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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.

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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:

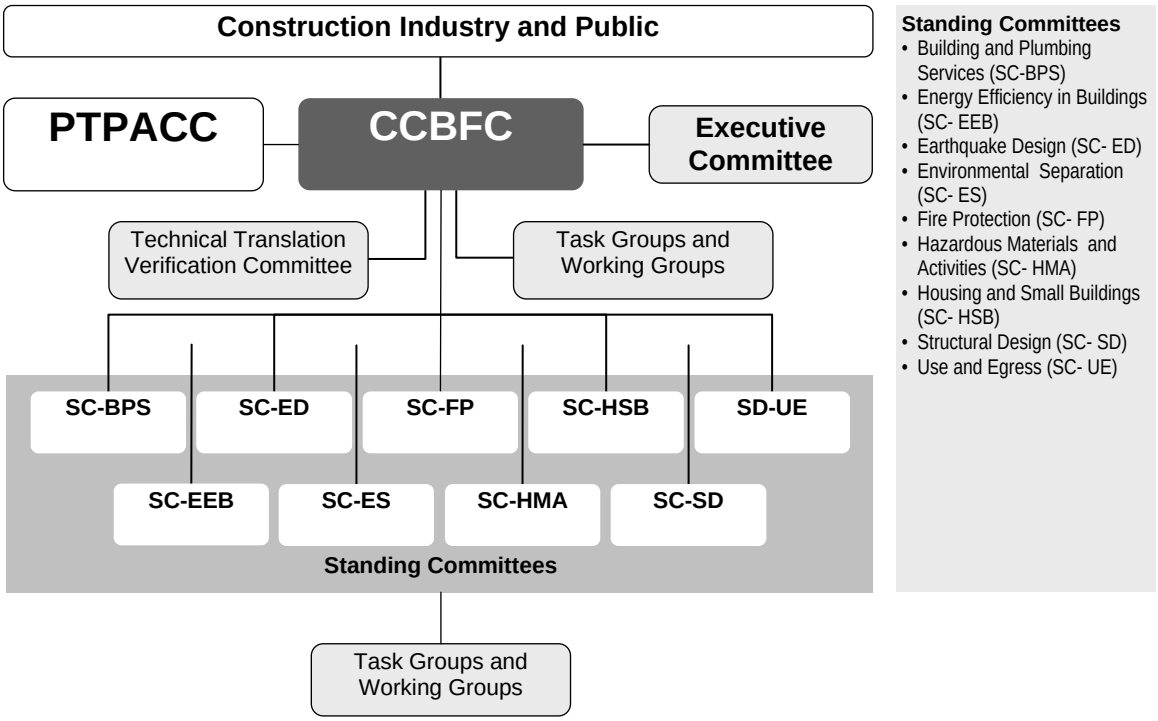
Canadian Commission on Building and Fire Codes (CCBFC) www.nationalcodes.ca
National Research Council, Institute for Research in Construction www.nrc-cnrc.gc.ca/irc
Provincial Territorial Policy Advisory Committee on Codes, PTPACC www.nationalcodes.ca

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