) (www.nationalcodes.ca), an independent volunteer body of provincial, territorial and municipal building and fire officials, designers, architects, manufacturers, builders and building owners/operators and public interest groups which is served by a Secretariat at the National Research Council of Canada. The Canadian Codes Center at NRC has 15 professionals who are specialists in various aspects of the code, and provide technical expert advice to the Commission and its standing committees. The Centre can also call on the community of NRC's researchers, as well the support of staff involved in production, marketing and product evaluation (www.nrc-cnrc.gc.ca/irc). The Commission also receives policy advice on issues and priorities of concern to the provinces and territories through an advisory body of provincial and territorial officials. Called originally the Provincial/Territorial Committee on Building Standards (PTCBS), it later evolved into the Provincial Territorial Policy Advisory Committee on Codes, or PTPACC (www.nationalcodes.ca).

Model codes are very technical documents designed for very knowledgeable users. It is important to note that model codes have no force in law until they are adopted officially by a provincial or territorial government, i.e. an "authority with the appropriate jurisdiction". Today, however, most provinces and territories have passed laws that have adopted the national building code either in whole or with variations.

The first National Building Code was published in 1941. In 1990, a Memorandum of Understanding was signed between NRC and most of the provincial and territorial governments that established a partnership and established the foundation of a national model code system. By this agreement provinces and territories are agreeing to aim at adopting the National Building Code as a core document with as few amendments as possible.

How the building code works

A building code is a set of rules that specify minimum requirements for various components of buildings. In the three national model codes, there are more than 6000 such rules or requirements that need to be enforced. That is the role of building inspectors. One former inspector described her role as follows:

> *There is a set of regulations and bylaws relating to construction of buildings, and 'authorities having jurisdiction' are responsible for enforcing these rules. They do this by receiving the owner's application for a building permit and reviewing the proposal and plans for compliance with the rules. Then there are site visits to inspect that the construction conforms to the plans that were approved as well as any other conditions of the building permit. There's a great variety of buildings and applications, ranging from a backyard wooden deck on a house to a full high-rise building tower.*

The building code does not cover everything, only those elements that need to be regulated. Many aspects of buildings are covered by other tools or instruments, such as design best practices or market forces and consumer preference. One of the difficulties of enforcement is that most buildings are "one-off" in terms of design and construction.

> *Constructing buildings is not like manufacturing automobiles, where you develop a detailed plan and build thousands of units in a controlled environment. In buildings, there are usually unique combinations of features even in typical buildings like houses.*"

Common or recurring faults do occur in construction and building officials play a role in fixing these problems. Sometimes, however, the faults are not obvious during construction and only come to light long after the building code enforcement official is done with a building.

How the code is amended

Over the years, many changes have been brought to the code and many new requirements were introduced. An amendment to the code is a very formal process and requires a trigger to initiate the process. An idea can come from industry, the public, building officials, or governments. In principle, anyone can request a change.

Staff at the Codes centre will take a code change request, analyze it, and put it forward to the appropriate standing committee. The standing committee will determine if it wants to add the requested change to its work plan and submit it to the CCBFC to ask for their authorization and direction. The Commission is where policy discussions and final decisions take place. The Commission in turn will provide the standing committee with direction on how to proceed further.

Once the standing committee has developed a proposed change, it will be subject to a public review. Based on the comments received in the course of the public consultation, the standing committee will make recommendation to the CCBFC, which then makes the final approval of the proposed changes.

Up to its 1995 edition, the National Building Code followed a primarily prescriptive approach, which was very predictable and straightforward. It specified the precise requirements for particular materials and construction methods. In that sense, it was like a checklist against which all buildings had to comply. In the words of one former inspector:

> *Some people including some inspectors wanted a clear checklist and if everything checked out, life was good. They wanted a clear black-and-white set of rules that are straightforward to apply and easily enforced. This eliminated the need for debating whether the rules were being followed or not.*

Limitations of the old prescriptive code

There was a problem, however. Even though there was an equivalency provision in the code (Section 2.5 in the NBC) that allowed for new or alternative solutions to be proposed by designers and builders, there was an arduous and complex process of getting such innovative solutions approved by code inspectors. There was also no set procedure or uniform criteria for dealing with innovations across the various jurisdictions. What further complicated the situation was that the code requirements evolved since 1941 and it was not clear what the intent of some of the requirements were – code requirements were typically written with the products/systems/methods of the day in mind and not future innovations.

This prescriptive framework did not sit well with people who were innovative and thought outside the box. Many designers and architects wanted to try new construction ideas that did not necessarily fit into the neat checklists of the prescriptive code. There was a growing need to allow for innovation in the building sector, but there was also a significant impediment: everyone involved in the construction of a building bears legal responsibilities. The more innovative a design, the greater the risk of increased liability will be for the government, the 'authority having jurisdiction', the building inspector, the designer and the builder.

At a policy level, the building regulatory system was and is today seen as a way to affect change in the marketplace. The structure of the old codes did not lend itself to clarity in process and debate when the scope of the codes were to change. Clearly changing the scope the model codes and thus the provincial and territorial regulations through the codes adoption, required a proper process engaging regulators and stakeholders in a proper debate on the policy. It should not be up to technical committees to affect such policy change by changing a technical requirement that could have long reaching impact.

International developments

The emergence of a new generation of codes based on performance criteria rather than prescriptive requirements was accelerated by the example of other countries.

As a rule, code developers were very focused on their own national or regional needs and didn't have the time for comparing notes with international counterparts. Finding out what happened in other countries usually fell to research organizations, who brought this information into the code development process. Canada was no different from other countries although having the lead code development work done within Canada's main centre for research helped with this knowledge transfer. Canada also benefitted from a strong relationship with US research providers because of their special relationship. With growing interest in the new performance-based codes, however, there was a stronger willingness to learn from the experience of countries that had made this transition.

One development that contributed to this change was the creation of a new international forum under the International Council for Research and Innovation in Building and Construction (in French *Conseil International du Bâtiment* or CIB). A special Task Group was formed and chaired by Bob Bowen with NRC staff providing a major supporting role. At the beginning, the Task Group involved the UK, New Zealand, and Australia who already had performance-based codes, as well as Canada, the US and Japan who were considering it. The mandate was to encourage a greater sharing of international experiences in code development using the performance-based approach.

At the time, NRC officials also traveled to some of these countries, including the UK, to talk to officials and find out firsthand about how they reoriented their building codes from a prescriptive basis to a performance-based approach. In one instance, they even picked a building inspector at random from a UK telephone directory and met with him to find out first-hand how the new performance code actually worked and what practical impact it had on architects, designers, and builders. In the UK, for example, the new code replaced some especially antiquated requirements, some of which were centuries old.

This building inspector also indicated that the new performance based code made intentions and objectives of regulations clearer, and generated a more congenial problem-solving environment for dealing with specific issues. There was a more positive partnership between inspectors and builders/designers. The new mode of operation made it easier to find acceptable solutions that would meet the performance criteria of the code.

One finding was that for those countries that made the dramatic switch to performance-based codes, there was a big difference between what was written about the process and what really happened. In practice they had to find acceptable solutions either formally or informally to the performance requirements and that were "deemed to satisfy" the objectives. While this went against the theory of pure performance-based codes, Bowen and others saw that as an opportunity.

This was particularly true for existing buildings that had to be retrofitted to meet modern requirements. A classic example is a prescriptive requirement in the fire code that an exit must be located no further than a specified distance to allow safe egress of occupants in case of fire. In older buildings this may be difficult to achieve without major and costly reconstruction. From a performance perspective, however, other measures can be put in place such as a fire alarm to warn occupants earlier of a fire risk, or water sprinklers to retard the progress of the fire. Both measures contribute to the same objective of ensuring the safe exit of occupants during a fire emergency.

NRC officials observed that a number of countries who were the first to make the transition to performance-based codes did so because of significant dissatisfaction with their current approach. They consequently were prepared to have dramatic and disruptive change. For instance, when performance-based codes were introduced in one country, they decided to only use the new performance-based requirements and abandoned the previous prescriptive requirements. This meant that the industry suddenly had no defined checklist against which to build and was left to its own devices to put up buildings with "acceptable" solutions that met code requirements "well enough". This proved to be quite disruptive for the industry and left a lot of uncertainty when it came to the need for safety features such as sprinklers.

Finding "acceptable solutions" that were "deemed to satisfy" the objectives inherent in the code was not a simple process and designers, architects and builders struggled with it. From Canada's perspective, they believed the code system was strong and basically well established but it needed to be looked at in terms of new and emerging needs. The challenge became how to take all the good things that were experienced with performance-based codes in other countries and to keep the good aspects of Canada’s existing system. This became the starting point for the unique approach to “objective-based” codes in Canada.

The origins of the objective-based code

A uniquely Canadian approach to structuring and revising the building code emerged: devise a system where the objectives and purpose of the requirements were very clear and understandable (something that was implicit but not always clear in the old code) in order to be able to find or propose a novel or alternative solution to satisfy these objectives. That meant, in contrast to the experience of other countries, that the 6000 or so detailed prescriptive requirements under all three codes (NBC, NFC, and NPC) would not be discarded but would be

kept as “acceptable solutions”. Moreover there would be features in the code that would show clearly how requirements are linked to the overall objectives of the code. As one NRC manager said "We were looking for a more evolutionary approach. It appeared from Canada’s perspective that other countries had adopted a more revolutionary approach, which led to significant disruption. We wanted to avoid that." The approach sounded simple and appeared novel, but the work involved turned out to be monumental.

It was generally agreed within the Commission that Canada already had a very good code that worked quite well. The Canadian code development system already included the key players in the decision process: the volunteer committees, the provincial and territorial policy makers, the industry stakeholders, the inspectors, and all the other participants. The challenge was how to improve that system and meet the 21st century needs of Canadians.

At the time the 1995 code was developed, there was a realization within the Commission and the NRC that there could be some improvements: the scope could be more defined, the intent behind code requirements could be clearer, the code could be more accommodating to innovation, and it should be easier to apply to renovations.

The strategic plan

At the time the Commission was developing the 1995 codes, it started a strategic planning process that would launch the formal process of change. In the words of Bob Bowen, Director of the Codes Centre at the time,

> *We were viewed as having a good code system but we also recognized there were a number of issues or stress points that needed to be considered. The intent of the strategic planning initiative was to identify problems like the expanding scope of the code, application to existing buildings, time to formal adoption to name a few. We didn’t set out with a solution in our pocket called objective-based codes. The concept evolved as a result of issues that needed to be addressed.*
>
> *There were 3 main areas of concern at the time:*
> - *The need to understand the national code development process and how it was part of the larger building regulatory system and where should different types of decisions be made i.e. policy and technical,*
> - *The need to address specific aspects of the system that had been identified.*
> - *To learn from other countries who had tackled change in their codes system*.

Another perspective on the need for change is provided by the Commission's chairman Bruce Clemmensen, who identifies two factors that motivated the Commission to start the process:

> *The first was that the code in its current prescriptive form was a barrier to innovation. It was not conducive to nor did it allow for alternative solutions, in terms of how it was being developed and administered and how it was written. The second concern was that the relationship with the provinces and territories,*

which had jurisdiction over how the code was being applied, was not clearly defined yet they were a major partner in the overall system.

The strategic plan defined six goals for the Commission:

1. To provide national model codes that meet the needs of all code users in Canada.
2. To have future national model codes adopted without change by all authorities having jurisdiction in Canada.
3. To have uniform interpretation and understanding of code requirements throughout Canada.
4. To have a responsive, objective, efficient and effective code development system.
5. To strengthen the Commission's leadership role.
6. To be substantially self-funded

In the Commission's January 1997 progress report on the strategic plan, there were optimistic expectations as to the task it was facing. The Commission and its committees would focus on the development of objective-based codes and it was estimated that this task would occupy them only "for the next three years."

In fact, it took almost a decade to complete the new code. The first half of that process consisted of going through the code, section by section, to perform a "bottom up analysis". The other half of the process consisted of dealing with more technical issues to bring the code up to date.

One commission member recalls that when he first met with the staff of the Canadian Codes Centre, he began to realize the enormity of the task ahead and the urgent need to revise the work plan. The Commission decided that technical revisions of the current codes - the daily bread and butter of the Commission's work and that of the Canadian Codes Centre staff - would have to come to a near standstill during the transition period to objective-based codes and "would be limited to vital issues only."

The first challenges - deriving intent statements

The task facing the Commission and the Canadian Codes Center was to transform the 6000 or so existing prescriptive requirements of the NBC, NFC and NPC into an objective-based framework. Such an objective-based code was seen as more flexible because it made the intent of specific requirements better known and thus allowed owners, designers and architects to consider options that satisfied the same objectives in a more cost-effective manner. In contrast to purely performance-based codes, the Canadian approach kept the prescriptive requirements intact, for the most part. The real work was to show clearly how these requirements were linked to objectives that, in turn, supported the broad objectives of the building code. These prescriptive requirements were to be kept in a new “Division B” as examples of acceptable solutions meeting the objectives of the code.

Intent statements explain in plain language the basic thinking behind each provision contained in "Division B." of the code. Each unique intent statement explains how that provision helps to achieve its attributed objective and functional statements. Also, there was a new “Division A” which contained all the objectives and functional statements. (See Appendix A)

The enormity of this task can be appreciated by understanding that the Commission, the working groups and standing committees, together with NRC staff had to go through the code section by section, item by item, sentence by sentence and do what was called a "bottom-up analysis". This involved taking each individual requirement and determining what was its underlying intent and how that contributed to overall objectives. Since the Canadian building, fire and plumbing codes are composed of approximately 6000 such sentences or requirements, this was a lengthy and painstaking process.

But there were also issues with the concept of performance codes and performance standards. For example, how can authorities determine what is minimum acceptable performance for something like drywall? How thick should it be? How strong should it be? What is a suitable measure of strength – be able to resist the impact of a blackboard eraser?

As the people around the table reviewed the initial set of requirements, they discovered language issues, anomalies, and conflicting statements. In some cases, they had to go back to historical documents to tease out the original reasons for including specific requirements in the codes.

Garage floors offer an interesting example to explain the difficulty with prescriptive requirements and the potential for misunderstanding what is intended. One could imagine, if not very well informed, that the requirement for a sloping floor of an attached garage to the outdoors was to allow liquids to drain off the car, possibly salty water in the winter, to flow away from the house. What may not have been obvious was this prescriptive solution was to allow gasoline fumes, which were heavier than air, to drift outward if there were emanating or leaking from a car's gas tank. This was to reduce the risk of the fumes accumulating and flowing into the basement of the house and being ignited accidentally by an electrical spark and cause an explosion or fire. In this case, the intent of the provision was not immediately obvious and some historical digging was needed to clarify its purpose.

A lot of the work was done by consultants and staff, but the Standing Committees were ultimately responsible for the outcome of all analytical work. Over time, they had to develop techniques to streamline the process. There was even a manual developed by the staff of the Codes Centre on a standard methodology to derive intent statements. They created a database that included the requirements, the intent, application, objectives, functional statements and in some cases the history. In total, there were 15,000 records in this database.

Because of the sheer volume of the number of intent and application statements -- tens of thousands for the National Building Code alone -- they are only published in the electronic version of the code as well as in a separate User's Guide document only available in an electronic format.

Some contentious issues – non-existing and new objectives

The staff and the standing committees were trying to map out clearly how the different requirements in the code supported higher-level intents, which in turn fulfilled the high level objectives of the code. Not surprisingly, there were a number of intense debates. One reason was that over the years new requirements were introduced without clarifying what high level objectives they fulfilled. In other cases, when higher-level objectives were proposed, it was

thought that there were better ways of satisfying them than through a national code. For instance, in some cases, market forces can do as good or better a job ensuring that buildings and houses satisfy consumer needs.

One issue that generated a lot of debate was the concept of "durability." Should the code ensure that consumers will enjoy a house or building that will be durable? The question was whether "durability" should become an objective of the code or whether it should belong somewhere else. At the time, there were a number of lawsuits in Canada around building and residential project failures that made the issue highly topical. In the end, the discussion helped the Commission reaffirm that the real purpose of the code is to specify "minimum practice" versus "best practice." It finally decided that the notion of durability would be appropriate for the code only when it supports fulfilling a code objective like structural integrity. However, durability of colour finish for aesthetic reasons was deemed *not* appropriate for codes.

Another example had to do with the long-standing requirement of having a door to the washroom in a house. In examining the intent behind this requirement, the Standing Committee realized it would necessitate developing a new objective called "privacy" within a house, which would not fit well with the “minimum standards” role of the code. The Commission determined after much discussion that market forces and consumer preferences would be sufficient to ensure that bathrooms had doors. As a result the requirement was dropped from the new objective-based code.

A related debate had to do with privacy and the requirement that public toilets have a lock. Because privacy was not an explicit objective of the code, there was no justification for this requirement. However, since accessibility is an objective of the code, from that perspective it was deemed that public toilets for disabled people had to offer resistance to entry for the safety of the occupant. As a result, large stalls in public washroom for disabled people have a requirement for locks, while normal stalls do not have such a code requirement. But again, consumer preference and social norms dictate that all toilet stalls have a lock.

Another example of a requirement that was dropped from the new code was that there had to be a minimum number of windows with a certain size in a house. This led to an exploration of the objectives that such a requirement would fulfill including aesthetics, having a view of the outdoors, health, or psychological well-being. All of these objectives proved inappropriate for the code. How then to explain the requirement for windows? What objective does that meet? In the end, the requirement was dropped on the basis that market forces would again look after the issue. A windowless house would simply not sell in the market.

Another discussion led to the creation of a new objective, to protect a building from fire damage. Consider the example of a building with two different occupancies such as a library and a factory. The specific requirement states that the building needs at least two hours of fire protection before fire can spread from one unit to the other. The debate centered around the underlying reason for that particular length of time. Was it really intended to protect people? Or was there another reason? As the Standing Committee considered the real intent of that requirement, it became apparent that this length of time had to do with more than only the safety of people, who can evacuate a building in 3 to 7 minutes. The two hours was intended to allow enough time for sprinklers and firefighters to contain or stop the fire and prevent it from spreading. And it became clear that in addition to the safety of people, the requirement had to

do with reducing damage to the building from fire. The historical requirement was likely introduced in response to the needs of insurance companies. But that objective had never been mentioned previously. After much discussion it became obvious that "building protection against fire damage" had to become an explicit objective of the code. A similar analysis of other code requirements identified “building protection against structural damage” as another objective of the code.

In the end, the new objectives of the National Building Code were clearly identified: safety, health, accessibility for persons with disability, and fire and structural protection of buildings, as well as “functional statements” identifying the functions or conditions in the building that help satisfy the objectives.

Building bridges with provinces and territories

One of the major objectives of the Canadian Commission on Building and Fire Codes (CCBFC) was to make sure that "The *code development system* became more responsive to the needs of the provinces and territories".

The provinces and territories had legal jurisdiction over the building sector, and a number of them took a long time to adopt new changes to the code. There was also no mechanism for sharing information among themselves or with the CCBFC. There was often duplication in consultations on potential changes. This absence of coordination or harmonization meant that a typical updating cycle between different versions or editions of the code could take several years. This lack of coordination among provinces and territories was largely due to the fact that each government had its own process for dealing with changes to the code. Some of these legal and political processes involved orders in Council while others required legislative amendments or regulatory changes.

The code development system was a *system* in the sense that there were a number of different stakeholders, agencies, and jurisdictions that worked together not only to develop and update the code, but also to administer it and enforce it. The code development system includes the volunteer committees, the NRC staff, the provincial and territorial policy makers, the stakeholders, the inspectors, and all participants and users. Given the complexity of this system, the successful completion of revisions to the National Building Code and the publication of a new version in 2005 after ten years of effort, marks one of the most significant and least visible achievement in federal/provincial/territorial collaboration.

The Commission recognized that there were two distinct aspects to code development. Take the example of a request to change the code to require a low-flow showerhead. There are technical considerations in defining the requirement, but there is also a significant policy dimension underneath such a request, such as promoting water use efficiency. Clearly the first is the domain of technical experts while the second is really the prerogative of provinces and territories that had to agree that that was indeed a policy objective they wanted to pursue. In earlier versions of the code, this distinction was sometimes muddled, leading to misunderstandings that slowed code adoption by provinces and territories.

The fundamental explicit objectives of the new objective-based building code are safety, health, accessibility and protection of buildings (fire and structure). The provinces and territories

include these objectives in their legislation and regulations and it is important that they be able to integrate them consistently across the country.

An example is swimming pools inside buildings. Pools can pose health and safety risks to users. They also generate moisture that can sometimes lead to building problems. At one point, there had been a request that the National Building Code address this in new requirements but to do so would require taking provincial and territorial legislative reality into account. In one province, these requirements are covered under a separate code that governs indoor swimming pools. That does not work with another province either, because indoor swimming pools come under that province's health regulations.

This underscores the importance of having a policy discussion first before developing the code. If there is a need to add new objectives to the code or expand its scope, these have to be compatible with the legislation of most of the provinces and territories. "We need to have their agreement that they want to cover them in their codes, and that they would do it together," said one commission member.

Early in the process, the Commission chairman, Bruce Clemmensen, resolved to address this problem head-on. The Commission put together a working group of key people from the provinces and territories. Its initial premise was that it would consider any new structure proposed by the provinces and territories and any new idea on how to improve the national code system, including disbanding the Commission altogether. "We were ready to retire ourselves. After some discussion, the provinces and territories saw the merits and benefits of a body that would be arm's-length, and do a lot of the work including public consultations. We said to them 'you have the jurisdiction and you can always say no'. We only ask that we do things together and coordinate our activities."

There were a number of meetings with provinces and territories to forge this consensual approach to defining building code objectives and to improve and better coordinate what people now referred to as "the national model code development system".

One such meeting was chaired by the president of NRC, Dr. Arthur Carty, and included the Deputy Ministers from all the provinces and territories that were involved in building, fire and plumbing regulations. This meeting, which occurred in November 1998, was fully attended. In those jurisdictions where there was more than one Deputy Minister involved with the various codes, all of them attended. The idea was to capture the interest of the provincial and territorial Deputy Ministers and get their buy-in into the process of transforming the code to an objective-based framework. "This meeting was essential if we were to build the kind of federal provincial and territorial cooperation that we wanted," said the commission chairman.

There was another meeting in 1996 with the legal advisers of the provinces and territories to which the NRC invited the Australian expert to discuss performance-based codes and questions of liability. This group had never met previously even though its members were all pursuing the same kind of work. One of the discussions focused on the legal and bureaucratic mechanisms that each of the jurisdictions used to adopt and implement building codes. This in turn led to recognition of the need for greater harmonization.

Understanding the importance of getting early buy-in from provinces and territories has contributed immensely to the streamlining of the code development system. As one NRC director noted "One of the reasons that we were successful is that the NRC is not seen as a policy body, but as a purely technical one. We have no policy role and cannot put a new objective in the code."

Today, there is a lot more coordination with the provinces and territories. For example, the Commission looked recently at the process for developing energy efficiency requirements for small buildings and houses. It now works closely with the new Provincial Territorial Policy Advisory Committee on Codes (PTPACC) who is involved in all stages of its development. This is very different from the early days where provinces and territories would be presented with the finished product and where there was a lot more separation of activities. "Now we work virtually as a team. The chair of the Commission is an ex officio member of PTPACC and vice versa. Also, provinces and territories communicate better and work more closely on a policy matters." The communication process with the Commission is more formalized, resulting in more pertinent input and faster and better decisions.

Getting buy in from stakeholders

Clearly, building consensus was a major *modus operandi* of this whole process. For example, arriving at a consensus on "how safe is safe" required a consensus to provide practical guidelines to builders and architects. There was a need to engage in a broad consensus to avoid getting into conflicts over specific regulations. This has become particularly important today, now that the Commission and the building code are faced with new challenges such as water and energy conservation, which are very much new areas of concern.

The commission and the working groups on pilot testing of the objective-based code initiated two public consultations open to anyone. Documents were posted on the National Building Code website. The first public consultation focused on the general concept of objective-based codes, and the second one in 2003 sought public reaction to prototypes of what the new code would look like. As one Codes Centre manager pointed out, "Some comments pointed at things we wouldn't have noticed otherwise" Thousands of unique viewers registered on the site.

Many of the negative comments submitted showed that people were not clear on the concept of objective-based codes, and why it was necessary for every prescriptive code provision to be attributable to at least one of the code's objective. This led to a significant educational effort, including a joint initiative between NRC and provinces/territories to develop training material aimed at enforcement officials.

Growing pains

A project of such magnitude spanning almost a decade has to leave its mark on the people involved. One such impact was the clarification of roles between the Commission volunteers who spent considerable time on attending meetings, some of which were quite intense in terms of debates and discussions, and the paid full-time staff of the Canadian Codes Center. Over the duration of the project, this relationship matured and the Commission eventually took on its rightful role as the final arbiter or decision-maker regarding the content of the code, with the NRC staff supporting the CCBFC with analysis, technical expertise and knowledge.

There were also predictable discussions around semantics, such as the precise meaning of the words in intent statements. For example, if there is a requirement for guardrails, why should they be put up? Is it to prevent falls and injuries? This is where the particular standing committee members realized that the code could not "prevent" and that this term was not correct. This made the group realize that complying with the code would only "reduce the probability" or "limit the probability" of someone falling over an unsafe area leading to injury and possibly death. These kinds of discussions and insights contributed immensely to the collective understanding of the code's ultimate role.

As the various standing committees reviewed the initial set of requirements, they discovered language issues, anomalies and conflicting statements. Initially, every group was working separately and the work and analysis was going in different directions. Eventually, they moved towards a more common methodology, and developed a "bottom-up analysis" manual which essentially described a standardized method for deriving intent statements, the underpinning logic, and how best to express results.

Because of the length of the process, there was even a fear that the NRC would run out of funding. Codes were published on a five-year cycle and were sold to users: the revenue from sales was an important part of the funds NRC used for supporting the national model code development system. When the original estimate of three years stretched to nearly ten, there was serious concern that these revenues would drop significantly causing a cash crunch and NRC would have had to find other funds to support the national process during this transition. Fortunately, sales of the 1995 code did not drop and continued, avoiding a cash crisis.

The end product

The NRC's virtual store describes the salient features of the 2005 National Building Code:

> *Over 800 technical changes have been incorporated in this new edition. The NBC sets out technical provisions for the design and construction of new buildings. It also applies to the alteration, change of use and demolition of existing buildings.*
>
> *New information has been added to make the 2005 NBC clearer, easier to apply to existing buildings and more accommodating to innovation. It explains the objectives that the Code's provisions are intended to achieve and describes the functions that a building or its components must perform to fulfill these objectives.*
>
> *The NBC is available in two volumes and has a new organizational layout that comprises three divisions: Divisions A, B and C. Division A includes the compliance options, the objectives and the functional statements. Division B contains the provisions-now referred to as "acceptable solutions"-relating to such issues as fire protection, occupant safety and accessibility, structural design, environmental separation, heating, ventilating and air-conditioning, plumbing services and housing and small buildings. Division C contains administrative provisions. Volume 1 contains Divisions A, B and C, and Volume 2, the appendices to these divisions as well as the index.*

There is also a CD-ROM version that has the following additional features:

One of the main features of the CD-ROM version of the NBC is the linking of most Code provisions to:

- *intent statements (detailed statements on the specific intent of the provisions), and*
- *application statements (detailed statements on what the provisions apply to).*

The CD-ROM version allows users to easily navigate between the various parts of the NBC. The integrated external links allow for instant cross-referencing to provisions in other Codes and the active internal links allow for consultation of cross-references, defined terms and Appendix Notes. The CD-ROM version also includes an easy-to-use search engine. Technical changes or additions made relative to the 1995 edition of the NBC are displayed on a colored background. Revisions and errata to the 2005 NBC can be incorporated automatically.

Lessons learned

International counterparts in the building code community were, to say the least, impressed by the tremendous effort undertaken by Canadians over the previous decade. The reaction to the new code bordered on disbelief with foreign colleagues wondering how Canada managed to keep all the participants involved and committed over such a lengthy period.

In the words of the Commission chairman, one lesson learned from the process of transforming the code was the strengthening of the Commission's respect for the consensus approach. A useful way of achieving this was to pay particular attention to dissenting views on a given issue, which more often than not allowed the group to eventually arrive at a consensus.

The composition of the Commission also reflects this principle. As one member commented, "Committee members represent a matrix of people selected by geographical areas, by skills set, and by expertise. Members can be selected from industry, regulator or end-users communities. There are always a number of different perspectives around the table."

Another key success factor was the quality and dedication of the volunteers. As one member stated "There was no magic bullet: all our volunteer committee members worked with their departments and their groups. Some people went to extraordinary lengths to offer their input. It was a very remarkable effort. It makes me proud of everybody who participated in this". Everyone involved agreed that even though some discussions were exhausting, people were fully engaged and committed to the process, and this allowed everyone to complete the task.

Most people also agreed that there is now a lot more coordination with the provinces and territories now than had previously occurred. The Commission works very closely with the PTPACC, which is involved in all stages of code development. The regular process now ensures that provincial and territorial review comes before the public review and the final approval of code changes by the CCBFC.

As one senior provincial representative said "The real achievement underlying this whole process was that we got ten provinces, three territories, and one federal agency working together, generally in a harmonious way, where there were disagreements but there was also a clear intent to find harmonious solutions".

In terms of external stakeholders, the new building codes will require more training and skills from all the people involved, because they need to invest the time to fully understand the underlying objectives.

This is made easier by the new digital form of the code in the CD-ROM version, which "allows you to click on the requirement and see the intent behind it. This helps not only the designers architects and builders to understand the code, but it also helps with compliance and enforcement." In effect, the National Building Code has fully entered the knowledge economy for the first time.

Early impacts of the new code on innovation

Most performance-based building codes in other countries (and in Canada, the objective-based code) were introduced in the past two decades, some as late as 2007 and 2008. Already, however, there are a number of common observations apparent across different countries. One is that these new codes have yet to be fully embraced and that people still largely depend, in one form or another, on the older prescriptive codes. The real impact of performance and objective-based building codes has yet to be fully realized.

This was one of the conclusions at an international workshop of code developers held in Calgary in September 2009 to examine the impact on innovation of new performance and objective building codes. The general consensus among the 17 participating countries was that it was too early to point to significant changes in the rate of building innovation arising as a result of objective and performance-based codes. But there were some noticeable trends.

While there was anecdotal evidence of innovations and new design resulting from performance and objective-based codes, there was little quantitative evidence of this so far. There were no studies, as yet, that attempted a systematic measurement of the number of building innovations (including products and designs) attributable to the new building codes. There were some examples where objective-based codes proved particularly effective in renovating older or heritage buildings.

Not surprisingly, one of the more prevalent trends observed to date is that proposed new solutions are more difficult to assess and evaluate for compliance than using the older prescriptive solutions. Determining whether a building component meets the required level of performance described in a code has brought in a new era of uncertainty with few established guideposts.

This is reflected in how many countries, including Canada, have found the process of getting approval for a novel solution to be time-consuming, burdensome, complex, and unfamiliar to the parties involved.

This has led to a growing demand across many jurisdictions for more quantitative assessments or tests to evaluate alternative solutions under performance and objectives-based regimes.

Many countries reduce the uncertainty in determining performance requirement by including with their codes a set of "approved documents" or user guides that include proven acceptable solutions, based on older prescriptive approaches. (In Canada, however, this is not the case as Division B of the 2005 NBC already consists of acceptable solutions based on all the previous primarily prescriptive requirements of the 1995 code.)

A corollary to these trends is the recognition by many jurisdictions that using and applying performance and objective codes requires a higher level of sophistication on everyone's part. For instance, inspectors need new skills and more training to assess whether a building meets the performance requirements of the new codes. In some countries, the new code has even led to a burgeoning new group of certified third party assessors with the authority to approve new buildings and projects. As a by-product, these third party evaluators, unburdened by past traditions, have become ardent proponents of the new codes and the flexibility they offer. Even Canada has seen an increase in consulting engineers who assist builders and designers with approval of novel solutions and demonstrate compliance with the new code requirements. Other jurisdictions have simply increased and adjusted the level of knowledge that is required for certification of building inspectors and engineers.

A number of countries also pointed out that the new codes provided greater clarity of language and a better understanding of the goals and intents of the codes, which in a number of cases facilitated harmonization both across jurisdictions and internationally.

In summary, the transition to objective and performance-based building codes has just begun. It is a story that is still unfolding and will probably take at least another generation of designers, builders, engineers and building officials before its fundamental impacts are fully appreciated and its benefits fully realized. In the mean time, Canada continues to play a leading role in developing and promoting the concept of performance and objective codes in international regulatory fora. All these efforts will benefit Canadian industry and other stakeholders, by providing them with a regulatory framework more responsive to innovation and supportive of international trade.

Appendix A: Selected examples of changes between the 1995 and 2005 National Building Code

The 1995 National Building Code had only one division, the 2005 NBC was divided in three, as shown below:

Division A	**Compliance, Objectives and Functional Statements**	
	Part 1	Compliance
	Part 2	Objectives
	Part 3	Functional Statements
Division B	**Acceptable Solutions**	
	Part 1	General
	Part 2	Reserved
	Part 3	Fire Protection, Occupant Safety and Accessibility
	Part 4	Structural Design
	Part 5	Environmental Separation
	Part 6	Heating, Ventilating and Air-conditioning
	Part 7	Plumbing Services
	Part 8	Safety Measures at Construction and Demolition Sites
	Part 9	Housing and Small Buildings
Division C	**Administrative Provisions**	
	Part 1	General
	Part 2	Administrative Provisions

The four top-level objectives and their sub-objectives as they appeared in the 2005 NBC are shown here:

Safety (OS) • OS1 Fire Safety • OS2 Structural Safety • OS3 Safety in Use • OS4 Resistance to Unwanted Entry • OS5 Safety at Construction and Demolition Sites **Health (OH)** • OH1 Indoor Conditions • OH2 Sanitation • OH3 Noise Protection • OH4 Vibration and Deflection Limitation • OH5 Hazardous Substances Containment	**Accessibility (OA)** OA1 Barrier-Free Path of Travel OA2 Barrier-Free Facilities **Fire & Structural Protection of Buildings** • OP1 Fire Protection of the Building • OP2 Structural Sufficiency of the Building • OP3 Protection of Adjacent Buildings from Fire • OP4 Protection of Adjacent Buildings from Structural Damage

Next, we show three selected examples of specific requirements, as they appeared in the 1995 NBC, and the 2005 NBC:

Example A): Adequate Light and Air for Occupants

1995 NBC:

3.7.1.1. Room and Space Height

1) The height of every room and space shall be sufficient that
a) adequate light and air are provided for the intended occupancy, and
b) no obstruction to movement or activities below is caused by the ceiling or ceiling fixtures.

2005 NBC:

3.7.1.1. Room and Space Height

1) The height of every room and space shall be sufficient so that the ceiling or ceiling fixtures do not obstruct movement or activities below.

Reason for the change: Requirements having to do with lighting for other than emergency egress purposes cannot be linked to any of the objectives or sub-objectives of the NBC. This decision was made by the CCBFC following the public consultation on Objectives in 2003.

The objective-based information for the remaining portion of this requirement (contact or collision with items at the ceiling level) was determined to be: [F30-OS3.1]

The nomenclature F30 refers to a functional statement of the Code, and that of OS3.1 to a specific Code sub-objective, namely:

F30 To minimize the risk of injury to persons as a result of tripping, slipping, falling, contact, drowning or collision.

OS3.1 Safety in Use: An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to hazards addressed in this Code are those caused by … tripping, slipping, falling, contact, drowning or collision.

Example B): Doors to bathrooms

1995 NBC:

9.6.2.1. Doors for Dwelling Units

1) A door shall be provided at each entrance to a *dwelling unit* and to each room containing a water closet within a dwelling unit. (See Sentence 9.10.9.16.(3) and Article 9.10.13.15.)

2005 NBC:

9.6.2.1. Doors for Dwelling Units

1) A door shall be provided at each entrance to a *dwelling unit*. (See Article 9.10.13.15.)

Reason for the change: The requirement in 9.6.2.1. that bathrooms (rooms containing a water closet) be fitted with a door (for privacy reasons) was deleted, as the provision of such doors was not considered necessary in order to meet the minimum health and safety objectives of the NBC 2005. Following the 2003 public consultation, the CCBFC determined that privacy should not be an objective of the NBC 2005. The following is the list of the objective-based attributions that can be found in Section 9.36. of the 2005 edition of the National Building Code for Sentence 9.6.2.1.(1):.

9.6.2.1. Doors for Dwelling Units	
(1)	[F42–OH2.5]
	[F51,F54–OH1.2] [F40,F61,F42–OH1.1]
	[F61,F42–OS2.3]

The meaning of each group of functional statements and objectives is reproduced here:

F42 To resist the entry of vermin and insects.

OH2.5 Health – Sanitation: An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to unsanitary conditions. The risks of illness due to unsanitary conditions addressed in this Code are those caused by … contact with vermin and insects.

F51 To maintain appropriate air and surface temperatures.

F54 To limit drafts.

OH1.2 Health – Indoor Conditions: An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to indoor conditions. The risks of illness due to indoor conditions addressed in this Code are those caused by … inadequate thermal comfort.

F40 To limit the level of contaminants.

F61 To resist the ingress of precipitation, water or moisture from the exterior or from the ground.
F42 To resist the entry of vermin and insects.
OH1.1 Health – Indoor Conditions: An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to indoor conditions. The risks of illness due to indoor conditions addressed in this Code are those caused by … inadequate indoor air quality.

F61 To resist the ingress of precipitation, water or moisture from the exterior or from the ground.
F42 To resist the entry of vermin and insects.
OS2.3 Safety – Structural Safety: An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to structural failure. The risks of injury due to structural failure addressed in this Code are those caused by … damage to or deterioration of building elements.

Example C): Excavation Construction

1995 NBC:

4.2.5.2. Excavation Construction

1) Every excavation shall be undertaken in such a manner as to
a) prevent movement that would cause damage to adjacent property, existing structures, utilities, roads and sidewalks at all phases of construction, and
b) comply with the appropriate requirements of Part 8.

2005 NBC:

4.2.5.2. Excavation Construction

1) Every excavation shall be undertaken in such a manner as to

a) prevent movement that would cause damage to adjacent buildings at all phases of construction, and
b) comply with the appropriate requirements of Part 8.

Reason for the change: The reference to adjacent property, existing structures, utilities, roads and sidewalks was deleted in 2005, as the approved 2005 objective relates to the protection of adjacent buildings only, not of adjacent property.

The following is the objective-based attribution that can be found in Section 4.5. of the 2005 edition of the National Building Code for Sentence 4.2.5.2.(1):.[F62–OP4.1]

F62 To facilitate the dissipation of water and moisture from the *building*.
OP4.1 Protection of Adjacent Buildings from Structural Damage: An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, adjacent *buildings* will be exposed to an unacceptable risk of structural damage. The risks of structural damage to adjacent *buildings* addressed in this Code are those caused by … settlement of the medium supporting adjacent *buildings*.

Appendix B: Timeline of major events

Date	***Event***
October 1992	Establishment of the CCBFC Strategic Planning Task Group
March 1995	Creation of a CCBFC Task Group on Planning for Objective-Based Codes
November 1995	First meeting of the TG on Objective-Based Codes
November 1995	Publication of the 1995 National Model Codes (NBC, NFC, NPC)
December 1995	Ratification of the Strategic Plan by the Executive Committee of the CCBFC
December 1995	Creation of a CCBFC/PTCBS Task Group on Code development and review process
September 1996	First Workshop on Legislative and Liability Issues related to the introduction of OBC
March 1997	Creation of a CCBFC Task Group on the Implementation of Objective-Based Codes
April 1997	First meeting of the TG on Implementation of Objective-Based Codes
November 1998	Meeting of Provincial/Territorial Deputy Ministers
February 2000	Meeting of Provincial/Territorial Deputy Ministers
October 2000	First meeting of the National Steering Committee on Education and Training
October 2000 - January 2001	First public consultation on the objective-based format of the NBC, NFC and NPC
June 2001	First meeting of the TG on Drafting the Objective-Based Codes
January - May 2003	Second public consultation on the objective-based format of the NBC, NFC and NPC
November 2003	First meeting of the Work Group on Test-drive of the Objective-Based Code
September 2005	Publication of the 2005 National Model Codes (NBC, NFC, NPC) in objective-based format

Appendix C: Bibliography and sources of information

Works consulted

"Building the Future - Working document to a strategic plan for a national model codes in Canada", June 1994.

"Building the Future – The Strategic Plan of the Canadian Commission on Building and Fire Codes 1995-2000" Canadian Commission on Building and Fire Codes, Institute for Research in Construction, National Research Council Canada 1995.

"Building the Future, Strategic Plan of the Canadian Commission on Building and Fire Codes, Progress Report", NRC January 1997

"Canada's construction system: the context for model codes", Canadian Commission on Building and Fire Codes, NRC October 2000

"Building Codes – A Good Tool In The Right Context", Paper presented by Bruce Clemmensen1 to the Global Summit on Performance-Based Building Codes, November 2003

"The Origin and Development of Canada's Objective-Based Codes Concept", CCBFC, NRC June 2004

Also minutes of CCBFC meetings and major task groups, and the following web sites:

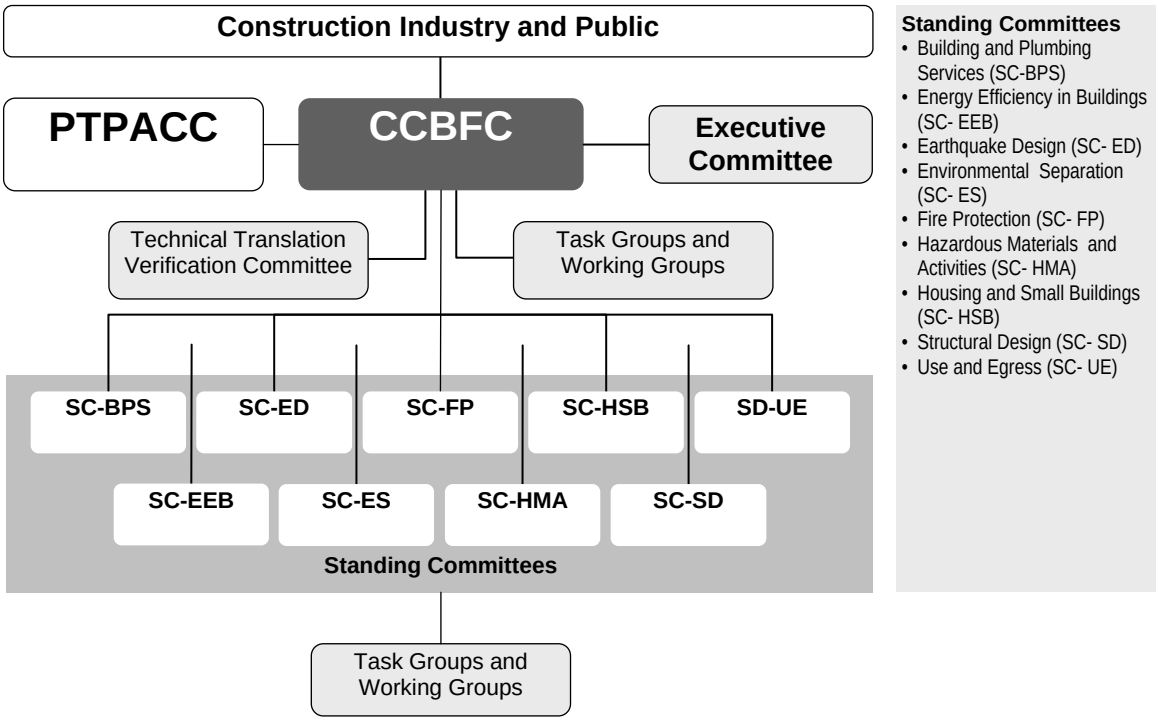
Canadian Commission on Building and Fire Codes (CCBFC) www.nationalcodes.ca
National Research Council, Institute for Research in Construction www.nrc-cnrc.gc.ca/irc
Provincial Territorial Policy Advisory Committee on Codes, PTPACC www.nationalcodes.ca

Persons interviewed

Ralph Bartlett, Bartlett Engineering, and chair of the Standing Committee on Hazardous Materials and Activities
Denis Bergeron, Director, Codes and Evaluation, Institute for Research and Construction, NRC
Bob Bowen, Director General, Institute for Research in Construction, NRC
Bruce Clemmensen, Clemmensen & Associates Limited, and chair of CCBFC
Doug Crawford, Deputy Chief Fire Marshal for Ontario, and chair of PTPACC
Richard Desserud, (NRC, Retired) former manager Canadian Codes Centre
John Haysom (NRC, Retired) former manager of objective-based codes project
Margaret Kuzyk, former Chief Building Official for the Province of Saskatchewan, and member of the executive committee of CCBFC
Greg Sereda, Cohos Evamy Integratedesign™, and chair of the Standing Committee on Use and Egress
Chris Tye, Executive Director of Safety Services for Alberta, CCBFC member and member for Alberta on PTPACC

Appendix D: Organization of the Canadian Commission on Building and Fire Codes (CCBFC)

There currently are nine standing committees dealing with: Building and Plumbing Services, Earthquake Design, Energy Efficiency in Buildings, Environmental Separation, Fire Protection, Hazardous Materials and Activities, Housing and Small Buildings, Structural Design and Use and Egress.



Appendix E: List of acronyms

CCBFC	Canadian Commission on Building and Fire Codes
NRC-IRC	Institute for Research in Construction
NBC	National Building Code of Canada
NFC	National Fire Code of Canada
NPC	National Plumbing Code of Canada
NRC	National Research Council Canada
PTPACC	Provincial Territorial Policy Advisory Committee on Codes

JAPAN

Status of Codes

The Ministry of Construction is responsible for the building regulation in Japan through the Building Standard Law and related Enforcement Order, Ministry Order, and Notifications. The Building Standard Law applies to all buildings throughout Japan. However, the codes that it provides are not necessarily uniform over the entire country since some codes are determined in accordance with regional conditions such as snow accumulation and seismic activities.

The Building Standard Law, which must be examined and amended in the Diet, amended in 1998 to introduce the performance-based requirements. The law and related Orders and Notifications became effective in June 2000. The Law stipulates the objective and functional (qualitative) performance requirements of the buildings. The objective of the Building Standard is to protect lives and property from disasters and to protect health by ensuring environmental sanitation. Quantitative (technical) performance criteria and deemed-to-satisfy (prescriptive) provisions as acceptable solutions are provided in the Enforcement Order, the Ministry Order and Notifications.

Structure and Key Features of Codes

The Law consists of three parts, namely, general provisions, building codes and zoning codes (Fig. 1). General provisions stipulate administrative provisions such as building confirmation and inspection. The building codes stipulate structural safety, fire safety, hygienic safety. The zoning codes stipulate land-use zoning regulations, building height-bulk-shape control, restriction in fire protection districts and others.

Major points of the amendment of the Law in 1998 are as follows:
- Rationalization of building confirmation procedures
- Incorporation of performance-based-regulations
- Ensuring effective enforcement of regulations

It is expected that the introduction of the performance-based requirements will increase design freedom and promote technical development as well as use of various materials. The prescriptive requirements in the previous Law have been generally adopted as the acceptable solutions in Notifications.

Under the current system, there are three options for code users. Firstly, they may follow the prescriptive provisions for their building design as in the past. Secondly, they may follow the provided verification methods. Thirdly, they may wish to prove that certain construction methods or materials would satisfy the performance-based provisions. In this case, a designated (recognized) Performance Evaluation Body will conduct a test and evaluate the result (Fig. 2).

Fig.1 Composition of the Building Standard Law

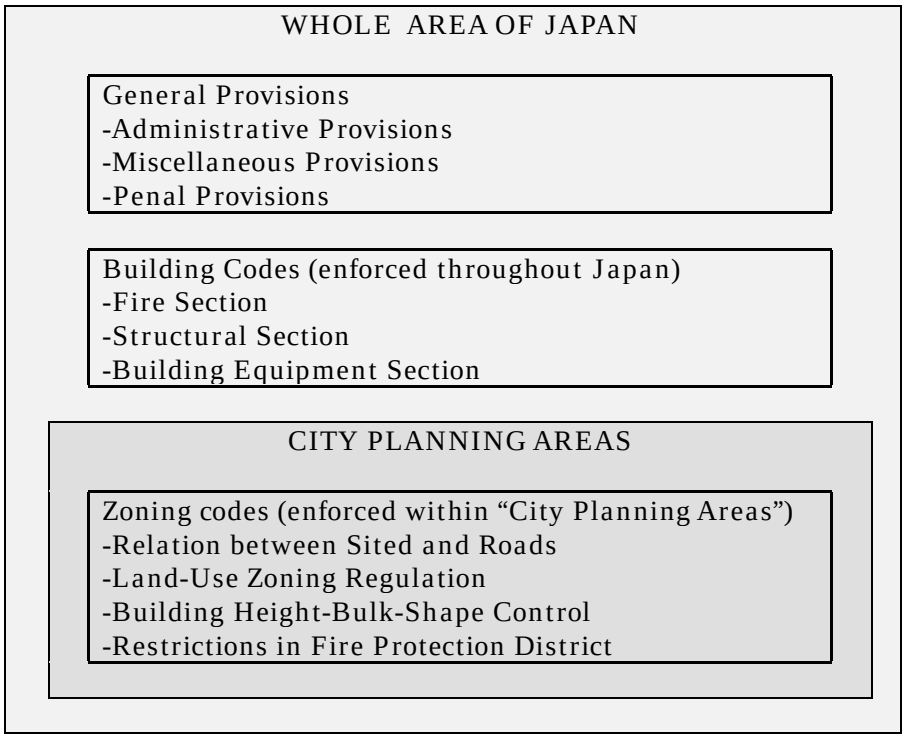
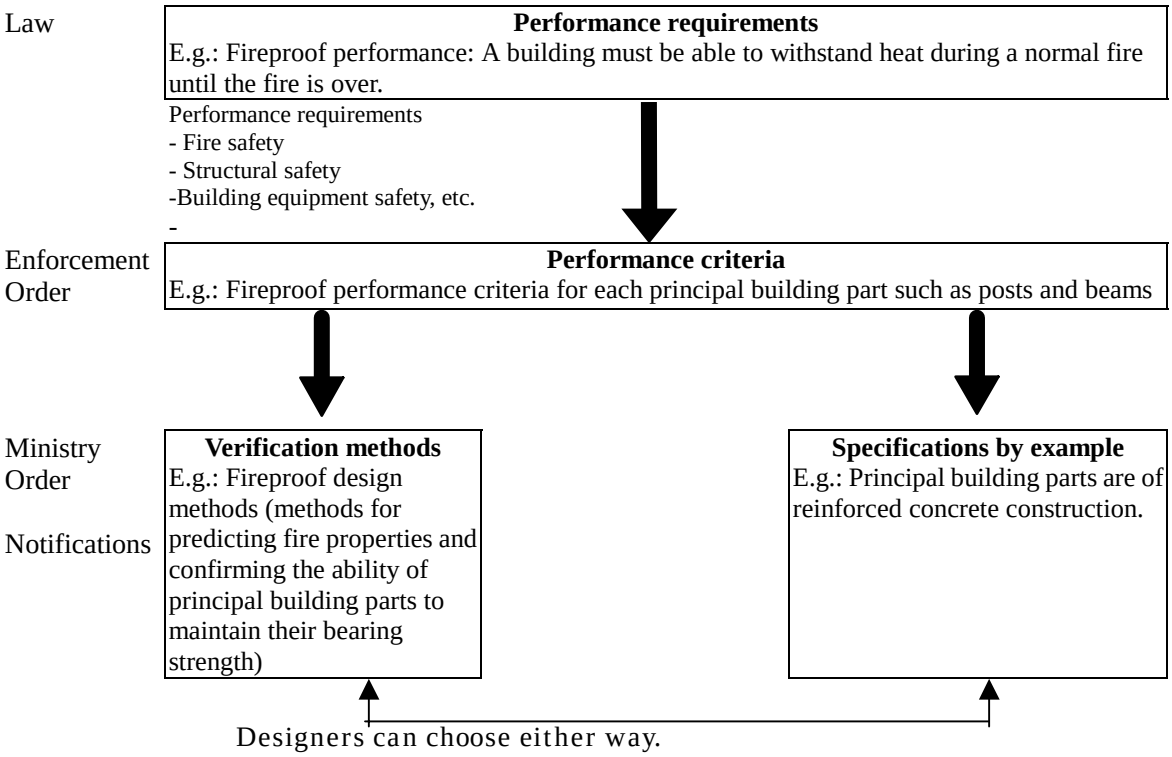


Fig.2 New Building Regulatory System



New Zealand

Status

The national performance-based New Zealand building code ("the building code") has been in force since 1 January 1993.

Mandatory requirements

The building code was introduced as part of a new building control system established by an Act of Parliament, namely the Building Act 1991 ("the Act"). The Act requires all new building work to satisfy the performance criteria specified in the building code. The building code was made, and is amended from time to time, by Cabinet on the recommendation of the Building Industry Authority ("the Authority"). The Authority was established under the Act to provide the central focus for the building control system. The Act is enforced by local territorial authorities (city and district councils). Private sector building certifiers approved by the Authority compete with territorial authorities for the tasks of checking and inspection of building work. The territorial authority is the office of record, required to keep all relevant plans and specifications and other documents available for public inspection for the life of the building. Doubts and disputes about whether particular building work complies with the building code (usually arising out of technical decisions by territorial authorities and building certifiers) may be submitted to the Authority for binding determinations. The Authority also issues accreditations of proprietary items.

The building code itself is part of mandatory regulations, namely the First Schedule to the Building Regulations 1992. The building code covers stability, durability, fire safety, access, moisture, safety of users, services and facilities (including electricity, gas, plumbing, and drainage), energy efficiency, and access and facilities for use by people with disabilities.

Structure

The building code contains two general clauses and 35 technical clauses. Each technical clause covers a specific topic and sets out "objectives" (which correspond to the purposes and principles specified in the Act), "functional requirements" (based on the "user requirement categories" of ISO 6241-1984E), and the mandatory "performance criteria" specified mainly, but not entirely, in qualitative terms.

Supporting material

The Act provides that certain documents issued or approved by the Authority are to be accepted by territorial authorities and building certifiers as establishing compliance with the building code. However, those documents are not the only ways of establishing compliance.

There are 35 "Approved Documents" (one for each functional requirement) that specify "acceptable solutions" and "verification methods" either directly or by reference to other documents, mainly New Zealand Standards. In effect, the acceptable solutions are simple "cook-book" specifications suitable for use without specific engineering design, whereas the

verification methods consist of design Standards and the like suitable for use by qualified professionals.

Other documents issued by the Authority that must be accepted as establishing compliance with the building code are accreditations of proprietary products and determinations of matters of doubt or dispute.

An accreditation is granted on the basis of an appraisal by a competent independent organisation, but there is no provision for any general approval of such organisations themselves. A product that complies with an accreditation must also be accepted as complying with the building code.

Determinations of technical doubts and disputes amount to “case law” about the application of the building code.

Innovative products or systems

The Act requires territorial authorities and building certifiers to be “satisfied on reasonable grounds” that building work complies with the building code. Usually, that means being satisfied on reasonable grounds that the work complies with the Approved Documents.

However, complying with such a document is not the only way of complying with the building code. Other ways are referred to as “alternative solutions”. A territorial authority or building certifier presented with a proposal that does not comply with the Approved Documents, must decide whether the proposal complies with the building code. In doing so, they must have due regard to various matters listed in the Act. Reasonable grounds for such a decision might include:

- Comparison with the Approved Documents.
- Expert opinions, including peer reviews and appraisals.
- A history of successful use.
- Compliance with overseas Standards or the like.
- Tests.
- Any other grounds that are reasonable in the circumstances.

NEW ZEALAND BUILDING CONTROL DOCUMENTS

THE LAW
mandatory

THE BUILDING ACT 1991

Legal provisions:
Definitions.
Purposes and principles.
Functions etc of the Building Industry Authority.
Functions etc of territorial authorities.
Building work: building consents and code compliance certificates.
Maintenance of certain systems and features in buildings: compliance schedules, building warrants of fitness.
National building code.
Documents for establishing compliance with the building code.
Building certifiers.
Accreditations.
Dangerous and insanitary buildings
Legal proceedings: offences, civil actions against the Authority, territorial authorities, and building certifiers.

THE BUILDING REGULATIONS 1992

Administrative provisions:
- Application of building code.
- Inspections.

First Schedule: The building code
- Classified uses
- Definitions
- Technical clauses
  - Objectives (descriptive)
  - Functional requirements (descriptive)
  - Performance criteria (mandatory)

Second Schedule: Forms

the mandatory line

DOCUMENTS FOR ESTABLISHING COMPLIANCE WITH THE BUILDING CODE
non-mandatory

THE APPROVED DOCUMENTS
numerous references to Standards and similar documents

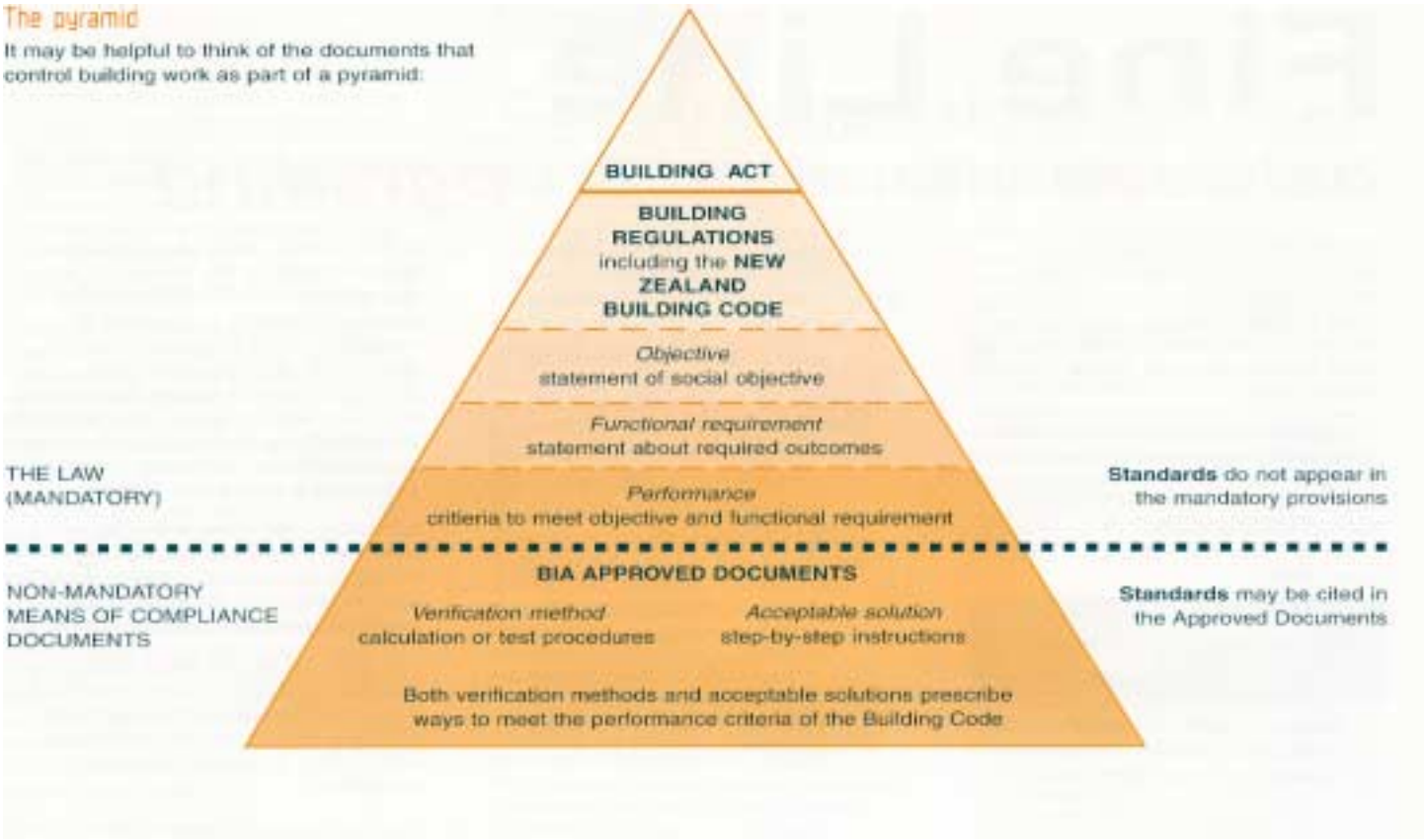
Acceptable solutions.
Verification methods.

ACCREDITATIONS

Proprietary items:
- Materials
- Methods of construction
- Designs
- Components

DETERMINATIONS

Doubts and disputes about whether certain building work complies with the building code.



EXAMPLE: NEW ZEALAND BUILDING CODE CLAUSE G8 ARTIFICIAL LIGHT

A standard is cited in the non-mandatory verification method that is provided in G8/VM1 of Approved Document G8.

MANDATORY

CLAUSE G8 ARTIFICIAL LIGHT

OBJECTIVE
G8.1 The objective of this provision is to safeguard people from injury due to lack of adequate lighting.
FUNCTIONAL REQUIREMENT
G8.2 Spaces within buildings used by people shall be provided with adequate artificial lighting which, when activated in the absence of sufficient natural light, will enable safe movement.
PERFORMANCE
G8.3 Illuminance at floor level shall be no less than 20 lux.

NON MANDATORY

VERIFICATION METHOD G8/VM1

1.0 ILLUMINANCE
1.0.1 An acceptable verification method for the measurement of illuminance is contained in NZS 6703 Section 11.

Paragraphs 1.0.2 to 1.0.5 continue

SPAIN

Status

In November 1999 a new Building Act was passed in the Spanish Parliament, establishing a new Building regulatory system. The Act aims to achieve a better quality in building, so provisions on regulations fixing the quality levels, the professional competencies and responsibilities, and the liabilities and insurance requirements are set out in it. The Act entered into force last May 2000.

The Act sets in terms of objectives the "basic building requirements" on functionality, safety and habitability, which includes requirements on accessibility, structural and fire safety, safety in use, hygiene, health and environment protection, protection against noise and energy and thermal insulation. These general objectives just set and briefly defined in the Act, have to be developed by the Government in a Technical Building Code ("Código Técnico de la Edificación", CTE). The scheduled time is two years, that is to say before May 2002. The Department competent for this task is the Spanish Ministry of Development (Public Works, Housing, etc).

Mandatory requirements

Situation before the new framework

Spain has never had a Building Code as a whole. Instead Spain always has had an "open framework" to establish the technical requirements for buildings. Several bodies are competent to set up regulations, and their scopes are sometimes overlapped.

On one hand there are "construction" regulations, i.e. the Rules for Concrete Structures, Seismic Regulations, etc., which apply to both building and civil engineering sectors. On the other hand the so-called "industrial safety regulations" are applied to products and installations in all sectors, building included. And finally there are specific regulations for buildings, termed Basic Building Standards (Normas Basicas de la Edificacion, NBE), which at present form a series of seven separate regulations of a compulsory nature dealing with structural, acoustical, thermal and energetic, water-tightness and fire requirements. NBE were approved through Royal decrees by the Government.

The old NBE approach has gone from a pure prescriptive set of requirements (i.e. the water-tightness regulations) to a well-defined performance approach, i.e. the one on acoustics, passing by intermediate or mixed approaches.

The revision of existing NBEs and the new ones under preparation before 1999 were drafted taking into account the performance-based approach.

Nevertheless they all have in common the provision of a "freedom clause" which allows the designer (architect or engineer) and the director of the works to adopt solutions differing from those in the regulations provided they prove by other means the fulfilment of the objectives in that regulation. Such clause it is not only aimed to permit innovation but also to consider the importance of the Spanish professional's competence

in the construction field, stronger than in other countries and linked to their civil and penal liabilities.

Currently, the trend in the industrial safety regulations field is becoming more and more Performance- Based, due to the influence of he EU directives in the matter, which are also based in the so-called New Approach. Therefore regulations on products, services and installations such as lifts, electrical installations, fuel, gas, and so on, just establish essential requirements. The way to demonstrate their compliance is through the conformity with European standards, drafted upon European Commission mandates.

Future situation

It will start in the 2002. The Ministry of Development is now actively working to prepare the new Technical Building Code (Código Técnico de la Edificación CTE) to be ready for mid 2002. Transitionally the old framework still applies. The goal is to supersede the old and obsolete framework by getting a modern, simple and effective set of building regulations unified in a single Code comparable to the most advanced in the world.

The picture is not sharp yet, but the main idea is to adopt the Performance-Based approach as much as possible and to arrange the code around the Nordic five levels hierarchy. Last March 2000 this idea was publicly presented in the document "Basis for the CTE". The response from all the interested parties to this presentation was very positive. This basis obviously included the experience learned from those countries that have recently changed their systems.

The idea is to write a first version of the CTE made out of those parts of the old NBEs that are still valid so that the provisions and verification methods of the Code look familiar to NBE users.

The Code is being arranged in two parts. The first will include general provisions and a detailed expression (in qualitative or quantitative terms) of the basic requirements laid down in the Act. The second part will include the fourth and fifth levels in the Nordic arrangement: the methods of verification or compliance and the acceptable solutions. Most of this second part will be made out of the old NBE. This will be considered the "official methods of fulfilment" the performance or functional requirements from the first part. They will be part of the code but other ways of compliance could be used. The way these alternative methods are to be recognised is still under discussion. Nowadays in some NBEs (as for instance the one on fire protection) the responsibility to accept the alternative is left to the permitting authority while in others nothing is said.

The new framework will increase the third party building control, particularly in structural requirements. The developer's obligation to subscribe an insurance policy to guarantee the structural damages during 10 years in residential buildings is leading to an increase on external controls on behalf of the insurance company. The quality control companies will carefully check the fulfilment of the codes in both projects and works.

The insurance of the rest of the requirements is not yet compulsory although it is being voluntarly adopted by developers, mainly by housing public promoters.

Supporting documents and innovative systems

Regulations in Spain normally use the reference to national (UNE) or international standards to specify products characteristics, testing methods and so on. In the European Union context it is compulsory to adopt the European harmonised standards when available.

For innovative products and systems Spain has the Agrément system since the sixties. The Instituto Torroja for Construction Sciences was accredited by the Government to issue the Agrément Certificates (DIT) following the UEAtc rules. The IETcc has more than 30 years of experience in the matter. There is also a European Technical Agreement foreseen in the European legislation on construction products that is applicable in cases when the construction products manufacturer wants to innovate.

A public site for the new Code is under preparation. Presently some information on the NBE in Spanish can be found in the URL
<http://www.mfom.es/vivienda/normativa/NormativaEdif.html>

The Spanish Building Act 1999 resumé

(Act 38/1999 of 5th November 1999 published in the Official Gazette 6.11.1999)

Objective

The primary objective is to regulate the building process by updating and completing the legal concept of the agents involved in the process, establishing their obligations in order to determine their responsibilities and cover the guarantees to users based on a definition of the basic requirements to be met by buildings.

In doing so, the legal concept of building has been technically defined and the essential principles and scope of the Act that must govern this activity have been delimited, specifying both the new building works and works on existing buildings to which these regulations shall apply.

Basic requirements

In view of increasing demands for quality on the part of citizens, the Act establishes the basic requirements to be met by buildings so that the guarantee protecting users are based not only on technical building requirements but also on the establishment of surety and property damage insurance.

These requirements cover both the functional and safety aspects of the buildings as well as those referring to habitability.

Agents participating in the building process

The Act establishes the obligations of each and every one of the different agents participating in the building project, and the liability derived therefrom, considering the developer as the individual or legal entity taking the initiative for the entire process and the one obliged to guarantee the building against potential property damages. Under the heading of building activities, special mention is made of the Construction Manager as well as the obligation to formalise any part of the works which may be subcontracted.

The Act also delimits the scope of the activity of the professionals, designer, the Works Director and the Director of Execution of the Works, clearly establishing the specific scope of their intervention based on their professional qualifications.

The different agents will be personally and individually liable for property damages to the buildings caused by their own acts as well as by the acts of others for whom they are legally responsible under the Act.

Liability periods

The liability periods are established for terms of one, three and ten years, depending on the different damages caused to the buildings. The builder is responsible for all property damages derived from deficient construction for a period of one year; the other agents involved in the construction of the building are liable for all property damages caused to

the building by faults or defects affecting its habitability for a period of three years, and for a period of ten years for the damages resulting from faults or defects which affect the building's structural safety.

Mandatory insurance

With regard to legal guarantees, the Act stipulates a mandatory insurance or surety policy for a period of one year to cover property damages, which may be replaced by the developer withholding 5 percent of the cost of the contract to cover the property damages caused by defective execution.

The Act furthermore stipulates for buildings used as housing that developers must take out an insurance policy to cover the property damages caused to the building by the failure to comply with habitability conditions or which affect the building's structural safety, for three and ten year terms, respectively.

Building Code

A second final provision authorised the Government to pass a Technical Building Code within two years which development the basic requirements to be fulfilled by the buildings mentioned in article 3; the third urges the Government to adapt the regulation of the Forced Expropriation Act to the modifications introduced in the fifth additional provision and the fourth addresses the matter of the Act coming into force.

Fostering quality

In short, the Act attempts, within the framework of the Government's powers, to promote quality by stressing the basic requirements and the obligations of the different agents taking part in the different activities involved in the construction of a building, in order to establish the liabilities and the guarantees which protect users and to fulfil the constitutional right to a dignified and habitable dwelling.

The Spanish Building Act 1999 Summary

General Provisions

Article 1. Purpose
Article 2. Scope

Technical and Administrative Building Requirements

Article 3. Basic Building Requirements

1. In order to guarantee people's safety, society's well-being and the protection of the environment, buildings must be projected, constructed, maintained and conserved in such a way as to satisfy the following basic requirements:

a) Functional Requirements:
a.1) Utility, to ensure that the arrangement and dimensions of the spaces and the fitting out of the services allow the building to be used for its intended purpose.
a.2) Accessibility to ensure that disabled (with impaired mobility and communication) people are able to access and move about the building under the terms foreseen in the specific regulations.
a.3) Access to telecommunications, audio-visual and information services pursuant to the provisions of the specific regulations.

b) Safety Requirements:
b.1) Structural safety, to insure against damages to the building or any part thereof originating in or affecting the foundation, supports, beams, framework, load-bearing walls or other structural elements which could jeopardise the building's mechanical resistance and stability.
b.2) Safety in case of fire, to insure that the occupants may evacuate the building safely, that the fire may be stopped from spreading inside the building and to neighbouring buildings and that fire extinguishing and rescue services may operate.
b.3) Safety of use, to insure that the normal use of the building poses no risk of accident to people.

c) Habitability Requirements:
c.1) Safety, hygiene and environmental protection to acceptable levels of healthiness and water tightness inside the building and to prevent any damage to surrounding environment, guaranteeing appropriate management of all kinds of waste.
c.2) Noise protection to ensure that noise levels do not threaten people's health and allow them to carry out their activities normally.
c.3) Energy savings and thermal insulation to ensure the rational use of the energy needed for the building to be run properly.
c.4) Other functional aspects of the constructive elements or services which allow the building to be used satisfactorily.

2. The ***Technical Building Code*** is the regulatory framework which establishes the basic quality requirements for buildings and services which allow them to comply with the preceding basic requirements.

As soon as this Act comes into effect, the basic building requirements and other compulsory technical requirements shall be the applicable technical regulations until the ***Technical Building Code*** is approved as foreseen in the second final provision of this Act.

The Code may be supplemented with other requirements and regulations dictated by the competent authorities and will be updated periodically in accordance with the evolution of technology and society's demands.

Article 4. Project
Article 5. Administrative Requirements and Permits
Article 6. Reception of the Works
Article 7. Documentation on the Works Performed

Building Agents

Article 8. Concept
Article 9. The Developer
Article 10. The Designer
Article 11. The Builder
Article 12. The Works Director
Article 13. The Director of the Execution of the Works
Article 14. Quality Control Laboratories and Entities
Article 15. Product Suppliers
Article 16. Owners and Users

Responsibilities and Guarantees

Article 17. The Civil Liability of the Agents who intervene in the Building Process.
Article 18. Prescription periods

Article 19. Guarantees Against the Property Damages Caused by Construction Faults or Defects
Article 20. Requirements for Deeds and Registration

Additional Transitory and Derogatory provisions
Final provisions

First. Constitutional Basis

Second. Authorisation for the Government to Approve a ***Technical Building Code*.**

The Government is hereby authorised to approve, by means of a Royal Decree within two years of this Act coming into force, a Technical Building Code which establishes the requirements to be met by buildings in relation to the basic requirements established in parts 1.b) and 1.c) of article 3.

Until such approval, the Basic Building Regulations - NBE (Normas Básicas de la Edificación) regulating the technical requirements for buildings as listed below shall be used to satisfy such basic requirements:

NBE CT -79	Thermal Conditions in Buildings.
NBE CA-88	Acoustical Conditions in Buildings.
NBE CA-88	Actions in Buildings.
NBE FL-90	Resistant Brick Walls.
NBE QB-90	Waterproofing of Roofs made of Bituminous Materials
NBE AE-95	Steel Structures used in Buildings
NBE CPI-96	Fire Protection Conditions for Buildings

Likewise, the rest of the mandatory technical regulations governing any of the basic requirements established in article 3 shall apply.

Third. Adaptation of the Regulations of the Forced Expropriation Act.
Fourth. Validity.

United States of America

Status of Codes

The National Fire Protection Association (NFPA) is advancing building codes to provide options for the development of structures by providing the design option of either prescriptive-based development or performance-based development. This option can be found in *NFPA 101® Life Safety Code®*, 2000 Edition. There are several other documents which do, and in the future will, have the same option, including the *NFPA Building Code™*.

Structure

Documents in the *NFPA Consensus Codes Set™* fall into four categories: codes, standards, recommended practices, and guides. Codes and standards are divided into the text of the code or standard and informational material. The text of the code or standard consists of the mandatory requirements. All nonmandatory or informational text shall appear in one or more separate annexes. The text of an NFPA recommended practice consists of recommendations, while the text of an NFPA guide can contain both recommendations and explanatory material. (NFPA recommended practices and guides may not be adopted into law because they do not contain any mandatory language.) The provisions of NFPA codes discussed below are contained in the text and are therefore mandatory requirements, unless otherwise noted.

The provisions provided in the *Life Safety Code* address the construction, protection, and occupancy features necessary to minimize danger to life from fire. The code's goal is to determine the minimum criteria for the design of egress facilities to enable prompt escape of occupants from buildings or, where desirable, into safe areas within buildings. The *Life Safety Code* is set up in such a manner that the life safety design must meet the stated goals and objectives using either the prescriptive-based provisions or the performance-based provisions.

Prescriptive-based provisions are used in a code or standard that prescribes fire safety for a generic application or building use. Life safety is achieved by specifying certain construction characteristics, limiting dimensions, or protection systems without referring to how these requirements achieve a desired fire safety goal. Fixed values are generally stated to ensure a system is properly designed.

When using a prescriptive-based option, an alternative or equivalent method may be desired. An equivalency uses an alternative system, method, or device that is approved as equivalent and therefore recognized as being in compliance with the code without actually meeting the exact requirements of the code. The use of an equivalency is a means of meeting the intent of the prescribed code provisions without strictly adhering to the prescriptive provisions. The approval of an equivalency is at the discretion of the

Authority Having Jurisdiction. This approach should not be confused with a performance-based option.

Performance-based designs are based on an engineering approach to fire protection design which first establishes goals and objectives. The next step is to apply accepted engineering tools and methodologies (i.e., deterministic and/or probabilistic analysis) to the fire scenarios stipulated in the *Life Safety Code* and compare the quantitative assessment of the design alternatives to the criteria, also defined in the *Life Safety Code*.

Figure 1 provides a schematic of the *Life Safety Code*, 2000 edition compliance process. Each of the sections identified in Figure 1 are mandatory and, with the exception of Section 4.2, has nonmandatory material in an annex (i.e., an appendix). The nonmandatory material for Section 5.2, Performance Criteria, suggests four possible methods of quantifying the qualitative criteria provided in Section 5.2.

The overall focus of this concept is to determine the goals, objectives, and performance criteria for a design to properly ensure life safety for the structure. The use of computer fire modeling is used to help verify and assess the design for several different established types of fire scenarios. The key element in this process is to keep accurate and continuous documentation throughout the entire design of the project, which the *Life Safety Code* also stipulates. This will ensure an overall understanding of the operations and maintenance that must occur in the future when the building is occupied. This process is discussed in detail in the *SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings*.

Key Features

While both options provide an adequate level of life safety, the option using performance-based elements allows greater freedom for the designer. This enables the designer to have increased flexibility regarding innovation in design, construction methods and materials selection, to have equal or better fire safety, and to optimize the fire safety design with respect to the available resources.

Further Information:

National Fire Protection Association
http://www.nfpa.org

Society of Fire Protection Engineers
http://www.sfpe.org

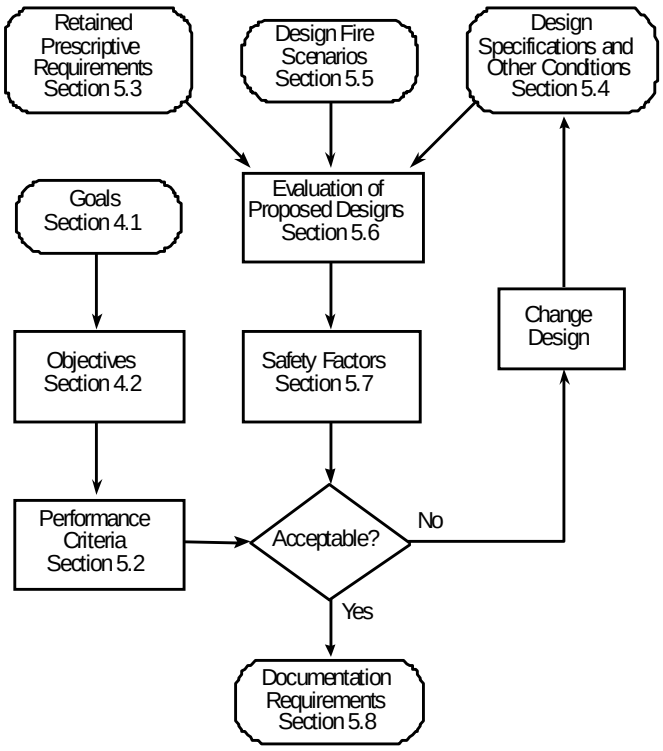


Figure 1. Performance-Based *Life Safety Code* Compliance Process.