Alberta Building Officials Association

A.B.O.A. Building Safety

12 Storey EMTC Standata

Building and Fire Code Variance

Safety Codes Council

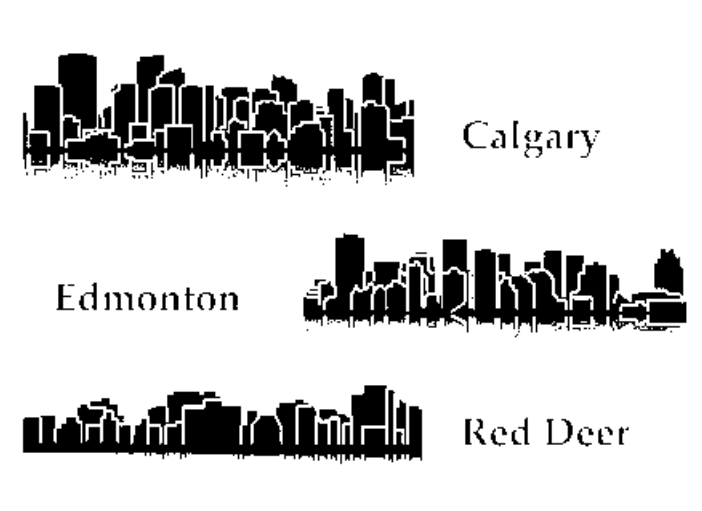
Presented By:

Paul Chang

Provincial Building Administrator

Alberta

BUILDING TEAM



COMMUNITY AND TECHNICAL SUPPORT

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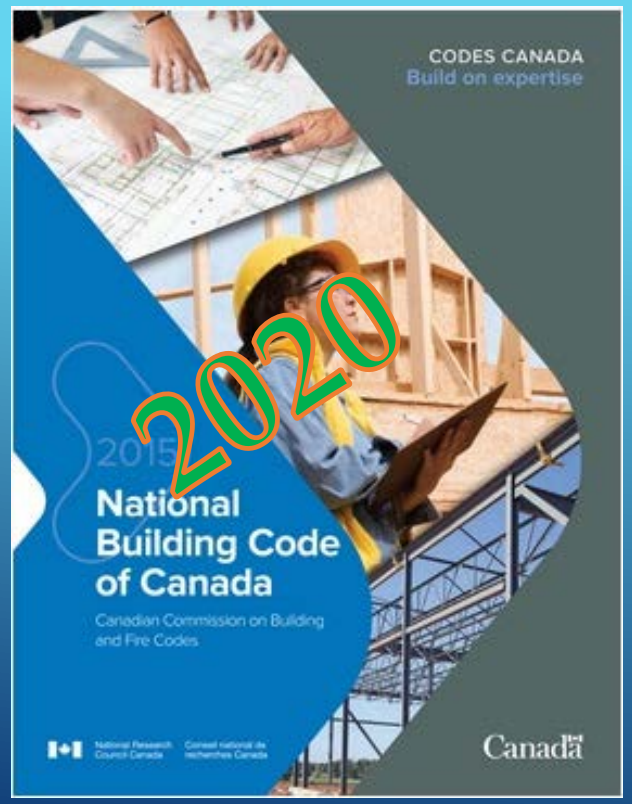
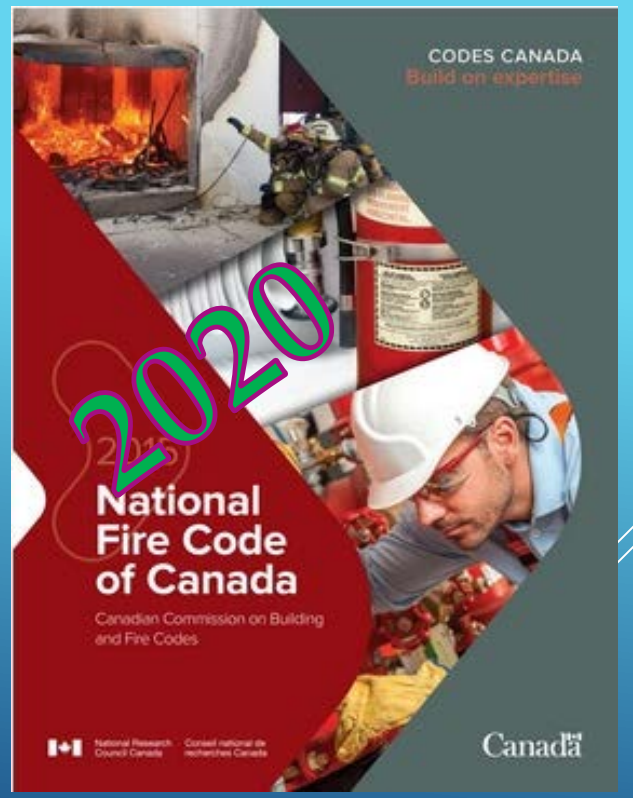
Lance Leger- Edmonton
Renna Alqasrani- Edmonton
Bruce Adair- Calgary
Roopendra Singh- Calgary
Joe Healy- Red Deer
Mike Hill- Red Deer

Encapsulated Mass Timber: a new construction type for the 2020 NBC and 2020 NFC





Proposed Changes for the 2020 NBC: Encapsulated Mass Timber Construction

Division B – 2020 NBC: Prescriptive Tall Wood Buildings

- Code Change Request package submitted by Canadian Wood Council
- Standing Committee on Fire Protection → Task Group → 5 Sub-Task Groups
- List of 25 potential issues/concerns developed
- Draft Proposed Code Changes submitted to public consultation in Fall 2017 and 2018
- Final public consultation was Fall 2019

12 STOREY EMTC CODE REFERENCES FOR NBCC 2020

3.2.2.48. Group C, up to 12 storeys, Sprinklered
3.2.2.56. Group D, up to 12 storeys, Sprinklered
1) A building classified as Group C is permitted to conform to Sentence (2), 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

2) Except as provided in Article 3.2.2.16., the building referred to in Sentence (1) is permitted to be of encapsulated mass timber construction or noncombustible construction, used singly or in combination,

Division B – 2020 NBC: Prescriptive Tall Wood Buildings

Current Code:

- **"*Noncombustible construction* means that type of construction in which a degree of fire safety is attained by the use of *noncombustible* materials for structural members and other *building* assemblies."**
- **"*Combustible construction* means that type of construction that does not meet the requirements for *noncombustible construction*."**

Division B – 2020 NBC: Prescriptive Tall Wood Buildings

Any building that does not follow all the requirements for "noncombustible construction", including

- **3.1.5.1. to 3.1.5.24.**
- **3.1.11.3. (fire blocking)**
- **3.1.13.8. (flame-spread ratings)**
- **3.2.3.19. (connected walkways)**
- **3.6.4.3. (plenums)**
- **3.6.5.5. (insulation and coverings on piping)**

is considered "combustible construction"

Division B – 2020 NBC: Prescriptive Tall Wood Buildings

Tall buildings in current Codes:

- “noncombustible construction”
- fire-resistance rating of structural members of 2 h
- automatic fire sprinklers
- unlimited height, unlimited area

Division B – 2020 NBC: Prescriptive Tall Wood Buildings

"Noncombustibility is an elemental concept, but 'noncombustible construction' is only a standard that has proved satisfactory for tall buildings and some other situations. When construction using combustible materials is developed that satisfies the conditions, the standard should be changed to permit it.... Noncombustibility will always be one, but not necessarily the only, solution."

R.S. Ferguson, *The Problem of "Noncombustible"*
Technical Note No. 428
National Research Council of Canada
1964

Division B – 2020 NBC: Prescriptive Tall Wood Buildings

General Premise:

Develop a set of provisions that achieves the current level of fire safety when wood structural elements are substituted for structural elements of noncombustible materials.

Division B – 2020 NBC: Prescriptive Tall Wood Buildings

General Premise

"Noncombustible Construction"

(i.e. all the current material restrictions and fire safety provisions required for NC)

+

Structural elements currently required to be of noncombustible material replaced with wood elements

+

Additional requirements - ??

Division B – 2020 NBC: Encapsulated Mass Timber Construction

So, proposed 3rd "type" of construction -

- **"*Noncombustible construction* means that type of construction in which a degree of fire safety is attained by the use of *noncombustible* materials for structural members and other *building* assemblies."**
- ***"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 the structural timber members and other *building* assemblies."**
- **"*Combustible construction* means that type of construction that does not meet the requirements for *noncombustible construction* or *encapsulated mass timber construction*."**

Division B – 2020 NBC: Encapsulated Mass Timber Construction

Encapsulation rating:

- **“*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 Code.”**

- **Encapsulation rating determined via new test method**
  - **Draft Standard: ULC S146-XX *Standard Method of Test for the Evaluation of Encapsulation Materials and Assemblies of Materials for the Protection of Mass Timber Structural Members and Assemblies***

Division B – 2020 NBC: Encapsulated Mass Timber Construction

Draft test method ULC S146-XX

- Standard time-temperature curve from CAN/ULC-S101
- Horizontal configuration (fire from underside)
- Minimum size of assembly: 3.66m x 3.66m
- Maximum average temperature increase of 250°C at the interface of the encapsulation material(s) and the wood substrate
- Maximum temperature increase at any individual point of 270°C at the interface of the encapsulation material(s) and the wood substrate

Codes Canada Update 2020

- It had been anticipated that the next editions of the model National Codes would be available in 2020.
- Codes Canada has announced that the publication date of the updated National Model Codes has been extended.
- The next editions are anticipated to be available in December 2021.

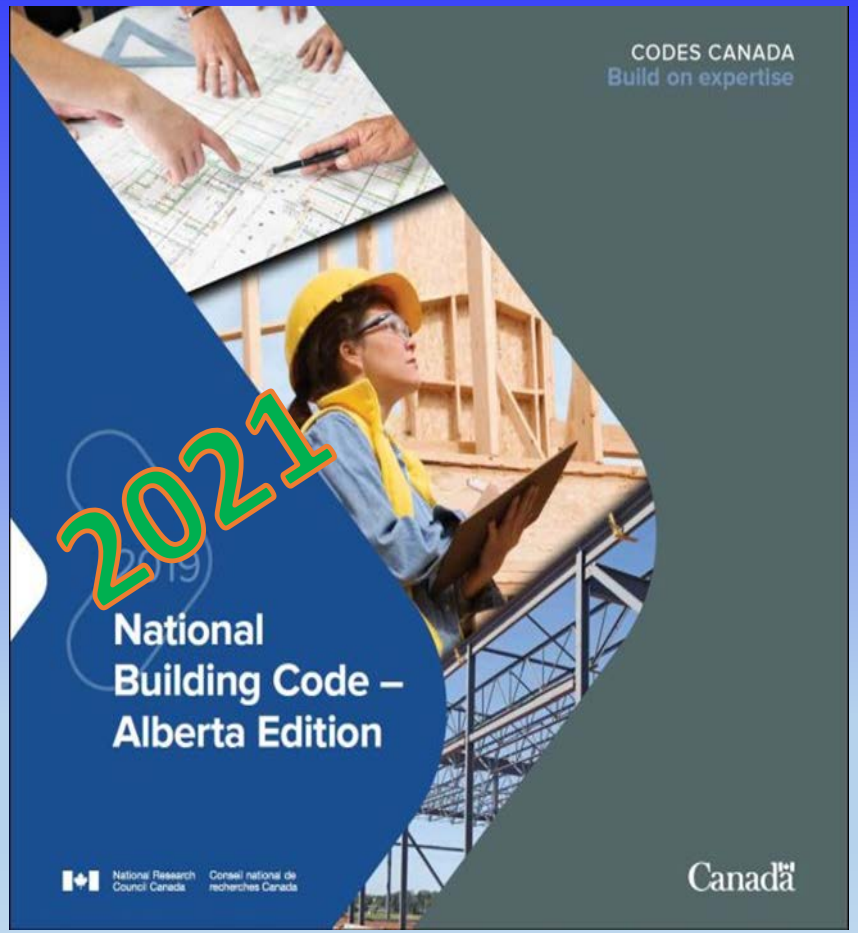
National Research Council Canada | Conseil national de recherches Canada

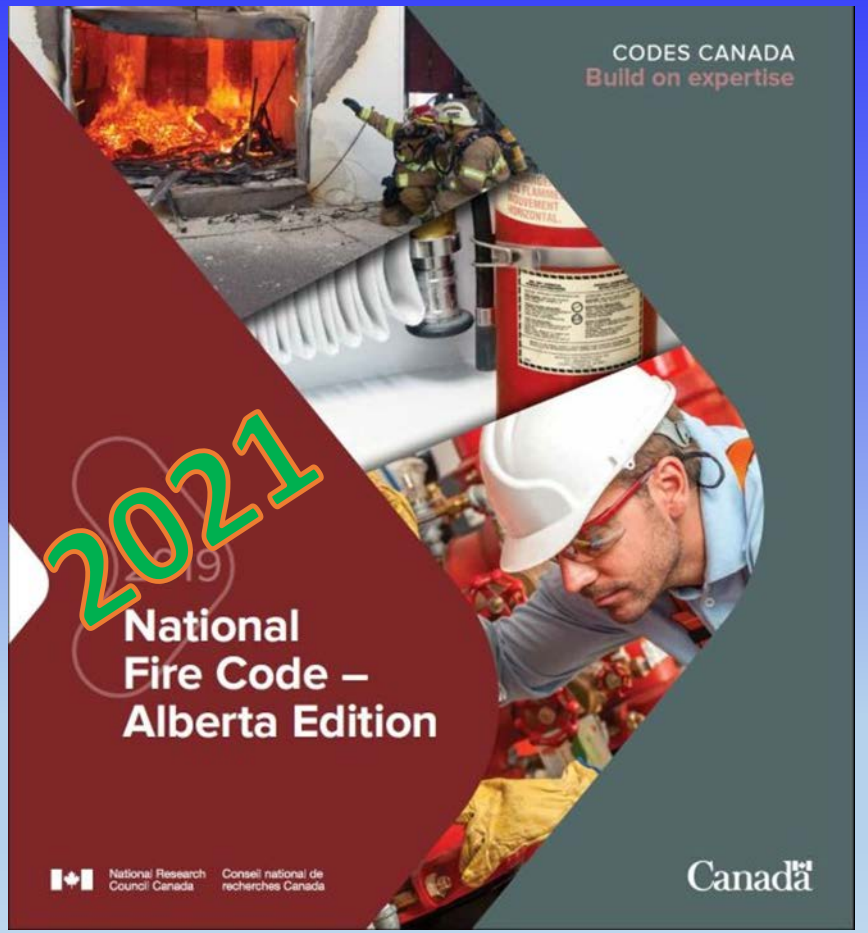
Alberta

Alberta Codes Update

- As the next National Code editions are anticipated to be available in December 2021.
- The Codes would not come into effect in Alberta till January 2023. 1st day of the month, following 12 months from date of publication

Alberta
Municipal Affairs





Alberta

- Working in Collaboration with the National Research Council of Canada (NRC)
- 30 National Building Code PCF’s and 4 National Fire Code PCF’s =(hundreds of pages) of (proposed code-change forms)
- Consolidated by NRC into 56 pages of the Code text only
- The PCF’s have been approved for inclusion into the NBC 2020

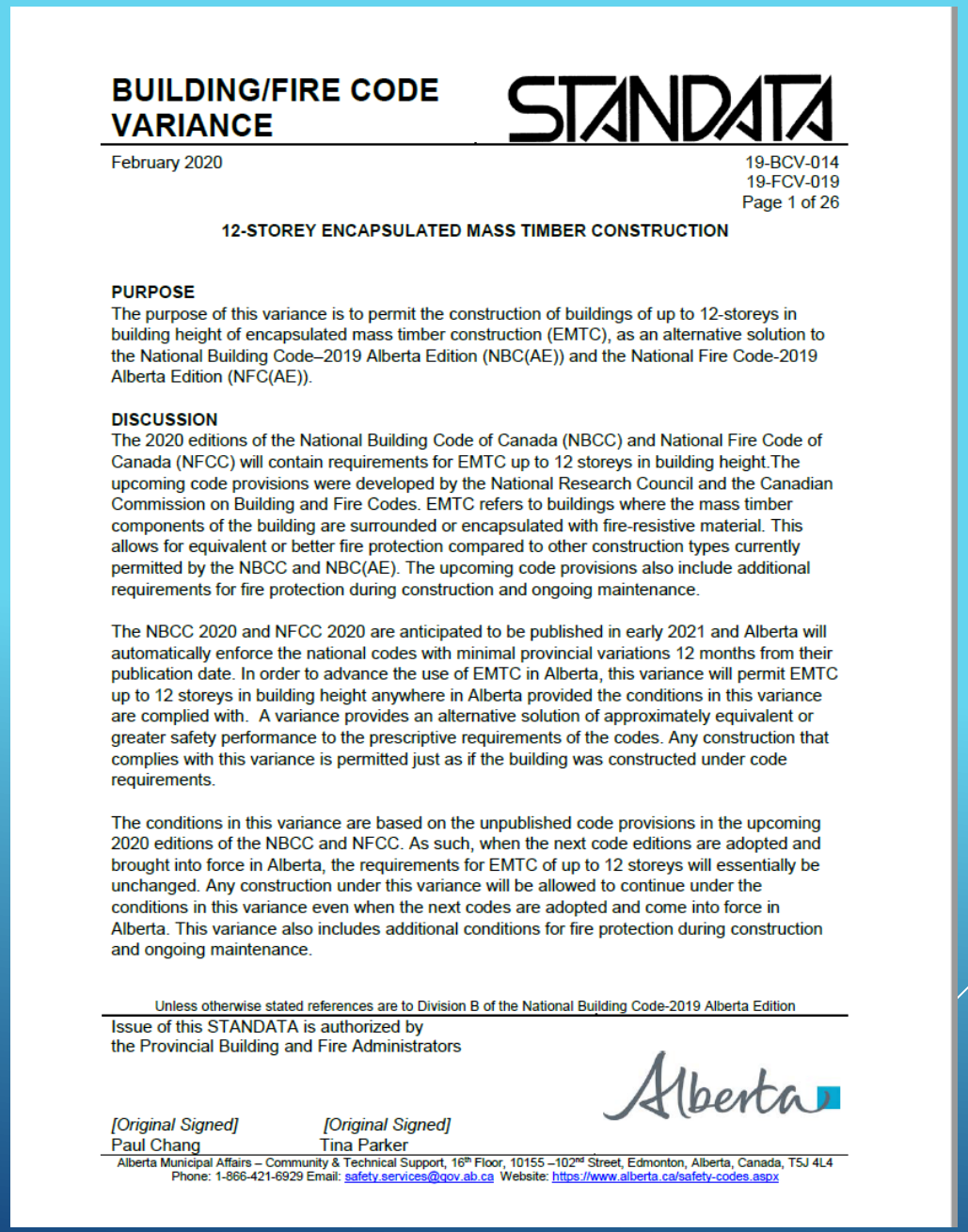
National Research Council Canada | Conseil national de recherches Canada

Alberta

- Community and Technical Support
- Technical Advisors using the documentation from NRC to correlate the information into a sequential format for use
- 203 Files, Numerous Iterations and Drafts from Code Text to Standata Format

Alberta
Municipal Affairs

STANDATA
26 PAGES
MUST BE USED IN CONJUNCTION WITH THE NBC(AE) AND THE NFC(AE)



BUILDING/FIRE CODE VARIANCE

STANDATA

February 2020

19-BCV-014
19-FCV-019

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

Alberta

[Original Signed] Paul Chang

[Original Signed] Tina Parker

Alberta Municipal Affairs – Community & Technical Support, 16th Floor, 10155 –102nd Street, Edmonton, Alberta, Canada, T5J 4L4
Phone: 1-866-421-6929 Email: safety.services@gov.ab.ca Website: https://www.alberta.ca/safety-codes.aspx

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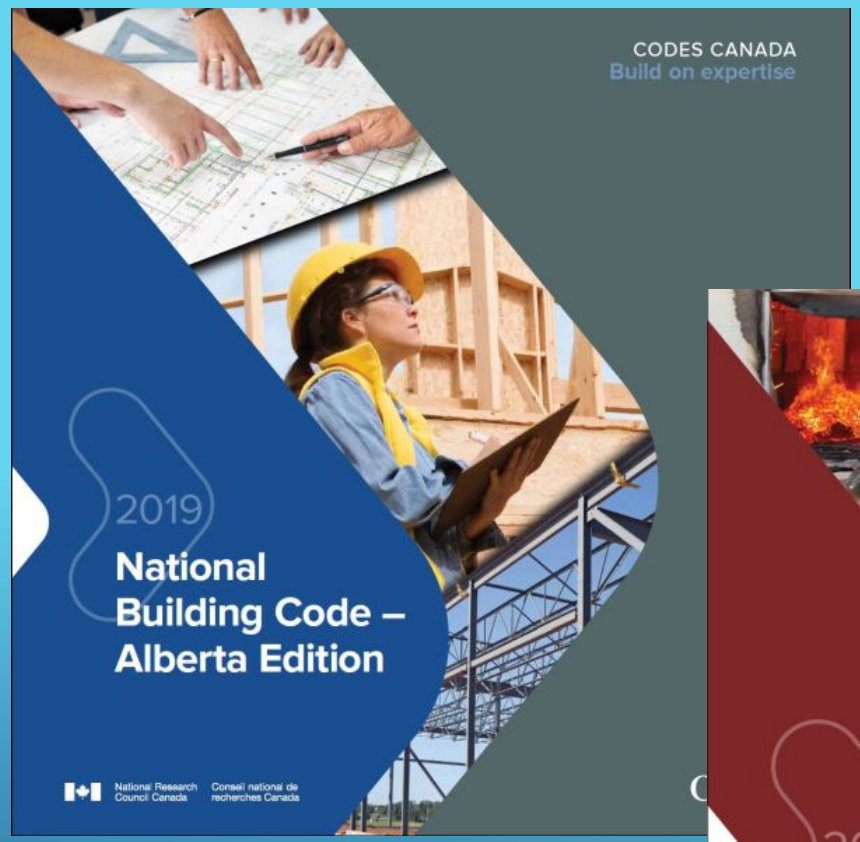
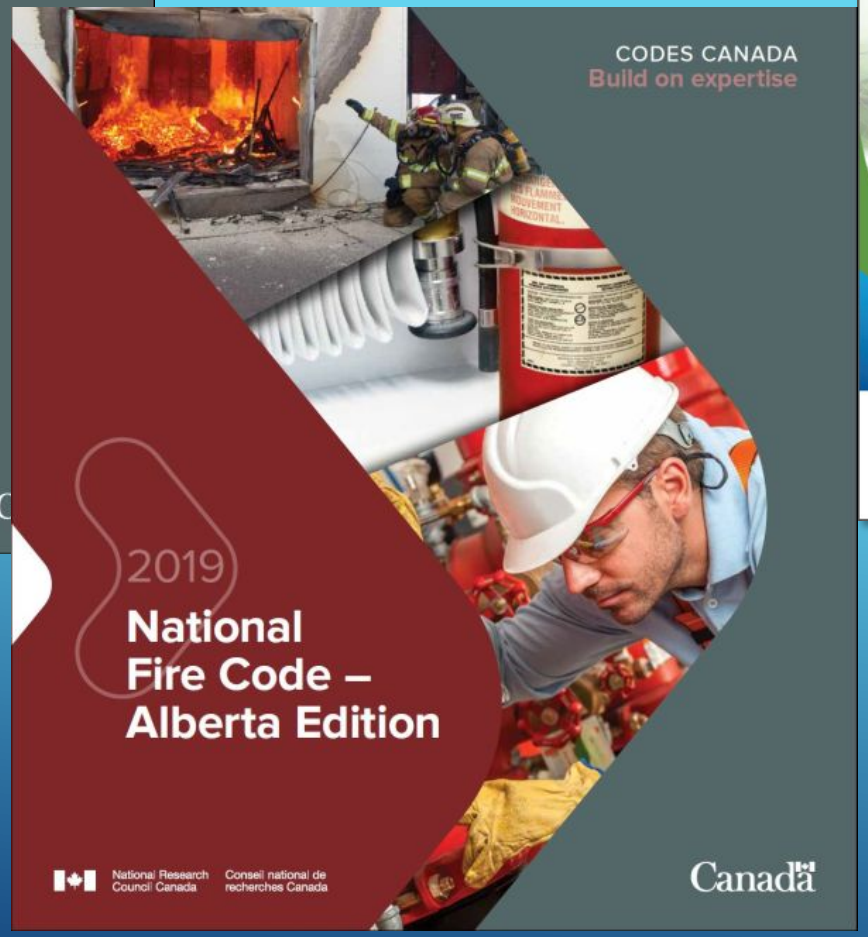
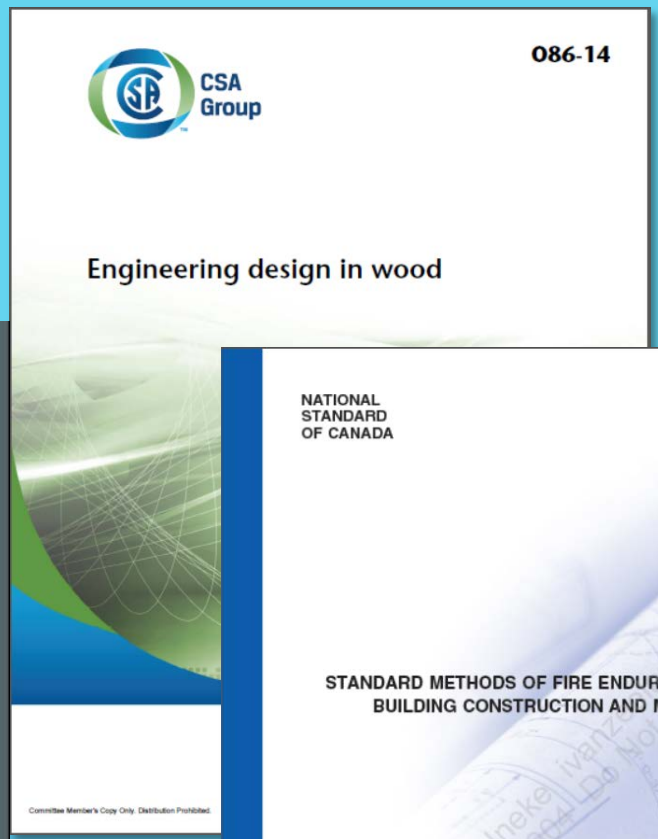
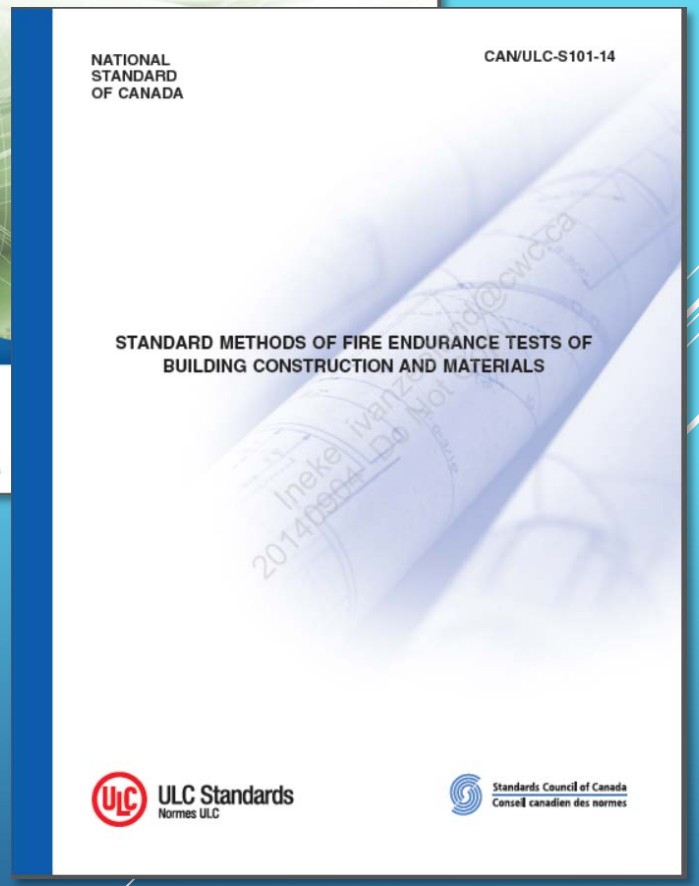








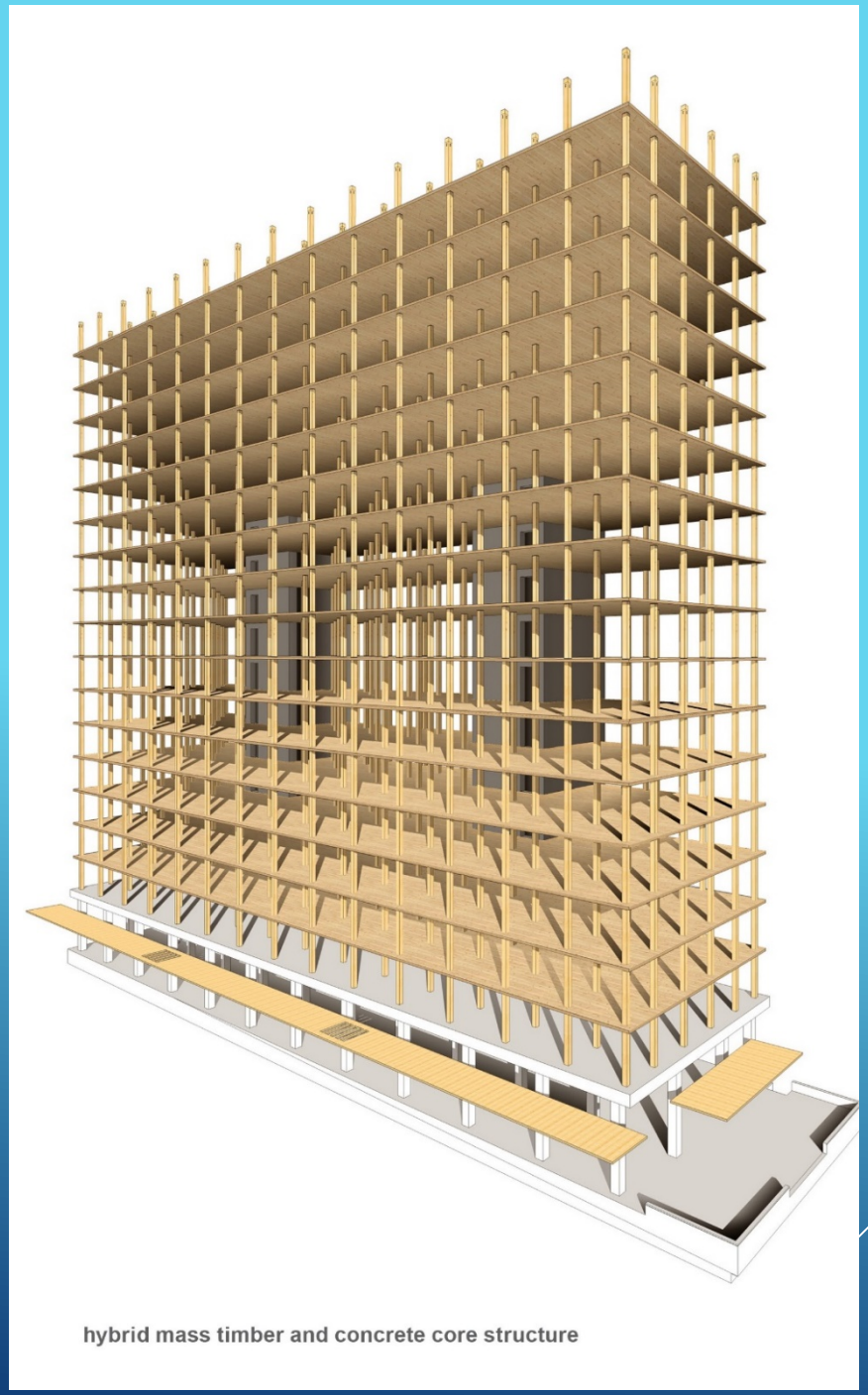
Alberta

12 STOREY ENCAPSULATED MASS TIMBER CONSTRUCTION

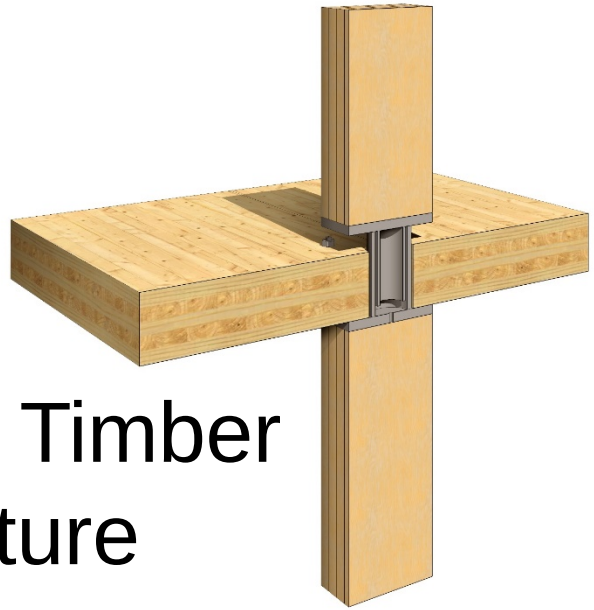
Encapsulated mass timber construction means that type of construction in which a degree of fire safety is attained by the use of encapsulated mass timber elements with an encapsulation rating and minimum dimensions for structural members and other building assemblies.

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 Code.

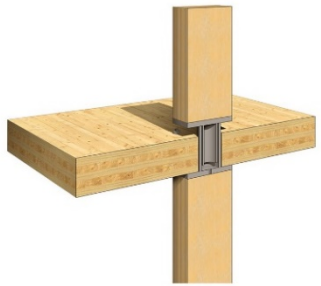
Hybrid Mass Timber concrete core structure



hybrid mass timber and concrete core structure



Mass Timber Structure

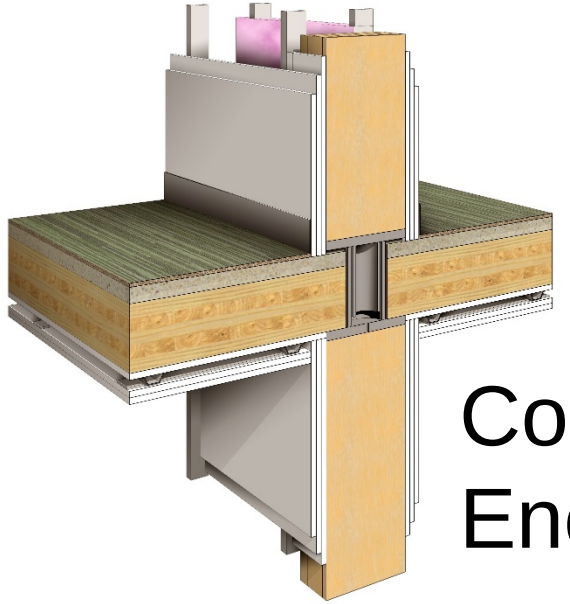


CLT floor slabs with glulam columns and steel connectors

partial encapsulation during construction

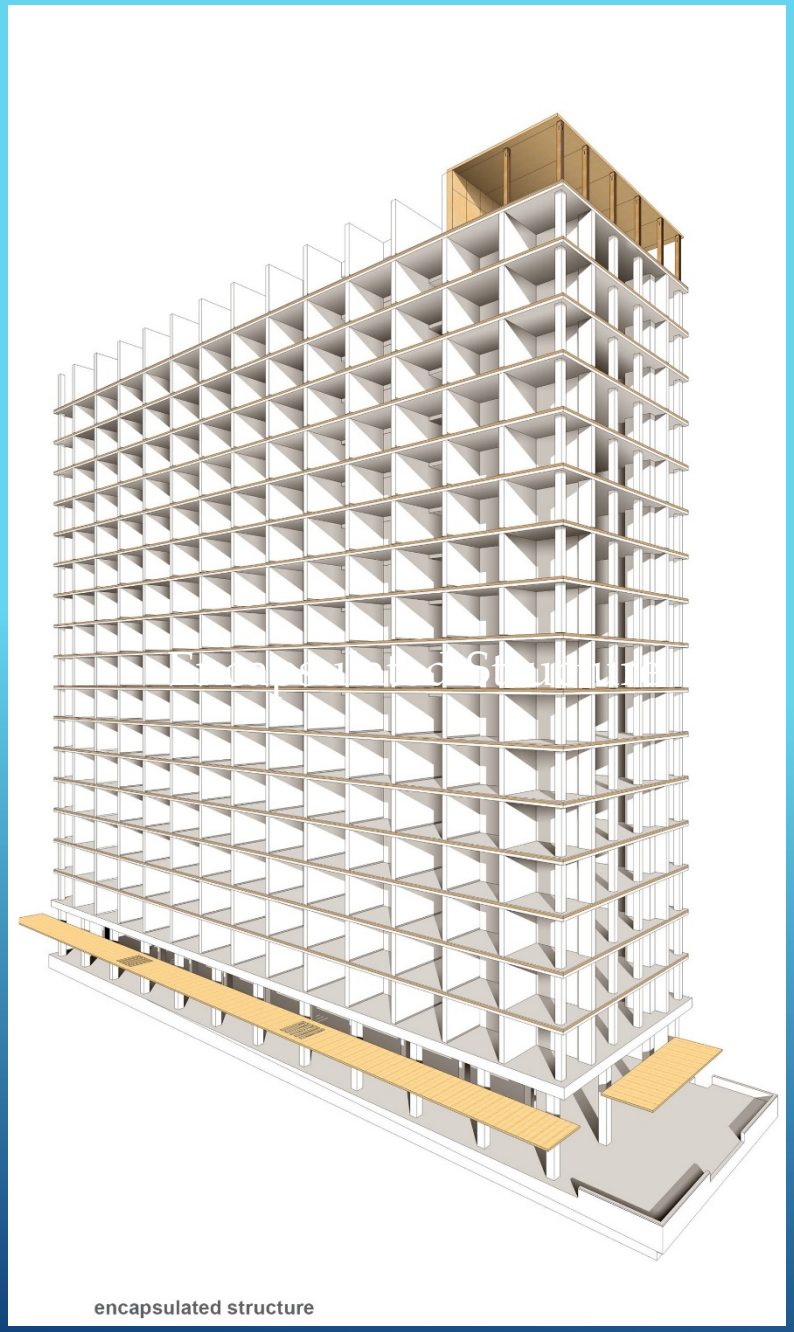
completed construction

Partial Encapsulation during construction



Completed Encapsulation

Encapsulated Structure



Key Safety Requirements – Mass timber Building Construction

Protection During Construction of the Building

The changes made to the National Building Code-2019 Alberta Edition (NBC(AE)) and National Fire Code-2019 Alberta Edition (NFC(AE)). The Fire Code address high-intensity residential fires in 2009 established site security measures to protect the building against accidental or deliberate ignition of fire as well as hazard protection for the public.

The national standards for Mass timber buildings of up to 12 storeys maintain protection during construction of the building and establish even better protection standards while the building is under construction.

The building may only be occupied once fire safety features are fully enabled.

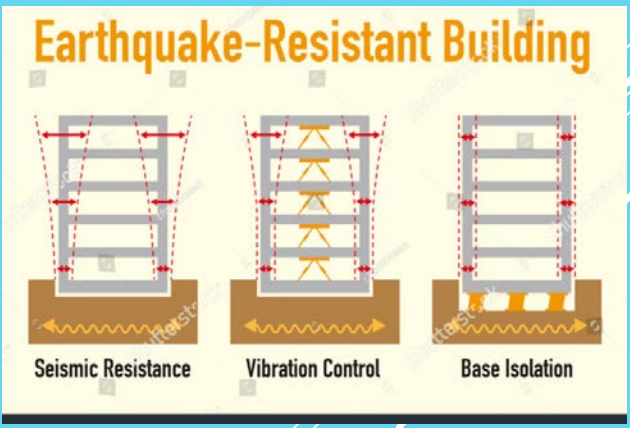
Mandatory Sprinkler Systems

Mandatory sprinklering apply to balconies and concealed spaces in residential buildings.

Requirements for Mass timber building construction are consistent with this expanded protection, using the National Fire Protection Association (NFPA) 13 standard for sprinkler systems.

Fire rating for roofing Covering

To prevent fire growth and the spread of fire across the roof covering, which could lead to the spread of fire to occupied parts of the building. Class A roofing is required.

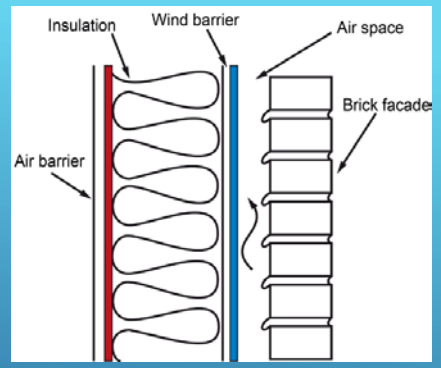


Structure and Earthquake Design

The national requirements reduce the risk of sway-storey seismic behaviour that can lead to building collapse.

Sealing and Drainage

The standards require designers to consider wood shrinkage in their designs to protect against moisture penetration of the wall and roof system or the building envelope.



Emergency Power

The duration of emergency power for fire alarm and emergency lighting is increased from 30 minutes to 1 hour for buildings.

Prohibitions on Certain Types of Mixed Uses

These standards prohibit combining residential with other commercial uses at the upper storeys, to reduce the fire load and risk of fire to the occupants.

At the lower storeys, mixed use is permitted.

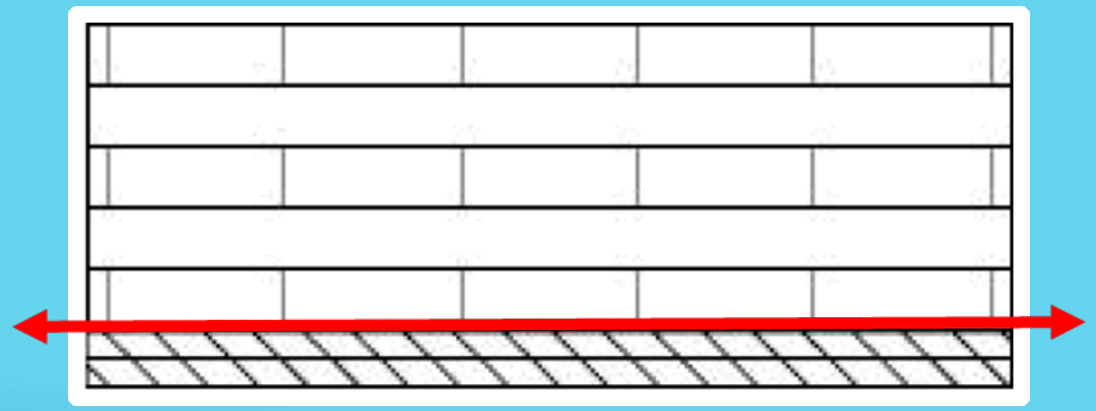
Strength of modern mass timber design vs. concrete

Despite being five-times lighter than concrete, Cross Laminated Timber (CLT) has comparable strength per weight ratio to concrete and the multi-layer wooden panel spans in two directions. Each layer is placed cross-wise to the adjacent layers to increase its stability and strength. Buildings using mass timber carry the same strength as concrete. This strength also enables mass timber buildings to commonly outperform other systems in terms of cost and life safety in earthquake zones.

Encapsulated Mass Timber Construction

This is a basic method for protecting all construction materials from fire. It can delay the thermomechanical effects of fire on structural elements, as in the case of traditional noncombustible construction, as well as delay the contribution of wood structural elements to the fire.

Encapsulated Mass Timber Construction



Encapsulation rating not less than <u>50 minutes</u>

- **2 layers of Type X gypsum board each not less than 12.7-mm-thick,**
- **Not less than 38-mm-thick gypsum-concrete or concrete topping, or**
- **Other noncombustible material or assembly of materials that provides an “encapsulation rating” of at least 50 minutes**

Encapsulated Mass Timber Construction

Mass Timber:

Minimum size requirements for structural timber elements to be considered "mass timber"

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 *fire separations* or exterior walls (1-sided exposure)	96	-
Walls that require a *fire-resistance rating*, but are not *fire separations* (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

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

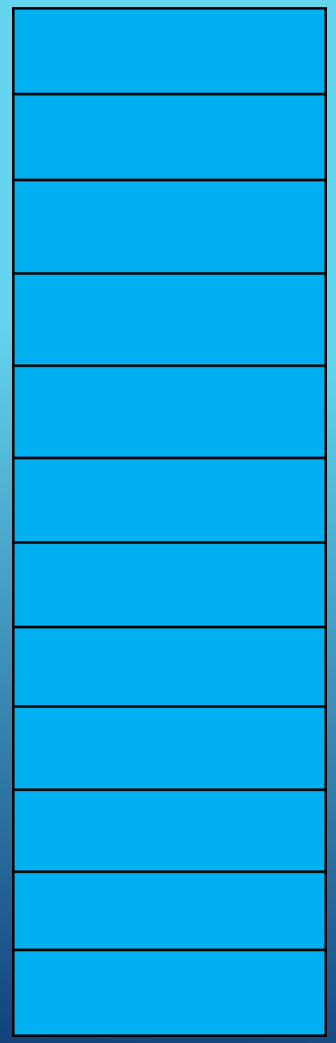
Occupancy Classification of *Building* or *Fire Compartment*	Maximum Area of *Unprotected Openings* Permitted, % of *Exposing Building Face* Area	Minimum Required *Fire-Resistance Rating*	Type of Construction Required	Type of Cladding Required
Group A, Division 2, C, D, or Group F, Division 3	0 to 10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

Encapsulated Mass Timber Construction

Requirements:

- Limited height of 12 storeys
- Sprinklered throughout to NFPA 13
- 2 hour fire-resistance rating
- Limited maximum building area (for any height):
  - Group C: 6,000 m^2 per storey
  - Group D: 7,200 m^2 per storey

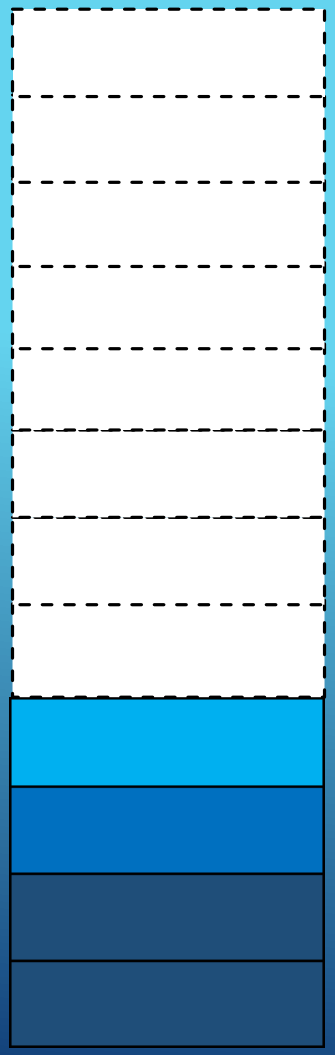
Encapsulated Mass Timber Construction



Permitted – all storeys:

- Group C
- Group D

Encapsulated Mass Timber Construction

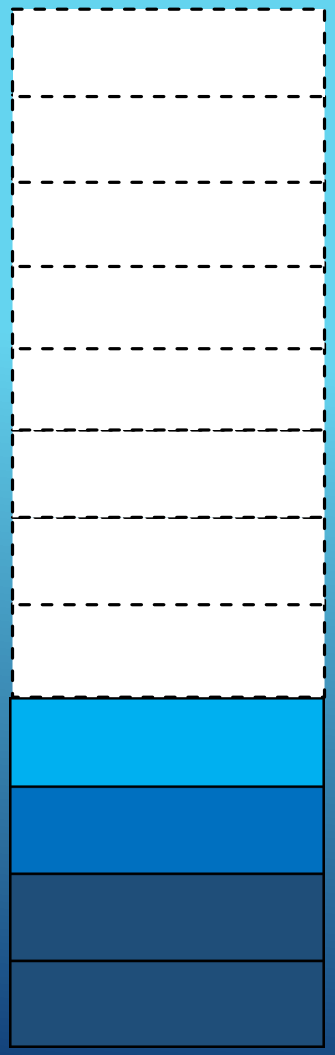


Permitted with Group C:

- Group E – 1st & 2nd storeys
- Group A, Division 2 - 1st, 2nd & 3rd storeys
- Storage garages – below 5th storey

- Increased fire-resistance rating for separation between some major occupancies

Encapsulated Mass Timber Construction

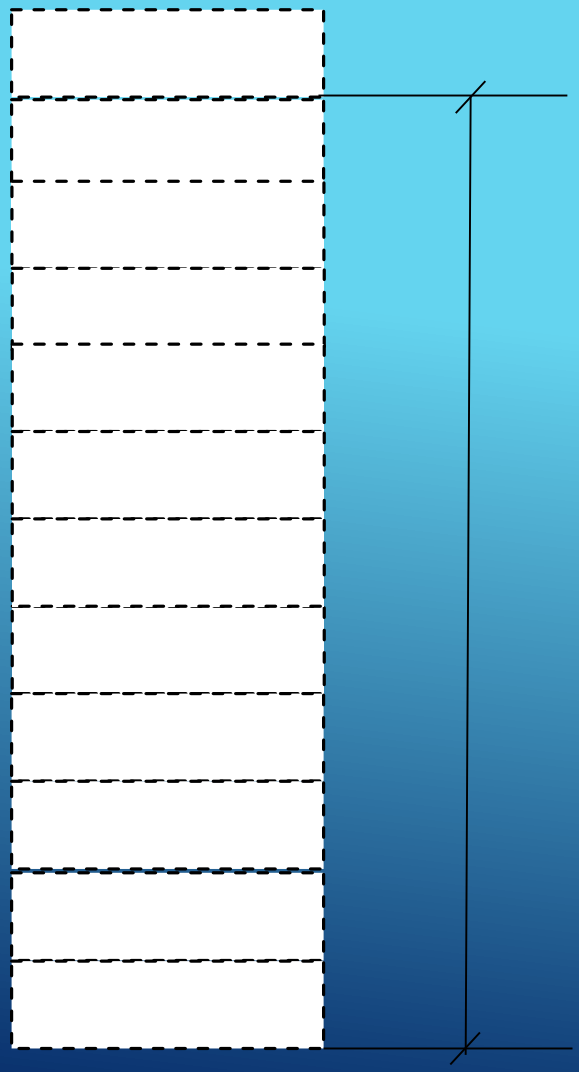


Permitted with Group D:

- Group E – 1st & 2nd storeys
- Group F, Division 2 or 3 – 1st & 2nd storeys
- Group A, Division 2 - 1st, 2nd & 3rd storeys
- Storage garages – below 5th storey

- Increased fire-resistance rating for separation between some major occupancies

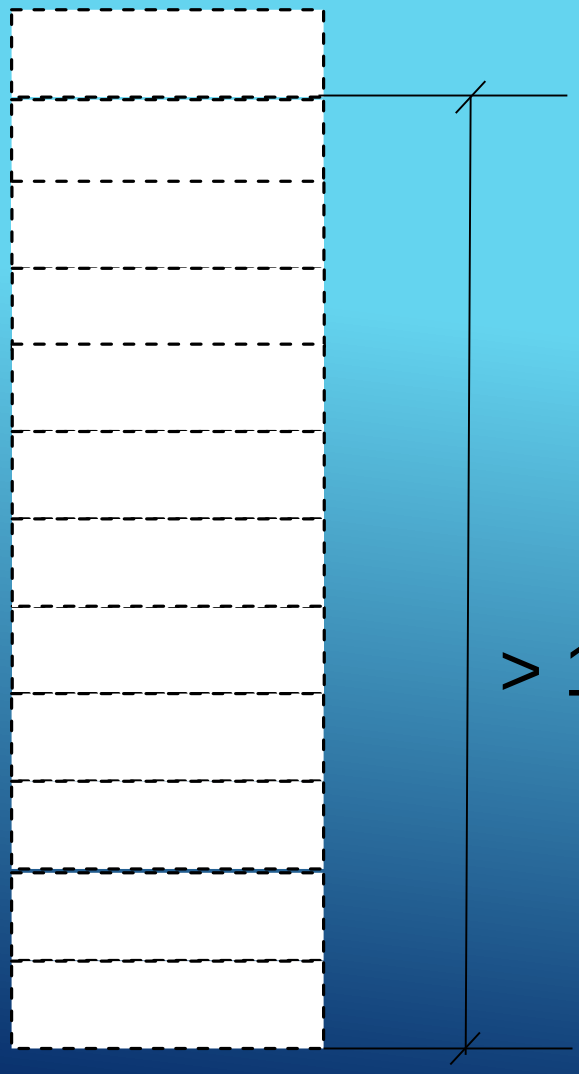
Encapsulated Mass Timber Construction



≤ 42 m

Limit height of uppermost floor level to 42 m above 1st floor

Encapsulated Mass Timber Construction



Requirements for high buildings applicable to EMTC buildings in which the floor level of the highest storey is more than 18 m above grade.

Encapsulated Mass Timber Construction

Additional Requirements:

- **Materials Permitted shall conform to Subsection 3.1.5. or these requirements for EMTC:**
  - **Combustible Roofing Materials**
  - **Combustible Window Sashes and Frames**
  - **Exterior Cladding**
  - **Combustible Components in Exterior Walls**
  - **Nailing Elements**
  - **Combustible Flooring Elements**
  - **Combustible Stairs**
  - **Combustible Interior Finishes**
  - **Combustible Elements in Partitions**
  - **Concealed Spaces**

Encapsulated Mass Timber Construction

Exterior Cladding:

- **Noncombustible exterior cladding**

or/and

- **Tested in accordance with CAN/ULC-S134, “Fire Test of Exterior Wall Assemblies”**

or/and

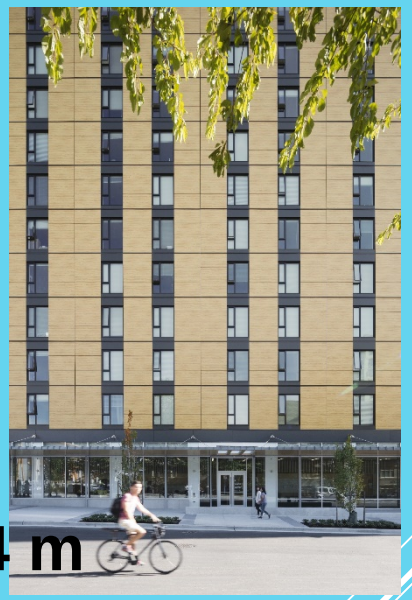
- **Three approaches for combustible cladding**

Encapsulated Mass Timber Construction

Exterior Combustible Cladding:

- Approach 1
  - Represents not more 10% on each storey
  - Not contiguous over more than 4 storeys
  - Not more than 1.2 m in width
  - Separated from other portions on the same storey by 1.2 m
  - Separated from other portions on adjacent storeys by 2.4 m
  - Flame-spread rating not more than 75

Encapsulated Mass Timber Construction

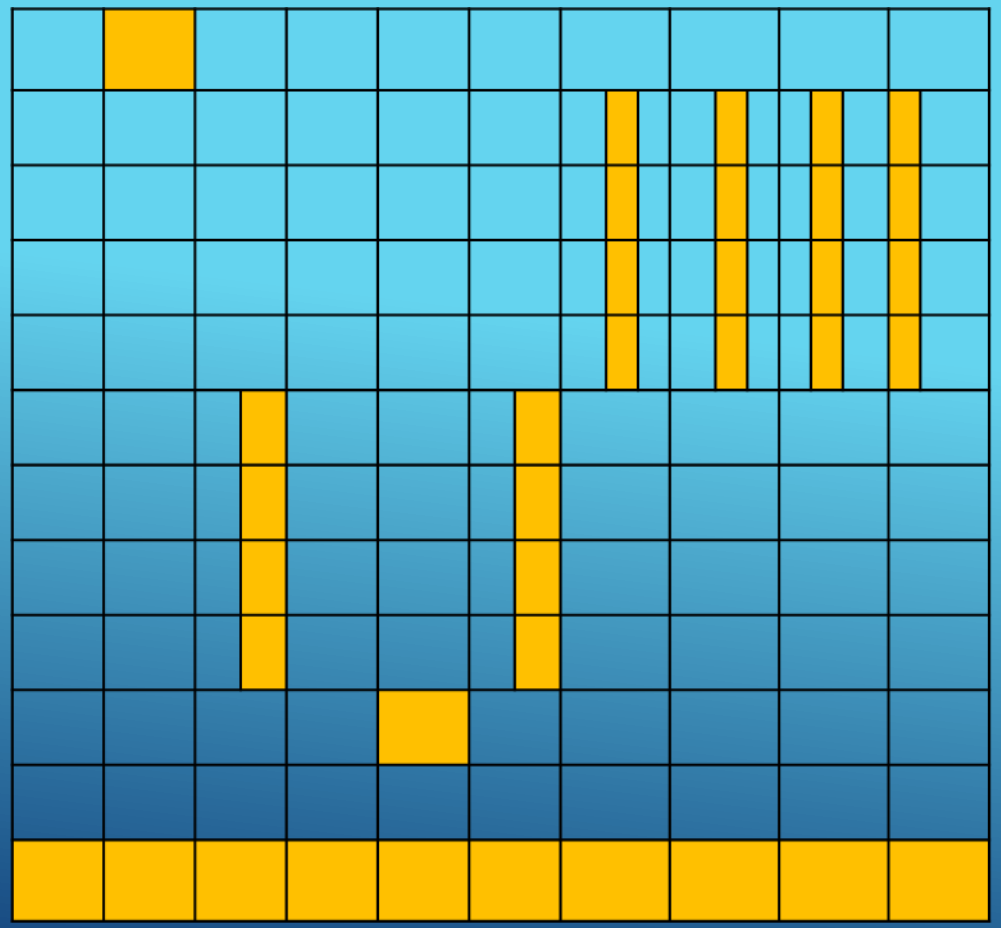


Exterior Combustible Cladding:

- Approach 2
  - Represents not more 10% on each storey
  - Not contiguous across adjacent storeys
  - Separated from other portions on adjacent storeys by 2.4 m
  - Flame-spread rating not more than 75
- Approach 3
  - Represents up to 100% of the first storey
  - Located not more than 15 m from a street or access route

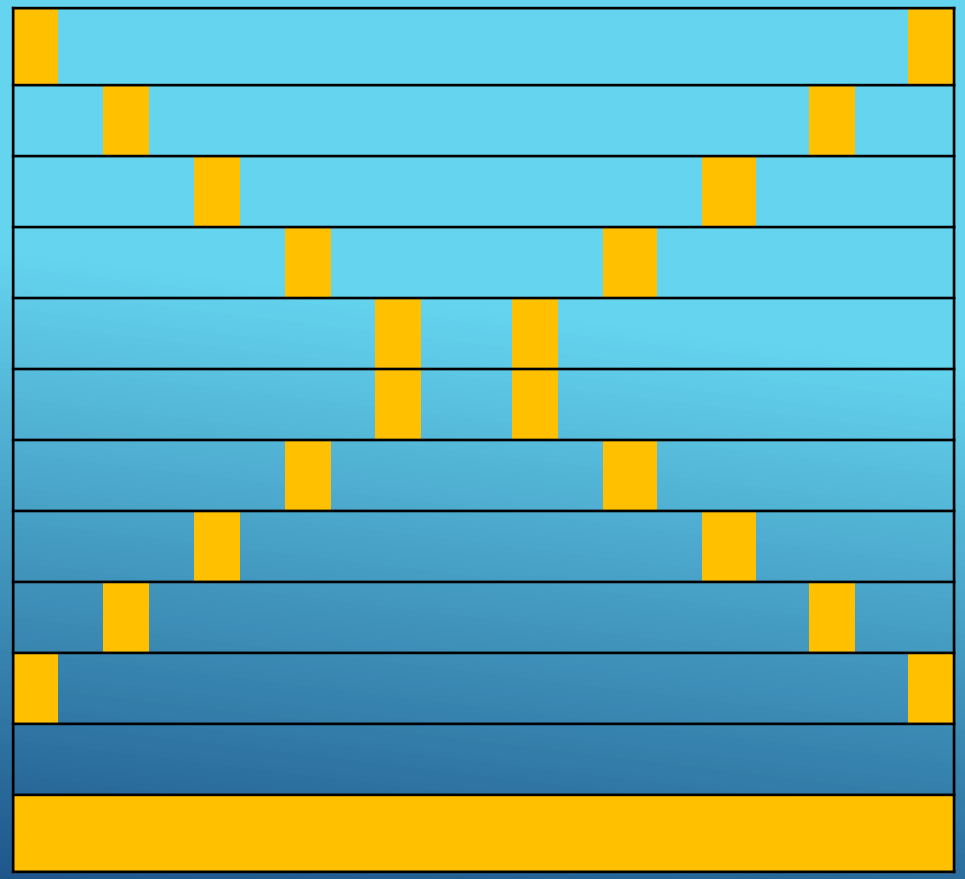
Encapsulated Mass Timber Construction

Exterior Combustible Cladding:



Encapsulated Mass Timber Construction

Exterior Combustible Cladding:



Encapsulated Mass Timber Construction

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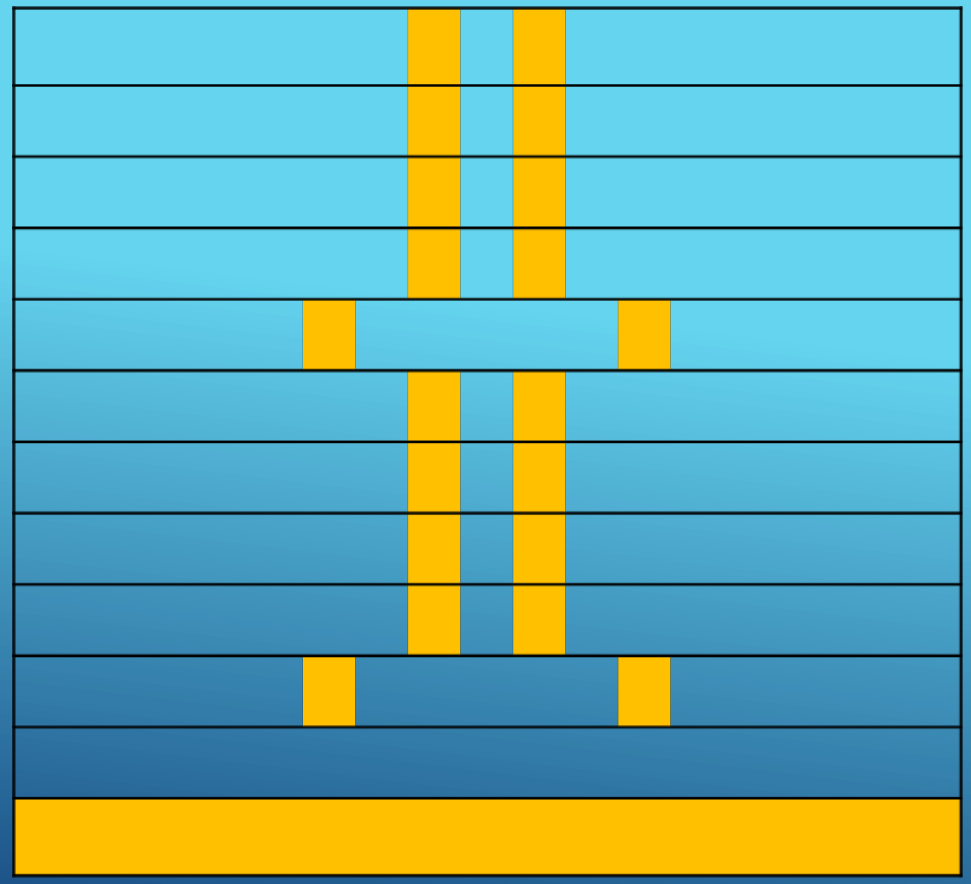

ENCAPSULATED MASS TIMBER CONSTRUCTION

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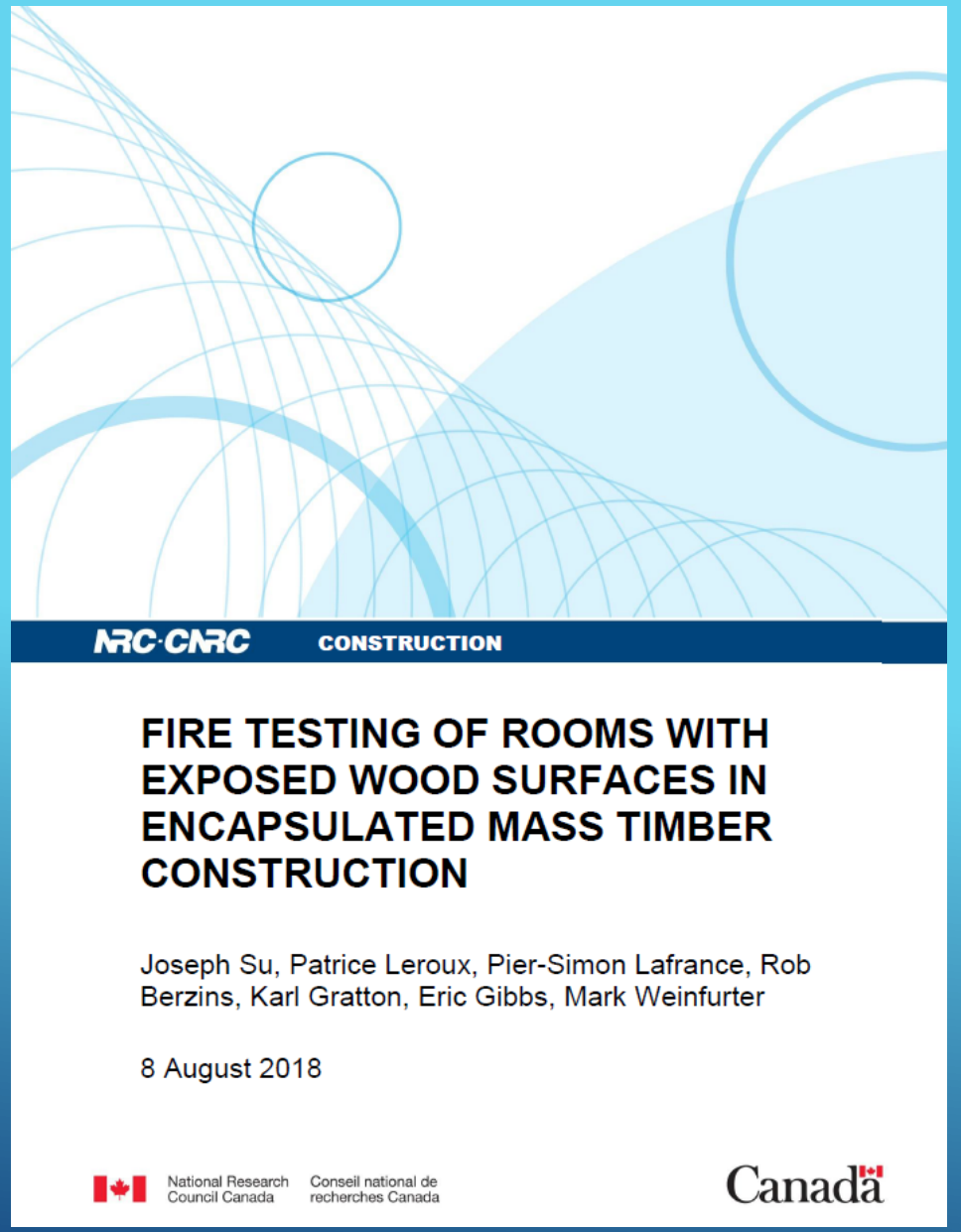

Fire Testing of Rooms with Exposed Wood Surfaces in Encapsulated Mass Timber Construction

Fire Testing of Rooms with Exposed Wood Surfaces in Encapsulated Mass Timber Construction

fire load

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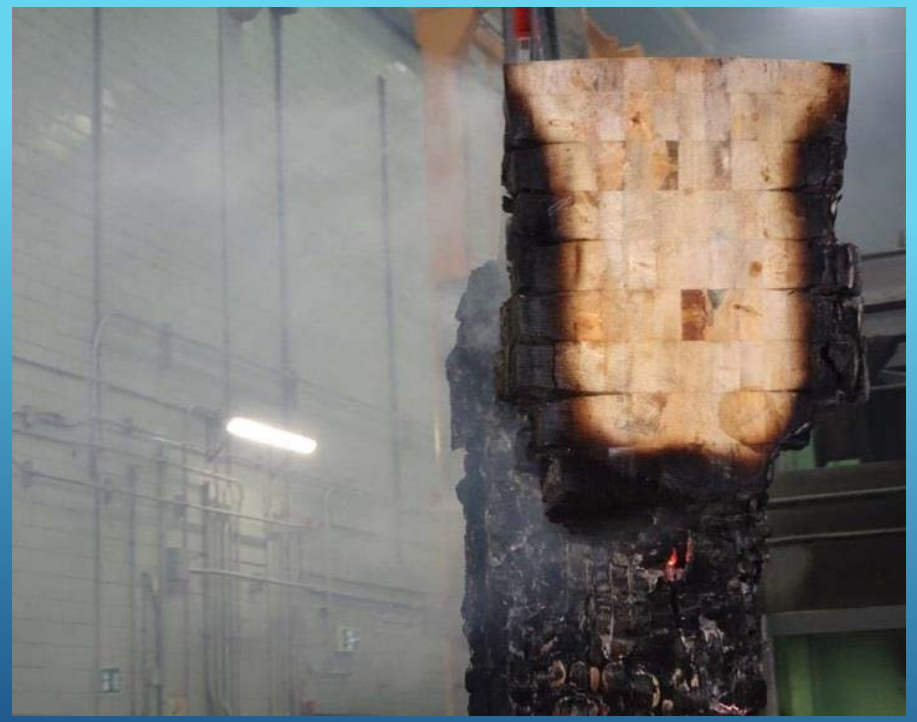


Fire Testing of Rooms with Exposed Wood Surfaces in Encapsulated Mass Timber Construction

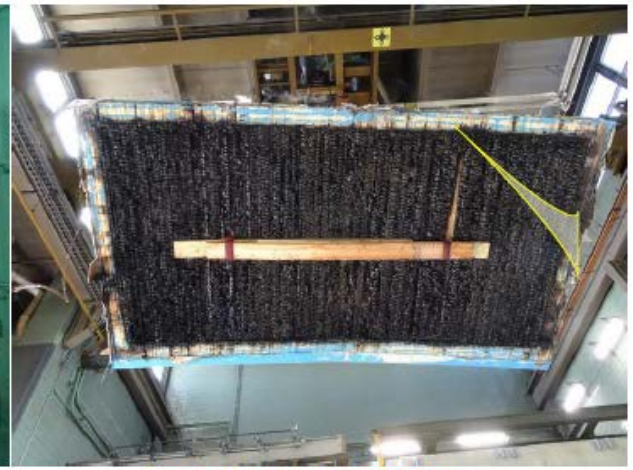
Fire Testing of Rooms with Exposed Wood Surfaces in Encapsulated Mass Timber Construction

Nail Laminated Timber Compartment Fire Tests

Nail Laminated Timber Compartment Fire Tests

Nail Laminated Timber Compartment Fire Tests

(a) NLT exterior (gypsum board removed)



(b) NLT ceiling (interior)

(c) Wall A (interior gypsum board removed)

(d) Wall B (interior)

12 STOREY EMTC
STANDATA USERS
GUIDE
106 PAGES
INCLUDES HYPERLINKS
FROM THE STANDATA

Wires and Cables in an EMTC Building

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).

NBC(AE)
3.1.5. Noncombustible Construction

NBC(AE)

3.1.5.21. Wires and Cables
1) Except as required by Sentence (2) and Article 3.1.5.22., optical fibre cables and electrical wires and cables with *combustible* insulation, jackets or sheathes are permitted in a *building* required to be of *noncombustible construction*, provided
a) the wires and cables exhibit a vertical char of not more than 1.5 m when tested in conformance with the Vertical Flame Test – Cables in Cable Trays (FT4 rating) in CSA C22.2 No. 0.3, "Test Methods for Electrical Wires and Cables,"

b) the wires and cables are located in

i) totally enclosed noncombustible raceways (see Note A-3.1.4.3.(1)(b)(i)),

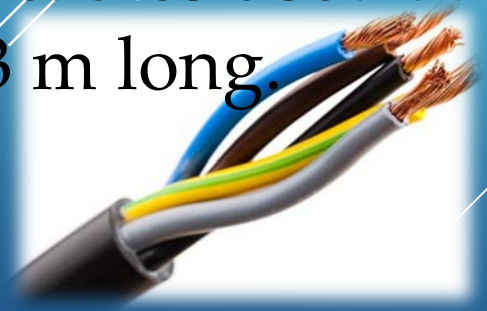
ii) masonry walls,

iii) concrete slabs,

iv) a service room separated from the remainder of the building by a fire separation having a fire-resistance rating not less than 1 h, or

v) totally enclosed non-metallic raceways conforming to Clause **3.1.5.23.(1)(b),** or

c) the wires and cables are communication cables used at the service entry to a building and are not more than 3 m long. (See Note A-3.1.5.21.(1).)



Encapsulated Mass Timber Construction

Some mass timber surfaces permitted to remain exposed within a suite:

Exposed mass timber element	Max aggregate surface area as a percentage of the total		Flame spread rating	Other requirements
	Wall area of the perimeter of the suite	Ceiling area		
Beams, columns and arches	10%	-	150	Also permitted in a *fire compartment*
Walls	35%	-	150	Surfaces face the same direction
Combined beams, columns, arches and walls	35%	-	150	Wall surfaces face the same direction
Ceilings (option 1)	-	10%	150	Exposed B/C/A and walls permitted
Ceilings (option 2)	-	25%	75	No exposed walls

Encapsulated Mass Timber Construction

FIRE SAFETY

Requirements:

- **Damage or Removed Encapsulation Materials**
  - **They shall be repaired or replaced so that the encapsulation rating of the materials is maintained.**

- **Additional requirements in Subsection 5.6.3. NFC(AE) on construction site fire safety to be applied:**
  - **Construction Access**
  - **Standpipe Installation**
  - **Protective Encapsulation**
    - **4 storeys are permitted to be unprotected**
    - **Minimum of 25 min encapsulation rating is needed on (1 layer of 12.7 mm Type X gypsum board):**
      - **80% of the total area of mass timber ceilings**
      - **65% of the total area of mass timber walls**

Encapsulated Mass Timber Construction
FIRE SAFETY

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).

Encapsulated Mass Timber Construction

FIRE SAFETY

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….

4.9 At least two stairways conforming to Item 4.8 shall be a) extended upward as each floor is installed in new construction, or
b) maintained for each floor still remaining during demolition.

Encapsulated Mass Timber Construction

FIRE SAFETY

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).

18 Storey Brock Commons Tallwood House-UBC

9 Week Time Lapse of the Encapsulated Mass Timber Construction portion of the building

Week 1

Week 2


Week 3

Week 4

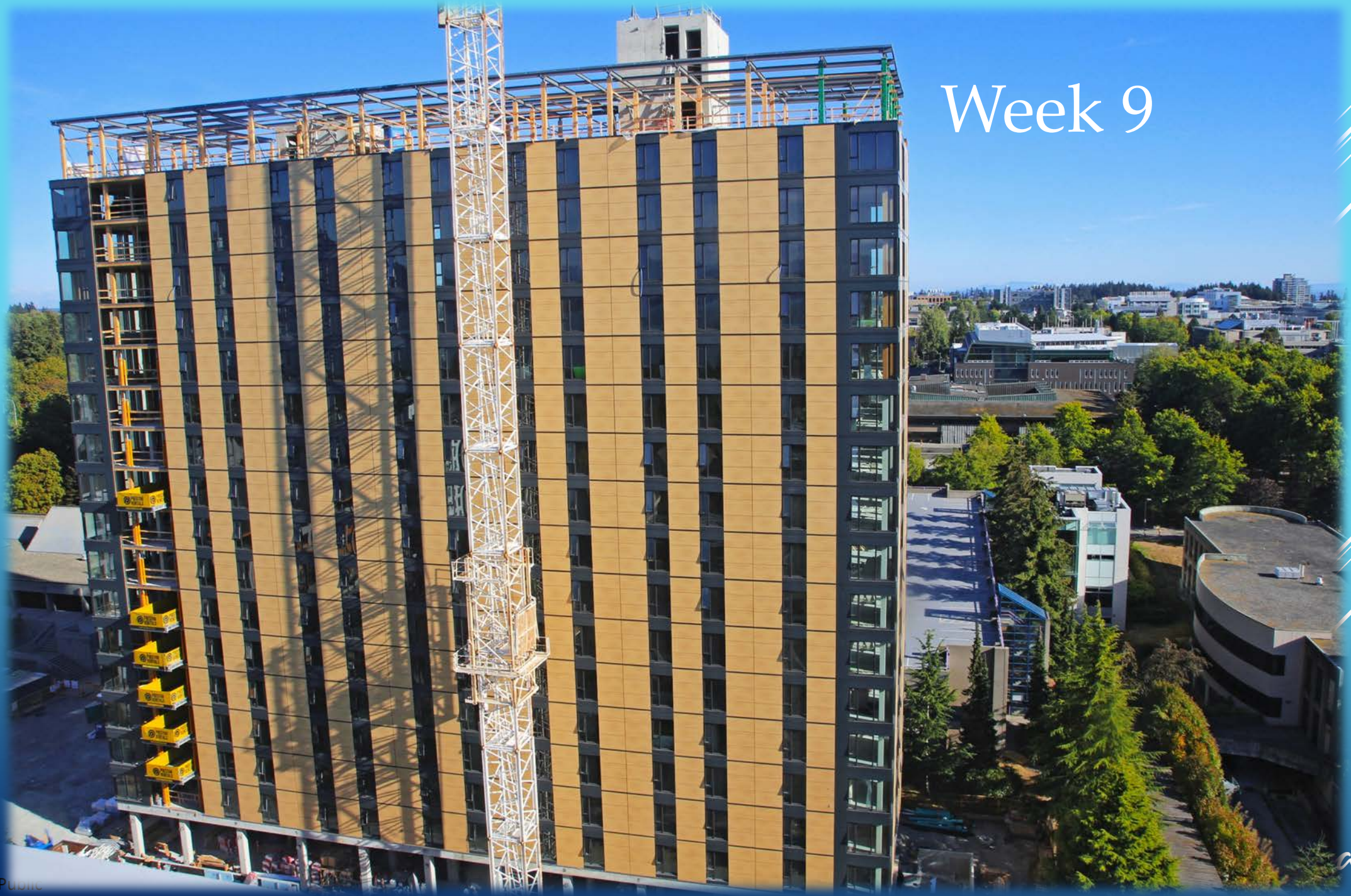
Week 5

Week 6

Week 7

Week 8

Week 9



Brock Commons Tallwood House photo credits

Courtesy of Acton Ostry Architects Inc

EMTC Fire Tests photo credits & additional content Courtesy of the Canadian Wood Council

THANK YOU

Questions

E-mail :

safety.services@gov.ab.ca

Phone :1.866.421.6929

Note: Due to new protocols Phone calls go to Voice Mail and then forwarded to the appropriate Duty Officer via email.

Presented By:
Paul Chang
Provincial Building Administrator

Alberta