

12-STOREY ENCAPSULATED MASS TIMBER CONSTRUCTION

PURPOSE

The purpose of this variance is to permit the construction of buildings of up to 12-storeys in building height of encapsulated mass timber construction (EMTC), as an alternative solution to the National Building Code–2019 Alberta Edition (NBC(AE)) and the National Fire Code-2019 Alberta Edition (NFC(AE)).

DISCUSSION

The 2020 editions of the National Building Code of Canada (NBCC) and National Fire Code of Canada (NFCC) will contain requirements for EMTC up to 12 storeys in building height. The upcoming code provisions were developed by the National Research Council and the Canadian Commission on Building and Fire Codes. EMTC refers to buildings where the mass timber components of the building are surrounded or encapsulated with fire-resistive material. This allows for equivalent or better fire protection compared to other construction types currently permitted by the NBCC and NBC(AE). The upcoming code provisions also include additional requirements for fire protection during construction and ongoing maintenance.

The NBCC 2020 and NFCC 2020 are anticipated to be published in early 2021 and Alberta will automatically enforce the national codes with minimal provincial variations 12 months from their publication date. In order to advance the use of EMTC in Alberta, this variance will permit EMTC up to 12 storeys in building height anywhere in Alberta provided the conditions in this variance are complied with. A variance provides an alternative solution of approximately equivalent or greater safety performance to the prescriptive requirements of the codes. Any construction that complies with this variance is permitted just as if the building was constructed under code requirements.

The conditions in this variance are based on the unpublished code provisions in the upcoming 2020 editions of the NBCC and NFCC. As such, when the next code editions are adopted and brought into force in Alberta, the requirements for EMTC of up to 12 storeys will essentially be unchanged. Any construction under this variance will be allowed to continue under the conditions in this variance even when the next codes are adopted and come into force in Alberta. This variance also includes additional conditions for fire protection during construction and ongoing maintenance.

Unless otherwise stated references are to Division B of the National Building Code-2019 Alberta Edition

Issue of this STANDATA is authorized by
the Provincial Building and Fire Administrators

The logo for the province of Alberta, featuring the word "Alberta" in a stylized, cursive font with a small blue square at the end of the word.

[Original Signed]
Paul Chang

[Original Signed]
Tina Parker

Construction Categories

The current prescriptive requirements in the NBC(AE) separate buildings into two construction type categories: combustible construction and noncombustible construction. The provisions severely restrict the height and area of buildings of combustible construction whereas they permit unlimited height and area for buildings of noncombustible construction. The combustible/noncombustible construction classification system was introduced in the National Codes over 50 years ago and is increasingly being regarded as being outdated and unnecessarily restrictive.

The definition of 'combustible construction' in Article 1.4.1.2. of Division A, along with Subsection 3.1.5. of Division B of the NBC(AE), prohibit the use of combustible structural elements in noncombustible buildings. Therefore, the use of such elements is restricted to smaller buildings permitted to be of combustible construction.

The restriction on the use of combustible structural elements could affect building construction in three ways:

- (a) the building height and building area cannot exceed the limits currently placed on all forms of combustible construction;
- (b) the building cannot contain any combustible structural elements; or
- (c) the designer must submit an alternative solution for approval by the authority having jurisdiction (AHJ) on a project-by-project basis.

This process can require significant resources and expertise, both for the designer to develop and alternative solution and for the AHJ to evaluate it.

Even with the increased use of performance-based design, some code users will continue to prefer to comply via prescriptive provisions, whether for simplicity, efficiency, cost-effectiveness or other reasons. In order to provide code users with the ability to explore construction methods for taller buildings using renewable resources, this variance aims to make designs using EMTC more attainable.

The NBC(AE) requires that buildings greater than 6 storeys in height be of noncombustible construction. This variance permits the construction of EMTC buildings of certain occupancy classifications up to 12 storeys in height.

APPLICATION

This variance applies to construction of buildings or parts thereof using encapsulated mass timber construction. Chapters 1 through 3 and 5 apply to construction. Chapter 4 applies to fire safety for areas undergoing construction and ongoing maintenance.

VARIANCE

This variance provides approximately equivalent or greater safety performance with respect to persons and property as that provided for by the Safety Codes Act, the NBC(AE) and NFC(AE).

Buildings or parts thereof up to 12 storeys in height that are constructed of encapsulated mass timber are permitted, provided the following criteria are met:

See Appendix A

This VARIANCE is applicable throughout the province of Alberta.

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Appendix A

Numbering System

The first number indicates the Chapter of the Variance; and the second, the Item in the Chapter. Items may be broken down into Clauses and Subclauses. This structure is illustrated as follows:

3	Chapter
3.5	Item
3.5(a)	Clause
3.5(a)(i)	Subclause

1 GENERAL REQUIREMENTS

- 1.1 Except as specifically varied in this Variance, the NBC(AE) and NFC(AE) apply to a *building* regulated by this Variance.
- 1.2 Except as provided in Item 1.3, all words and terms in italics in this Variance shall have the meanings assigned to them in Article 1.4.1.2. of Division A of the NBC(AE).
- 1.3 The following words and terms in italics in this Variance shall have the following meaning:
- Combustible construction* means that type of construction that does not meet the requirements for *noncombustible construction* or *encapsulated mass timber construction*.
- Encapsulated mass timber construction* means that type of construction in which a degree of fire safety is attained by the use of encapsulated mass timber elements with an *encapsulation rating* and minimum dimensions for structural members and other *building* assemblies.
- Encapsulation rating* means the time in minutes that a material or assembly of materials will delay the ignition and combustion of encapsulated mass timber elements when it is exposed to fire under specified conditions of test and performance criteria, or as otherwise prescribed by this Variance.
- 1.4 Where documents are referenced in this Variance, they shall be the editions designated in Table 1.

Table 1
Documents Referenced in this Variance
 Forming Part of Item 1.4

Issuing Agency	Document Number ⁽¹⁾	Title of Document ⁽²⁾	Variance Reference
ANSI/APA	ANSI/APA PRG 320-19	Performance-Rated Cross-Laminated Timber	2.4
ASTM	C 840-19b	Application and Finishing of Gypsum Board	2.46(c)
ASTM	C 1396/C 1396M-17	Gypsum Board	2.38(a) 2.46(d)
ASTM	D 2898-10	Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing	2.22 3.20(c) Table 5
ASTM	D 5456-19	Evaluation of Structural Composite Lumber Products	3.6(a) & (c)
CSA	CAN/CSA-A82.27-M91	Gypsum Board	2.38(a) 2.46(d)
CSA	O86-19	Engineering Design in Wood	5.7 5.8 5.9(b) 5.11 5.12
ULC	CAN/ULC-S101-14-Rev1	Fire Endurance Tests of Building Construction and Materials	5.1
ULC	CAN/ULC-S102-10	Test for Surface Burning Characteristics of Building Materials and Assemblies	Table 5
ULC	CAN/ULC-S110-13	Test for Air Ducts	3.24(a)
ULC	CAN/ULC-S134-13	Fire Test of Exterior Wall Assemblies	5.13 Table 5
ULC	CAN/ULC-S146-19	Test for The Evaluation of Encapsulation Materials and Assemblies of Materials for the Protection of Structural Timber Elements	2.44
ULC	CAN/ULC-S702.1-14-AMD1	Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification	2.5(b) Table 5

Notes to Table 1

(1) Some documents may have been reaffirmed or reapproved. Check with the applicable issuing agency for up-to-date information.

(2) Some titles have been abridged to omit superfluous wording.

- 1.5 A *building* classified as Group C is permitted to conform to Item 1.6, provided
- a) it is *sprinklered* throughout,
 - b) it is not more than 12 *storeys* in *building height*,
 - c) it has a height not more than 42 m measured between the floor of the *first storey* and the uppermost floor level that does not serve a rooftop enclosure for elevator machinery, a stairway or a *service room* used only for service to the *building*, and
 - d) it has a *building area* not more than 6 000 m².

- 1.6 Except as provided in Article 3.2.2.16. of the NBC(AE), the *building* referred to in Item 1.5 is permitted to be of *encapsulated mass timber construction* or *noncombustible construction*, used singly or in combination, and
- except as provided in Item 1.7, floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
 - mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
 - loadbearing walls*, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.
- 1.7 In a *building* that contains *dwelling units* that have more than one *storey*, subject to the requirements of Sentence 3.3.4.2.(3) of the NBC(AE), the floor assemblies, including floors over *basements*, that 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*.
- 1.8 Group A, Division 2 *major occupancies*, Group E *major occupancies* and *storage garages* located in a *building* or part of a *building* within the scope of Item 1.5 are permitted to be constructed in accordance with Items 1.6 and 1.7, provided
- the Group A, Division 2 *major occupancy* is located below the fourth *storey*,
 - the Group E *major occupancy* is located below the third *storey*, and
 - the *storage garage* is located below the fifth *storey*.
- 1.9 A *building* classified as Group D is permitted to conform to Item 1.10, provided
- it is *sprinklered* throughout,
 - it is not more than 12 *storeys* in *building height*,
 - it has a height not more than 42 m measured between the floor of the *first storey* and the uppermost floor level that does not serve a rooftop enclosure for elevator machinery, a stairway or a *service room* used only for service to the *building*, and
 - it has a *building area* not more than 7 200 m².
- 1.10 Except as provided in Article 3.2.2.16. of the NBC(AE), the *building* referred to in Item 1.9 is permitted to be of *encapsulated mass timber construction* or *noncombustible construction*, used singly or in combination, and
- floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
 - mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
 - loadbearing walls*, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.
- 1.11 Group A, Division 2 *major occupancies*, Group E *major occupancies*, Group F, Division 2 and 3 *major occupancies*, and *storage garages* located in a *building* or part of a *building* within the scope of Item 1.9 are permitted to be constructed in accordance with Item 1.10, provided
- the Group A, Division 2 *major occupancy* is located below the fourth *storey*,
 - the Group E *major occupancy* and Group F, Division 2 or 3 *major occupancy* are located below the third *storey*, and
 - the *storage garage* is located below the fifth *storey*.

- 1.12 Except as permitted by Sentence 3.2.2.18.(2) of the NBC(AE), an automatic sprinkler system conforming to the requirements of Item 1.13, Articles 3.2.4.7., 3.2.4.8., 3.2.4.9. and Sentences 3.2.5.12.(1) to (6) and (8) to (11) of the NBC(AE) shall be installed throughout the *building*.
- 1.13 Notwithstanding the requirements of the standards referenced in Sentences 3.2.5.12.(1) and (2) of the NBC(AE) regarding the installation of automatic sprinkler systems, sprinklers shall be provided for balconies and decks exceeding 610 mm in depth measured perpendicular to the exterior wall.
- 1.14 A *fire separation* with a 2 h *fire-resistance rating* is required between the Group C and Group A, Division 2 *major occupancies*.
- 1.15 A *fire separation* with a 2 h *fire-resistance rating* is required between the Group D and Group A, Division 2 *major occupancies*.
- 1.16 A *fire separation* with a 1 h *fire-resistance rating* is required between the Group D and Group E or Group F, Division 2 or 3 *major occupancies*.
- 1.17 Except for portions of *buildings* constructed in accordance with Item 3.15 and Sentences 3.2.2.7.(2) to (4) of the NBC(AE) that are required to be of *noncombustible construction*, assemblies of *noncombustible construction* in *buildings* or portions of *buildings* of *encapsulated mass timber construction* are permitted to be supported by *encapsulated mass timber construction*.
- 1.18 A *building* or part of a *building* constructed in accordance with Items 1.9 to 1.11 in which the floor level of the highest *storey* is more than 18 m above *grade* shall comply with Subsection 3.2.6. of the NBC(AE).

2 ENCAPSULATED MASS TIMBER CONSTRUCTION

- 2.1 Except as otherwise provided in this Variance, a *building* or part of a *building* of *encapsulated mass timber construction* shall conform to Subsection 3.1.5. of the NBC(AE).
- 2.2 Except as otherwise provided in this Chapter, Items 3.21 and 3.22, Article 3.2.2.16. of the NBC(AE), a *building* or part of a *building* of *encapsulated mass timber construction* is permitted to include structural mass timber elements, including beams, columns, arches, and wall, floor and roof assemblies, provided they comply with Items 2.3 and 2.4.
- 2.3 Structural mass timber elements referred to in Item 2.2 shall
- except as provided in Item 2.5, be arranged in heavy solid masses containing no concealed spaces,
 - have essentially smooth flat surfaces with no thin sections or sharp projections, and
 - except as provided in Item 2.41, conform to the minimum dimensions stated in Table 2.

Table 2
Minimum Dimensions of Structural Mass Timber Elements in Encapsulated Mass Timber Construction
 Forming Part of Item 2.3

Structural Wood Elements	Minimum Thickness, mm	Minimum Width x Depth, mm x mm
Walls that are <i>fire separations</i> or exterior walls (1-sided exposure)	96	-
Walls that require a <i>fire-resistance rating</i> , but are not <i>fire separations</i> (2-sided exposure)	192	-
Floors and roofs (1-sided exposure)	96	-
Beams, columns and arches (2- or 3-sided fire exposure)	-	192 x 192
Beams, columns and arches (4-sided fire exposure)	-	224 x 224

- 2.4 Adhesives used in structural mass timber elements referred to in Item 2.2 that are constructed of cross-laminated timber shall conform to the elevated temperature performance requirements in ANSI/APA PRG 320 “Performance-Rated Cross-Laminated Timber.”
- 2.5 Concealed spaces are permitted within structural mass timber elements referred to in Item 2.3 and need not comply with Item 2.6 provided the concealed spaces are
- a) *sprinklered*, and divided into compartments by *fire blocks* in conformance with Subsection 3.1.11. of the NBC(AE) and Items 3.1 to 3.8,
 - b) completely filled with rock or slag fibre insulation conforming to CAN/ULC-S702.1, “Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification” and having a minimum density of 32 kg/m³,
 - c) if horizontal, lined with not less than a single layer of 12.7 mm Type X gypsum board or *noncombustible* material providing an *encapsulation rating* of not less than 25 min, or
 - d) if vertical, lined with not less than a single layer of 12.7 mm Type X gypsum board or *noncombustible* material providing an *encapsulation rating* of not less than 25 min and vertically divided into compartments by *fire blocks* in conformance with Subsection 3.1.11. of the NBC(AE) and Items 3.1 to 3.8.
- 2.6 Except as provided in Items 2.5, 2.9 to 2.15, 2.29 to 2.31 and 2.40 to 2.43, the exposed surfaces of structural mass timber elements conforming to Items 2.2 to 2.5 shall be protected from adjacent spaces in the *building*, including adjacent concealed spaces within wall, floor and roof assemblies, by a material or assemblage of materials conforming to Item 2.7 that provides an *encapsulation rating* of not less than 50 min.

- 2.7 Except as provided in Item 2.27, the material or assemblage of materials referred to in Item 2.6 shall consist of
- gypsum board,
 - gypsum concrete,
 - noncombustible* materials,
 - materials that conform to Sentences 3.1.5.1.(2) to (4) of the NBC(AE), or
 - any combination of the materials listed in Clauses (a) to (d).
- 2.8 In addition to the information required in Article 2.2.3.1. of Division C of the NBC(AE), the source of information for the *encapsulation ratings* of mass timber elements of construction shall be indicated on large-scale sections.
- 2.9 Except as provided in Item 2.12, the exposed surfaces of mass timber beams, columns and arches within a *suite* or *fire compartment* need not be protected in accordance with Item 2.6, provided
- their aggregate surface area does not exceed 10% of the total wall area of the perimeter of the *suite* or *fire compartment* in which they are located, and
 - the *flame-spread rating* on any exposed surface is not more than 150.
- 2.10 The exposed surfaces of mass timber walls within a *suite* need not be protected in accordance with Item 2.6, provided
- each exposed surface faces the same direction, and
 - the *flame-spread rating* on any exposed surface is not more than 150.
- 2.11 The aggregate exposed surface area of mass timber elements within a *suite* permitted in Items 2.9 and 2.10 shall not exceed 35% of the total wall area of the perimeter of the *suite*.
- 2.12 The exposed surfaces of mass timber ceilings within a *suite* need not be protected in accordance with Item 2.6, provided their aggregate area does not exceed
- 10% of the total ceiling area of the *suite*, where the exposed surfaces have a *flame-spread rating* not more than 150, or
 - 25% of the total ceiling area of the *suite*, where
 - the *suite* contains no mass timber walls with exposed surfaces, and
 - the exposed surfaces of the mass timber ceiling have a *flame-spread rating* not more than 75.
- 2.13 Wood roof sheathing and roof sheathing supports that do not conform to Items 2.2 to 2.7 and 2.9 to 2.12 are permitted, provided they are installed
- above a concrete deck in accordance with Clauses 3.1.5.3.(2)(a) to (f) of the NBC(AE), or
 - above a deck of *encapsulated mass timber construction*, where
 - the deck is permitted to be encapsulated between the roof sheathing supports by a material or assembly of materials conforming to Item 2.7 that provides an *encapsulation rating* of not less than 50 min,

- ii) the height of the roof space is not more than 1 m,
 - iii) the roof space is divided into compartments by *fire blocks* in conformance with Items 3.3. and 3.4, and Sentences 3.1.11.5.(1) to (3) of the NBC(AE),
 - iv) openings through the deck other than for *noncombustible* roof drains and plumbing piping are protected by shafts constructed as *fire separations* having a *fire-resistance rating* not less than 1 h that extend from the deck to not less than 150 mm above the adjacent sheathing, and
 - v) except as permitted by Subclause (iv), the roof space does not contain any *building services*.
- 2.14 *Combustible* cant strips, roof curbs, nailing strips and similar components used in the installation of roofing are permitted.
- 2.15 Wood nailer facings to parapets not more than 600 mm high are permitted, provided the facings and any roof membranes covering the facings are protected by sheet metal.
- 2.16 *Combustible* window sashes and frames are permitted, provided
- a) each window in an exterior wall face is an individual unit separated from every other opening in the wall by *noncombustible* wall construction or mass timber wall construction conforming to the dimensions stated in Table 2,
 - b) windows in exterior walls in contiguous *storeys* are separated by not less than 1 m of *noncombustible* wall construction or mass timber wall construction conforming to the dimensions stated in Table 2, and
 - c) the aggregate area of openings in an exterior wall face of a *fire compartment* is not more than 40% of the area of the wall face.
- 2.17 Except as provided in Items 2.18, 2.19 and 2.22, cladding on an exterior wall assembly shall be *noncombustible*.
- 2.18 Except as provided in Items 2.19 to 2.21, cladding on an exterior wall assembly is permitted to consist of
- a) *combustible* cladding that
 - i) is not contiguous over more than 4 *storeys*,
 - ii) represents not more than 10% of the cladding on each exterior wall of each *storey*,
 - iii) is not more than 1.2 m in width,
 - iv) has a *flame-spread rating* not more than 75 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction,
 - v) is separated from other portions of *combustible* cladding on adjacent *storeys* by a horizontal distance of not less than 2.4 m, and
 - vi) is separated from other portions of *combustible* cladding by a horizontal distance of not less than 1.2 m,
 - b) *combustible* cladding that
 - i) is not contiguous across adjacent *storeys*,
 - ii) represents not more than 10% of the cladding on each exterior wall of each *storey*,

- iii) has a *flame-spread rating* not more than 75 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction, and
 - iv) is separated from other portions of *combustible* cladding on adjacent *storeys* by a horizontal distance of not less than 2.4 m,
 - c) *combustible* cladding representing up to 100% of the cladding on exterior walls of the *first storey*, provided all portions of the cladding can be directly accessed and are located not more than 15 m from a *street* or access route conforming to Article 3.2.5.6. of the NBC(AE), measured horizontally from the face of the *building*,
 - d) a wall assembly that satisfies the criteria of Item 5.13 or Clause 3.1.5.5.(1)(b) of the NBC(AE), or
 - e) a combination of *noncombustible* cladding and the cladding described in Clauses (a) to (d).
- 2.19 The permitted area of *combustible* cladding in Clauses 2.18(a) or (b) shall not exceed 5% of the cladding on each exterior wall of each *storey* where the time from receipt of notification of a fire by the fire department until the first fire department vehicle capable of beginning suppression activities arrives at the *building* exceeds 10 min in 10% or more of all fire department calls to the *building*.
- 2.20 An exterior wall assembly constructed in conformance with Item 5.13 is deemed to satisfy the criteria of Clause 2.18(d).
- 2.21 Except as provided in Article 3.2.3.10. of the NBC(AE), where the *limiting distance* in Table 3.2.3.1.-D or 3.2.3.1.-E of the NBC(AE) permits an area of *unprotected openings* of not more than 10% of the *exposing building face*, the construction requirements of Table 3 shall be met.
- 2.22 A wall assembly conforming to Clause 2.18(d) that includes *combustible* cladding made of *fire-retardant-treated wood* shall be tested for fire exposure after the cladding has been subjected to the accelerated weathering test specified in ASTM D 2898, "Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing."
- 2.23 Where *combustible* cladding conforming to Clause 2.18(a) or (b) on an exterior wall of a *fire compartment* is exposed to *combustible* cladding conforming to Clause 2.18(a) or (b) on an exterior wall of the same *fire compartment* or of another *fire compartment*, and the planes of the two walls are parallel or at an angle less than 135° measured from the exterior of the *building*, the different portions of *combustible* cladding shall
- a) be separated by a horizontal distance of not less than 3 m, and
 - b) not be contiguous over more than 2 *storeys*.
- 2.24 *Combustible* components, other than those permitted by Items 2.17 to 2.23, are permitted to be used in an exterior wall assembly, provided the wall assembly meets the requirements of Clause 2.18(d).

- 2.25 An exterior wall assembly constructed in conformance with Item 5.13 is deemed to comply with Item 2.24.
- 2.26 Non-*loadbearing* wood elements permitted in Article 3.1.5.6. of the NBC(AE) need not conform to Items 2.2 to 2.5.
- 2.27 Wood nailing elements are permitted to be used for the attachment of a material or assembly of materials to provide an *encapsulation rating*, provided the concealed space created by the wood nailing elements is not more than 25 mm deep.
- 2.28 Except as permitted by Items 2.40, 2.45 and 2.46, wood nailing elements are permitted to be used for the attachment of interior finishes, provided the concealed space created by the wood nailing elements is not more than 50 mm deep and
- exposed surfaces in the concealed space have a *flame-spread rating* not more than 25, or
 - the concealed space is filled with *noncombustible* insulation.
- 2.29 Wood members more than 50 mm but not more than 300 mm high are permitted to be used for the construction of a raised platform, and need not conform to Items 2.2 to 2.7 and 2.9 to 2.12 provided
- the concealed spaces created by the wood members are divided into compartments by *fire blocks* in conformance with Item 3.2, and
 - the wood members are
 - applied directly to or set into a *noncombustible* floor slab, or
 - applied directly to a mass timber floor assembly that conforms to the requirements of Items 2.2 to 2.5.
- 2.30 The upper surface of the mass timber floor assembly referred to in Subclause 2.29(b)(ii) is permitted to be encapsulated only between the wood members by a material or assembly of materials conforming to Items 2.6 and 2.7.
- 2.31 The floor system for the raised platform referred to in Item 2.29 is permitted to include a *combustible* subfloor and *combustible* finished flooring.
- 2.32 Wood stairs and landings conforming to the requirements for floor assemblies in Items 2.2 to 2.7 are permitted in an *exit* stairwell.
- 2.33 Wood stairs in a *suite* need not conform to Items 2.2 to 2.7 and 2.9 to 2.12.
- 2.34 Except as provided in Items 2.35 and 2.36, *combustible* interior wall and ceiling finishes referred to in Clause 3.1.13.1.(2)(b) of the NBC(AE) that are not more than 1 mm thick are permitted.
- 2.35 Except as provided in Items 2.9 and 2.10, *combustible* interior wall finishes, other than foamed plastics, that are not more than 25 mm thick are permitted, provided they have a

- flame-spread rating* not more than 150 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction.
- 2.36 Except as provided in Items 2.9, 2.12 and 2.37, *combustible* interior ceiling finishes, other than foamed plastics, that are not more than 25 mm thick are permitted, provided they have a *flame-spread rating* not more than 25 on any exposed surface or on any surface that would be exposed by cutting through the material in any direction, except that not more than 10% of the ceiling area within each *fire compartment* is permitted to have a *flame-spread rating* not more than 150.
- 2.37 *Combustible* interior ceiling finishes made of *fire-retardant-treated wood* are permitted, provided they are not more than 25 mm thick or are exposed *fire-retardant-treated wood* battens.
- 2.38 Solid lumber *partitions* not less than 38 mm thick and *partitions* containing wood framing that do not conform to Items 2.2 to 2.5 are permitted, provided the *partitions* are
- a) protected on each face with not less than
 - i) a single layer of 12.7 mm thick Type X gypsum board, with all joints either backed or taped and filled, conforming to ASTM C 1396/C 1396M, "Gypsum Board," or CAN/CSA-A82.27-M, "Gypsum Board,"
 - ii) a single layer of 19 mm thick *fire-retardant-treated wood*, on solid lumber *partitions*, or
 - iii) a single layer of 19 mm thick *fire-retardant-treated wood*, on *partitions* containing wood framing, with wood stud cavities filled with *noncombustible* insulation, and
 - b) not installed as enclosures for *exits* or *vertical service spaces*.
- 2.39 Except as provided in Items 2.40 and 3.5 to 3.8, and Sentences 3.1.11.7.(1) to (3) of the NBC(AE), and except as otherwise provided in Items 2.1 to 2.7 and 2.9 to 2.43, only construction materials and components permitted in *noncombustible construction* shall be permitted in concealed spaces within floor, roof, and wall assemblies.
- 2.40 Exposed surfaces are permitted in a concealed space created by the attachment of a material or assembly of materials conforming to Item 2.6, provided the concealed space is not more than 25 mm deep.
- 2.41 The minimum dimensions stated in Table 2 need not apply at cutouts in structural mass timber elements where outlet boxes are installed in accordance with Article 3.1.9.4. of the NBC(AE).
- 2.42 The exposed surfaces of cutouts described in Item 2.41 need not be protected in accordance with Item 2.6.
- 2.43 Outlet boxes on opposite sides of a vertical structural mass timber element having a *fire-resistance rating* shall be separated by a horizontal distance of not less than 600 mm.

- 2.44 Except as provided in Items 2.45 and 2.46, the rating of a material or assembly of materials that is required to have an *encapsulation rating* shall be determined on the basis of the results of tests conducted in conformance with CAN/ULC-S146, "Test for The Evaluation of Encapsulation Materials and Assemblies of Materials for the Protection of Structural Timber Elements."
- 2.45 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.
- 2.46 Two layers of Type X 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
- 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,
 - c) are installed in conformance with ASTM C 840, "Application and Finishing of Gypsum Board," except that their joints need not be taped and finished, and
 - d) conform to
 - i) ASTM C 1396/C 1396M, "Gypsum Board," or
 - ii) CAN/CSA-A82.27-M, "Gypsum Board."

3 ADDITIONAL CONSTRUCTION REQUIREMENTS

- 3.1 A concealed space in which there is an exposed ceiling finish with a *flame-spread rating* more than 25 shall be provided with *fire blocks* conforming to Items 3.5 to 3.8 and Sentences 3.1.11.7.(1) to (3) of the NBC(AE) between wood nailing elements so that the maximum area of the concealed space is not more than 2 m².
- 3.2 *Fire blocks* conforming to Items 3.5 to 3.8 and Sentences 3.1.11.7.(1) to (3) of the NBC(AE) shall be provided in the concealed spaces created by the wood members permitted by Item 2.29 so that the maximum area of a concealed space is not more than 10 m².
- 3.3 Except for crawl spaces conforming to Sentence 3.1.11.6.(1) of the NBC(AE) and except as provided in Item 3.4, horizontal concealed spaces within a floor assembly or roof assembly of *encapsulated mass timber construction* shall be separated by construction conforming to Items 3.5 to 3.8 and Sentences 3.1.11.7.(1) to (3) of the NBC(AE) into compartments that are
- a) not more than 600 m² in area with no dimension more than 60 m, if the exposed construction materials within the space have a *flame-spread rating* not more than 25, and

- b) not more than 300 m² in area with no dimension more than 20 m, if the exposed construction materials within the space have a *flame-spread rating* more than 25.
- 3.4 *Fire blocks* conforming to Item 3.3 are not required where the horizontal concealed space within the floor or roof assembly is entirely filled with *noncombustible* insulation such that any air gap between the top of the insulation and the floor or roof deck does not exceed 50 mm.
- 3.5 Wood nailing elements referred to in Items 2.27 and 2.28 need not be tested in conformance with Sentence 3.1.11.7.(1) of the NBC(AE).
- 3.6 In a *combustible* roof system permitted by Item 2.13 and Sentence 3.1.5.3.(2) of the NBC(AE), and in a raised platform permitted by Item 2.29 and Sentence 3.1.5.10.(2) of the NBC(AE), *fire blocks* are permitted to be
- a) solid lumber or a structural composite lumber product conforming to ASTM D 5456, "Evaluation of Structural Composite Lumber Products", not less than 38 mm thick,
 - b) phenolic bonded plywood, waferboard, or oriented strandboard not less than 12.5 mm thick with joints supported, or
 - c) two thicknesses of lumber or a structural composite lumber product conforming to ASTM D 5456, "Evaluation of Structural Composite Lumber Products", each not less than 19 mm thick with joints staggered, where the width or height of the concealed space requires more than one piece of lumber or structural composite lumber product not less than 38 mm thick to block off the space.
- 3.7 Openings through materials referred to in Item 3.5 and 3.6 and Sentences 3.1.11.7.(1) to (3) of the NBC(AE) shall be protected to maintain the integrity of the construction.
- 3.8 Where materials referred to in Item 3.5 and 3.6 and Sentences 3.1.11.7.(1) to (3) of the NBC(AE) are penetrated by construction elements or by service equipment, a *fire stop* shall be used to seal the penetration.
- 3.9 The *flame-spread ratings* required by Chapter 2 shall apply in addition to the requirements in Subsection 3.1.13. of the NBC(AE).
- 3.10 The *flame-spread ratings* for *exits* required by Subsection 3.1.13. of the NBC(AE) shall apply to any surface in the *exit* that would be exposed by cutting through the material in any direction, except that this requirement does not apply to doors, structural mass timber elements conforming to Item 2.9, *heavy timber construction* and *fire-retardant-treated wood*.
- 3.11 Except as provided in Item 3.12, roof coverings shall have a Class A classification as determined in accordance with Article 3.1.15.1. of the NBC(AE) where the roof height is greater than 25 m measured from the floor of the *first storey* to the highest point of the roof.

- 3.12 Where *buildings* or parts of *buildings* include non-contiguous roof assemblies at different elevations, the roof coverings referred to in Item 3.11 are permitted to be evaluated separately to determine the roof covering classification required.
- 3.13 The exterior wall of a *basement* that is required to be a *fire separation* with a *fire-resistance rating* in accordance with Sentence 3.2.1.2.(1) of the NBC(AE) is permitted to be penetrated by openings that are not protected by *closures* provided
- a) the *storage garage* is *sprinklered* throughout,
 - b) every opening in the exterior wall is separated from *storeys* above the opening by a projection of the floor or roof assembly above the *basement*, extending not less than 2 m beyond the exterior face of the *storage garage*, or
 - c) the exterior walls of any *storeys* located above the floor or roof assembly referred to in Sentence 3.2.1.2.(1) of the NBC(AE) are recessed behind the outer edge of the assembly by not less than 2 m.
- 3.14 Except as permitted by Items 1.8, 1.11 and 3.15, Article 3.2.2.8. and Sentence 3.2.2.7.(2) of the NBC(AE), in a *building* containing more than one *major occupancy*, the requirements of Subsection 3.2.2. of the NBC(AE) for the most restricted *major occupancy* contained shall apply to the whole *building*.
- 3.15 Except as provided in Items 1.8 and 1.11, Article 3.2.2.8. and Sentence 3.2.2.18.(2) of the NBC(AE), in a *building* in which one *major occupancy* is located entirely above another *major occupancy*, the requirements in Subsection 3.2.2. of the NBC(AE) for each portion of the *building* containing a *major occupancy* shall apply to that portion as if the entire *building* were of that *major occupancy*.
- 3.16 The floor assembly of an exterior balcony shall be
- a) of *noncombustible construction*, or
 - b) constructed in accordance with Items 2.2 to 2.5, but need not comply with Item 2.6.
- 3.17 Except as provided in Items 3.19 and 3.20 and Articles 3.2.3.10. and 3.2.3.11. of the NBC(AE), the *fire-resistance rating*, construction and cladding for *exposing building faces* of *buildings* or *fire compartments* of Group A, Division 2, C, D or Group F, Division 3 *occupancy* classification shall comply with Table 3.
- 3.18 Except as provided in Items 3.19 and 3.20 and Article 3.2.3.10. of the NBC(AE), the *fire-resistance rating*, construction and cladding for *exposing building faces* of *buildings* or *fire compartments* of Group E or Group F, Division 2 *occupancy* classification shall comply with Table 3.

Table 3
Minimum Construction Requirements for Exposing Building Faces
 Forming Part of Items 3.17 and 3.18

<i>Occupancy Classification of Building or Fire Compartment</i>	<i>Maximum Area of Unprotected Openings Permitted, % of Exposing Building Face Area</i>	<i>Minimum Required Fire-Resistance Rating</i>	<i>Type of Construction Required</i>	<i>Type of Cladding Required</i>
Group A, Division 2, C, D, or Group F, Division 3	0 to 10	1 h	<i>Noncombustible</i>	<i>Noncombustible</i>
	> 10 to 25	1 h	<i>Combustible, Encapsulated mass timber, or Noncombustible</i>	<i>Noncombustible</i>
	> 25 to 50	45 min	<i>Combustible, Encapsulated mass timber, or Noncombustible</i>	<i>Noncombustible</i>
	> 50 to < 100	45 min	<i>Combustible, Encapsulated mass timber, or Noncombustible</i>	<i>Combustible or Noncombustible⁽¹⁾</i>
Group E or Group F, Division 2	0 to 10	2 h	<i>Noncombustible</i>	<i>Noncombustible</i>
	> 10 to 25	2 h	<i>Combustible, Encapsulated mass timber, or Noncombustible</i>	<i>Noncombustible</i>
	> 25 to 50	1 h	<i>Combustible, Encapsulated mass timber, or Noncombustible</i>	<i>Noncombustible</i>
	> 50 to < 100	1 h	<i>Combustible, Encapsulated mass timber, or Noncombustible</i>	<i>Combustible or Noncombustible</i>

Note to Table 3:

(1) The cladding on Group C or Group D *buildings* shall conform to Item 2.18 or be *noncombustible*.

- 3.19 Except as provided in Items 2.17 to 2.23 and Article 3.1.4.8. of the NBC(AE), the requirement in Table 3 for *noncombustible* cladding for *buildings* or *fire compartments* where the maximum permitted area of *unprotected openings* is more than 10% of the *exposing building face* is permitted to be waived for exterior wall assemblies that comply with Article 3.1.5.5. of the NBC(AE).
- 3.20 Except as provided in Items 2.17 to 2.23 and Article 3.1.4.8. of the NBC(AE), the requirement in Table 3 for *noncombustible* cladding for *buildings* or *fire compartments* where the maximum permitted area of *unprotected openings* is more than 25% but not more than 50% of the *exposing building face* is permitted to be waived where
- a) the *limiting distance* is greater than 5 m,
 - b) the *building* or *fire compartment* and all *combustible* attic and roof spaces are *sprinklered* throughout,
 - c) the cladding
 - i) conforms to Subsections 9.27.6. , 9.27.7. , 9.27.8. , 9.27.9. or 9.27.10. of the NBC(AE),
 - ii) is installed without furring members, or on furring not more than 25 mm thick, over gypsum sheathing at least 12.7 mm thick or over masonry, and
 - iii) after conditioning in conformance with ASTM D 2898, "Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing", has a *flame-spread rating* not greater than 25 on the exterior face when tested in accordance with Sentence 3.1.12.1.(1) of the NBC(AE),
 - d) the cladding
 - i) conforms to Subsection 9.27.12. of the NBC(AE),
 - ii) is installed with or without furring members over gypsum sheathing at least 12.7 mm thick or over masonry,
 - iii) has a *flame-spread rating* not greater than 25 when tested in accordance with Sentence 3.1.12.1.(2) of the NBC(AE), and
 - iv) does not exceed 2 mm in thickness exclusive of fasteners, joints and local reinforcements, or
 - e) the exterior wall assembly complies with Article 3.1.5.5. of the NBC(AE).
- 3.21 Except as provided in Item 3.22, a *walkway* connected to a *building* or part of a *building* of *encapsulated mass timber construction* shall be of *noncombustible construction* or *encapsulated mass timber construction*.
- 3.22 A *walkway* connected to a *building* required to be of *noncombustible construction* or a *building* or part of a *building* of *encapsulated mass timber construction* is permitted to be of *heavy timber construction*, provided
- a) not less than 50% of the area of any enclosing perimeter walls is open to the outdoors, and
 - b) the *walkway* is at ground level.

- 3.23 A concealed space used as a *plenum* within a floor assembly or within a roof assembly need not conform to Item 3.24 and Sentences 3.1.5.18.(1), 3.6.5.1.(1) and (3) to (5) of the NBC(AE), provided
- a) all materials within the concealed space have a *flame-spread rating* not more than 25 and a smoke developed classification not more than 50, except for
 - i) tubing for pneumatic controls,
 - ii) optical fibre cables and electrical wires and cables with *combustible* insulation, jackets or sheathes that are used for the transmission of voice, sound or data and conform to Sentences 3.1.4.3.(2) and 3.1.5.21.(2) of the NBC(AE),
 - iii) totally enclosed non-metallic raceways with an FT6 rating, when tested in accordance with Clause 3.1.5.23.(1)(a) of the NBC(AE), and
 - b) the supports for the ceiling membrane are of *noncombustible* material having a melting point not below 760°C.
- 3.24 Except as permitted by Sentence 3.6.5.1.(3) of the NBC(AE), ducts, associated fittings and *plenums* are permitted to contain *combustible* material provided they
- a) conform to the appropriate requirements for Class 1 duct materials in CAN/ULC-S110, "Test for Air Ducts",
 - b) conform to Article 3.1.5.18. of the NBC(AE) in a *building* required to be of *noncombustible construction* or in a *building* or part of a *building* permitted to be of *encapsulated mass timber construction*,
 - c) conform to Subsection 3.1.9. of the NBC(AE),
 - d) are used only in horizontal runs, and
 - e) are not used in air duct systems in which the air temperature could be more than 120°C.
- 3.25 Except as permitted by Sentence 3.6.5.5.(5) of the NBC(AE), where *combustible* insulation is used on piping in a *horizontal service space* or a *vertical service space*, the insulation and coverings on that piping shall have a *flame-spread rating* not more than 25, on any exposed surface and on any surface that would be exposed by cutting through the material in any direction.
- 3.26 A *noncombustible* lining or backing shall be provided for every steam or hot water radiator and convector
- a) located in a recess or concealed space, or
 - b) attached to the face of a wall of *combustible construction* or *encapsulated mass timber construction*.

4 FIRE SAFETY

- 4.1 Where encapsulation materials or an assembly of materials that provide protection for mass timber elements are damaged or removed so as to effect their integrity, they shall be repaired or replaced so that the *encapsulation rating* of the materials is maintained.

- 4.2 Where encapsulation materials or an assembly of materials described in Item 4.1 are repaired or replaced, the repairs or replacements shall be in conformance with this Variance.
- 4.3 Required clearances between *chimneys, flue pipes or appliances* and *encapsulated mass timber construction* shall be maintained in conformance with the NBC(AE).
- 4.4 *Buildings* or parts thereof shall comply with Articles 5.6.3.2., 5.6.3.6. and 5.6.3.8., and Sentences 5.6.3.3.(1) and 5.6.3.4.(2) of the NFC(AE).
- 4.5 A sign identifying the floor level, stair location and civic address shall be posted at each floor in a stairway required by Item 4.8.
- 4.6 A clearance of not less than 3 m between *exits* or any portion of the *building* and containers used for the disposal of *combustible* refuse shall be maintained, or equivalent protection shall be provided as specified in the fire safety plan.
- 4.7 An adequate water supply for firefighting shall be provided in accordance with Article 3.2.5.7. of the NBC(AE) as soon as *combustible* or *encapsulated mass timber construction* material arrives on the site.
- 4.8 During construction and in addition to the requirements of Sentences 5.6.1.4.(2) and (3) of the NFC(AE), at least two stairways shall be provided that
- consist of treads and risers complying with the dimensional requirements of Article 3.4.6.8. of the NBC(AE),
 - are equipped with one handrail conforming to Sentences 3.4.6.5.(5), (6), (7), (11), (13), and (14) of the NBC(AE),
 - are not less than 900 mm wide, and
 - are equipped with *guards* that are
 - not less than 920 mm high when measured vertically to the top of the *guard* from a line drawn through the outside edges of the stair nosings, and
 - not less than 1070 mm high around landings.
- 4.9 At least two stairways conforming to Item 4.8 shall be
- extended upward as each floor is installed in new construction, or
 - maintained for each floor still remaining during demolition.
- 4.10 Stairways referred to in Item 4.8 and 4.9
- shall be separated from the remainder of the *storey* by a wall assembly having a *fire-resistance rating* not less than 30 min, and
 - shall have doorways that are provided with
 - 45 mm solid core wood doors,
 - hollow metal doors,
 - doors constructed of not less than 12.7 mm thick gypsum board mechanically fastened to not less than 12.7 mm thick plywood with the gypsum board facing the floor area, or
 - door assemblies having a *fire-protection rating* not less than 20 min.

- 4.11 Doors for stairways described in Item 4.10(b) shall
- a) swing on the vertical axis, and
 - b) be equipped with
 - i) latches, and
 - ii) a means to close automatically.
- 4.12 For each new level at which hose valves are installed, the standpipe system shall be subjected to
- a) a pneumatic test at 275 kPa for not less than 24 h, or
 - b) a hydrostatic test at 1 380 kPa for not less than 2 h.
- 4.13 The standpipe system shall be corrected and re-tested if the drop in pressure
- a) when tested in accordance with Clause 4.12(a), is in excess of 21 kPa, or
 - b) when tested in accordance with Clause 4.12(b), is in excess of 35 kPa.
- 4.14 Where a standpipe system is maintained dry,
- a) after each test or re-test carried out in accordance with Item 4.12, it shall be provided with supervisory air not greater than 172 kPa and not less than 35 kPa,
 - b) each fire department connection shall be provided with
 - i) an audible warning system that sounds when the supervisory air is less than 35 kPa, or
 - ii) an air pressure gauge indicating the supervisory air pressure,
 - c) a manual air release with one or more valves of a minimum 30 mm diam shall be provided immediately adjacent to each fire department connection such that the air pressure from a pneumatic test is released in not more than 3 min,
 - d) each fire department connection shall be provided with signage
 - i) indicating that the dry standpipe system is pressurized with air, and
 - ii) showing the location of the manual air release, and
 - e) provisions shall be made to drain water in any trapped sections of the dry standpipe system that are subject to freezing.
- 4.15 Where a standpipe system is maintained wet, each fire department connection shall be provided with a water pressure gauge.
- 4.16 The standpipe system, whether a temporary system or a permanent system being installed progressively, shall be in operable condition at all times when it is not actively being worked on, until the permanent standpipe system is completed.
- 4.17 Except as provided in Items 4.18 and 4.19, a protective encapsulation material or an assemblage of materials providing an *encapsulation rating* of not less than 25 min, as determined in accordance with Item 2.44, shall be installed
- a) such that not more than 20% of the area of the underside of each mass timber floor assembly on each *storey* is exposed during construction,
 - b) on the interior side of stairways required by Item 4.8 and of *vertical service spaces* where the enclosures are constructed of mass timber elements,

- c) on each face of solid lumber or mass timber *partitions* not less than 38 mm thick and of *partitions* containing wood framing as permitted by Item 2.38, and
 - d) such that not more than 35% of the total area of structural mass timber walls within the *storey* is exposed during construction.
- 4.18 Not more than the four uppermost contiguous *storeys* are permitted to be unprotected as required by Item 4.17 during construction.
- 4.19 The encapsulation material or assemblage of materials used to meet the requirements of Item 4.17 is permitted to consist of a single layer of Type X gypsum board not less than 12.7 mm thick conforming to Clauses 2.46(a), (c) and (d).

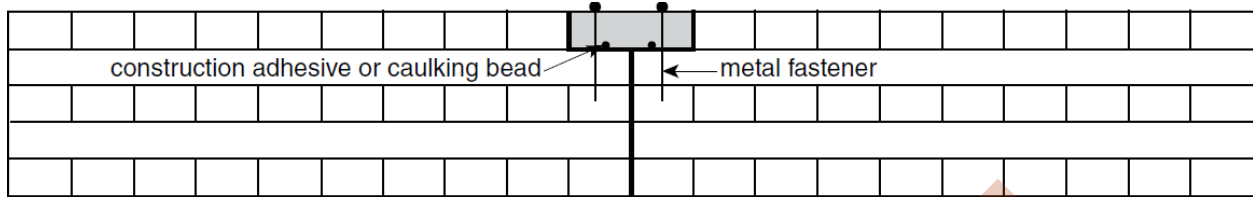
5 FIRE-RESISTANCE RATING CALCULATION

- 5.1 The calculation methods described in Items 5.2 to 5.12 are intended to be used to determine *fire-resistance ratings* for structural mass timber elements on the basis of the elements being subjected to the standard fire exposure conditions described in CAN/ULC-S101, "Fire Endurance Tests of Building Construction and Materials."
- 5.2 *Loadbearing* mass timber members, such as beams and columns, subjected to the conditions described in Item 5.1 are assigned a *fire-resistance rating* that relates to the time at which the applied load is no longer sustained.
- 5.3 Mass timber wall, floor and roof assemblies subjected to the conditions described in Item 5.1 are assigned a *fire-resistance rating* that relates to the lesser of the times at which
- a) an average temperature rise of 140°C or a maximum temperature rise of 180 °C at any location is recorded on the unexposed side,
 - b) there is passage of flame or passage of gases hot enough to ignite cotton pads through the unexposed side, or,
 - c) the applied load is no longer being sustained, where the assembly is *loadbearing*.
- 5.4 The method described in D-2.11.2. in Appendix D of the NBC(AE) applies to glued-laminated timber beams and columns required to have *fire-resistance ratings* greater than those afforded under the provisions of Article 3.1.4.6. of the NBC(AE).
- 5.5 The method described in Items 5.7 to 5.12 applies to mass timber elements, including solid sawn timber and glued-laminated timber beams and columns, required to have *fire-resistance ratings* greater than those afforded under the provisions of Article 3.1.4.6. of the NBC(AE).
- 5.6 The methods of calculation in D-2.11.2. in Appendix D of the NBC(AE) and Items 5.7 to 5.12 are separate and independent methods that use different approaches to determine the *fire-resistance ratings* for mass timber elements.
- 5.7 The *fire-resistance rating* of structural mass timber members, such as beams and columns constructed of glued-laminated timber, solid sawn timber, or structural

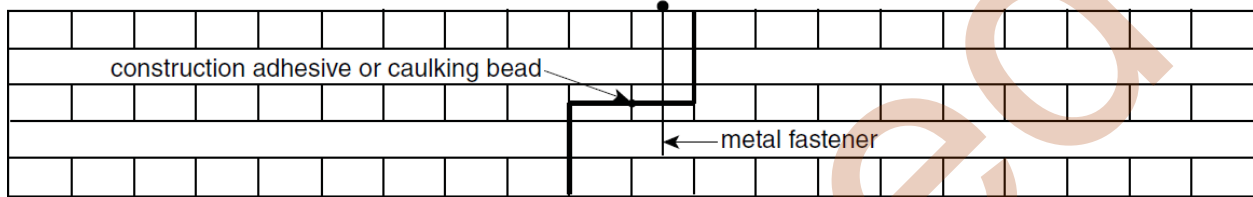
composite lumber, is permitted to be determined using the calculation method described in Annex B of CSA O86, "Engineering Design in Wood."

- 5.8 Except as provided in Items 5.9 to 5.12, the *fire-resistance rating* of mass timber wall, floor and roof assemblies, including those constructed of cross-laminated timber, is permitted to be determined using the calculation method described in Annex B of CSA O86, "Engineering Design in Wood."
- 5.9 Except as provided in Item 5.10, the assemblies described in Item 5.8 shall be protected to maintain the integrity and thermal insulation properties of the assembly for the time period corresponding to the calculated *fire-resistance rating* as follows:
- a) except as provided in Clause (b), for floor and roof assemblies, at least one of the following protection methods applied to the unexposed surface:
 - i) OSB or plywood not less than 12.5 mm thick, with the joints in the layer staggered relative to those in the assembly,
 - ii) concrete topping not less than 38 mm thick, or
 - iii) gypsum-concrete topping not less than 25 mm thick,
 - b) for plank decking designed in accordance with Clause B.10 of CSA O86, "Engineering Design in Wood," at least one of the protection methods for the unexposed surface listed in Clause B.10.4 of CSA O86 applied to the unexposed surface,
 - c) for interior wall assemblies, by applying at least one of the following layers to at least one side of the assembly, with the joints in the layer staggered relative to those in the assembly:
 - i) OSB or plywood not less than 12.5 mm thick, or
 - ii) Type X gypsum board not less than 12.7 mm thick, and
 - d) for exterior wall assemblies, by applying at least one of the following layers to at least one side of the assembly, with the joints in the layer staggered relative to those in the assembly:
 - i) OSB or plywood not less than 12.5 mm thick,
 - ii) Type X gypsum board not less than 12.7 mm thick,
 - iii) gypsum sheathing not less than 12.7 mm thick applied to the exterior side of the assembly, or
 - iv) rock or slag insulation sheathing not less than 50 mm thick applied to the exterior side of the assembly.
- 5.10 For wall, floor and roof assemblies constructed of cross-laminated timber, the joints between cross-laminated timber panels in the assembly need not be protected in accordance with Item 5.9, provided the joints are either lapped or splined to maintain the integrity and thermal insulation properties of the assembly for the time period corresponding to the calculated *fire-resistance rating*. (See Figure 5.10)

Figure 5.10
Joints between cross-laminated timber panels in wall, floor and roof assemblies






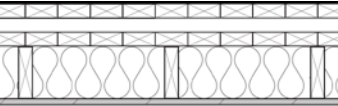
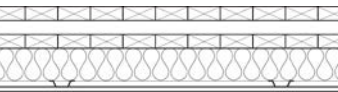
Side view of splined joint between cross-laminated timber panels



Side view of lapped joint between cross-laminated timber panels

- 5.11 For interior wall assemblies, the additional times assigned in Clause B.8.1 of CSA O86, “Engineering Design in Wood,” shall only be applied to the calculated *fire-resistance rating* where both sides of the assembly are protected in accordance with Clause B.8 of CSA O86. Where the level of protection differs on the two sides, the additional time corresponding to the lesser level of protection shall be applied.
- 5.12 For exterior wall assemblies, the additional times assigned in Clause B.8.1 of CSA O86, “Engineering Design in Wood,” shall only be applied to the calculated *fire-resistance rating* where
 - a) the interior side of the assembly is protected in accordance with Clause B.8 of CSA O86, and
 - b) except where the assembly is constructed of cross-laminated timber panels with lapped or splined joints as described in Item 5.10, the exterior side of the assembly is protected in accordance with Clause 5.9(d).
- 5.13 Table 5 shows construction specifications for exterior wall assemblies that are deemed to satisfy the criteria of Clause 3.1.5.5.(1)(b) of the NBC(AE) when tested in accordance with CAN/ULC-S134, “Fire Test of Exterior Wall Assemblies.”

Table 5
Construction Specifications for Exterior Wall Assemblies that are Deemed to Satisfy the
Criteria of Clause 3.1.5.5.(1)(b) when Tested in Accordance with CAN/ULC-S134
 Forming part of Item 5.13

Wall Number	Structural Members	Absorptive Material	Sheathing	Cladding	Design
EXTW-1	38 mm x 89 mm wood studs spaced at 400 mm o.c. ⁽¹⁾⁽²⁾	89 mm thick rock or slag fibre in cavities formed by studs ⁽³⁾⁽⁴⁾	-	12.7 mm thick fire-retardant-treated plywood siding ⁽⁵⁾	
EXTW-2	38 mm x 140 mm wood studs spaced at 400 mm o.c. ⁽¹⁾⁽²⁾	140 mm thick rock or slag fibre in cavities formed by studs ⁽³⁾⁽⁴⁾	Gypsum sheathing ≥ 12.7 mm thick	<i>Noncombustible</i> exterior cladding	
EXTW-3	38 mm x 140 mm wood studs spaced at 400 mm o.c. ⁽¹⁾⁽²⁾	140 mm thick rock or slag fibre in cavities formed by studs ⁽³⁾⁽⁴⁾	15.9 mm thick fire-retardant-treated plywood ⁽⁶⁾	<i>Noncombustible</i> exterior cladding	
EXTW-4	38 mm x 140 mm wood studs spaced at 600 mm o.c. attached to cross-laminated timber wall panels ≥ 38 mm thick ⁽¹⁾⁽⁷⁾⁽⁸⁾	140 mm thick glass, rock or slag fibre in cavities formed by studs ⁽³⁾	Gypsum sheathing ≥ 12.7 mm thick	<i>Noncombustible</i> exterior cladding	
EXTW-5	89 mm horizontal Z-bars spaced at 600 mm o.c. attached	89 mm thick rock or slag fibre in cavities formed by Z-bars ⁽³⁾⁽⁴⁾	-	<i>Noncombustible</i> exterior cladding attached to 19 mm vertical hat channels spaced at 600	

	to cross-laminated timber wall panels \geq 105 mm thick ⁽⁸⁾			mm o.c.	
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Notes to Table 5:

- (1) The stated stud dimensions are maximum values. Where wood studs with a smaller depth are used, the thickness of absorptive material in the cavities formed by the studs must be reduced accordingly.
- (2) Horizontal blocking between the vertical studs or horizontal stud plates must be installed at vertical intervals of at most 2 324 mm, such that the maximum clear length between the horizontal blocking or stud plates is 2 286 mm.
- (3) The absorptive material must conform to CAN/ULC-S702.1, "Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification."
- (4) The absorptive material must have a density not less than 32kg/m³.
- (5) The fire-retardant-treated plywood siding must conform to the requirements of Article 3.1.4.5. of the NBC(AE) and must have been conditioned in conformance with ASTM D 2898, "Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing," before being tested in accordance with CAN/ULC-S102, "Test for Surface Burning Characteristics of Building Materials and Assemblies."
- (6) The fire-retardant-treated plywood must conform to the requirements of Article 3.1.4.5. of the NBC(AE).
- (7) Horizontal blocking between the vertical studs or horizontal stud plates must be installed at vertical intervals of at most 2 438 mm, such that the maximum clear length between the horizontal blocking or stud plates is 2 400 mm.
- (8) A water-resistant barrier may be attached to the face of the cross-laminated timber wall panels.

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