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The National Building Code of Canada*:*
A Tool for Recovery in the Forest Industry?

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CONTENTS

THE *NATIONAL BUILDING CODE OF CANADA*: A TOOL FOR RECOVERY IN THE FOREST INDUSTRY?

1 INTRODUCTION

In the last 10 years, the Canadian forest sector, which includes wood product manufacturing, pulp and paper product manufacturing, forestry and logging, has experienced considerable economic pressure that has seriously interfered with growth in the industry and led to plant closings and job losses. Between 2005 and 2009, the contribution of the forest sector in Canada to the gross domestic product (GDP) fell by 37%, from $31.7 billion to $19.9 billion (in constant 2002 dollars).[1]

During that period, the contribution to GDP made by wood product manufacturing, which generates 41% of the economic impact from the forest sector, declined by 28%, from $13.4 billion to just under $8.1 billion.[2] Given that this segment of the industry, which is firmly established in the North American residential construction sector, has been hit hard by the economic crisis, we may wish to consider what measures could be adopted that might breathe new life into the Canadian forest industry, particularly in the wood product manufacturing sector. Could the multi-storey building market offer opportunities for wood-frame buildings? Can we say that Canada, which has 10% of the world's forest cover and 30% of the boreal forest on the planet,[3] has a national building code that can encourage greater use of wood in the construction of multi-storey wood-frame buildings, within timelines comparable to those followed when traditional materials are used?

To answer these questions, we will first describe the *National Building Code of Canada* (NBC). We will then discuss multi-storey wood-frame building construction in Canada, and then move on to a brief consideration of building codes and multi-storey wood-frame buildings in some other countries. We will conclude with an overview of commentary regarding possible amendments to the *National Building Code of Canada* relating to multi-storey wood-frame buildings.

2 THE *NATIONAL BUILDING CODE OF CANADA*: PERSPECTIVES

2.1 ONE OF SEVERAL MODEL CODES

The NBC is a set of rules that govern the design and construction of new buildings and the alteration, change of use and demolition of existing buildings. It contains both technical provisions and explanatory information. The NBC is one of six model national building codes, the others being the *National Fire Code of Canada*, the *National Plumbing Code of Canada*, the *National Farm Building Code of Canada*, the *National Energy Code for Buildings* and the *National Energy Code of Canada for Houses*.[4]

2.2 ADMINISTRATIVE AND LEGAL ASPECTS

The Canadian Commission on Building and Fire Codes (CCBFC), which was established by the National Research Council Canada (NRC), is responsible for development of the national model codes of Canada and amends them periodically. The CCBFC is composed of nine standing committees made up of representatives of the construction industry and of the provincial and territorial governments. The codes are prepared and updated collaboratively. The NRC provides the CCBFC with administrative and technical support, as well as research-related support.

Under Canadian law, the provinces and territories are responsible for regulating the construction industry. These jurisdictions may, in turn, delegate their powers in this area to municipalities. The federal government is also entitled to regulate the construction industry to ensure compliance with the *National Housing Act* and the *Hazardous Products Act*.[5]

Provincial and territorial authorities may decide to adopt the various codes developed by the CCBFC in full, or they may adapt them to their needs, and it is for this reason that they are referred to as model codes. Overall, they are of key importance to the construction industry, since they set out what is and is not permitted.

We will now take a closer look at the NBC.

2.3 HISTORY, AMENDMENT PROCESS AND OBJECTIVES

In Canada, the first *National Building Code* was published in 1941. The NBC is updated every five years; for example, in November 2010, the 2010 version will replace the 2005 version. However, the amendment process may be shortened if authorities and industry stakeholders think it necessary (in the United States, by comparison, the process lasts three years).

The NBC has four objectives: safety, health, accessibility and fire and structural protection of buildings. In industry jargon, an objective-based building code (whether provincial or national) is one in which each technical requirement meets at least one of the objectives stated in the code. The NBC, as an objective-based code, then, describes the methods of achieving a specified objective, in terms of materials and technology.

There may be objectives that go beyond the four objectives listed above. Some countries include such additional objectives in their building codes. In 2002, for example, the European Union countries issued the Directive on Energy Performance of Buildings (DEPB) to comply with the EU's commitments in the Kyoto protocol. The directive came into force in 2006, and calls for improvement in the energy performance of European buildings.[6] In Canada, one province has also adopted objectives that go beyond the objectives specified in the NBC: British Columbia amended its provincial building code in 2009 to encourage the use of wood, by increasing the maximum height of wood-frame residential buildings from four storeys to six.

3 MULTI-STOREY WOOD-FRAME BUILDING CONSTRUCTION IN CANADA

Studies tend to show that greater use of wood in the construction industry may help to improve the energy efficiency of buildings and reduce greenhouse gas emissions and building maintenance costs throughout the buildings' life cycles; according to some analysts, the costs of wood buildings are in fact comparable to those of steel, concrete or masonry buildings.[7]

A study done by the Athena Sustainable Material Institute in the residential sector reports that building with wood has particularly valuable effects on greenhouse gas emissions. The study shows that for a typical 2,300-square-foot (214-square-metre) North American house, the level of carbon dioxide (CO_2) emissions is 58 metric tonnes when building materials are sent to the dump at the end of their useful life. For a house the same size in which the use of wood is maximized, where the materials are also sent to the dump at the end of their useful life, the figure would be 28 metric tonnes.[8]

If, at the end of the useful lives of these houses, the wood was used to produce clean bioenergy, replacing fossil fuels like oil, CO_2 emissions for the typical North American house would amount to 44 metric tonnes, and to -3.4 metric tonnes for the house in which the use of wood was maximized. In other words, a house in which greater use is made of wood would store the CO_2 instead of emitting it (see Table 1).

Table 1 – Carbon Dioxide Emissions for a Typical and for a Wood-enhanced North American House (metric tonnes)

Fate of Building Materials	Typical House	Wood-enhanced House
Buried in the dump	58	28
Biomass recovery	44	-3.4

Source: BC Forestry Climate Change Working Group and the California Forestry Association, in cooperation with WoodWorks, *Tackle Climate Change – Use Wood*, September 2009, p. 25.

It seems, then, that the DEPB and the amendment to the *British Columbia Building Code* could lead to greater use of wood in multi-storey wood-frame building construction, which could also help to reduce energy consumption and the environmental footprint of the buildings.

3.1 CODE REQUIREMENT FOR MULTI-STOREY WOOD-FRAME BUILDINGS

Under the NBC, it is possible to construct multi-storey wood-frame buildings to a maximum height of three storeys, but the buildings are subject to floor area limits. The NBC also allows the construction of four-storey wood-frame buildings, provided that they:

- are equipped with automatic extinguishers;
- have a floor area within the requirements;

- are located on a street; and/or
- have a limit on the number of occupants.

These requirements are in place in large part to take into account public safety issues, such as fire prevention.

3.2 Possible Exemptions from the Code and Associated Problems

The NBC does allow developers to obtain exemptions from regulatory bodies in order to construct wood-frame buildings higher than four storeys. However, under such exemptions, developers and designers can experience significant administrative delays, since the taller buildings fall outside the usual standards. These professionals carry the "burden of proof," with the responsibility to prove to the regulatory authorities that the alternatives they propose comply with the standards set out in the NBC.[9] To make that case, they often have to rely on technical information published outside Canada, because technical data relating to the construction of wood-frame buildings higher than four storeys are not necessarily found in the NBC.

Some developers and designers of wood-frame buildings find the limitation to four storeys an economic barrier, because the related administrative delays lead to additional costs. There are those who contend that as a result, innovation and competition are hindered since the choice of structural materials for buildings over four storeys is restricted to steel and concrete.

Despite the difficulties inherent in dealing with restrictions on wood-frame construction in the NBC or in obtaining an exemption, some designers and developers do venture to construct wood-frame buildings in Canada. Following are some examples.

3.3 Examples of Wood-frame Buildings in Canada

The Olympic Oval, constructed in Richmond, British Columbia, for the 2010 Winter Olympic Games, is a convincing example of a wood-frame building that combines the use of wood and steel. The framing for the roof is made of timber from the pine forests damaged by the pine beetle infestation.[10] The roof of the Oval has an area of two hectares, the equivalent of nearly four American football fields.

Table 2 – Characteristics of the Richmond Olympic Oval

Construction start date	17 November 2006
Opening date	12 December 2008
Cost	$178 million
Roof	Made of 1 million board feet of wood affected by the pine beetle infestation
Area	33,750 m^2

Source: Richmond Olympic Oval, *About Us – Facts & Figures*.

A second example in British Columbia is the Ellis Street building in Kelowna, a six-storey multi-family wood-frame residential building. Constructed before the government of British Columbia amended its provincial building code in 2009 to allow

the construction of wood-frame buildings over four storeys, it was designed and constructed in accordance with what the provincial code at that time required and allowed.[11] Construction of the building started in 2006, and occupancy began in the spring of 2008.

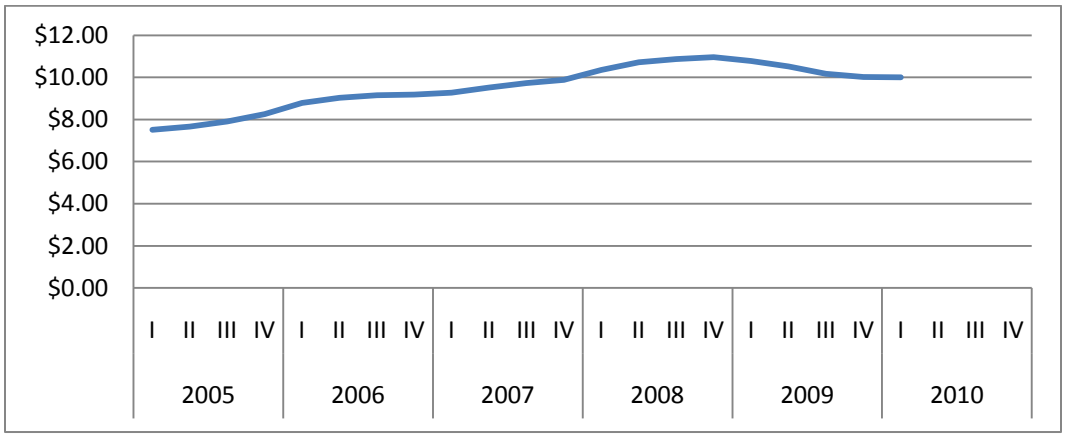
A third example, in the city of Québec, is the Fondaction (connected with the Confédération des syndicats nationaux pour la cooperation et l'emploi) building. A six-storey wood-frame office building, it is an engineered wood post and beam structure that is the tallest of its kind in North America. Construction work began on the project in 2007, and the official opening was held on the first *Journée du matériau bois* [day celebrating wood as a building material] in Quebec on 11 May 2010.[12]

These buildings are a few examples of the engineering capabilities and capacity for innovation in the wood construction industry in Canada. Many stakeholders in the forest industry and in the construction and ecological buildings industries hope that these projects will open the door to greater use of wood in the construction of multi-storey buildings.

3.4 Statistics on Investments and Buildings in the Non-residential Sector in Canada

It is estimated that only 3% of buildings are constructed or renovated every year in the developed countries.[13] If we take solely the non-residential segment of the industry in Canada (i.e., excluding multi-unit residential), the amounts invested in the first quarter of 2010 come to nearly $10 billion.[14]

Figure 1 – Investments in Non-residential Building Construction in Canada by Quarter Between 2005 and 2010 (constant seasonally adjusted $ billions)



Source: Statistics Canada, Table 026-0016, "Investment in non-residential building construction, by type of building, province and census metropolitan area (CMA), quarterly (dollars)," CANSIM (database), Using E-STAT (distributor), July 2010.

Estimates for 2005 indicate that there are 440,863 buildings in the commercial and institutional sector in Canada.[15] The federal government appears to own a significant proportion of these buildings: according to the Treasury Board Secretariat, it owns 42,535 buildings overall.[16]

Some observers maintain that the potential market for manufactured wood products in six- to ten-storey non-residential construction, which is a significant segment of the construction market in Canada,[17] could be well worth exploring. However, the *National Building Code* and the provincial codes (except that of British Columbia) limit multi-storey wood-frame building construction to four storeys (unless the regulatory authorities grant an exemption).

4 BUILDING CODES AND MULTI-STOREY WOOD-FRAME BUILDINGS IN SELECTED COUNTRIES

We compared Canada with other countries in terms of the maximum number of storeys permitted under the various national building codes for multi-storey wood-frame buildings. Our key findings in this regard are set out below.[18]

In Norway, where there is currently a project under way in the city of Kirkenes to construct a 17-storey wood-frame building,[19] the building code does not impose restrictions on the number of storeys for wood-frame buildings. Germany and Sweden do not set height limits on multi-storey wood-frame buildings.

In the United Kingdom, the maximum allowed is seven storeys, provided that fire prevention measures are in place. It also seems to be possible to obtain an exemption in order to build higher: the Stadthaus residential building, nicknamed the "Timber Tower," is nine storeys high.[20]

In the United States, the *International Building Code* – the model building code in force all across the country – sets the maximum number of storeys at five, if the building does not have automatic extinguishers for fire prevention. However, if a wood-frame building has extinguishers and meets the other requirements of the Code, the maximum number of storeys allowed rises to six.[21]

In Finland, Denmark and Canada, the maximum height for the construction of wood-frame buildings is four storeys. In all three countries, however, architects, engineers and developers may obtain an exemption to build higher than four storeys. Table 3 summarizes these findings.

Table 3 – Maximum Number of Storeys for Multi-storey Wood-frame Buildings Under Building Codes in Selected Countries

Country	Maximum Number of Storeys
Germany, Norway and Sweden	No limit
United Kingdom	Maximum of seven
United States	Maximum of six
Canada, Denmark and Finland	Maximum of four

Sources: European Centre for Parliamentary Research and Documentation and American Wood Council, 2010.

5 COMMENTARY REGARDING POSSIBLE AMENDMENTS TO THE *NATIONAL BUILDING CODE*

The industries competing with the use of wood – the steel and concrete industries – have been most vocal in criticizing possible amendments to the NBC to allow the construction of multi-storey wood-frame buildings over four storeys. The comments from the steel and concrete industries in this regard centre on the assertion that any amendments to the NBC must be based on technical information, so that the buildings constructed are safe and sustainable.[22]

Those with preconceived ideas question the fire resistance of the engineered wood materials used in the construction of multi-storey buildings, even though these notions have been refuted by scientific studies. In March 2010, at the hearings of the Standing Senate Committee on Agriculture and Forestry, a representative of the Canadian Association of Fire Chiefs said that the use of wood products does not necessarily undermine fire safety, stating that he would consider wood, as well as steel and concrete, for multi-storey building construction, as long as the materials satisfied the provisions of the Code and the building was equipped with a sprinkler system.[23]

Some construction industry stakeholders doubt that using wood would reduce buildings' environmental footprint. While they acknowledge that forests and wood capture CO_2 and help to reduce greenhouse gas emissions, they note that over its useful life, wood in forests or in buildings may burn or rot, and thus release CO_2 into the atmosphere. Steel industry representatives also point out that steel can, to a very large extent, be recycled at the end of its useful life. Concrete industry representatives observe that concrete has properties that favour energy efficiency and durability.

The Canadian Construction Association is also critical of possible amendments to encourage the use of wood. In its view, wood buildings would be more expensive to build than would those in which other materials were used.[24] Although that argument is true in some circumstances, a number of witnesses at meetings of the Standing Senate Committee on Agriculture and Forestry refuted that assertion. Some of them said that the question of costs depends on the type of building and the technical specifications. A number said that introducing engineered wood into the construction of buildings over four storeys would increase competition in the use of different materials, and could thus reduce construction costs and at the same time help to create a climate of innovation in the construction industry. In 2009 and 2010, a number of witnesses also told the Standing Senate Committee on Agriculture and Forestry that wood may even be cheaper than traditional materials like steel and concrete. Finally, according to some studies, if the energy efficiency of wood throughout the useful life of wood-frame buildings is taken into account, cooling expenses for such buildings might even be reduced.

6 CONCLUSION

In the last five years, the Canadian forest industry as a whole has seen its contribution to the GDP decline by 37%. The Canadian wood product manufacturing industry, which is a major supplier of the residential construction industry[25] and generates 41% of the economic impact of the forest industry, has seen its contribution to the GDP decline by 28%.

What measures can Canada adopt to alleviate this crisis? Can the *National Building Code* be used to bring about a recovery in the forest industry? One avenue that has been proposed is the promotion of the use of wood in the multi-storey segment of the construction industry, which includes multi-unit residential, industrial, commercial and institutional buildings. This would entail amending the Canadian regulatory framework, given that wood-frame building designers are currently not permitted to build higher than four storeys without seeking an exemption from the building code and adopting “alternatives.”

At present, it is easier and faster for a designer who wants to build higher than four storeys to rely on materials like steel and concrete, than it is to use engineered wood products. Not all developers are on a solid enough financial footing to deal with the additional administrative delays involved in demonstrating to regulatory authorities that a proposed building meets the standards set out in the Code.

A number of studies recommend wood as a construction material, because of its resistance, aesthetic value and comfort. Some studies also show that wood can improve Canada’s environmental footprint by reducing energy consumption and greenhouse gas emissions. If the NBC made more allowances for the use of wood, the demand for engineered wood products could be stimulated, helping the forest industry to grow and leading to environmental benefits resulting from the use of a renewable resource. The use of hybrid materials that combine, for example, wood and steel may also provide a solution for the construction industry. The Olympic Oval in Richmond, British Columbia, is one example.

In the introduction, we asked whether Canada can be considered to have a national building code that can encourage greater use of wood in the construction of multi-storey wood-frame buildings. In light of the information on this subject obtained from Germany, Norway, Sweden, the United Kingdom and the United States, and the fact that in Canada (with the exception of British Columbia) the height of buildings of this type are limited to four storeys unless the builder obtains an exemption, the answer is no. It is for this reason that some believe that amending the NBC to allow the construction of multi-storey wood-frame buildings higher than four storeys might help the Canadian forest industry to recover, the thinking being that while such a change would not bring about a recovery for the entire industry, it would likely open up access to a new segment of the market.

NOTES

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9. Senate, Standing Committee on Agriculture and Forestry, *Evidence*, 3rd Session, 40th Parliament, 25 March 2010 (Mr. Gilles Huot, architect).
10. Richmond Olympic Oval, *About Us – Facts & Figures*.
11. Wood *WORKS!*, *History and use of Midrise Buildings in other jurisdictions*.
12. Gilles Angers, "Fondaction inaugure son immeuble en bois 'intelligent,'" *Le Soleil* [Québec], 12 May 2010.
13. Ries et al. (2009).
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17. Senate, Standing Committee on Agriculture and Forestry, *Evidence*, 2nd Session, 40th Parliament, 29 September 2009 (Richard Desjardins, Manager, Building Systems, FPInnovations).
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21. Senate, Standing Committee on Agriculture and Forestry, *Evidence*, 3rd Session, 40th Parliament, 6 May 2010 (Robert Glowinski, President, Forestry and Wood Products, American Wood Council).

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24. Kathryn May, "How much wood can be chucked from Bill C-429?," the *Ottawa Citizen*, 20 October 2010, p. A1.

25. Excluding multi-family high-rise residential buildings.