

2015 REFERENCE GUIDE:

Mid-Rise Wood Construction
in the Ontario Building Code
Report by Morrison Hershfield (January 2015)





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On September 23, 2014, after many years of research, development, stakeholder feedback and discussion, the Ontario Ministry of Municipal Affairs and Housing announced amendments to the 2012 Ontario Building Code (OBC) that permit 5- and 6-storey combustible construction for Group C and D occupancies. The amendments to the OBC increase opportunities for designers and builders to create versatile and affordable new buildings. The changes recognize the advancements in wood products and systems as well as in fire detection, suppression, and containment systems.

Densification is mandated in almost all municipal growth plans in the province. Mixed-use mid-rise buildings are seen as an important solution that will help create higher density and attract businesses and families to urban centres. Previous code restrictions on combustible construction made non-combustible solutions the only option for mid-rise development and many potential developments were stalled because they were deemed cost-prohibitive. Developers now have a new, cost-effective option to provide mid-rise solutions.

Decisions about how and where we build our communities have significant impacts on the natural environment and on human health. Wood is a natural, sustainable material and the processing of raw material into building materials has a lower environmental impact when compared to other major building components. The use of sustainable materials and components reduces the negative impact our buildings have on the environment and assists in mitigating climate change.

The amendments to the OBC have created exciting new opportunities but there are also new design and construction challenges to consider. Ontario Wood *WORKS!* developed this guide to explain the new provisions in the OBC and to discuss the opportunities as well as the challenges. Visit www.wood-works.ca for additional information and support related to the use of wood in construction.

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QUATTRO I (Surrey, BC)
ZGF Cotter Architects Inc.
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1. INTRODUCTION

1.1 Introduction

Morrison Hershfield Limited (MH) was retained by Ontario Wood WORKS! to document the application of the Ontario Building Code (OBC) for use of wood in mid-rise (and, in particular, 5 and 6 storey) construction and identify features that are required to be provided, as well as conditions or restrictions based on the OBC provisions that became applicable January 1, 2015.

1.2 Scope and Methodology

This report presents the provisions of the 2012 OBC (O.Reg. 332/12 as amended) including amendment, O.Reg. 191/14 (applicable January 1, 2015) which permits some mid-rise buildings to be of wood construction. Features that are required to be provided for these buildings are identified along with any conditions on the use of wood relative to the new provisions.

This report is based on a review of applicable changes to the OBC and MH's experience in interpreting and applying the Building Code.

The focus of this report is for buildings of new construction.

1.3 Limitations

Comments and conclusions within this report represent the opinion of Morrison Hershfield Limited, which is based on an examination of the applicable Codes, background documentation, our Code analysis and our past experience. In issuing this report, Morrison Hershfield does not assume any of the duties or liabilities of the designers, builders, owner or operators who may use the information herein for the design or construction of a building. Persons who use or rely on the contents of this report do so with the understanding of the limitations of the documents examined. Such persons understand that Morrison Hershfield cannot be held liable for damages they may suffer in respect to the design, construction, purchase, ownership, use or operation of a subject property.



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2. ONTARIO BUILDING CODE

The Ontario Building Code (O.Reg. 332/12 as amended) is a set of regulations made under the Building Code Act (1992) (Ontario) and sets out the technical requirements for construction of buildings. The Ontario Building Code is a set of minimum requirements for buildings that address objectives of safety, health, accessibility, property protection, resource conservation, environmental integrity and conservation of buildings.

The 2012 Ontario Building Code (OBC) came into force January 1, 2014. Several amendments to the Code have come into effect since that time and future applicable amendments have been released (e.g., the provisions in O.Reg. 191/14 are applicable as of January 1, 2015). All references to the OBC in this report are to the 2012 edition including all amendments to the date of this report with consideration for the adoption of O.Reg. 191/14.

The Code references and paraphrases in this report are for convenience only. For the authoritative text of the Building Code regulations, the official version of Ontario Regulation 332/12, as amended, should be referenced. Official copies of Ontario's regulations are published in the Ontario Gazette and a consolidated version can be found on the Government of Ontario e-laws website.

Unless otherwise stated, Code references in this report are with respect to Division B, "Acceptable Solutions" of the OBC.



222 HENNEPIN (Minneapolis, Minnesota)
Humphreys & Partners Architects LP

3. BACKGROUND

3.1 Code Changes

As of January 1, 2015, the OBC permits wood construction for buildings of residential and business and personal (office) services occupancies with a maximum height of 6 storeys. The change to the OBC has expanded the application of the Code which previously restricted the maximum height of buildings of wood construction to 4 storeys.

The Code was updated to allow the new and innovative use of wood in buildings up to 6 storeys based on the balancing of two primary objectives of the Ontario government:

To help increase opportunities for designers and builders to create innovative, flexible and affordable new buildings.

To maintain Ontario's high fire safety standards for both the public and fire service personnel.

3.2 Code Content

The OBC prescribes the minimum technical requirements for the design and construction of new buildings in Ontario. The high level objectives of the OBC are safety, health, accessibility, fire/structural/water/sewage protection of buildings, resource conservation, environmental integrity and conservation of buildings. The use of wood in the construction of buildings is related to many of these objectives.

Division B "Acceptable Solutions" contains prescriptive (and some performance) requirements that establish the minimum performance level of the Code. Building Code provisions that influence the use of wood in buildings are in Division B in the following Parts:

- Part 3 Fire Protection, Occupant Safety and Accessibility
- Part 4 Structural Design
- Part 5 Environmental Separation
- Part 9 Housing and Small Buildings
- Part 12 Resource Conservation and Environmental Integrity

Provisions that permit or prohibit wood as a construction material are contained in Parts 3 and 9. Part 9 is applicable to “small” buildings up to 3 storeys in building height and up to 600 m² in building area (footprint) with restrictions on occupancy type. Part 3 is applicable to any building larger than this, and a building of any size that contains assembly, care, or high hazard industrial occupancies.

Parts 4, 5 and 12 generally do not explicitly require or prohibit wood as a construction material but rather set out the required performance standards for structural, envelope and energy elements that every building must meet.

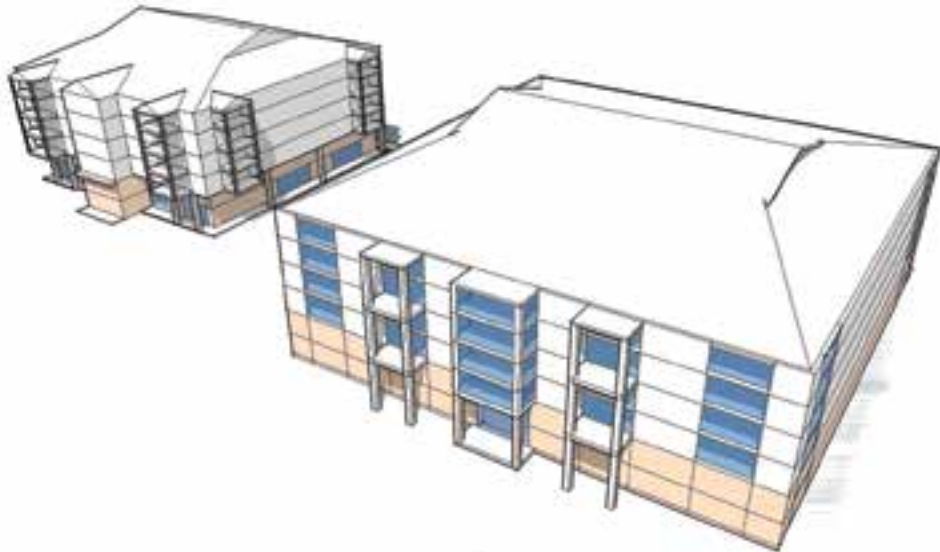


RIVERPORT FLATS, PHASE II (Richmond, BC)
Photo Courtesy of ZGF Cotter Architects Inc.

4. WHAT'S NEW?

4.1 General

On September 23, 2014 Ontario Regulation 191/14 was filed to amend the OBC to permit mid-rise buildings of wood construction for both residential and office occupancies, effective January 1, 2015. The amendment included the creation of new Articles 3.2.2.43A. and 3.2.2.50A. to prescribe the construction requirements and area limitations for mid-rise buildings of combustible construction.



In addition to the new construction requirements, several additional safety provisions not currently required in 4 storey buildings of wood construction will be applicable to mid-rise buildings of wood construction. As summarized in the Ontario CodeNews Issue 232, these features include:

- Residential (Group C) and office buildings (Group D) can be constructed using wood construction up to six storeys;
- These buildings may include other occupancies below the third floor, specifically, Group A, Division 2 such as restaurants and Group E uses such as grocery stores, as well as parking garages;
- enhanced automatic sprinklering in addition to the NFPA 13 provisions;

- sprinklering of all balconies over 610 mm deep;
- building height limits including height limits to the fire access route;
- a requirement for some exterior cladding and roof coverings to be noncombustible or combustion-resistant;
- additional compartmentalization for large sprinklered spaces such as attics;
- requiring at least 10% of the building perimeter to be within 15 m of a fire department access route;
- requiring that exit stairwells be separated from the remainder of the building by noncombustible construction and have a minimum 1½ hour fire rated separation;
- a requirement to meet a higher seismic load than similar noncombustible buildings; and
- more robust occupancy permit requirements.

Relevant new Code excerpts for mid-rise wood construction are indicated in the Appendix of this report.

4.2 Residential Buildings Construction Requirements

The new provisions of the Code permit residential buildings (Group C major occupancy) of combustible construction to be up to 6 storeys in building height. Prior to the 2015 amendments to the Code, the maximum height of a building of wood construction was 4 storeys. The new construction requirements of Article 3.2.2.43A. were introduced to permit mid-rise residential buildings of combustible construction. In addition, Article 3.2.2.43A. can also be applied to buildings less than 5 storeys in building height.

The advantage of applying the new Code requirements (Article 3.2.2.43A.) to shorter buildings (less than 5 storeys) is that Article 3.2.2.43A. permits larger building areas. However, when considering all Code requirements holistically, there are additional features that are mandated in the new provisions and it may be more advantageous to apply the current requirements (e.g., Article 3.2.2.45. which permits a building of wood construction be 4 storeys in building height) if the current area limitations are not a factor in the design of the building.

It is noted that when the new construction requirements are applied (i.e., Article 3.2.2.43A.) and a firewall is used to separate a building into two or more buildings and the required fire resistance rating of the firewall is 2 hours (rating based on occupancies of the buildings) the firewall is not required to be constructed of masonry or concrete provided the buildings on each side of the firewall are sprinklered.

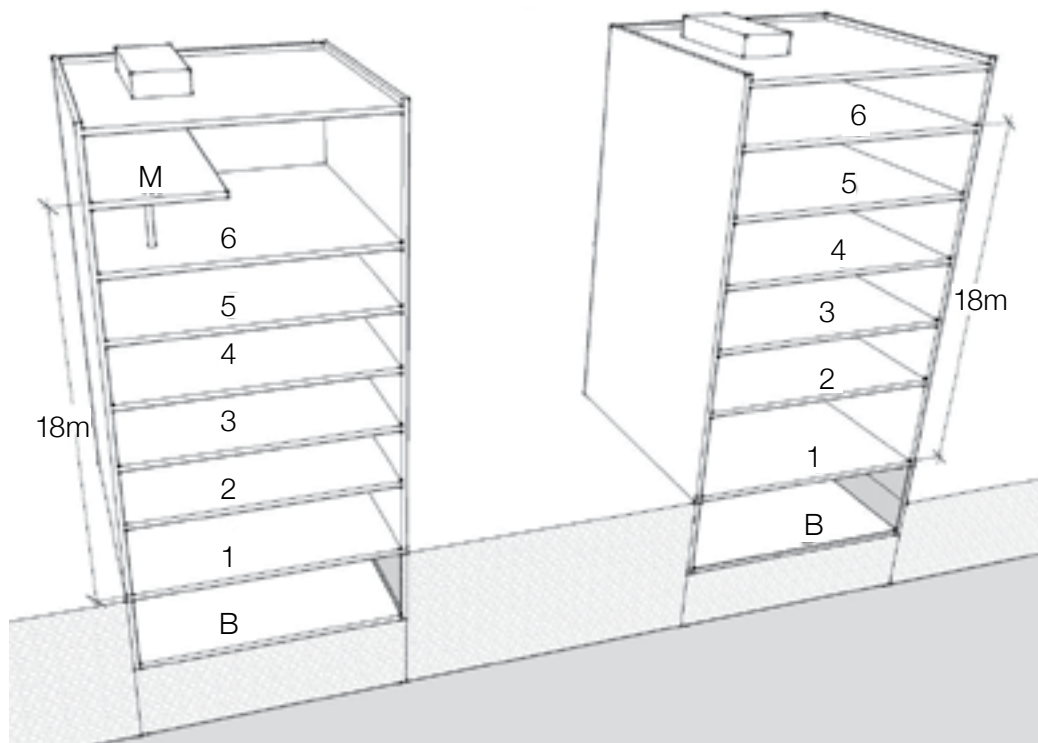
The new construction requirements of Article 3.2.2.43A., applicable to residential mid-rise buildings, are:

- A building is required to be fully sprinklered, as were most 4 storey residential buildings of wood construction prior to 2015.
- The sprinkler requirements of NFPA 13, “Standard for the Installation of Sprinkler Systems” are required to be applied to 5 and 6 storey buildings instead of NFPA 13R, “Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies”. NFPA 13R is permitted to be applied to maximum 4 storey residential buildings of wood construction. Application of NFPA 13 is more onerous than NFPA 13R as NFPA 13R has provisions to exempt sprinklers in attics, closets and bathrooms and provisions for less water demand which could lead to smaller pipe sizes.

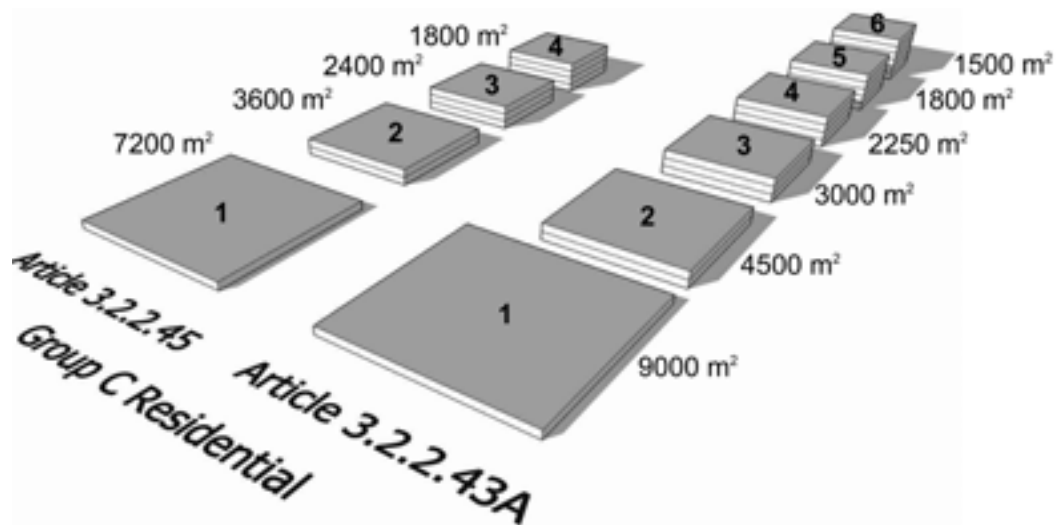
In addition, balconies greater than 610 mm in depth measured perpendicular to the exterior wall of the building are required to be sprinklered.

- A maximum height of 18 m measured between the floor level of the first storey¹ and the floor level of the uppermost storey or mezzanine is applicable. The floor level of a rooftop enclosure (for building services), service room, elevator machine room or stairway does not have to be considered. Prior to the 2015 amendments, there was no physical height associated with Fire Department access.

¹ *First storey* means the *storey* that has its floor closest to *grade* and its ceiling more than 1.8 m above *grade*. *Grade* means the average level of proposed or finished ground adjoining a building at all exterior walls.



- For a 5 storey building, maximum building area of 1800 m² is permitted and 1500 m² for a 6 storey building.
- For a 4 storey building, a maximum building area of 2250 m² is permitted. Prior to the 2015 amendments, a 4 storey building of wood construction would be limited to a building area of 1800 m². Similar maximum area limits have been increased for 1 to 3 storey buildings.



- Floor assemblies constructed as fire separations require a 1 hour fire resistance rating. This requirement is consistent with mid-rise buildings of any construction which are within the corresponding maximum building area limits of the Code for buildings up to 6 storeys in building height.
- Mezzanines are required to be constructed with a 1 hour fire resistance rating. This requirement is not new and is consistent with buildings of similar height and occupancy. This requirement applies to all mezzanines whether located within a residential suite or not.
- Roof assemblies require a 1 hour fire resistance rating. Prior to the 2015 amendments, the Code exempted a roof rating for all buildings if the building was sprinklered. This exemption is not applicable to mid-rise buildings of wood construction. Other provisions include the following:
 - If the roof assembly has a height greater than 25 m from the floor level of the first storey to the highest point of the roof assembly, the roof assembly is required to be of noncombustible construction or be constructed of fire-retardant treated wood. This is a new requirement that was introduced to facilitate firefighting. Prior to the 2015 amendments there were no height limitations for buildings beyond the limitation on the number of storeys. It is noted that mezzanines can be used for additional levels in the building that are not considered in the calculation of the number of storeys in a building, however, the 25 metre height limit will effectively limit the number of floor levels in a building based on a comfortable floor to ceiling height.
 - The noncombustible roof applicable for mid-rise wood construction is permitted to be supported by combustible structural elements (Sentence 3.1.7.5.(3)). Prior to the 2015 amendments, an assembly that was required to be noncombustible would be required to be supported by noncombustible construction. This new provision does not conflict with the remainder of the building being wood construction.
 - A building can have several roofs that are at different elevations. The construction of non-contiguous roof assemblies at different elevations is permitted to be evaluated separately with respect to the requirements for noncombustible construction for roofs more than 25 m above the floor level of the first storey. Depending of the configuration, the roof assemblies may be of mixed construction.

- Note: Combustible roof coverings are required to have a Class A classification (Sentence 3.1.15.2.(3)). For most other buildings the Code requires a Class A, B or C classification.
- Loadbearing assemblies are required to have a fire resistance rating not less than that required for the supported assembly. This is not a new requirement and is consistent with the remainder of the Code for the protection of supporting assemblies.
- Floor assemblies completely within individual dwelling unit greater than 1 storey in height are required to have a fire resistance rating of 1 hour but these assemblies are not required to be constructed as fire separations. This is consistent with residential buildings of any height. However, for some other residential buildings that are 4 storeys or less, the fire resistance rating for floor assemblies entirely within a dwelling unit is waived if there were no dwelling units above another dwelling unit.

4.3 Office Buildings Construction Requirements

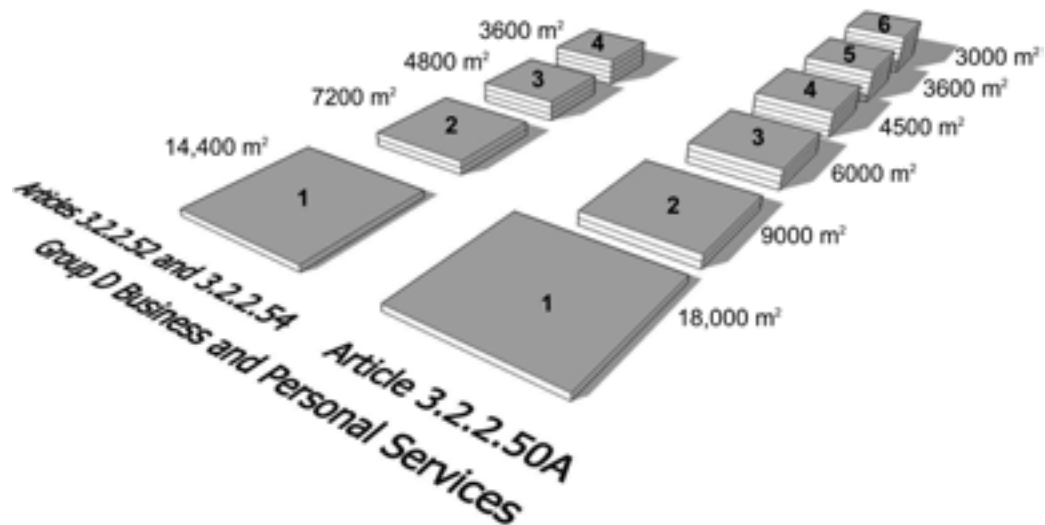
The new provisions of the Code permit business and personal services (office) buildings (Group D major occupancy) of combustible construction to be up to 6 storeys in building height. Prior to the 2015 amendments to the Code, the maximum height of an office building of wood construction was 4 storeys. The new construction requirements of Article 3.2.2.50A. were introduced to permit mid-rise office buildings of combustible construction. Article 3.2.2.50A. can also be applied to buildings less than 5 storeys in building height.

The advantage of applying the new Code provisions (Article 3.2.2.50A.) to shorter buildings (less than 5 storeys) is that Article 3.2.2.50A. permits larger building areas. However, when considering all Code requirements holistically, there are additional features that are mandated in the new provisions and it may be more advantageous to apply the current requirements (e.g., Article 3.2.2.52. which permits a building of wood construction to be 4 storeys in building height) if the current area limitations are not a factor in the design of the building.

It is noted that when the new construction requirements are applied (i.e., Article 3.2.2.50A.) and a firewall is used to separate a building into two or more buildings and the required fire resistance rating of the firewall is 2 hours (rating based on occupancies of the buildings) the firewall is not required to be constructed of masonry or concrete provided the buildings on each side of the firewall are sprinklered.

The new construction requirements of Article 3.2.2.50A., applicable to mid-rise office buildings, are:

- A building is required to be fully sprinklered as were 4 storey office buildings of wood construction prior to 2015. In addition, similar to the requirements for residential buildings, balconies greater than 610 mm in depth measured perpendicular to the exterior wall of the building are required to be sprinklered.
- A maximum height of 18 m measured between the floor level of the first storey² and the floor level of the uppermost storey or mezzanine is applicable. The floor level of a rooftop enclosure (for building services), service room, elevator machine room or stairway does not have to be considered. Prior to the 2015 amendments, there was no maximum physical height associated with Fire Department access.
- For a 5 storey building, a maximum building area of 3600 m² is permitted and 3000 m² for a 6 storey building.
- For a 4 storey building, a maximum building area of 4500 m² is permitted. Prior to the 2015 amendments, a 4 storey building of wood construction would be limited to a building area of 3600 m². Similar maximum area limits have been increased for 1 to 3 storey buildings.



² First storey means the storey that has its floor closest to grade and its ceiling more than 1.8 m above grade. Grade means the average level of proposed or finished ground adjoining a building at all exterior walls.

- Mezzanines are required to be constructed with a 1 hour fire resistance rating. This requirement is not new and is consistent with buildings of similar height and occupancy.
- Roof assemblies are required to be constructed with a 1 hour fire resistance rating. Prior to the 2015 amendments, the Code exempted a roof rating for all buildings if the building was sprinklered. This exemption is not applicable to mid-rise buildings of wood construction. Other provisions include the following:
 - If the roof assembly has a height greater than 25 m from the floor level of the first storey to the highest point of the roof assembly, the roof assembly is required to be of noncombustible construction or be constructed of fire-retardant treated wood. This is a new requirement that was introduced to facilitate firefighting. Prior to the 2015 amendments there were no height limitations for buildings beyond the limitation on the number of storeys. Mezzanines can be used for additional levels in the building that are not considered in the calculation of the number of storeys in a building, however, the 25 metre height limit will effectively limit the number of levels in a building based on a comfortable floor to ceiling height.
 - The noncombustible roof is permitted to be supported by combustible construction (Sentence 3.1.75.(3)). Prior to the 2015 amendments, an assembly that was required to be noncombustible would be required to be supported by noncombustible construction. This new provision does not conflict with the remainder of the building being wood construction.
 - A building can have several roofs that are at different elevations. The construction of non-contiguous roof assemblies at different elevations is permitted to be evaluated separately and depending of the configuration, the roof assemblies may be of mixed construction.
 - Note: Combustible roof coverings are required to have a Class A classification (Sentence 3.1.15.2.(3)). For most other buildings the Code requires a Class A, B or C classification.
- Loadbearing assemblies are required to have a fire resistance rating not less than that required for the supported assembly. This is not a new requirement and is consistent with the remainder of the Code for the protection of supporting assemblies.

4.4 Provisions Common to Residential and Office Buildings

4.4.1 Combustible Materials

The Code has two Subsections (i.e., Subsection 3.1.4. and 3.1.5.) that explicitly state the additional combustible elements and prescriptive requirements that are applicable in buildings permitted to be of combustible construction or required to be of noncombustible construction.

The provisions of Subsection 3.1.4. are applicable to buildings that are permitted to be of combustible construction. New provisions in Subsection 3.1.4. include the requirement for mid-rise buildings designed under Article 3.2.2.43A. or Article 3.2.2.50A. to have noncombustible cladding (Sentence 3.1.4.8.(1)) subject to Sentence 3.2.3.7.(6). Prior to the 2015 amendments, a building permitted to be of combustible construction did not have limitations on the cladding construction type unless there was an exposure condition (e.g., limiting distance condition). Cladding requirements are still also driven by the limiting distance provisions of Subsection 3.2.3. However, for a 5 or 6 storey building designed under Article 3.2.2.43A. or Article 3.2.2.50A., the cladding is not required to be noncombustible if flaming on or in the wall assembly does not spread more than 5 m above an opening when tested in accordance with CAN/ULC-S134, “Fire Test of Exterior Wall Assemblies” (Sentence 3.2.3.7.(6) and Sentence 3.1.5.5.(3)). In addition, if the wall assembly includes combustible cladding of fire-retardant treated wood, the above fire test is required to be conducted after the cladding has been conditioned in conformance with ASTM D2898, “Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing”(Sentence 3.2.3.7.(7)).

Where Article 3.2.2.43A. or Article 3.2.2.50A. is being applied, combustible pipe and tubing and associated adhesives used in the building are required to have a maximum flame spread rating of 25 (Sentence 3.1.4.9.(1)). However, there are exemptions that apply (Sentence 3.1.4.9.(2)) for the following building features:

- combustible sprinkler piping and associated adhesives,
- combustible tubing for pneumatic controls and associated adhesives, provided the tubing has an outside diameter not more than 10 mm,
- combustible piping and tubing and associated adhesives used in public pools and public spas, and

- combustible piping and tubing and associated adhesives concealed in a concrete floor slab.

There are no restrictions for the flame spread ratings of combustible pipe and tubing and associated adhesives for buildings of combustible construction not subject to Article 3.2.2.43A. or Article 3.2.2.50A.

4.4.2 Sprinkler Design Features

New mid-rise combustible buildings are required to conform to National Fire Protection Association Standard NFPA 13 “Standard for the Installation of Sprinkler Systems”. In addition, the Code specifies additional requirements that amend the NFPA 13 provisions.

The unique areas where sprinkler coverage is not required for combustible construction per NFPA 13 include:

- Combustible eave projections up to 1.2 m, provided the eaves meet additional prescribed rules or provisions with respect to fire stopping
- Under decks that do not project more than 610 mm from the exterior wall
- Under decks located on the uppermost roof of the building

For combustible residential buildings, sprinkler coverage is exempted from certain areas within dwelling units such as:

- Bathrooms with a maximum area of 5.1 m², provided the walls and ceiling are protected by a minimum 15 minute thermal barrier (e.g. 12.5 mm fire rated gypsum board)
- Closets with a maximum area of 2.2 m², with dimensional limitations

4.4.3 Fire Blocking

Fire blocking is a material or system that is installed in a concealed space to mitigate fire spread within a concealed space or from the concealed space to an adjacent space. Fire blocks in concealed spaces are required to be provided as per Subsection 3.1.11.

Additional new fire blocking requirements are applicable for a building designed under Article 3.2.2.43A. or Article 3.2.2.50A.

Concealed spaces created by the wood construction, within a floor assembly or roof assembly (does not apply where there is a noncombustible roof) are required to be separated into compartments with the following features (Sentence 3.1.11.5.(3)):

- Maximum area of 600 m² with no dimension more than 60 m if the exposed construction materials within the space have a maximum flame spread rating of 25
- Maximum area of 300 m² with no dimension more than 20 m if the exposed construction materials within the space have a flame spread rating of more than 25

However, the above fire blocking requirements do not apply if the concealed space is filled with noncombustible insulation (e.g., mineral wool) such that any air gap between the insulation and the underside of the floor or roof deck is a maximum of 50 mm.

4.4.4 Streets

Depending on the size, occupancy and protection of the building (sprinklered versus unsprinklered), a building may be required to face one to three streets. As a minimum, each building is required to face at least one street.

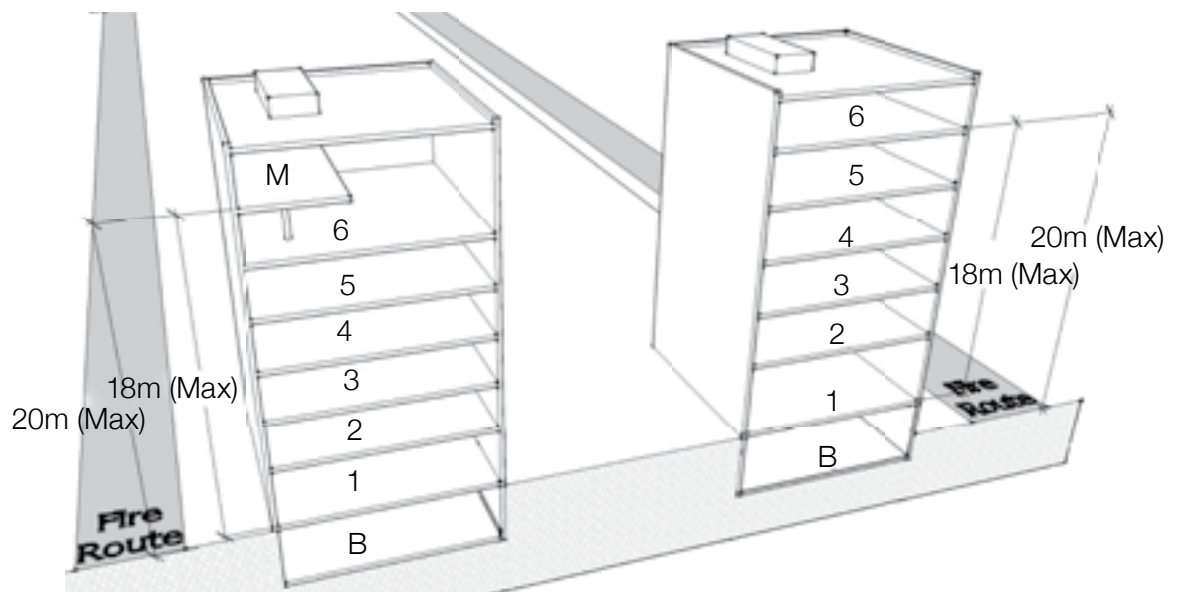
Typically, sprinklered buildings are not required to have a minimum percentage of the building perimeter facing a street, except that the principal entrance must be within 3–15 m of a street. However, a building designed per Article 3.2.2.43A. or Article 3.2.2.50A. is required to face at least one street and new criteria related to the percentage of the building perimeter facing a street is explicit. A building designed as per Article 3.2.2.43A. or Article 3.2.2.50A. is considered to face at least one street if a minimum of 10% of the building perimeter is located within 15 m of a street or streets (Sentence 3.2.2.10.(3)).

4.4.5 Fire Department Access

Each building is required to be served by a Fire Department access route which can be a street, highway, road, boulevard, square, or other improved thoroughfare that is 9 m or more in width, designed for public use and accessible to Fire Department vehicles and equipment.

Prior to the 2015 amendments, there were no provisions related to the relationship between the Fire Department access route and the height of a building. For a building designed in accordance with Article 3.2.2.43A. or Article 3.2.2.50A., no portion of the required Fire Department access route is to be located more than 20 m below the floor level of the uppermost storey or mezzanine.

A building may have other building service features at the roof level, such as rooms for elevator machinery, stairway or service room, located above the uppermost occupied level (storey or mezzanine). However, the 20 metre height measurement is not required to be measured to a rooftop of the roof of that rooftop enclosure. (Sentence 3.2.5.6.(2)).



4.4.6 Emergency Power

All buildings have basic emergency power requirements for emergency lighting, exit signs (where required) and the fire alarm system (where required).

The emergency power requirements for a building designed as per Article 3.2.2.43A. or Article 3.2.2.50A. are enhanced compared to a similar sized building with the same occupancy where other construction provisions of Subsection 3.2.2. are applied.

With respect to emergency power for emergency lighting, an emergency power supply is required for a period of 1 hour as opposed to 30 minutes which would be applicable to a similar sized building with the same occupancy (Subclause 3.2.7.4.(1)(b)(iii)).

With respect to emergency power for the fire alarm system, emergency power for the fire alarm system must be capable of providing supervisory power for a minimum of 24 hours followed by 1 hour under full load (Sentence 3.2.7.8.(3)). Typically, the emergency power under full load would be 30 minutes for residential and office buildings not more than 6 storeys in building height.

4.4.7 Exit Compartments

The Code requires that the construction of the fire separation between exits and the remainder of the building be noncombustible.

The exit stairway fire separations are otherwise typically required to have a fire resistance rating not less than the fire resistance rating of the floor assembly above the storey unless there is no floor assembly above the storey in which case, the fire resistance rating of the floor assembly below governs the fire resistance rating of the fire separation of the exit on that storey.

Typically, Article 3.4.4.1. specifies the fire resistance rating of exit stairs. However, for buildings where Article 3.2.2.43A. or Article 3.2.2.50A. is applied, although the floor fire separations are required to have a 1 hour fire resistance rating, exit stairs are required have a minimum fire resistance rating of not less than 1½ hours (Refer to Clause 3.2.2.43A.(2)(e), Clause 3.2.2.50A.(2)(e) and Sentence 3.4.4.1.(3)).

In addition, although the building is permitted to be of combustible construction, the walls of the exit stairway are required to be noncombustible, implying that the stairways are “part of the building” that is required to be noncombustible per Sentence 3.1.5.1.(1). The application of Sentence 3.1.5.9.(1) may be deemed applicable to stairs within these buildings since the compartment boundaries of the exit stairway are only required to be noncombustible.

4.4.8 Structural

For a building designed under Article 3.2.2.43A. or Article 3.2.2.50A., there is a requirement to meet a higher seismic load than that which is applicable for similar noncombustible buildings (i.e., there are special properties for buildings of wood construction that are greater than 4 storeys). These changes can be found in Sentences 4.1.8.10.(3), (4), 4.1.8.11.(11) and 4.1.8.12.(12). See additional information with respect to structural performance requirements in Section 5.2 of this report.

4.4.9 Occupancy Permit

Division C, Article 1.3.3.1. contains conditions for occupying a portion of an unfinished building. These requirements ensure that there is an adequate and appropriate level of safety in place for occupancy prior to completion of the building. However, where Article 3.2.2.43A. or Article 3.2.2.50A. is applied, there are more specific conditions for an occupancy permit as per Division C, Article 1.3.3.5.

An occupancy permit will be issued if:

- the structure of the building is completed to the roof,
- the building envelope, including, but not limited to, cladding, roofing, windows, doors, assemblies requiring fire-resistance ratings, closures, insulation, vapour barriers and air barriers, is complete,
- the walls enclosing the space to be occupied are completed, including balcony guards,
- all required fire separations and closures are completed,
- all required exits are completed, including all fire separations, doors, door hardware, self-closing devices, guards and handrails,
- all shafts including closures are completed,
- measures have been taken to prevent access to parts of the building and site that are incomplete or still under construction,
- floors, halls, lobbies and required means of egress are free of loose materials and other hazards,
- if service rooms should be in operation, required fire separations and closures are completed,
- all building drains, building sewers, water systems, drainage systems and venting systems are complete and tested as operational for the storeys to be occupied,

- required lighting, heating and electrical supply are provided for the suites, rooms and common areas to be occupied,
- required lighting in corridors, stairways and exits is completed and operational,
- required standpipe, sprinkler and fire alarm systems are complete and operational, together with required pumper connections for such standpipes and sprinklers,
- required smoke alarms and carbon monoxide alarms are complete and operational,
- required fire extinguishers have been installed,
- main garbage rooms, chutes and ancillary services are completed to all storeys to be occupied,
- required firefighting access routes have been provided and are accessible, and
- the sewage system has been completed and is operational.

Except where specifically noted, the conditions for an occupancy permit apply to the entire building.



THE EMERY (Portland, OR)
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4.5 Mixed Use Buildings

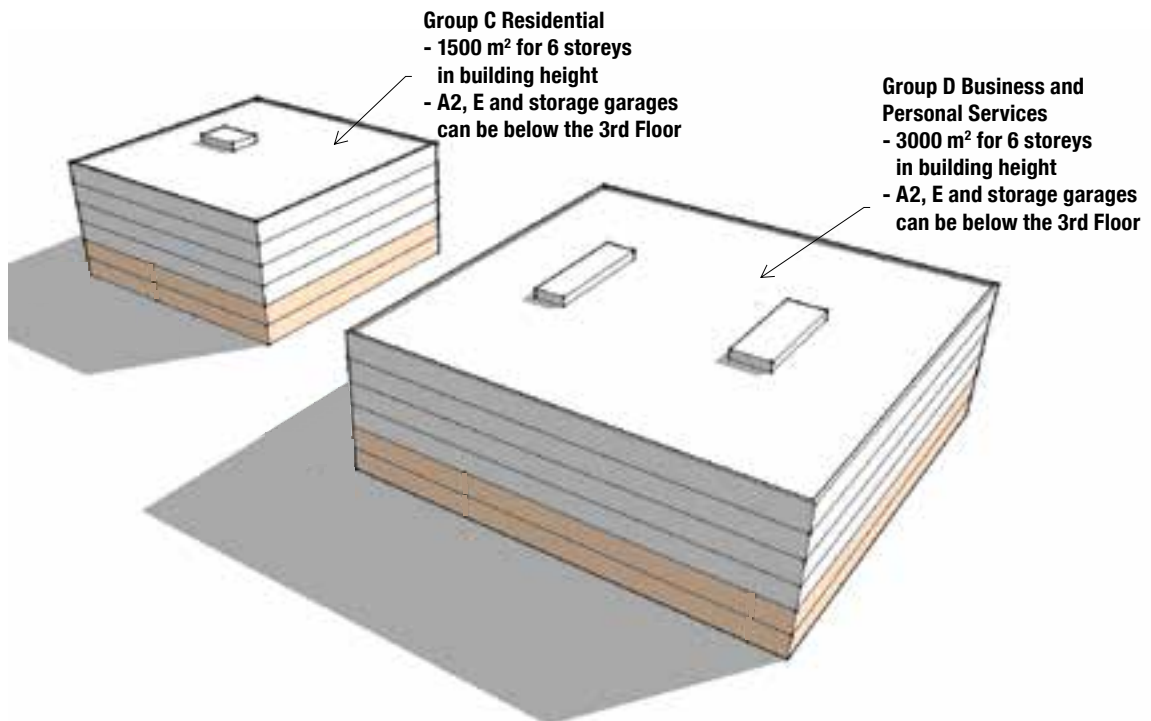
The new provisions of the OBC outline the core provisions for mid-rise buildings of wood construction containing residential (Group C) or office (Group D) major occupancies as principal occupancies.

The major occupancy of the buildings is not limited to the residential or office major occupancies and the Code permits mid-rise buildings of wood construction to include other major occupancies to be constructed in accordance with the provisions of Article 3.2.2.43A. or 3.2.2.50A., however, the Code also prescribes limitations.

4.5.1 Permitted Major Occupancies

A building within the scope of Articles 3.2.2.43A. (residential major occupancy) or 3.2.2.50A. (office major occupancy) is permitted to contain the following major occupancies (Sentence 3.1.3.2.(5) and (6)):

- Group C (residential) and Group D (offices) per the relevant construction provision
- Group A, Division 2 (assembly) below the third storey
- Group E (mercantile) below the third storey
- Storage garage below the third storey



4.5.2 Other Major Occupancies

Other major occupancies can be incorporated into a building using the concept of multiple major occupancies described in Articles 3.2.2.6. to 3.2.2.8.

For typical buildings that include multiple major occupancies, the construction requirements for the building are based on the most restrictive major occupancy and are required to be applied as if the whole building is of that major occupancy (subject to the exception of superimposed major occupancies) (Sentence 3.2.2.6.(1)). However, in the case of buildings designed as per Articles 3.2.2.43A. or 3.2.2.50A. and incorporating Group A, Division 2, Group E, and storage garage occupancies as permitted, the construction requirements of Articles 3.2.2.43A. or 3.2.2.50A. are applicable to the entire building.

For typical buildings that include superimposed major occupancies where one major occupancy is located above another major occupancy, the construction provisions of Articles 3.2.2.20. to 3.2.2.83. for each portion of the building containing the relevant major occupancy are applicable to that portion as if the entire building was of that major occupancy. This provides for design flexibility to incorporate podiums for other major occupancies using the applicable construction provisions for those major occupancies, and construction in accordance with Articles 3.2.2.43A. or 3.2.2.50A. for the Group C or Group D occupancy above.

4.5.3 Separation of Major Occupancies

Adjacent major occupancies in a building are required to be fire separated from each other and include the following new requirements:

- A fire separation with a 2 hour fire resistance rating is required between Group C (residential) and Group A, Division 2 (assembly) major occupancies (Sentence 3.1.3.1.(3)).
- A fire separation with a 2 hour fire resistance rating is required between Group D (office) and Group A, Division 2 (assembly) major occupancies (Sentence 3.1.3.1.(4)).



THE STANDARD AT ATHENS (Athens, Georgia)
Humphreys & Partners LP

5. TRADITIONAL CODE REQUIREMENTS

5.1 Background

This section includes key provisions of the OBC that are required to be applied to mid-rise buildings of wood construction and that were already included in the Code prior to the changes to the Code that permitted mid-rise buildings wood construction and that remain applicable.

5.2 Structural Design Using Wood (Part 4)

The Code generally permits the use of wood as a structural material. The application and use of wood in the Code is subject to limitations based on the building size and occupancy as defined by Division A, Subsection 1.1.2. and using Part 3 (Fire Protection, Occupant Safety and Accessibility), Part 4 (Structural Design) or Part 9 (Small Buildings) as applicable. With respect to using wood as a structural material, in the case of buildings more than 3 storeys or otherwise not within the scope of Part 9, the use of wood as a structural material is governed by Part 4.

Part 4 of the Code provides a framework of procedures and requirements for determining the minimum structural loads and design standards to be applied so that buildings and their structural members have sufficient structural capacity and structural integrity to safely and effectively resist all loads and effects. Parameters to be considered include structural strength, serviceability and reliability. The minimum loads specified in the Code are primarily based on the use and occupancy of the building, as well as the building's geographic location and exposure (e.g., climatic and seismic influences). Part 4 of the Code does not provide use and occupancy structural loads based on the type of materials to be used. However, the Code does require that the design be completed in accordance with the corresponding material design standard. The design of the structure will be governed by the applicable design standard (such as CSA-O86 in the case of wood design). This essentially provides the designer with the freedom to select and utilize the material(s) of their choice, subject to the physical properties and limitations inherent with that material.

In general, Part 4 of the Code does not contain restrictions on the use of wood or timber structures, with the exception that in certain cases it does not permit the use of wood as structural components intended to act as the seismic force resisting system (SFRS). The SFRS is the part of the structural system that is designed to provide the required resistance to earthquake forces and effects (Article 4.1.8.9). Under the Code the SFRS can be designed using wood, subject to height restrictions that are imposed in certain cases based on design parameters such as the geographic seismic zone in which the building is located, and the type of SFRS utilized. The Code presents the allowable usages for wood in tabular form (Table 4.1.8.9) for the most common SFRS's (e.g., shear walls, moment resisting frames), with imposed height restrictions varying from 'not limited' to values ranging from 15 to 30 m. Similar types of restrictions exist for the other common structural materials (i.e., steel, concrete, and masonry), again based on design parameters such as geographic seismic zone in which the building is located, and the type of SFRS utilized. See Section 4.4.8. of this report for additional information regarding the additional seismic loads applicable to buildings constructed under Articles 3.2.2.43A. or 3.2.2.50A.

Part 4 of the Code contains a provision for the use of wood in foundations or structures supporting soil and rock. This provision is outlined in Article 4.2.3.1. which permits wood as a material used in foundations provided that it conforms to the applicable requirements of CSA-O86. Article 4.2.3.2. provides requirements for the preservation treatment of wood used in foundations, generally stating that it must be treated with preservation in conformance with CSA-O80 Series, "Wood Preservation."

Composite lumber and panel products are permitted for use as structural members, provided that they are designed and fabricated in accordance with the requirements of CSA-O86. This Standard specifically deals with two types of composite building products; glued panel web beams (box or I-section) and stress skin panels (for floor or roof constructions), provided that they are not manufactured by a proprietary process. However, a proprietary process can be used and compliance with CSA-O86 can be demonstrated via testing.

5.3 Use of Wood in Environmental Separations (Part 5)

Part 5 “Environmental Separation” of the OBC applies to all buildings except those within the scope of Part 9 or the scope of the National Farm Building Code of Canada. Under this context, Part 5 applies to building elements (e.g., walls, floors, roofs, windows, doors) that separate dissimilar environments. This includes both the separation between indoors (i.e., conditioned space) and outdoors (including the ground), as well as between interior spaces that have significantly different environments (e.g., between an indoor pool and classroom space).

In general terms, Part 5 deals primarily with the control of heat, air and moisture, where moisture includes the control of vapour, precipitation, surface water and ground water. Part 5 of the Code generally does not restrict the use of wood (or other materials) provided that the materials or assemblies fulfill the prescriptive requirements for their intended function within the building envelope (i.e., control of heat, air, and/or moisture), and that any of the applicable reference standards are satisfied. The ability of a material or assembly to achieve the required performance related to the transfer of heat, air and moisture must be determined based on sound engineering principles and practices.

The Part 5 requirements have not been modified by the 2015 amendments to the Code. However, a designer may not be able to use the same methods and approaches as were applied for 4 storey buildings of wood construction. Careful design and analysis will be required to meet Part 5 requirements of the Code.

5.4 Combustible Materials – Other Provisions

For all buildings permitted to be of combustible construction, additional combustible materials that are permitted to be used in the building are specified in Subsection 3.1.4. This Subsection includes provisions to address the protection of foamed plastics, wire and cables that are permitted to be used, required features of fire-retardant treated wood and required features of heavy timber construction.

5.5 Subsidiary Occupancies

Buildings typically include several occupancies, however, these occupancies generally do not impact the core construction requirements (in some cases there are specific occupancy specific requirements).

The Code permits subsidiary occupancies that are in direct support and are an integral part of the principal occupancy.

For example, residential buildings typically include amenity spaces that are used only by the building occupants (e.g., pool or fitness area). Although these assembly spaces have a different occupancy than the remainder of the building (i.e., residential) these spaces are an integral part of the principal occupancy and do not constitute a separate major occupancy.

The new limitations for major occupancies does not apply to subsidiary occupancies (with the exception of a parking garage) such that these occupancies are permitted on all floors of the building.

5.6 Other Fire and Life Safety Provisions

For mid-rise buildings of wood construction, the designer is to undertake an analysis of all the traditional required fire and life safety features of a building. A mid-rise building will require a fire alarm system, standpipe system, etc. Other provisions will also have to be considered in design and will be similar to any mid-rise building and will include the continuity of fire separations, firestopping penetrations through fire rated assemblies, interior finishes, occupancy based fire separations (e.g., separation of dwelling units), etc.



QUATTRO III (Surrey, BC)

Cotter Architects Inc

Photo Courtesy of Martin Knowles Photo/Media

www.mkphotomedia.com

6. HOW TO BUILD MID-RISE BUILDINGS OF WOOD CONSTRUCTION

6.1 Construction Practices

Different techniques and processes apply depending on the materials used, type of construction, weather, etc. When constructing a mid-rise building of wood construction, there are several features that are to be considered that are different than the features that have to be carefully analyzed for other types of construction. The information provided in this report with respect to features that are to be considered during design and construction is not exhaustive but there are several reoccurring themes in other jurisdictions that have been included.

6.2 Design of Mid-Rise Buildings of Wood Construction

There are several factors that designers are to take into consideration when designing mid-rise buildings of wood construction. For example, factors such as the integration of dissimilar materials (e.g., noncombustible exit fire separations from the remainder of the building), shrinkage, differential movement when the upper portion and lower portion of the building contract under varying temperatures (moisture control), seismic performance and lighter foundations are to be considered.

Wood construction in mid-rise buildings may have longer exposures to the elements during construction since the construction period may be longer than for 4 storey buildings of wood construction. Consideration to the exposure to the elements is to be taken into consideration.

With respect to Part 5 provisions, different methodologies may have to be considered and the methodologies applied to 4 storey buildings of wood construction may not be necessarily scalable to 5 or 6 storey buildings of wood construction.

With a building height of 5 or 6 storeys, the building will experience increased loading on environmental separators which will require a different approach to be used compared to 4 storey buildings of wood construction. Some considerations include the following:

- Air barrier assemblies

Noncombustible cladding is required for mid-rise buildings of combustible construction as described in Section 4.4.1 of this report. A cladding such as a masonry veneer will have penetrations of sheathing membrane by metal ties. These penetrations are to be considered as they may lead to the tearing of air barrier materials.

- Insulation

There will be additional loads due to the height of a 5 or 6 storey building compared to a 4 storey building and wood framing may be used to support the load. The increased amount of framing is to be considered so that there is enough space for insulation within the framing.

- Fenestration selection

The increased rain and wind exposure for a 5 or 6 storey building compared to a 4 storey building may impact the window assembly selection.

- Protection from precipitation

Wind and rain loads are required to be assessed relative to the building envelope in consideration with features such as cladding attachments, accumulation of run-off, water shedding, etc.

- Differential movement due to wood shrinkage

Differential vertical and lateral movement (between shrinking wood elements and masonry) is required to be taken into consideration and may have an impact on the structural design, design of building systems and features (e.g., trip hazards may be created when there is movement of shrinking materials against non-shrinking materials).

- Roofing selection and design

Some roofing applications that would commonly be used in low-rise buildings will require careful consideration due to the higher wind loads in 5 and 6 storey buildings that would result in higher wind uplift forces on the edges of buildings.

6.3 Firewalls

In some cases, the design may dictate or it may be desired to make use of firewalls to create a building complex that is larger than the limits otherwise permitted under the new provisions. The use of firewalls will permit a complex to be designed as more than one building meeting the occupancy, height and area limits of Article 3.2.2.43A. and Article 3.2.2.50A.

Firewalls are required to be of noncombustible construction; however, where the required fire resistance rating for the firewall is a maximum of 2 hours, the firewall is not required to be constructed of masonry or concrete, which otherwise applies for firewalls required to have a minimum 4 hour fire resistance rating.

Careful design of the firewall is required with consideration of design of openings, sacrificial wall assemblies that maintain the structural independence of the firewall, as well as other listing conditions that may apply, depending on the chosen wall construction.

6.4 Construction Quality

The availability of skilled labour to construct mid-rise buildings is to be considered, especially in jurisdictions where buildings constructed of wood have been typically only small residential projects. It is necessary that contractors have appropriate knowledge and skills to construct fire separations, seismic connections, etc.

6.5 Construction Site Safety for Buildings of Wood Construction that are under Construction

Once completed, a building of wood construction that has been designed and built as per the provisions of the OBC is as safe as a building constructed of different materials. However, during construction, the risk of fire in buildings of wood construction is different. There are many risks during construction of any type, numerous ignition sources, and prior to enclosure with gypsum board membranes, wood framing is a very high fuel load with little barrier to fire spread. In addition, active fire suppression systems are not yet installed during the time with the highest risk, and Fire Departments may find construction site access difficult.

In Ontario, the OBC or Ontario Fire Code does not have jurisdiction for construction safety as of this printing there are no prescribed requirements for construction safety related to mid-rise buildings of wood construction.

Careful consideration must be taken by the contractor to mitigate the risk of fire during construction and can include additional security (to mitigate arson fires), more frequent fire watches, heightened awareness during hot work, etc.

6.6 Construction Phasing

As with any construction, construction phasing has an impact on the project. Due to the speed at which a building of wood construction can be erected, enabling other trades to start their work sooner, there must be careful coordination of trades such that design details (e.g., construction of fire separations) are not compromised.

6.7 Additions to Existing Buildings

Part 11 of the OBC, “Renovation” applies when there is an addition to an existing building. Typically an addition would be required to be constructed as per the provisions of new construction and the existing portion of the building would not be required to be upgraded unless it is being renovated or the addition has an impact on the existing building (i.e., for example, the addition causes the removal of an exit).

However, the 2015 amendments have additional provisions for when storeys are added to buildings of wood construction. If a storey or storeys are added so that the extended building height will be greater than four storeys, the entire building is required to be sprinklered.

Although it may be desired for the entire existing building to be upgraded with other features that are applicable if the building was of new construction, when there is an addition, this may not be feasible due to several reasons including construction complexity, cost, etc. As such, existing buildings have to be carefully evaluated so that they meet the required performance level of the Code.

7. CLOSING AND ADDITIONAL REFERENCES

7.1 Closing

The OBC has been amended to expand the permission to use combustible construction in a wider variety of buildings. This report presents the changes to the OBC, applicable as of January 1, 2015 that permit the use of wood construction for mid-rise residential and office buildings and outlines the new features that are required to be provided. Traditional Code requirements are still applicable and will have to be taken into consideration when designing a mid-rise residential or office building of wood construction.

7.2 Resources and Information on Wood as a Construction Material

Increasing amounts of information are available on wood as a construction material for use by designers, contractors and owners. The providers of this information intend to facilitate the use of wood on construction projects, and aim for consideration of wood as a construction material by owners and designers early in the design process.

There are new websites, brochures, design guides etc. that document the benefits of wood, and assist designers in applying the Building Codes for wood construction. Examples of these resources include:

- Ontario Building Code O.Reg. 332/12 as amended to January 1, 2015
- Wood *WORKS!* website: wood-works.ca
- Canadian Wood Council website: cwc.ca
- Wood Facts website: woodfacts.cwc.ca
- American Wood Council website: americanwoodcouncil.org
- FPInnovations website: fpinnovations.ca/media/publications
- Online Compilation of wood information resources:
www.naturallywood.com

APPENDIX:

Key Code Excerpts from O.Reg. 191/14 applicable to Mid-Rise Wood Construction

The Ontario Building Code, O.Reg. 332/12 as amended to January 1, 2015 is available for purchase from Service Ontario Publications:
www.publications.serviceontario.ca/

The Code (O.Reg. 332/12 as amended to January 1, 2015 and includes O.Reg. 191/14) is also available on-line at the Government of Ontario's e-Laws website:
<http://www.e-laws.gov.on.ca/>

Division B, Article 3.2.2.43.A. and Article 3.2.2.50A. which were introduced in O.Reg. 191/14 have been reproduced for convenience.

Division B, 3.2.2.43A. Group C, up to 6 Storeys, Sprinklered, Combustible Construction

- (1) A *building* classified as Group C is permitted to conform to Sentence (2) provided,
 - (a) it is *sprinklered*,
 - (b) it is not more than 6 *storeys* in *building height*,
 - (c) it has a height of not more than 18 m, measured between the floor level of the *first storey* and the floor level of the uppermost *storey* or *mezzanine* that is not a rooftop enclosure, provided for elevator machinery, a stairway or a *service room* used for no purpose other than for service to the *building*, and
 - (d) it has a *building area* of not more than,
 - (i) 9 000 m² if 1 *storey* in *building height*,
 - (ii) 4 500 m² if 2 *storeys* in *building height*,
 - (iii) 3 000 m² if 3 *storeys* in *building height*,
 - (iv) 2 250 m² if 4 *storeys* in *building height*,
 - (v) 1 800 m² if 5 *storeys* in *building height*, or
 - (vi) 1 500 m² if 6 *storeys* in *building height*.
- (2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction*, used singly or in combination, and,
 - (a) except as permitted by Sentence (3), floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
 - (b) roof assemblies shall have a *fire-resistance rating* not less than 1 h,

- (c) except as provided by Sentence (4), where the roof assembly has a height greater than 25 m measured from the floor level of the *first storey* to the highest point of the roof assembly, the roof assembly shall,
 - (i) be of *noncombustible construction*, or
 - (ii) be constructed of *fire-retardant treated wood* conforming to Article 3.1.4.5.,
- (d) *mezzanines* shall have a *fire-resistance rating* not less than 1 h,
- (e) the *fire separation of exits* described in Sentence 3.4.4.1.(3) shall be of *noncombustible construction*, and
- (f) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.
- (3) In a *building* that contains *dwelling units* that have more than 1 *storey*, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over *basements*, which are entirely contained within these *dwelling units*, shall have a *fire-resistance rating* not less than 1 h but need not be constructed as *fire separations*.
- (4) The construction of non-contiguous roof assemblies at different elevations is permitted to be evaluated separately to determine which roof assemblies are required to be constructed in accordance with Clause (2)(c).
- (5) Group A, Division 2 *major occupancies*, Group E *major occupancies* and *storage garages* located in a *building* within the scope of this Article are permitted to be constructed in accordance with this Article provided they are located below the third *storey* of the *building*.

Division B, 3.2.2.50A. Group D, up to 6 Storeys, Sprinklered, Combustible Construction

- (1) A *building* classified as Group D is permitted to conform to Sentence (2) provided,
 - (a) it is *sprinklered*,
 - (b) it is not more than 6 *storeys* in *building height*,
 - (c) it has a height of not more than 18 m, measured between the floor level of the first *storey* and the floor level of the uppermost *storey* or *mezzanine* that is not a rooftop enclosure provided for elevator machinery, a stairway or a *service room* used for no purpose other than for service to the *building*, and
 - (d) it has a *building area* of not more than,
 - (i) 18 000 m² if 1 *storey* in *building height*,
 - (ii) 9 000 m² if 2 *storeys* in *building height*,
 - (iii) 6 000 m² if 3 *storeys* in *building height*,
 - (iv) 4 500 m² if 4 *storeys* in *building height*,
 - (v) 3 600 m² if 5 *storeys* in *building height*, or
 - (vi) 3 000 m² if 6 *storeys* in *building height*.

- (2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and,
- (a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
 - (b) roof assemblies shall have a *fire-resistance rating* not less than 1 h,
 - (c) except as provided by Sentence (3), where the roof assembly has a height greater than 25 m measured from the floor level of the *first storey* to the highest point of the roof assembly, the roof assembly shall,
 - (i) be of *noncombustible construction*, or
 - (ii) be constructed of *fire-retardant treated wood* conforming to Article 3.1.4.5.,
 - (d) *mezzanines* shall have a *fire-resistance rating* not less than 1 h,
 - (e) the *fire separation of exits* described in Sentence 3.4.4.1.(3) shall be of *noncombustible construction*, and
 - (f) *loadbearing walls, columns and arches* shall have a *fire-resistance rating* not less than that required for the supported assembly.
- (3) The construction of non-contiguous roof assemblies at different elevations is permitted to be evaluated separately to determine which roof assemblies are required to be constructed in accordance with Clause (2)(c).
- (4) Group A, Division 2 *major occupancies*, Group E *major occupancies* and *storage garages* located in a *building* within the scope of this Article are permitted to be constructed in accordance with this Article provided they are located below the third *storey* of the *building*.

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