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## Proposed Change 1963

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<b>Code Reference(s):</b>	<b>NBC20 Div.B 3.1.6.6. (first printing)</b>
Subject:	Encapsulated Mass Timber Construction
Title:	Exposure of Mass Timber Elements
Description:	This proposed change expands the application of encapsulation materials from two to three layers of Type X gypsum board with a greater encapsulation rating.
Related Proposed Change(s):	PCF 1870, PCF 1872

This change could potentially affect the following topic areas:

- |  |   |
|--|---|
| <input type="checkbox"/> Division A                                | <input checked="" type="checkbox"/> Division B              |
| <input type="checkbox"/> Division C                                | <input checked="" type="checkbox"/> Design and Construction |
| <input type="checkbox"/> Building operations                       | <input type="checkbox"/> Housing                            |
| <input type="checkbox"/> Small Buildings                           | <input checked="" type="checkbox"/> Large Buildings         |
| <input checked="" type="checkbox"/> Fire Protection                | <input checked="" type="checkbox"/> Occupant safety in use  |
| <input type="checkbox"/> Accessibility                             | <input type="checkbox"/> Structural Requirements            |
| <input type="checkbox"/> Building Envelope                         | <input type="checkbox"/> Energy Efficiency                  |
| <input type="checkbox"/> Heating, Ventilating and Air Conditioning | <input type="checkbox"/> Plumbing                           |
|  | <input type="checkbox"/> Construction and Demolition Sites  |

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## Problem

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Over the past decade, fire research on mass timber structures, specifically those constructed using cross-laminated timber (CLT), have shown that in some fire scenarios (i.e., no automatic sprinkler activation and no fire department intervention) a secondary fire growth and even a secondary flashover can occur, due to the delamination of the CLT elements. As a result of the concerns arising from these fire phenomena, the encapsulation requirements and special exceptions for encapsulated mass timber construction (EMTC) were introduced in the National Building Code of Canada (NBC) 2020, which include restrictions on exposed mass timber surfaces as well as exposed surface flammability (via flame-spread ratings) for the different elements.

The exceptions were based on the research conducted using CLT product that was manufactured in conformance with ANSI/APA PRG 320-2014, "Standard for Performance-Rated Cross-Laminated Timber." Since that time, additional fire research was performed that resulted in a revision to that product specification, the 2018 edition

of the standard, which was referenced in the NBC 2020, and includes additional fire-performance requirements for the adhesives used in CLT product to stop it from delaminating in a fire.

Also, research testing was recently performed by the National Fire Laboratory of the National Research Council of Canada (NRC) using CLT product conforming to ANSI/APA PRG 320-2018, as well as nail-laminated timber (NLT) elements and additional mass timber elements, such as glued-laminated timber (glulam) beams and columns. Furthermore, research on real-scale fire tests was conducted by the Research Institutes of Sweden (RISE) on compartments constructed of CLT product that is also compliant with ANSI/APA PRG 320-2018. These tests have demonstrated that the existing provisions in the NBC 2020 are now conservative in nature and can be safely expanded to provide additional options to designers and builders.

The requirements in Article 3.1.6.6. of Division B of the NBC on the encapsulation of mass timber elements do not reflect the latest research and need to be revised to consider the performance levels of the materials that are now available on the market. As such, the requirements need to be updated to include the application of multiple layers of gypsum board to achieve a greater encapsulation rating for timber elements.

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## Justification

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In alignment with the proposed higher encapsulation rating for unexposed walls in PCF 1870, this proposed change revises Article 3.1.6.6. to include a generic solution that meets the new 80 min encapsulation rating. (Please refer to the rationale provided for PCF 1870.)

An NRC encapsulation test report shows that three layers of 12.7 mm thick Type X gypsum board achieve an encapsulation rating of 80 min. This proposed change revises Article 3.1.6.6. to include the installation requirements for both two and three layers of gypsum board.

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## PROPOSED CHANGE

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### NBC20 Div.B 3.1.6.6. (first printing)

#### [3.1.6.6.] 3.1.6.6. Encapsulation Materials

##### (See Note A-3.1.6.6.)

- [1] 1) Gypsum-concrete topping and concrete not less than 38 mm thick are deemed to have an *encapsulation rating* of 50 min when installed on the upper side of a mass timber floor or roof assembly.
- [2] 2) Two layers of Type X gypsum board conforming to ASTM C1396/C1396M, "Standard Specification for Gypsum Board," or CAN/CSA-A82.27-M, "Gypsum Board," each not less than 12.7 mm thick, are deemed to have an *encapsulation rating* of 50 min when installed on a mass timber

element, ~~provided they~~ in accordance with Sentence (4).

- [a] a) ~~are fastened with a minimum of two rows of screws in each layer~~
  - [i] i) ~~directly to the mass timber element with screws of sufficient length to penetrate not less than 20 mm into the mass timber element that are spaced not more than 400 mm o.c. and 20 mm to 38 mm from the boards' edges, or~~
  - [ii] ii) ~~to wood furring or resilient metal or steel furring channels not more than 25 mm thick spaced not more than 400 mm o.c. on the mass timber element,~~
- [b] b) ~~are installed with the joints in each layer staggered from those in the adjacent layer,~~
- [c] c) ~~are installed in conformance with ASTM C840, "Standard Specification for Application and Finishing of Gypsum Board", except that their joints need not be taped and finished, and~~
- [d] d)
- [e] --) conform to
  - [i] i) ~~ASTM C1396/C1396M, "Standard Specification for Gypsum Board", or~~
  - [ii] ii) ~~CAN/CSA A82.27-M, "Gypsum Board".~~
- [f] --)
 

~~(See Note A-3.1.6.6.(2).)~~

**[3] --)** Three layers of Type X gypsum board conforming to ASTM C1396/C1396M, "Standard Specification for Gypsum Board," or CAN/CSA-A82.27-M, "Gypsum Board," each not less than 12.7 mm thick, are deemed to have an *encapsulation rating* of 80 min when installed on a mass timber element in accordance with Sentence (4).

**[4] --)** The gypsum board described in Sentences (2) and (3)-2025 shall be

- [a] --) ~~are~~ fastened with a minimum of two rows of screws in each layer
  - [i] --) directly to the mass timber element with screws of sufficient length to penetrate not less than 20 mm into the mass timber element that are spaced not more than 400 mm o.c. and 20 mm to 38 mm from the boards' edges, or
  - [ii] --) to wood furring or resilient metal or steel furring channels not more than 25 mm thick spaced not more than 400 mm o.c. on the mass timber element,
- [b] --) ~~are~~ installed with the joints in each layer staggered from those in the adjacent layer, and
- [c] --) ~~are~~ installed in conformance with ASTM C840, "Standard Specification for Application and Finishing of Gypsum Board", except that their joints need not be taped and finished.

~~(See Note A-3.1.6.6.(24).)~~

#### **Note A-3.1.6.6. Encapsulation Materials.**

Research has been conducted on different types of encapsulation materials, such as

gypsum board, gypsum concrete and cement board. The results of tests using an intermediate-scale furnace and of cone calorimeter tests indicate that a combustible timber element protected with a 38 mm thick layer of gypsum-concrete topping or with two or three layers of 12.7 mm Type X gypsum board will not ignite or contribute significant heat to a fire until average temperatures of 325°C to ~~380~~380°C are attained at the interface between the encapsulation material or assembly of materials and the combustible substrate. These temperatures are consistent with the ignition temperatures of wood-based materials.

**Note A-3.1.6.6.(24) Protection of Gypsum Board from Foot Traffic.**

Where gypsum board is used as the encapsulation material on the top of a mass timber floor assembly, it should be protected from physical impact arising from normal pedestrian traffic that could damage it and possibly compromise its encapsulation rating.

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## Impact analysis

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This proposed change does not entail any additional costs because it would not increase the stringency of the requirements for encapsulating mass timber elements. This proposed change merely clarifies the encapsulation rating attributed to assemblies using two layers of gypsum installed according to a referenced standard and it introduces an encapsulation rating for assemblies using three layers of gypsum.

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## Enforcement implications

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This proposed change can be enforced by the current Code enforcement infrastructure. This proposed change would not introduce conflict or create enforcement issues since it clarifies the encapsulation rating of assemblies using two layers of gypsum and introduces an encapsulation rating for assemblies using three layers of gypsum.

Regulators are already familiar with the EMTC requirements that were introduced in the 2020 edition of the Code.

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## Who is affected

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Architects, designers, developers, owners and engineers would benefit from the increased flexibility provided by this proposed change.

Authorities having jurisdiction, including fire departments, would need to continue to evaluate their operating procedures in accordance with the Code requirements for EMTC.

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## OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

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### NBC20 Div.B 3.1.6.6. (first printing)

[3.1.6.6.] 3.1.6.6. ([1] 1) no attributions

[3.1.6.6.] 3.1.6.6. ([2] 2) no attributions

[3.1.6.6.] -- ([3] --) **no attributions**

[3.1.6.6.] -- ([4] --) [F02-OS1.2]

[3.1.6.6.] -- ([4] --) [F04-OS1.3]

[3.1.6.6.] -- ([4] --) [F02-OP1.2]

[3.1.6.6.] -- ([4] --) [F04-OP1.3]