WOOD USE IN NONCOMBUSTIBLE BUILDINGS

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INTRODUCTION

The *National Building Code of Canada (NBCC)*[1] requires that some buildings be of noncombustible construction under its prescriptive requirements.

Noncombustible construction is, however, something of a misnomer: it does not exclude the use of combustible materials but rather, it limits their use. Some combustible materials can be used since it is neither economical nor practical to construct a building entirely out of noncombustible materials.

Wood is probably the most prevalent combustible material used in noncombustible buildings.

For example, there are permissions for use of heavy timber construction for roofs and roof structural supports. It may also be used in partition walls and as wall finishes, as well as furring strips, fascia and canopies, cant strips, roof curbs, fire blocking, roof sheathing and coverings, millwork, cabinets, counters, window sash, doors, and flooring.

Its use in certain types of buildings such as tall buildings is slightly more limited in areas such as exits, corridors and lobbies, but even there, fire-retardant treatments can be used to meet NBCC requirements.

HEAVY TIMBER CONSTRUCTION

In sprinklered noncombustible buildings not more than 2 storeys in height, entire roof assemblies and the roof supports can be heavy timber construction. Fire loss experience has shown, even in unsprinklered buildings, that heavy timber construction is superior to noncombustible roof assemblies not having any fire-resistance rating.

In other noncombustible buildings, heavy timber construction, including the floor assemblies, is permitted without the building being sprinklered.

Examples of permitted heavy timber construction uses in or, as an alternative to, noncombustible buildings are shown in Table 1.

Table 1. Permitted uses of heavy timber construction in or as an alternative to noncombustible buildings

Occupancy[1]	Height	Sprinklered[2]	Permitted Uses
Group A, Div 1	1 Storey	Yes	Roof, floor and supports
Group A, Div 3	2 Storeys	No	Roof and its supports
Group A, Div 3	2 Storeys	Yes	Roof, floor and supports, arches supporting floors
Group A, Div 4	Not regulated	No	Roof and its supports
Group F, Div 1	3 Storeys	Yes	Roof, floor and supports
Group F, Div 1	1 Storey	Yes	Roof, floor and supports

Note:
1. Occupancy definitions are contained in the NBCC.
2. Article 3.2.2.16 permits roof assemblies and the supports to be heavy timber construction in any sprinklered noncombustible building not more than two stories in height.

WOOD PARTITIONS

Wood framing has many applications in partitions in both low rise and high rise buildings required to be of non-combustible construction. The framing can be located in most types of partitions, with or without a fire-resistance rating.

Wood framing and sheathing is permitted in partitions, or alternatively, solid lumber partitions at least 38 mm thick are permitted, provided:

- the partitions are not used in a care, treatment or detention occupancy;
- the area of the fire compartment, if not sprinklered, is limited to 600m^2 (the area of the fire compartment is unlimited in a floor area that is sprinklered); and,
- the partitions are not required by the Code to be fire separations.

Alternatively, wood framing is permitted in partitions throughout floor areas, and can be used in most fire separations with no limits on compartment size or a need for sprinkler protection provided:

- the buildings is not more than three storeys in height;
- the partitions are not used in a care, treatment or detention occupancy; and,
- the partitions are not installed as enclosures for exits or vertical service spaces.

Similarly, as a final option, wood framing is permitted in buildings with no restriction on building height provided:

- the building is sprinklered;
- the partitions are not used in a care, treatment or detention occupancy;
- the partitions are not installed as enclosures for exits or vertical service spaces; and,
- the partitions are not used as fire separations to enclose a mezzanine.

These allowances in the code are based on the performance of fire-rated wood stud partitions compared to steel stud partitions. This research showed similar performance for wood and steel stud assemblies.

Also, the increase in the amount of combustible framing material permitted is not large compared to what is permitted as contents. In many cases, the framing is protected and only burns later in a fire once all combustible contents have been consumed, by which time the threat to life safety is not high.

The exclusion of the framing in care and detention occupancies and in applications around critical spaces such as shafts and exits are applied to keep the level of risk as low as practical in these applications.

WOOD FINISHES

The use of interior finishes is mostly regulated by restrictions on their flame-spread rating. However, where finishes are used as protection for foamed plastic insulation, they are required to act as a thermal barrier.

Wood finishes not exceeding 25 mm in thickness and having a flame spread rating (FSR) of 150 or less may be used extensively in noncombustible buildings that are not considered high buildings. They may be used on walls both within and outside suites.

Some restrictions do apply in certain areas of a building. The area permitted to have a FSR of 150 or less is limited as follows:

- in exits – only 10% of total wall area
- in certain lobbies – only 25% of total wall area
- in vertical spaces – only 10% of total wall area

The use of wood finishes on the ceilings in non-combustible buildings is much more restricted, but not totally excluded. In such cases, the flame-spread rating must be 25 or less. In certain cases, ordinary wood finishes (a FSR of 150 or less) can also be used on 10%

of the ceiling area of any one fire compartment, as well as on the ceilings of exits, lobbies and corridors.

Fire-retardant-treated wood (FRTW) must be used to meet the most restrictive limit of FSR 25. Consequently, it is permitted extensively throughout noncombustible buildings as a finish. The only restriction is that it cannot exceed 25 mm in thickness when used as a finish - except when used as wood battens on a ceiling, in which case no maximum thickness applies.

The FSR 75 flame limit for interior wall finishes in certain corridors does not exclude all wood products. For example, western red cedar, amabilis fir, western hemlock, western white pine and white or sitka spruce all have flame-spread ratings at or lower than 75.

Corridors requiring FSR 75 include:

- public corridors in any occupancy;
- corridors used by the public in assembly or care or detention occupancies;
- corridors serving classrooms; and,
- corridors serving sleeping rooms in care and detention occupancies.

If these corridors are located in a sprinklered building, wood finishes having FSR 150 or less may be used to cover the entire wall surface.

In high rise buildings regulated by NBCC, Division B, Subsection 3.2.6., wood finishes are permitted within suites or floor areas much as for other buildings of noncombustible construction. However, certain additional restrictions apply for:

- exit stairways;
- corridors not within suites;
- vestibules to exit stairs;
- certain lobbies;
- elevators cars; and,
- service spaces and service rooms.

Wood Furring

Wood is particularly useful as a nailing base for different types of cladding and interior finishes. Wood furring strips can be used to attach interior finishes such as gypsum wallboard, provided:

- The strips are fastened to noncombustible backing or recessed into it.
- The concealed space created by the wood elements is not more than 50 mm thick.
- The concealed space created by the wood elements is fire blocked.

Experience has shown that a lack of oxygen in these shallow concealed spaces prevents rapid development of fire.

Wood nailer strips can also be used on parapets, provided the facings and any roof membrane covering the facings are protected by sheet metal. This is permitted because it is considered that a nailing base such as plywood or oriented strandboard (OSB) does not constitute an undue fire hazard.

Wood Cladding Systems

The NBCC contains rules on the use of combustible claddings and supporting assemblies on certain types of buildings required to be of noncombustible construction. Specifically, the use of wall assemblies containing both combustibles cladding elements and non-loadbearing wood framing members is allowed.

These wall assemblies can be used as in-fill or panel type walls between structural elements, or be attached directly to a load-bearing noncombustible structural system. This applies in unsprinklered buildings up to three storeys and sprinklered buildings of any height.

The wall assembly must satisfy the criteria of a test that determines its degree of flammability and the interior surfaces of the wall assembly must be protected by a thermal barrier (for example, 12.7 mm gypsum board)

to limit the impact of an interior fire on the wall assembly.

These requirements stem from fire research that indicated that certain wall assemblies containing combustible elements do not promote exterior fire spread beyond a limited distance.

The ULC test standard, CAN/ULC-S134, *Standard Method of Fire Test of Exterior Wall Assemblies* is referenced in the NBCC. Each assembly must be tested in accordance with this standard to confirm compliance with fire spread and heat flux limitations specified in the code.

Roofing Materials

Roof sheathing and sheathing supports of wood are also permitted in noncombustible buildings provided:

- they are installed above a concrete deck;
- the concealed space does not extend more than 1 m above the deck not less than 50 mm thick.
- the concealed roof space is compartmented by fire blocks;
- openings through the concrete deck are located in noncombustible shafts;
- parapets are provided at the deck perimeter extending at least 150 mm above the sheathing; and
- no building services are located on the roof other than those placed in noncombustible shafts.

The noncombustible parapets and shafts are required to prevent roof materials igniting from flames projecting from openings in the building face or roof deck.

In buildings that are required to be of noncombustible construction, the roof coverings must have a fire classification of Class A, B or C. In such cases, the use of fire-retardant-treated wood shakes and shingles on sloped roofs is allowed.

Wood Fascias and Canopies

Fire-retardant-treated wood (FRTW) decorative cladding is permitted on first floor canopy fascias. In this case, the wood must undergo accelerated weathering before testing to establish the flame-spread rating. A FSR of 25 or less is required.

Stairs and Storage Lockers

Stairs within a dwelling unit can be made of wood, as can storage lockers in residential buildings. These are permitted, as their use is not expected to present a significant fire hazard.

Millwork

Wood millwork such as interior trim, doors and door frames, show windows and frames, aprons and backing, handrails, shelves, cabinets and counters are also permitted in noncombustible construction. Because these elements

contribute minimally to the overall fire hazard it is not necessary to restrict their use.

Window Sashes and Frames

Wood sashes and frames are permitted in noncombustible buildings provided each window is separated from adjacent windows by noncombustible construction and meets a limit on the aggregate area of openings in the outside face of a fire compartment.

Glass typically fails early during a fire, allowing flames to project from the opening and thereby creating serious potential for the vertical spread of fire. The requirement for noncombustible construction between windows is intended to limit fire spread along combustible frames closely set into the outside face of the building.

Wood Flooring Elements and Stages

Combustible sub-flooring and finished flooring, such as wood strip or parquet, is allowed in any noncombustible building, including high rises. Finished wood flooring is not a major concern. During a fire, the air layer close to the floor remains relatively cool in comparison with the hot air rising to the ceiling.

Wood supports for combustible flooring are also permitted provided:

- they are at least 50 mm but no more than 300 mm high;
- they are applied directly onto or are recessed into a noncombustible floor slab; and,
- the concealed spaces are fire blocked (as in Figure 1 below)

This allows the use of wood joists or wood trusses, the latter providing more flexibility for running building services within the space.

Stages are normally fairly large and considerably higher than 300 mm which creates a large concealed space. Because of this, wood stage flooring must be supported by noncombustible structural members.

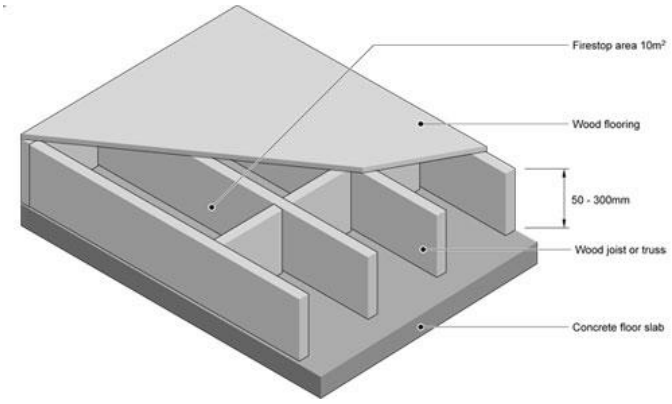

Figure 1. Raised wood floor

[1] National Building Code of Canada, National Research Council, Ottawa, ON, 2010.