HOUSING OBSERVER 2016

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Mid-rise residential wood construction

Article 1—February 2016

Canada

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1 Changes taking place in Canada

Based on research, advanced construction technologies and innovative wood products such as cross-laminated timber and structural composite lumber, 5- and 6-storey residential construction is becoming accepted in Canada and elsewhere. It has been adopted in British Columbia, Alberta, Ontario and Quebec. Allowances for 6-storey combustible construction will be reflected in the 2015 edition of National Building Code and the National Fire Code, expected to be released in early 2016, which will facilitate its introduction to and adoption by other provinces and territories.

The increase in building height is predicated on additional life safety requirements for completed buildings. In addition, some best practices have been proposed to reduce fire risk for buildings under construction:

- additional security (to mitigate arson fires),
- more frequent fire watches,
- heightened awareness during hot work, and
- strict protocols for 'hot activities' such as welding.

Learn more about this change in Canadian residential construction.

2 Code changes in Canada and the United States

Over the past decade, several major urban centres in the western United States have eased restrictions that limited the construction of wood-frame buildings to four-storeys. The push to amend legislation to allow the building of 5- or 6-storey wood-frame buildings reflects the desire of city planners to increase urban density and provide the home building industry with additional residential construction options. Buildings of 5- and 6-storeys in height are often referred to as mid-rise construction.

Based on a review of residential building practices in the United States and Europe and on technical risk assessments related to fire safety, structural and building envelope factors, British Columbia, through the Ministry of Housing and Social Development, in 2009, became the first province to amend its provincial building code to permit the construction of 5- and 6-storey wood-frame buildings, including buildings of residential occupancy. Since then, more than 250 buildings have been completed or are reaching completion in B.C.

Other provinces followed suit shortly thereafter with amendments to their building codes to permit mid-rise wood construction, including Quebec, Ontario and Alberta (in 2013, January 2015 and May 2015 respectively). In August 2015, Quebec amended its building codes further to become the first province to permit wood construction in buildings up to 12 storeys in height.

It is expected that updates to the 2015 National Building Code of Canada (NBCC) will include provisions for 5- and 6- storey residential wood buildings. As the NBCC is the model building code for Canada other provinces may elect to follow the lead of British Columbia, Quebec, Ontario, and Alberta. Over the past five years, collaborative research activities, such as the Network on Engineered Wood-based Building Systems (NEWBuildS), which involves 13 universities across Canada, FPInnovations, the National Research Council (NRC), Canadian Wood Council (CWC) and technical experts from industry, have supported mid-rise wood-frame research and development as well as the code development process. In addition, the recently published "Mid-rise Wood-Frame Construction Handbook" by FPInnovations, provides valuable insights and understanding in the design and construction of mid-rise wood-frame buildings to architects, engineers, code consultants, developers, building owners and authorities having jurisdiction.

3 Supporting research

Some of the research undertaken in support of mid-rise wood construction is listed in Table 1.

Table 1 Examples of research conducted between 2011 and 2015 in support of amendments to the National Building Code to permit the design and construction of 5- and 6-storey wood buildings

Fire safety
Fire safety summary: fire research conducted for the project on mid-rise wood construction
Full-scale apartment fire tests for wood-frame and cross laminated timber construction
Full-scale standard fire resistance tests of wall assemblies for use in lower storeys of mid-rise buildings
Full-scale standard fire resistance test of a wall assembly for use in lower storeys of mid-rise buildings
Encapsulation time data from NRC fire resistance projects
Acoustics
Cone calorimeter results for acoustic membrane materials used in floor assemblies
Guide to calculating airborne sound transmission in buildings
Acoustics: sound insulation in mid-rise wood buildings
Building Envelope
Mid-rise wood constructions- hygrothermal modelling and analysis
Mid-rise wood – characterization of hygrothermal properties
Mid-rise wood constructions: investigation of water penetration through cladding and deficiencies

There are also many supporting technical studies that were completed prior to 2011.

4 Advantages of mid-rise wood construction

Reports prepared for the Building Industry and Land Development Association (BILD) suggest cost savings of 8 to 15% can be realized for six-storey wood construction compared to other construction systems.

Experience with mid-rise wood construction in B.C. has shown that in areas with poor soil conditions, the lighter weight of wood construction will deliver greater savings because less-intensive sub-grade structure and ground preparation are required.

5 Construction methods for mid-rise wood buildings

To save time and reduce the amount of work done at height, 5- and 6-stories are typically built using preassembled components. For wood-frame construction, this may entail the use of pre-manufactured wall and floor panels that can be quickly hoisted into place. This includes a relatively new technology known as cross-laminated timber (CLT) panels. CLT panels are engineered and manufactured by arranging and gluing 3, 5 or 7 layers of dimension lumber with each layer set perpendicular to the next to form a very strong and stable panel. CLTs can be used to form floor, wall and roof assemblies.

In buildings of mixed-use occupancies, quite often the ground floor podium may be concrete construction to accommodate commercial or retail shops. The four or five storeys of residential units above may be of wood construction.

In general, for mid-rise wood buildings, the footprint area, permitted by codes, decreases with increased height; that is, the total building floor area remains the same regardless of height. For example, while a single storey residential building could have a total plan area of 9,000 m^2, a 3-storey wood building would be limited to each floor having a maximum area of 3,000 m^2 and a 6-storey building would be limited to 1,500 m^2 per floor.

6 Construction site safety for wood buildings under construction

During construction, wood frame buildings can be susceptible to fire. The exposed wood represents a high fuel load and offers little resistance to fire spread. In addition, active fire suppression systems, such as sprinklers and standpipes, are not yet installed and operational. Furthermore, site access during construction by the fire department can be very limited due to the presence of construction materials, equipment, vehicles and site hoarding. However, once completed with gypsum board finishes and sprinkler systems, wood buildings must meet the same fire resistance requirements as other types of construction.

In general, building codes focus on building performance after construction is complete and do not have prescribed requirements for fire safety during the construction. Best practices have been developed for contractors to reduce fire risk during construction such as:

- additional security (to monitor the site to prevent accidental and deliberate fires);
- more frequent fire watches; and
- heightened awareness and strict protocols for 'hot activities' such as welding, soldering, etc.

7 Additional safety provisions

Compared to conventional 4-storey (and under) residential wood construction, there are additional safety provisions in the building codes for 5- and 6-storey buildings, such as:

- increased level of sprinkler / water protection;
- more concealed spaces requiring sprinklers;
- sprinkler protection required for balconies;
- greater water supply required for fire protection;
- non-combustible or limited combustible exterior wall cladding required for the 5th and 6th storeys;
- requirement to meet a higher seismic load than similar non-combustible buildings;
- guidance on impact of increased rain and wind loads for the 5- and 6-storeys; and
- acoustics requirements for Apparent Sound Transmission Class (ASTC).

Some provisions may vary by province. For example, Ontario requires that exit stair walls have a 1.5 hour fire-resistant rating and be of non-combustible construction.

8 Implications for the housing industry

Mid-rise residential wood construction is being adopted by more and more North American building code jurisdictions. In Canada, changes to the National Building Code are expected to make 5- and 6-residential wood-frame construction accepted practice in most Canadian provinces and territories. This change in residential construction has the potential to increase urban density, offer builders and developers more options, and keep housing economical. As with the introduction of any new technology or practice to the housing sector, a concerted effort is required to raise awareness and knowledge of the design and construction of residential mid-rise wood construction. The wood products industry has developed workshops and handbooks to help professional designers learn how to design and build 5- and 6-storey wood-frame residential buildings (see Sources of Information). Such initiatives can help to ensure this new construction system not only meets expectations but also costly failures are avoided.

Sources of Information

1. Canadian Wood Council, http://cwc.ca/building-solutions/mid-rise/
2. FPInnovations, Mid-Rise Wood-Frame Construction Handbook, http://midriseguide.fpinnovations.ca
3. 2015 Reference Guide: Mid-Rise Wood Construction in the Ontario Building Code, free download, http://wood-works.ca/
4. Mid-rise design workshops:
   WoodWORKS! British Columbia http://wood-works.ca/bc/;
   WoodWORKS! Ontario http://wood-works.ca/ontario/

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