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ADVANCING TALL WOOD BUILDINGS WITHIN CANADIAN PROVINCIAL BUILDING CODES

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ABSTRACT: Mass timber is swiftly becoming the preferred choice for structural building components in innovative, sustainable, and aesthetically pleasing tall building projects as it offers a durable, cost-effective, and low-carbon alternative to conventional construction materials. The 2020 edition of the National Building Code of Canada (NBCC) introduced "encapsulated mass timber construction" (EMTC) as a new construction type, allowing residential and office buildings to be erected up to 12 storeys in height. Since then, industry professionals across Canada have expressed a keen interest in expanding the applicability of EMTC to a wider range of occupancies and building sizes, aspiring to achieve greater design flexibility while realizing the full economic and environmental benefits of mass timber construction. Although new editions of the NBCC are published every 5 years, the expansion of prescriptive EMTC Code provisions was postponed to 2030 due to resource constraints during the shortened 2020-2025 Code development cycle. As Provincial governments in Canada have the authority to regulate building design and construction within their jurisdictions, several provinces agreed to jointly expedite the development of expanded EMTC Code provisions to meet growing needs, ahead of, and outside, the National Code framework. This paper summarizes the newly expedited building Code changes for the design and construction of EMTC buildings, as accepted by participating provinces, and discusses the underlying justification used to support them.

KEYWORDS: tall wood buildings, encapsulated mass timber construction

1 – INTRODUCTION

In order to limit the potential contribution of structures to fire growth and spread, the National Building Code of Canada (NBCC) has historically restricted buildings of combustible construction to a maximum height of 6 storeys, requiring the use of noncombustible construction for buildings exceeding this limit [1]. The 2020 edition of the NBCC introduced "encapsulated mass timber construction" (EMTC) as a new construction type, which enabled the design and construction of tall wood buildings of Group C (residential) and Group D (business and personal services) major occupancies up to 12 storeys in building height, while maintaining an acceptable level of fire and life safety performance equivalent to similarly sized buildings of noncombustible construction [2]. Division A, Article 1.4.1.2. of the 2020 NBCC defines EMTC as the "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" [1]. Although the 2020 NBCC does not formally define "tall wood building" or "mass timber", the former generally refers to a building measuring at least 7 storeys high and constructed of mass timber as the primary structural material [3]; and the latter is an umbrella term used to describe a family of large cross-section engineered wood products such as structural composite lumber (e.g., laminated veneer lumber, parallel strand lumber, laminated strand lumber, and oriented strand lumber), mass timber plywood, cross-laminated, glued-laminated, nail-laminated, and dowel-laminated timber, to name a few [4].

Several case studies have been published for some notable tall wood building projects both internationally and domestically. Some Canadian projects include the *Brock Commons Tallwood House* (Fig. 1), an 18-storey student residence at the University of British Columbia in Vancouver which was the world's tallest hybrid mass timber building at the time of completion [5], and the *Limberlost Place* (Fig. 2), Ontario's first net-zero institutional 10-storey mass timber building located on the George Brown College campus in Toronto [6].

Figure 1. Photograph of the Brock Commons Tallwood House under construction (image courtesy of naturally:wood ®).

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Figure 2. Architectural rendering of the Limberlost Place [6].

These case studies have unequivocally accentuated the compelling benefits of building with mass timber, illustrating its evolution from an emerging technology to the preferred choice for structural building components in state-of-the-art construction projects worldwide. More specifically, mass timber has demonstrated the following key advantages over conventional construction materials such as steel and concrete:

- *Significant reduction in the carbon footprint of the built environment:* Mass timber buildings exhibited up to 50% reduction in embodied carbon compared to concrete buildings [7] and achieved 19% reduction in carbon emissions compared to the functionally equivalent steel structures [8],

- *Improved return on investment facilitated by ease of installation:* The prefabrication of mass timber panels and advanced fastener technology can provide developers with construction schedule and labour cost savings of up to 25% and 43%, respectively, over comparable noncombustible buildings [9], and

- *Increased levels of positive semantic response driven by affinity to biophilic architecture:* The aesthetic and experiential appeal of exposed mass timber in the built environments significantly improves restorative and physiological responses, fostering higher levels of occupant wellbeing, comfort, and productivity [10, 11].

Global recognition of the economic, environmental, and physio-psychological benefits of mass timber has urged industry professionals across Canada to express a keen interest in expanding the applicability of EMTC to a broader range of occupancies and building sizes, aiming to achieve greater versatility and flexibility for project design, construction, and occupancy experiences. However, the expansion of prescriptive EMTC Code provisions in the NBCC was deferred to 2030 due to time constraints and limited staff availability during the 2020-2025 Code development cycle. Since Provincial governments in Canada have the authority to regulate building design and construction within their respective jurisdictions, the provinces of British Columbia, Ontario, and Québec agreed to form a joint Expert Technical Advisory Group – Harmonized Variations for Mass Timber (ETAG-HVMT) to promote expedited development and adoption of expanded EMTC Code provisions, operating parallel to the conventionally established National framework and in advance of the publication of the 2030 NBCC. At the time of writing this paper, the provinces of British Columbia and Ontario have published and adopted the 2024 editions of their respective building Codes, which are largely based on the 2020 NBCC with some province-specific variations, including the new set of prescriptive EMTC Code provisions developed under the ETAG-HVMT. Although *Régie du bâtiment du Québec*, which administers construction laws and regulations in the province of Québec, has not published a new version of the Québec Construction Code (QCC) since 2022, similar EMTC provisions that have already been adopted in the 2024 British Columbia Building Code (BCBC) and 2024 Ontario Building Code (OBC) are expected to come into effect in the newest edition of the QCC in early 2025.

This paper summarizes the ETAG-HVMT amendments to the 2024 editions of the BCBC (applicable as of April 5, 2024) and OBC (effective January 1, 2025), pertinent to the design and construction of EMTC buildings, with a particular focus on:

(a) *the broadened range of occupancy classifications* where mass timber can be used as the primary structural material,

(b) *new limitations on building height* as a function of major occupancy classification (i.e., principal occupancy for which the building is intended to be used) and the degree of required encapsulation,

(c) *permissions for increasing the amount of exposed mass timber surfaces* in select EMTC buildings,

(d) *revised exterior cladding requirements* based on the building height, and

(e) *the underlying justification* used to support the amendments described in items (a) to (d) above.

2 – BACKGROUND

2.1 CANADA'S MODEL BUILDING CODE DEVELOPMENT SYSTEM

The NBCC is a model Code that sets out the minimum technical requirements for the design and construction of buildings to address at least one of the following objectives: safety, health, accessibility, fire and structural protection of buildings, and environment. The provinces in Canada have the authority to regulate construction laws within their respective jurisdictions and may choose to adopt the NBCC with or without modifications to suit their unique geography, climate, industry practices, local government needs, and Provincial priorities. Once adopted or adapted by a province, the NBCC becomes a

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regulation, enforceable by authorities having jurisdiction (e.g., chief building official) whose legal powers and duties are established under the Provincial building act.

Since 1941, the National Research Council of Canada (NRCC) has been publishing new editions of the NBCC on a five-year cycle, with each Code cycle running from the release of the last edition to the expected publication time of the next edition [12]. During this period, anyone with an interest in the Codes can contribute to their development by submitting a Code change request. The Canadian Board for Harmonized Construction Codes (CBHCC), with support from Codes Canada (an administrative unit within the Construction Research Centre of the NRCC) is responsible for developing the NBCC's content. The governance system for the management of the model Code development is depicted schematically in Fig. 3. At each stage of the Code development process, as illustrated in Fig. 4, the CBHCC evaluates the technical and practical implications of the proposed Code changes relative to the scope, policy, and strategic priorities set by the Canadian Table for Harmonized Construction Codes.

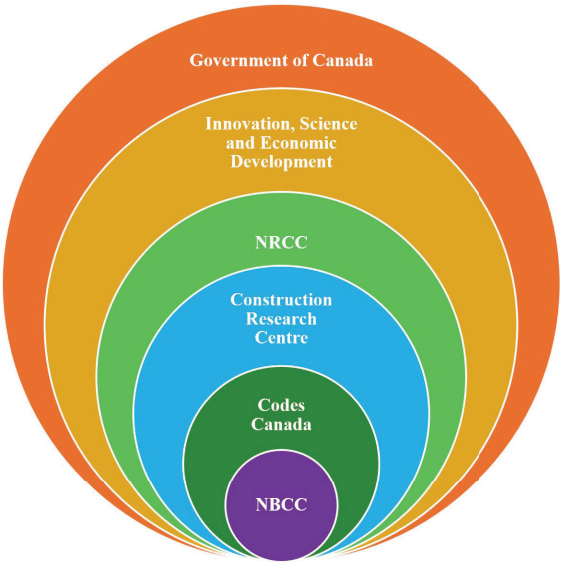

Figure 3. The hierarchical governance system for the management of the NBCC's development.

Typically, when a proposed Code change is deemed acceptable for inclusion in the model Code as a 'provision', it is documented in the next edition of the NBCC, followed by (voluntary) Provincial adoption of that provision. This process is commonly referred to as the 'National framework'.

The formation of ETAG-HVMT for promotion of the expanded use of EMTC showcases a unique pilot initiative wherein provinces' aligned interests to adopt a set of prescriptive Code provisions proceeded outside the conventionally established National framework.

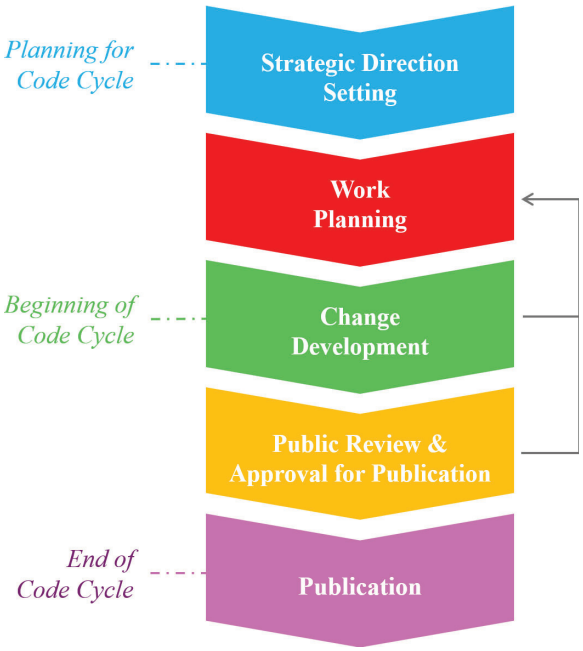

Figure 4. The National model Code development cycle.

2.2 ENABLING OPPORTUNITIES FOR TALL WOOD BUILDINGS

Use, occupancy, and construction

EMTC was introduced into the 2018 edition of the BCBC in September 2020 [13] and into the 2012 edition of the OBC in July 2022 [14]. Similar to the 2020 NBCC, both Provincial building Codes restricted the application of this novel construction type to tall wood buildings of only Group C and Group D major occupancy classifications and prescribed specific building and physical height and area limitations for such buildings, as detailed below:

- *Building height:* Building height (in storeys) is defined as the "number of storeys contained between the roof and the floor of the first storey" [1]. The 2018 BCBC and 2012 OBC mandated a building height limit of 12 storeys, with a physical height restriction of 42 m (138 ft), measured from the floor of the first storey to the uppermost floor level.

- *Building area (m^2):* Building area means "the greatest horizontal area of a building above grade within the outside surface of exterior walls or within the outside surface of exterior walls and the centre line of firewalls" [1]. EMTC buildings designed and constructed under either the 2018 BCBC or 2012 OBC were limited to a maximum building area of 6,000 m^2 (64,585 ft^2) for Group C and 7,200 m^2 (77,500 ft^2) for Group D major occupancies, regardless of intended building height.

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Encapsulation of structural mass timber elements

As mentioned previously, one of the key components of the encapsulated mass timber construction is the concept of "encapsulation". Encapsulation refers to the passive means of surface protection of structural mass timber elements against exposure to direct flame impingement and elevated temperatures and is intended to limit the effect of their potential contribution to the overall fire severity, including subsequent burning and fire spread within a storey. The time that an encapsulation material will delay the ignition and combustion of a protected structural mass timber element, under a specified fire condition, is known as "encapsulation rating". A more detailed description on how the encapsulation rating is determined can be found in [2].

The 2018 BCBC and 2012 OBC prescribed a minimum encapsulation rating of 50 minutes for the protection of structural mass timber elements such as beams, columns, arches, wall, floor and roof assemblies in both Group C and Group D EMTC buildings. These Provincial building Codes permitted the use of two layers Type X gypsum board each not less than 12.7 mm ($^1/_2$ in) thick and a minimum 38 mm thick ($1^1/_2$ in) gypsum-concrete or concrete topping to achieve this rating.

Allowance for exposed mass timber surfaces

The 2018 BCBC and 2012 OBC editions permitted certain structural mass timber elements to remain exposed, subject to various combinations of area and flame-spread rating limitations, as detailed below:

- *Mass timber beams, columns, and arches:* Portions of mass timber beams, columns, and arches were permitted to be exposed within a suite or a fire compartment provided (i) the total area of exposed surfaces did not exceed 10% of the total perimeter wall area of the suite or fire compartment; (ii) all exposed surfaces had a flame-spread rating of not more than 150; and (iii) the aggregate (i.e., combined) surface area of exposed mass timber beams, columns, arches, and *walls* was not more than 35% of the total perimeter wall area of the suite.

- *Mass timber walls:* Portions of mass timber walls were permitted to be exposed only within suites provided (i) all exposed wall surfaces faced the same direction (Fig. 5); (ii) all exposed surfaces had a maximum flame-spread rating of 150; and (iii) the aggregate (i.e., combined) surface area of exposed mass timber walls and *beams, columns, and arches* was not more than 35% of the total perimeter wall area of the suite.

- *Mass timber ceilings:* If a suite contained exposed mass timber *walls*, the surface area of exposed mass timber ceiling was limited to 10% of the total ceiling area of the suite, provided all exposed ceiling surfaces had a maximum flame-spread rating of 150. If there were no exposed mass timber *walls* within a suite, up to 25% of the total ceiling area of the suite was permitted to be exposed, provided all exposed surfaces had a flame-spread rating of not more than 75.

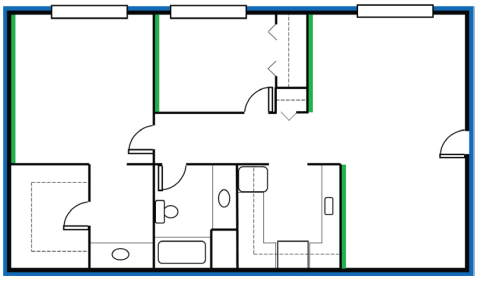

Figure 5. Example of a residential suite with exposed mass timber walls (green) as permitted by the 2018 BCBC and 2012 OBC [2].

All remaining portions of the mass timber beam, column, arch, wall, and ceiling surfaces that were not permitted to be exposed, were required to be protected from adjacent spaces in the building by a material having a minimum 50-minute encapsulation rating.

The need for expanded prescriptive opportunities

The introduction of EMTC into the 2018 BCBC and 2012 OBC has revolutionized the tall wood building industry in Canada, sparking and inspiring new perspectives for residential and office buildings, changing the way in which projects are designed, built, and experienced. This shift has prompted a growing demand from the Canadian design and construction community to further expand the applicability of EMTC to allow even greater design flexibility while maximizing the economic, environmental, and physio-psychological benefits of building with mass timber.

Under the 2018 BCBC and 2012 OBC, Code compliance for the design and construction of larger and taller mass timber buildings beyond the prescriptive limits, including any design proposals for increasing the amount of exposed mass timber surfaces in the finished building, were only available through the "alternative solution" pathway. Alternative solutions typically require significant resources and expertise, both for the designer (i.e., proponent) to develop and for the authorities having jurisdiction to evaluate. Moreover, such alternative solutions were not universally applicable, as their merit was evaluated on a project-by-project basis and could not be extended to another site or building without further investigation. As such, many Code users would continue to prefer to follow the prescriptive provisions of the building Codes, whether for simplicity, efficiency, cost-effectiveness, or a variety of other reasons, unless changes were made.

Acknowledgement of this pressing need to expand the prescriptive opportunities beyond the current limitations

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has spurred the urge to incorporate additional prescriptive solutions to permit the use of EMTC for other major occupancies with greater variations in building sizes as a function of the degree of encapsulation, and to increase the amount of mass timber surfaces that can remained exposed. As a point of reference, similar options for the design and construction of larger and taller mass timber buildings were also included in the United States by the 2021 edition of the International Building Code (IBC) [15], which have been primarily based on the same underlying fire research that had informed the development of the EMTC provisions in the 2018 BCBC and 2012 OBC.

3 – NEW PROVINCIAL BUILDING CODE PROVISIONS

This section outlines the ETAG-HVMT amendments adopted by the 2024 BCBC and 2024 OBC, which allow EMTC buildings to be constructed up to 18 storeys high as a function of the degree of encapsulation, broadening the occupancies where EMTC can be used as the primary construction material, increasing the amount of mass timber that can remain exposed in the finished building, and revising the exterior combustible cladding requirements for tall wood buildings based on their intended building height.

3.1 PERMITTED MAJOR OCCUPANCIES

The new provisions in the 2024 BCBC and 2024 OBC permit buildings of the following major occupancies to feature EMTC as the primary structural material, expanding on the previously permitted residential (Group C) and office (Group D) uses:

- *Group A, Division 2 (assembly occupancy):* e.g., art galleries, places of worship, libraries, schools, lecture halls, restaurants, gymnasia, community centres, and restaurants.
- *Group B, Division 3 (care occupancy without treatment):* e.g., residential care facilities, children's custodial homes, convalescent homes, and group homes for adult residents with developmental disabilities.
- *Group E (mercantile occupancy):* e.g., department stores, flea markets, shopping malls, supermarkets.
- *Group F, Division 2 (medium-hazard industrial occupancy):* e.g., aircraft hangars, abattoirs, bakeries, body shops, repair garages, and electrical substations; and
- *Group F, Division 3 (low-hazard industrial occupancy):* e.g., creameries, storage garages, and laboratories, wholesale rooms and workshops with low fire load.

Please note that buildings with Group C (e.g., apartments, student residences, hotels) and Group D (e.g., banks, beauty parlours, offices) major occupancy classifications are still permitted to be constructed of encapsulated mass timber construction in the 2024 editions of the BCBC and OBC.

3.2 NEW BUILDING SIZE LIMITATIONS

As in the previous editions of the Provincial Codes, buildings permitted to be of EMTC under the 2024 BCBC and OBC are also limited to specific heights and areas, as summarized in Table 1 below.

Table 1: Construction requirements for EMTC buildings in the 2024 BCBC and OBC.

Major Occupancy	Maximum Height (storeys)	Maximum Height	Maximum Area	Minimum Encapsulation Rating
Group A, Division 2	18	76 m (249 ft)	7,200 m^2 (77,500 ft^2)	70-minute
	12	51 m (167 ft)		50-minute
	6	26 m (85 ft)		0-minute
Group B, Division 3	10	42 m (138 ft)	8,000 m^2 (86,111 ft^2)	70-minute
	6	26 m (85 ft)		50-minute
	4	17 m (56 ft)		0-minute
Group C	18	76 m (249 ft)	6,000 m^2 (64,583 ft^2)	70-minute
	12	42 m (138 ft)		50-minute
	8	34 m (112 ft)		0-minute
Group D	18	76 m (249 ft)	7,200 m^2 (77,500 ft^2)	70-minute
	12	42 m (138 ft)		50-minute
	9	38 m (125 ft)		0-minute
Group E	12	51 m (167 ft)	6,000 m^2 (64,583 ft^2)	70-minute
	8	34 m (112 ft)		50-minute
	6	26 m (85 ft)		0-minute
Group F, Division 2	10	42 m (138 ft)	4,500 m^2 (48,438 ft^2)	70-minute
	7	30 m (98 ft)		50-minute
	5	21 m (69 ft)		0-minute
Group F, Division 3	12	51 m (167 ft)	7,200 m^2 (77,500 ft^2)	70-minute
	8	34 m (112 ft)		50-minute
	5	21 m (69 ft)		0-minute

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Maximum permitted EMTC building areas listed in Table 1 were determined in a similar fashion to those established for the original EMTC provisions in the 2020 NBCC [1]. These building areas were derived based on the largest building areas of the tallest sprinklered noncombustible buildings with 1-hour fire-resistance rated floors.

The EMTC building height limits listed in Table 1 have been largely based on the similarly sized buildings of Type IV-A, IV-B, and IV-C construction in the 2021 edition of the IBC with a careful, and in most cases, more conservative modifications. In the context of the IBC, building size limits for tall wood buildings (referred to as Type IV construction) were derived from historical values permitted for heavy timber construction, adjusted as a function of the degree of noncombustible protection (i.e., "encapsulation rating" in the Canadian context; see Section 3.3 of this paper for further discussions) wherein structural mass timber elements of:

- Type IV-A buildings are fully protected with no permission for exposed mass timber surfaces,
- Type IV-B buildings are partly protected with limited allowance for exposed mass timber surfaces, and
- Type IV-C buildings are permitted to be completely exposed and require protection only when they are located outside of a suite or fire compartment (e.g., in an exit stair shaft).

In addition to the above, members of the ETAG-HVMT concluded that the results of extensive fire research conducted since the adoption of the EMTC provisions in the 2018 BCBC and 2012 OBC [16–19], along with the development of a new material standard for cross-laminated timber [20], were adequate to support this new suite of expanded EMTC provisions for taller and larger buildings, while continuing to maintain an acceptable level of fire and life safety inherent to the Canadian building Codes. For example, regardless of the maximum building height or the minimum encapsulation rating listed in Table 1, all EMTC buildings are required to be provided with an automatic sprinkler system, designed, installed, and tested in conformance with NFPA 13 [21]. Additionally, floor assemblies within all EMTC buildings are required to be constructed as fire separations with a minimum 2-hour fire-resistance rating, and mezzanines shall have a fire-resistance rating of at least 1 hour. The fire-resistance rating of loadbearing assemblies, such as mass timber beams, columns, arches, and walls, shall not be less than that prescribed for the supported assembly.

3.3 EXPOSED MASS TIMBER SURFACES

Similar to Type IV-A, IV-B, and IV-C construction in the 2021 IBC, and based on the same body of research that informed the development of expanded prescriptive provisions for taller and larger EMTC buildings listed in Table 1, the ETAG-HVMT members developed a tiered approach for a new suite of encapsulation requirements, based on the relative fire risk profiles associated with taller mass timber buildings. For example, structural mass timber elements in the "lower-risk" EMTC tier (i.e., where 0-minute encapsulation rating is allowed) are permitted to be fully exposed (i.e., unencapsulated) provided that the mass timber walls and ceilings within vertical service spaces (e.g., elevator shaft), public corridors, and exits are protected on the interior side with a material, or an assembly of materials, providing an encapsulation rating of 25 minutes. A single layer of minimum 12.7 mm ($^1/_2$ in) thick Type X gypsum board is deemed to achieve this encapsulation rating. Such level of protection reduces the likelihood of fire spread between storeys via the vertical service shafts and increases the performance of public corridors and exits to facilitate safe occupant egress throughout the entire building.

In buildings of "medium-risk" EMTC tier (i.e., where 50-minute encapsulation rating is required), structural mass timber elements are permitted to be exposed, which are reproduced from the Codes in Table 2. Unlike the previous editions of the BCBC and OBC, exposed mass timber wall surfaces are permitted even when the mass timber ceiling is fully (i.e., 100%) exposed. The same set of generic materials in the 2018 BCBC and 2012 OBC that were deemed to achieve a 50-minute encapsulation rating can still be used to demonstrate Code compliance with the 2024 BCBC and OBC.

Table 2: Summary of exposed mass timber surfaces permitted in "medium-risk" EMTC buildings in the 2024 BCBC and OBC.

Exposed Mass Timber Element		Maximum Aggregate Surface Area as % of the total…		Maximum Flame-Spread Rating
		perimeter wall area	ceiling area	
Beams, Columns & Arches (B/C/A)[(1)]		35%	–	150
B/C/A & Walls[(2)]		35%	–	150
Ceiling	Option 1[(1)]	–	10%	150
	Option 2[(1)]	–	25%	75
	Option 3[(3)]	–	100%	75

Notes to Table 2:
[(1)] also permitted in a fire compartment
[(2)] exposed walls to face the same direction or be separated by a minimum 4.5 m horizontal distance
[(3)] exposed B/C/A in Row 1 limited to maximum 20% and increased encapsulation rating for unexposed walls

Structural mass timber elements in tall wood buildings of "higher-risk" EMTC tier (i.e., where 70-minute encapsulation rating is required) shall be fully protected (i.e., encapsulated); that is, no permission for exposed mass timber surfaces is offered for the tallest EMTC buildings listed in Table 1. The 70-minute encapsulation rating can be achieved using two layers of Type X

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gypsum board, with each layer not less than 15.9 mm ($^5/_8$ in) thick. The encapsulation rating for the upper side of a mass timber floor assembly within a "higher-risk" EMTC tier is permitted to be 50 minutes.

3.4 EXTERIOR COMBUSTIBLE CLADDING

Historically, the BCBC and OBC have prescribed exterior cladding requirements based on the type of construction. This meant that even though an EMTC building constructed in conformance with either 2018 BCBC or 2012 OBC was only one storey in building height, the type of cladding permitted on the exterior wall assemblies of this building was restricted on the same basis as a 12-storey EMTC building, designed and constructed to the same prescriptive structural fire safety specifications (i.e., sprinklered building with 2-h fire-resistance rated floors). However, as implied by the existing provisions of the Codes the risk of external fire spread (i.e., along the exterior of a building) associated with the use of combustible cladding tends to increase with increasing building height, and potentially, to a lesser degree as a function of building area. This concept has been further discussed in [22]. Therefore, given that the new EMTC building area limits listed in Table 1 are constant with the building height (for the same major occupancy classification), members of the ETAG-HVMT developed various options for regulating the fire performance of cladding materials based on the intended building height. These options provide a more direct alignment between the degree of combustibility of a cladding panel and the corresponding potential fire risk.

According to the 2024 BCBC and OBC, the exterior cladding on an EMTC building that measures:

- 13 or more storeys in building height, is required to be noncombustible (i.e., a material that meets the acceptance criteria of CAN/ULC-S114 [23]) or meet the permissions that would apply to the cladding on a building required to be of noncombustible construction, such as the cladding on exterior wall assemblies tested in accordance with CAN/ULC-S134 [24], or cladding materials that exhibit limited combustibility when tested to CAN/ULC-S135 [25].

- 7 to 12 storeys in building height, is permitted to be combustible, provided it satisfies at least one of the options reproduced from the Codes in Table 3.

- 5 or 6 storeys in building height, is permitted to be combustible, provided it makes up to 10% of the cladding on each exterior wall of each storey and has a maximum flame-spread rating of 75 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction.

- 4 storeys or less in building height, is permitted to be combustible (on all exterior wall assemblies of the building), provided it has a surface and cut-through flame-spread rating of not more than 75.

Table 3: Permissions for combustible cladding on 7- to 12-storey EMTC buildings, as per the 2024 BCBC and OBC.

Option	Contiguity	Aggregate Area Limit	Maximum Size of Individual Cladding Panels	Minimum Separation between Combustible Claddings
1[(1)]	not contiguous over more than 4 storeys	up to 10% of exterior cladding on each storey	1.2 m (4 ft) in width	1.2 m (4 ft) on the same storey, and 2.4 m (8 ft) on adjacent storeys
2[(1)]	not contiguous across adjacent storeys	up to 10% of exterior cladding on each storey	N/A	2.4 m (8 ft) on adjacent storeys
3[(2)]	first storey only	100% of exterior cladding	N/A	N/A
4	any combination of Options 1 through 3			

Notes to Table 3:
[(1)] maximum flame-spread rating of 75 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction
[(2)] all portions of combustible cladding shall be directly accessible within 15 m (49 ft) of a street or an access route as defined by the BCBC and OBC, measured horizontally from the face of the building

Exterior combustible cladding can be used in combination with a cladding panel that meets the specified acceptance criteria when tested in conformance with CAN/ULC-S114, CAN/ULC-S134, and/or CAN/ULC-S135. The permitted cladding combinations, as a function of EMTC building height, are summarized in Table 4.

Table 4: Permitted cladding materials for EMTC buildings in the 2024 BCBC and OBC.

Type of Cladding on an Exterior Wall Assembly	Building Height (storeys)			
	13+	7–12	5 & 6	1–4
CAN/ULC-S114	✓	✓	✓	✓
CAN/ULC-S134	✓	✓	✓	✓
CAN/ULC-S135	✓	✓	✓	✓
Combustible Cladding as per Division B, Sentence 3.1.6.9.(2)	×	✓	✓	✓
Combustible Cladding up to 10% on Each Storey	×	×	✓	✓
100% Combustible Cladding	×	×	×	✓

Legend:
✓ – permitted
× – not permitted

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Regardless of whether EMTC permits the use of exterior combustible cladding, the requirements for spatial separation and exposure protection might impose further limitations on the use of such cladding panels due to the building's location relative to property lines or adjacent buildings. In general, the closer a building is to a property line, centreline of a street, or an adjacent building, the more restrictive the permissions for combustible cladding and combustible components in exterior walls (e.g., framing, sheathing, insulation).

4 – CONCLUSION

This paper summarizes the expedited building Code changes accepted by select Provincial regulations, expediated ahead of, and parallel to, the conventionally established National Code development framework. Details of the Canadian model Code development system were explained along with a presentation of key Code changes adopted in the new 2024 editions of the British Columbia Building Code and the Ontario Building Code, addressing various design and construction aspects of tall buildings of encapsulated mass timber construction. The rationale used to justify the Provincial Code changes was also discussed.

5 – ACKNOWLEDGEMENTS

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6 – REFERENCES

[1] National Research Council of Canada. "National Building Code of Canada 2020." Ottawa, 2022.

[2] M. Alam and R. McPhee. "Tall Wood Buildings within the 2020 National Building Code of Canada." World Conference on Timber Engineering, Oslo, 2023, pp. 3007–3014.

[3] R.M. Foster, T.P.S. Reynolds, and M.H. Ramage "What is Tall Timber? Towards the Formal Classification of Timber as a Material of Tall Building Design." World Conference on Timber Engineering, Seoul, 2018.

[4] M. Gong. "Lumber-Based Mass Timber Products in Construction." in "Timber Buildings and Sustainability" (G. Concu ed.), IntechOpen, London, 2019, pp. 7–27.

[5] A. Fallahi. "Innovation in Hybrid Mass Timber High-Rise Construction: A Case Study of UBC's Brock Commons Project." Master's thesis, University of British Columbia, Vancouver, 2017.

[6] Moriyama Teshima Architects. "Sustainability Case Study Limberlost Place." (2023) accessed online at: https://mtarch.com/.

[7] M. Puettmann, F. Pierobon, I. Ganguly, H. Gu, C. Chen, S. Liang, S. Jones, I. Maples, and M. Wishnie. "Comparative LCAs of Conventional and Mass Timber Buildings in Regions with Potential for Mass Timber Penetration." Sustainability, vol. 13(24), 2021.

[8] M. Hemmati, T. Messadi, H. Gu, J. Seddelmeyer, and M. Hemmati. "Comparison of Embodied Carbon Footprint of a Mass Timber Building Structure with a Steel Equivalent." Buildings, vol. 14(5), 2024.

[9] J. Cover. "Mass Timber: The New Sustainable Choice for Tall Buildings." International Journal of High-Rise Buildings, vol. 9(1), 2020, pp. 87–93.

[10] W.D. Browning and C.O. Ryan. "Biophilic Design with Wood in British Columbia." Forestry Innovation Investment, Vancouver, 2024.

[11] P.D. Kremer, B. Abbasnejad, A. Ahankoob, and R. Wakefield. "An Assessment of the Quantifiable Effects for Expressed Timber Biophilic Treatments: A Case for Mass Timber Construction?" Mass Timber Construction Journal, vol. 7(1), 2024, pp. 31–47.

[12] J.W. Archer. "A Brief History of the National Buildings Code of Canada." National Research Council of Canada Report No. NRCC-46136, 2003.

[13] British Columbia Ministry of Municipal Affairs and Housing. "Building Act Ministerial Order No. BA 2020 7." Victoria, 2020.

[14] Ontario Ministry of Municipal Affairs and Housing. "O. Reg. 451/22: Building Code." Toronto, 2022.

[15] International Code Council Incorporated. "2021 International Building Code." Washington, 2020.

[16] L. Garis, J. Clare, and C. Biantoro. "Structure Fires in British Columbia: Exploring Variations in Outcomes as a Function of Building Height and Life Safety Systems." University of Fraser Valley, Abbotsford, 2019.

https://doi.org/10.52202/080513-0158

[17] D. Brandon, J. Sjöström, A. Temple, E. Hallberg, and F. Kahl. “Fire Safe Implementation of Visible Mass Timber in Tall Buildings – Compartment Fire Testing.” RISE Research Institutes of Sweden Report No. 2021:40, 2021.

[18] A. Zheng, L. Garis, and I. Pike. “Fire Severity Outcome Comparison of Apartment Buildings Constructed from Combustible and Non-Combustible Materials.” Fire Technology, vol. 58, 2022, pp. 1815–1825.

[19] J. Su, E. Gibbs, M. Weinfurter, P-S. Lafrance, K. Gratton, A. Frade, and P. Leroux. “Large-Scale Fire Tests of a Mass Timber Building Structure for MTDFTP.” National Research Council of Canada Report No. A1-018329.1/A1-018487.1, Ottawa, 2023.

[20] ANSI/APA PRG 320. “Standard for Performance-Rated Cross-Laminated Timber.” American National Standards Institute, New York, 2019.

[21] National Fire Protection Association. “NFPA 13 Standard for the Installation of Sprinkler Systems.” Quincy, 2019.

[22] D.J. O’Connor. “Chapter 86 The Building Envelope: Fire Sperad, Construction Features and Loss Examples” in SFPE Handbook of Fire Protection Engineering, 5th edition (M.J. Hurley et al., eds.), Society of Fire Protection Engineers, New York, 2016, pp. 3242–3283.

[23] Underwriters Laboratories of Canada. “CAN/ULC-S114 Standard Method of Test for Determination of Non-Combustibility in Building Materials.” Standards Council of Canada, Ottawa, 2018.

[24] Underwriters Laboratories of Canada. “CAN/ULC-S134 Standard Method of Fire Test of Exterior Wall Assemblies.” Standards Council of Canada, Ottawa, 2013.

[25] Underwriters Laboratories of Canada. “CAN/ULC-S135 Standard Test Method for the Determination of Combustibility Parameters of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter).” Standards Council of Canada, Ottawa, 2004.