Potential Building Code Amendments for Mid-Rise Wood Frame Buildings up to Six Storeys

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Introduction

The Ministry of Municipal Affairs and Housing (MMAH) is currently proposing to amend the Building Code regulation (O. Reg. 332/12) to change the maximum height permitted for wood frame building from four storeys up to six. This policy document outlines the proposed changes and provides background and rationale. The Ministry is interested in seeking further advice from the public on these potential amendments.

About the Ontario Building Code

The *Building Code Act, 1992* (the Act) is the legislative framework governing the construction, renovation, change of use and demolition of buildings in Ontario. The Building Code, authorized by the Act, sets out detailed administrative and technical requirements, as well as establishing minimum health and safety standards for the construction of the buildings in Ontario, among other objectives.

The Ministry of Municipal Affairs and Housing is generally responsible for administering the Act and the Building Code, while municipalities are responsible for enforcing the Act and the Building Code (in some areas, other "principal authorities" enforce certain Building Code requirements, such as for small septic systems).

Ontario's Objective-Based Building Code

The 2006 edition of the Building Code introduced an "objective-based" approach to setting requirements, including defining the objectives or rationale underlying technical provisions of the Building Code. Objective-based code requirements allow for alternative solutions provided that the alternative solution can achieve the same level of performance as required by the applicable acceptable solution for the relevant Code objectives. The objective-based format is intended to facilitate innovation in building materials, systems and designs by establishing the intended objectives or outcomes of the Building Code.

Code Development in Ontario and the model National Building Code

In Canada, provinces (and, in some cases, municipalities) regulate building construction through building codes and other regulations and laws.

The Government of Canada, through the National Research Council and in co-operation with Canada's provinces and territories, develops the model National Building Code (mNBC). The mNBC is not law, but some provinces and territories adopt the mNBC as their Building Code. Others, including Ontario, while having distinct provincial legislation, harmonize to the extent possible with the mNBC to ensure consistency and competitiveness across the country.

Ontario relies significantly on the code development work and research of the NRC which supports the mNBC. However, while Ontario typically adopts the "core" structural requirements necessary to maintain harmonization among provinces, Ontario also varies from the mNBC in order to address government priorities, proposals from the public and stakeholders, and changing technology and industry standards.

Currently, the NRC is researching and consulting on potential requirements to be included in the 2015 edition of the mNBC. Among the proposals being considered are a number that would facilitate construction of mid-rise wood frame buildings up to six storeys.

In addition to the development of the 2015 mNBC, the NRC is also pursuing research into the fire safety of combustible buildings through the "Wood and Wood-Hybrid Midrise Buildings". This study is examining the performance of a variety of structural types that might be used in mid-rise wood buildings in experimental conditions approximating a real fire. Results from this study are anticipated to be made public in April 2014, and will also help inform the development of the proposed Building Code requirements discussed in this document.

Other Jurisdictions Permitting Mid-Rise Wood Construction

British Columbia was the first Canadian province to amend its Building Code to permit mid-rise wood construction up to six storeys. It did so in 2009 in the context of a broader government strategy to advance its wood industry. Initially, only residential uses were permitted but, British Columbia has since amended its regulations to allow a range of mixed-uses in mid-rise wood buildings, similar to what is being proposed for Ontario. At this time, roughly 70 mid-rise wood buildings are built and occupied or under construction in British Columbia.

Quebec, like Ontario, currently limits wood construction to four storeys or less. In July 2013, Quebec published a guideline entitled "Residential five or six storey Wood-Frame Construction Directives and Explanatory Guide". The Quebec guideline sets out criteria and conditions that must be met by a builder as an alternative solution to construct a five or six storey wood frame building. The guideline is intended to ensure safe construction of six storey wood frame buildings, and specifically restricts six storey wood frame buildings to residential uses only. Quebec is currently developing potential Building Code regulatory requirements that would permit up to six storey wood frame buildings.

Mid-rise wood construction is permitted in the building codes of most European Union countries, and is a well-established technique in Scandinavia and the United Kingdom. In some northwest U.S. jurisdictions, such as Oregon and Washington, mid-rise wood frame construction has been permitted for several decades.

A. Current Status of Wood Frame Construction in Ontario

Overview of Current Building Code requirements for fire safety in wood frame buildings up to four storeys

The Ontario Building Code currently limits the number of storeys, area and height of wood frame buildings. These height and size restrictions for particular occupancy classes were based on limiting the fuel load of the entire building and its contents.

In addition, the Building Code includes several fire safety provisions to ensure the safety of building occupants and emergency responders.

Many of the safety systems required in four storey wood frame buildings are also required for other buildings, and it is proposed they would be required for five and six storey wood frame buildings as well.

Four storey wood frame buildings are subject the following safety requirements:

- **Building area limits which require wood frame buildings to be much smaller than "non-combustible" sprinklered buildings.** Typically, 20% of non-combustible building area for residential occupancies, and 33% for business and personal services occupancies;
- **One hour fire separations throughout the building** (the fire separations apply to floor assemblies, walls around suites, and exit stairs);
- **Automatic heat-activated sprinklers meeting the National Fire Protection Association (NFPA) 13R standard** which are specifically designed for low-rise residential buildings and NFPA 13 for office buildings;
- **Fire hose cabinets and standpipes, on each floor** to NFPA 14 standard to provide the fire service with a water supply for fire-fighting operations;
- **Smoke detectors connected to a central fire alarm system, and in each corridor and exit stair,** sets off alarms in the entire building;
- **Smoke alarms in each apartment suites**;
- **Two means of exiting the building** through two sets of exit stairs protected by fire separations and sprinklers.

B. Proposed Amendments for Mid-Rise Wood Frame Construction

In order to move forward with any Building Code requirements permitting up to six storey wood frame construction, the Ontario government seeks to balance two primary objectives; first, to help increase opportunities for designers and builders to create innovative, flexible and affordable new buildings; and second, to maintain Ontario's high fire safety standards for both the public and fire service personnel. The proposed "made-in-Ontario" approach proposed below would meet both of these objectives.

Potential Benefits of Mid-rise Wood Frame Buildings

Extensive public consultations on the proposed mid-rise wood amendments to Ontario's Building Code already took place in 2011. The amendments being proposed in this document are substantially the same as those considered at that time. In addition, MMAH conducted further focussed stakeholder consultations on the proposed requirements contained in this document in October 2013. The British Columbia experience with mid-rise wood also provides a basis in practical delivery of mid-rise wood construction.

The proposed mid-rise wood amendments address a wide scope of government's objectives and priorities. These include the following:

- **Design flexibility and innovation**. In accordance with the philosophy of an "objective-based" Building Code, the proposed provisions enabling six storey wood frame buildings would contribute to more design flexibility and choice while protecting public safety.

- **Public and fire service personnel safety**. When constructed with modern fire safety technologies such as sprinklers, alarm systems and fire blocking, mid-rise wood can provide safety levels equivalent to those of buildings composed of non-combustible materials.

- **Urban intensification and main-street redevelopment**. Mid-rise buildings support the intensification and main-street redevelopment objectives of the Province's Growth Plan for the Greater Golden Horseshoe and the Provincial Policy Statement.

  Ontario's proposed changes enabling up to six storey wood frame buildings would permit mixed use buildings that could include commercial or retail uses on lower floors to facilitate construction of these buildings along urban arterial roads and in urban in-fill situations. This supports transit and pedestrian friendly development, thus contributing to meeting planning and intensification goals.

- **Environmentally friendly buildings and construction.** Wood-frame buildings contribute to the energy conservation and greenhouse gas reduction objectives of the Building Code. Wood requires less energy in production, it is a "carbon sink" (when combined with good forestry practices) and it is amenable to the re-use and recycling of wood building components.

- **Housing affordability.** Based on experience in British Columbia and elsewhere, up to six storey wood frame construction can, in some cases, be approximately 10% less expensive than steel or concrete construction. Contributing factors include faster construction (especially when pre-fabricated panels are used), lighter foundations, and less expensive materials.

- **Value added wood-based products help support the forestry industry.** Engineered and value-added wood products that can be used in mid-rise wood frame buildings help support the forestry industry. Supporting forestry and value-added forestry-related industries is one of the goals in the Province's Growth Plan for Northern Ontario.

Proposed Building Code Amendments to Enable up to Six Storey Wood Frame Buildings

It is proposed that the following 2012 Building Code requirements would continue to apply to all five and six storey buildings, whether constructed of combustible or non-combustible materials:

- automatic sprinklering to NFPA13 standard;
- one hour fire separations in floor and wall assemblies between apartment suites;
- minimum two independent sets of exit stairs;
- fire hose cabinets on each floor;
- fire detectors in exit stairways, corridors; and
- smoke alarms in all apartment suites.

To maintain Ontario as a leader in fire safety, in addition to meeting the existing requirements, the proposed amendments to the Building Code would require mid-rise wood frame buildings to also comply with the following new requirements:

- Mid-rise wood frame construction would be permitted for **residential buildings and office buildings;**
- To facilitate mixed uses, certain other building uses would be permitted on the first and second floors of mid-rise wood frame residential or office buildings, including restaurants, stores and medical offices;
- **Limits on building height** to top floor (18m from first floor, 20m from fire access route);
- **Limits on building area** to 25% of that of residential non-combustible buildings and 42% of office non-combustible buildings;
- Minimum **building perimeter** access requirements;
- **Improved fire service access** to the building.
- **Non-combustible stairwells** with a fire rating of at least 1.5 hours;
- **Enhanced automatic sprinklering,** beyond the NFPA 13 standard for large buildings. Enhancements include sprinklering of balconies, decks and certain types of concealed spaces;
- **Increased fire protection in concealed spaces;**
- **Non-combustible or combustion resistant exterior cladding;**
- **Combustion-resistant roof cladding.**

Rationale for Proposed Amendments

The following provides more specific information and rationale for these proposed requirements:

1. Increasing the maximum number of storeys for wood frame buildings from four to six

The basic purpose of these proposed amendments is to increase the maximum allowable height of wood frame buildings from four to six storeys. Other proposed amendments constitute "compensating measures" that would refine this amendment to better provide for public safety. Six storeys is the maximum height that can be permitted without becoming a "high building" under the Building Code for residential occupancies. Beyond that height, further storeys would be out of reach for fire safety equipment such as ladders and trucks.

2. Permitted Occupancies

The Building Code contains requirements based on the occupancies or uses a building may be used for. These uses are categorized according to specific "Groups" of occupancies. Depending on the needs or hazards of a particular occupancy, additional compensating measures may be required.

It is proposed that the following occupancies or uses be permitted in mid-rise wood frame buildings:

- **Residential ("Group C") buildings** up to six storeys, including apartments or condominiums, hotels, dormitories, etc.
- **Business ("Group D") buildings** up to six storeys, including banks, medical offices, general office space, barber shops, etc.

Group C and D occupancies would be permitted in any combination; for instance, five storeys of residential and one storey of commercial or vice versa, or entirely of one use or the other.

3. Other "Mixed-Use" Occupancies

Mid-rise wood construction is expected to be primarily suited to existing built-up areas of cities, especially on major avenues. Since the proposed changes would permit a variety of complementary uses to be located in mid-rise buildings, the changes would both maximize the value of the building and provide more local amenities such as restaurants, groceries, or retail stores.

It is proposed that some limitations would be placed on the types of uses permitted, and where they could be located within the building, as follows:

- On the first or second floors: art galleries; libraries, larger restaurants, etc. (Group A, Div.2 – Assembly) and small restaurants, stores and groceries (Group E - Mercantile).

These assembly uses are relatively small and would not include larger uses, such as theatres. Parking garages would be allowed up to the second storey, provided they are ancillary to the primary residential and/or commercial use of the building. Where a Group A, Division 2 or Group E occupancy is proposed to be constructed on the first or second floor, a two-hour fire separation would be required between it and a residential or business occupancy above.

4. Restricting the height of mid-rise wood frame buildings
Several height restrictions are proposed:

- 18 m to the top floor including mezzanine, measured from the first storey.
- 20 m from the fire service access route to the top floor, including mezzanine.

These height limits would help to ensure that the building benefits from external rescue and fire-fighting operations, which in turn depend on both the maximum height of fire ladders, and the maximum height that can be reached by external water hoses.

The 18m limit would be intended to limit the height of each storey. If this was not required, a building could be constructed with very high storey heights, potentially leading to the upper storey or storeys being above the reach of fire service equipment.

The 20m limit on the height of the top floor relative to the fire service access route would help to ensure that the top floor and roof are within the reach of most fire ladders and hoses from any part of the fire service access route.

5. Restricting the building area of mid-rise wood frame buildings
The proposed amendments would require mid-rise wood buildings to be significantly smaller in maximum building area relative to non-combustible buildings of the same occupancy classification. This proposed limitation is based on existing Building Code provisions that restrict the size of combustible buildings to a much smaller size than non-combustible buildings of the same occupancy classification.

The limit in building area would reflect the fact that the total potential fire load of a combustible building (composed not just of building contents but also its structure) is significantly higher than for a non-combustible building. Therefore, to keep the fire load limited, restrictions on building area are appropriate.

It is proposed that:

- Mid-rise wood buildings containing residential uses be limited to a building area of 1,500 m^2 at six storeys, or approximately 25% of the building area permitted for a non-combustible building.
- Mid-rise wood buildings containing no residential uses would be permitted to have a building area of 3,000 m^2 at six storeys, or about 42% of the building area permitted for a non-combustible building.

Currently four storey wood frame (combustible) buildings are limited to 20% of the size of a non-combustible residential building. In the case of office buildings, they are limited to 33% of the size of a non-combustible building.

The relative building area proposed for mid-rise wood buildings has been increased slightly compared to the mNBC proposals because of the additional compensating measures.

6. Minimum requirements for building perimeter facing one street
The proposed "made in Ontario" model would require that not less than 10% of the perimeter of a five or six storey wood frame building be within 15m of a street that provides fire service access.

The Building Code currently does not specify a minimum figure for the percentage of a building perimeter that must be within access of a street that provides fire service access. The proposed requirement for mid-rise wood would provide emergency responders greater capacity to access the building exterior and interior to undertake fire suppression activities, assist in the timely evacuation of building occupants, and help firefighters attack the fire from multiple angles if necessary.

Other instruments, such as municipal zoning and site plan control, may also have a significant effect on building siting and emergency access.

7. Non-combustible stairwells with a fire resistance rating of 1.5 hours
The proposed "made in Ontario" model would prescribe that stairwells in mid-rise wood buildings be constructed of non-combustible materials only [i.e. concrete, masonry (concrete block), or steel frame and drywall] with a fire resistance rating of at least one and one-half (1.5) hours.

Since stairwells are used for staging of public evacuation and fire fighter response they are subject to increased fire safety concerns. The Building Code currently requires that most structural elements such as floors, walls and stairwells have one-hour fire endurance. In addition, the Building Code currently requires that all buildings, whether combustible or non-combustible, have fire separations between the stairwell structure and the surrounding floors. This limits the potential for fire to spread to stairwells from floor assemblies.

This "made in Ontario" proposal for non-combustible stairwells would exceed current requirements in British Columbia, proposed requirements in Quebec, and requirements elsewhere in the United States and Europe. Generally, these jurisdictions require only a one-hour fire resistance rating and do not prescribe the use of specific structural materials, allowing the internal frame to be concrete, masonry, steel or wood as the designer may determine.

8. Requiring sprinklering for all balconies and decks

The proposed "made in Ontario" model would require sprinklers on any balconies or decks in mid-rise wood buildings. Exterior sprinklers are readily available on the market, and do not impose greater risks of water damage through pipe freezing, as the design of the sprinkler system keeps water well clear of cold weather until needed.

Fires on balconies are a reasonably common occurrence due to people smoking on their balconies. Unattended or poorly maintained barbeques are also a common source of balcony fires. When a fire starts on a balcony, it can gain access to the building interior by burning through the bottom surfaces of the balcony above, or into the wall assembly.

This proposed requirement would exceed NFPA 13 provisions, which require sprinklering only of balconies and decks over four feet deep. They would also be an increase in fire protection over current Building Code requirements for combustible buildings of four storeys or less, which do not require exterior sprinklers.

9. Increased fire protection in concealed spaces

The proposed "made in Ontario" model would require these areas to meet NFPA 13 sprinkler standard. It would also require additional fire blocking to be provided. NFPA 13 requires combustible concealed spaces, such as roof assemblies and attics to be provided with sprinkler protection. This limits the probability of fire spreading both within and from a concealed space to other parts of the building.

10. Require non-combustible exterior cladding

A key feature of the proposed "made in Ontario" model for mid-rise wood would be a requirement that all exterior wall cladding be composed of non-combustible materials or fire tested exterior assemblies. This requirement would apply to all wood frame buildings of five and six storeys. Brick is the most common of these materials, but other materials and systems that meet the referenced standard do exist, and would also be permitted to be used.

The requirement for non-combustible cladding on exterior walls on all storeys would recognize that one possible way that a fire can spread is on, or through, the exterior of the building. Currently, four storey wood frame buildings permitted under the Building Code do not require combustion resistant or non-combustible exterior cladding.

11. Require combustion-resistant roof cladding

It is proposed that all five and six storey wood frame buildings be required to have "Class A" roof covering providing maximum fire resistance. The intent is to help prevent flying embers from any nearby fires causing the roof of the mid-rise building to catch fire. This requirement would apply regardless of the height of the roof assembly.

12. Fire protection during construction

Wood buildings can pose particular fire risks during construction. This risk is not restricted to mid-rise wood structures, but can also exist with smaller wood structures.

Building Code requirements address the design and manner of construction of buildings, including the sufficiency of the building components for their intended use. This does not include safety requirements of workers during construction. While the Building Code requires a number of fire safety measures and systems that would be in place when a building is occupied (such as operational sprinkler systems), those measures and systems are not generally in place during construction. While construction is underway, a fire can occur before these systems are fully installed or operational.

To mitigate concerns about the risk of fires in mid-rise wood construction projects, the Ministries of Municipal Affairs and Housing, Community Safety and Correctional Services, and Labour will work together with stakeholders to explore opportunities to support fire safety during the construction of combustible buildings, such as developing supporting materials or guidelines.

13. Other technical matters related to mid-rise wood

A variety of other technical matters are also addressed in the "made in Ontario" proposals that are more technical in nature, and that would help to ensure best design practices, including:

- Structural design requirements to include anticipated building movement. This would be intended to ensure that designers take into account likely impacts of settling, shrinkage and other types of building movement.
- Anchor clips to allow for exterior maintenance. This would address best practice in terms of identifying the attachment points for window washers, etc.
- Increased structural loadings in design. This provision would require mid-rise wood frame buildings to withstand a structural load that is 20% higher than equivalent non-combustible buildings. The intent of this provision would be to help ensure that such structures are as safe or safer than other buildings permitted under the Building Code. Tests of wood frame buildings that simulate earthquake loads have demonstrated the capacity of wood frame structures to resist lateral loads.