



City of Richmond

Report to Committee

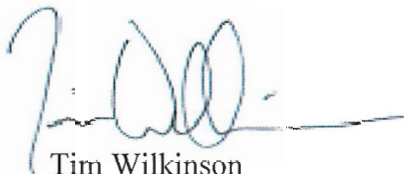
To: Planning Committee
From: James Cooper, Architect AIBC
Director, Building Approvals
Tim Wilkinson
Fire Chief
Date: June 7, 2019
File: 12-8360-01/2019-Vol
01
Re: Early Adoption of BC Building Code Provisions for 12 Storey Mass Timber
Construction

Staff Recommendation

1. That participation in the Province's program as identified in the report titled "Early Adoption of BC Building Code Provisions for 12 Storey Mass Timber Construction" dated June 7, 2019 from the Director, Building Approvals and the Fire Chief, Richmond Fire-Rescue be endorsed.
2. That staff be directed to consider mass timber construction for buildings only in those areas of the City Centre Area Plan where buildings up to a maximum of 35 m are permitted.

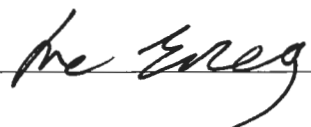




James Cooper, Architect AIBC
Director, Building Approvals
(604-247-4606)



Tim Wilkinson
Fire Chief
(604-303-2701)

Att. 3

REPORT CONCURRENCE		
ROUTED TO: Fire Rescue Development Applications Policy Planning	CONCURRENCE <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	CONCURRENCE OF GENERAL MANAGER 
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS: 	APPROVED BY CAO 

Staff Report

Origin

In March of 2019, the Province's Office of Housing and Construction Standards extended to the City of Richmond an invitation to participate in early adoption of new BC Building Code provisions allowing construction of buildings up to 12 storey using Encapsulated Mass Timber. These Code provisions permit the use of this innovative building system using wood in the construction of tall buildings. In order to participate in this Provincial program, Council approval is required.

Background

Mass timber is best described as engineered, solid wood building elements manufactured in dimensions that qualify as "heavy timber construction". The Encapsulated Mass Timber system adds further fire protection with fire resistant coverings and an automatic sprinkler system. The proposed Building Code provisions consider this building system as providing an equivalent level of safety as non-combustible construction within the 12 storey height limitation. It is important to note that this is not "wood frame or stick built construction" that is limited to 6 storey but rather heavy timber using solid wood beams, columns, load bearing walls and floor slabs that together comprise the structural system of the building.

The currently proposed system has been under consideration for taller building applications by building codes and jurisdictions throughout North America and Europe with present examples having been constructed in recent years. This building type is currently described in the 2020 version of the National Building Code (NBC) with the Province stating incorporation of those NBC sections into the next version of the BC Building Code.

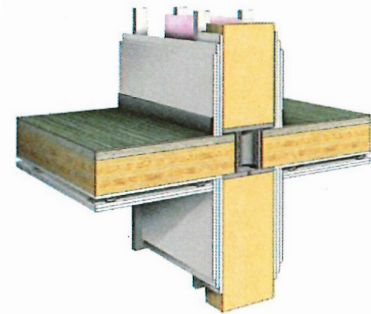


Figure 1: Encapsulated Mass Timber System incorporating fire protective coverings

Findings of Fact

Traditionally, taller and larger buildings have relied exclusively on steel and concrete classified as non-combustible construction to provide a level of fire safety that is commensurate to the size, height and occupant load of a building. Advancing technologies for innovative use of timber are enabling building departments provincially, nationally and internationally to either consider or adopt the Encapsulated Mass Timber system for use, with some restrictions, in construction formerly reserved for non-combustible construction.

The structural capacities of timber elements have increased markedly through innovative manufacturing techniques used for forming solid wood slabs, known as Cross Laminated Timber (CLT), from perpendicularly laminated layers to be used as load bearing floors and walls. In combination with other engineered wood beams and posts, and specially designed connectors, the structural forces experienced in tall buildings may be well managed within this type of wood building. Such technology



Figure 2: Cross Laminated Timber Slab

and design expertise have been demonstrated by built designs executed locally and internationally, notably by Canadian architects and engineers.

The fire safety of this building system has been demonstrated in conclusive studies performed by the National Research Council and Canadian Wood Council. Timber walls, posts, and beams with the minimum required thicknesses when cladded in fire resistant gypsum board passed all burn tests, remaining structurally intact. Testing in Europe, Japan and the United States has yielded similar results. Concluding from these tests, the International Code Council in the United States has recommended inclusion of this building system in the International Building Code for up to 18 storey buildings. The Province of Quebec presently has similar building code provisions as those being proposed in this report.

Brock Commons at the University of British Columbia is an 18 storey, local example constructed under a “Site Specific Regulation” approach based on engineering peer reviews. Recently completed, this students’ residence incorporates the Encapsulated Mass Timber approach and is the tallest mass timber building in North America. It demonstrates that the proposed construction system is practicable for buildings 12 storey and beyond.



Figure 3: Brock Commons, UBC, in Vancouver, BC

There are numerous other North American examples built or in design phase including office and residential towers between 10 and 12 storey in height. The applicable occupancies as proposed in the Code provisions would be residential, office, and mixed-uses on lower floors including assembly, retail shops and parking. A Norwegian example of a mixed-use tower at 18 storey and 85 m to the top of structure is currently the tallest wood structure building.



Figure 4: 10 storey office building in Portland, Oregon



Figure 5: 18 storey tower in Mjøstarnet, Norway

Richmond Fire and Rescue, Development Applications and Building Approvals departments concur with the approach described in the proposed BC Building Code amendments as derived from the National Building Code.

Analysis

Leadership

Early adoption of the proposed Building Code provisions would be consistent with the City of Richmond's leadership record of encouraging innovative technologies that reduce the carbon footprint of construction and improve the energy conservation of buildings. Richmond was the first municipality in BC to permit 6-storey wood frame construction, supporting the Province's innovation at that time by accepting enabling amendments to the 2008 version of the Building Code in advance of their adoption in the 2012 Building Code. Through this participation the City of Richmond is recognized as a regulatory leader managing the design, construction, and construction site safety issues in that construction typology, with staff having been asked to lecture at conferences for other jurisdictions throughout Canada.

Participation in the Encapsulated Mass Timber initiative aligns with Richmond's commitment and programs for a more sustainable community and furthers its leadership role in innovative construction.

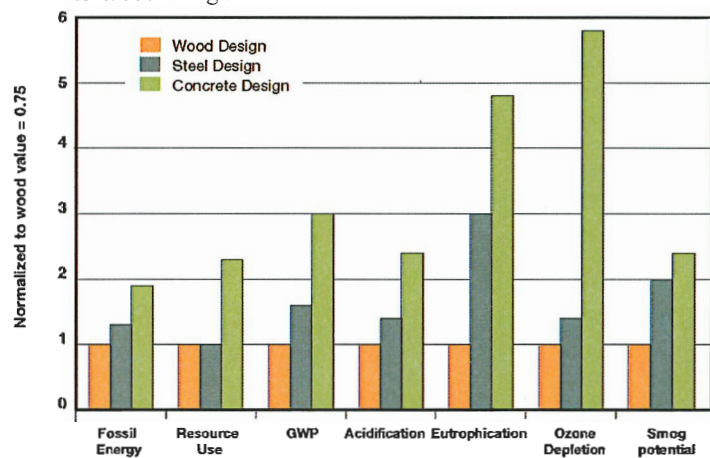
Sustainability

Mass timber construction offers unique advantages that relate to sustainability and constructability. In general it avoids the greenhouse gas emissions commonly associated with the manufacture of steel and concrete, and lowers the embodied energy and carbon footprint involved in a building's construction.

Wood as a building material has much less embodied energy in its manufacture than concrete or steel which involves the burning of large amounts fossil fuels, releasing commensurate amounts of carbon emissions and using large amounts of water. If harvested from forests managed under the Canadian Standards Association's (CSA) Sustainable Forest Management Standards, wood represents a source of renewable building materials that uses a smaller investment in energy and water resources.

Construction using this system would allow larger, taller buildings to be less taxing on primary resources, less polluting, and present a smaller investment in energy. There is also potential for improved operational energy performance as wood has higher natural insulation value compared to other structural materials. This is an advantage when wood elements can contribute to the overall insulation value of the building exterior while providing structural support.

Figure 6: Life Cycle Assessment of Construction Types Relative to Wood Design



Source: Canadian Wood Council – Dovetail Partners using Athena Calculator 2014

Seismic (Cost) Advantages

Technical advancements in timber structural systems make it possible to use wood in place of much heavier concrete to reduce the building's weight, and to address the lateral (seismic) and vertical forces experienced in tall buildings. The proposed system leverages advanced technology in the manufacture of cross-laminated timber slabs used for spanning floors and bearing walls, in conjunction with wood beams and posts. These elements together provide a high degree of confidence in structural designs that are capable of supporting tall buildings that are functional and light weight.

Currently, tall buildings in Richmond are typically constructed of reinforced concrete in order to address the horizontal loads experienced during an earthquake or high winds. By being comparatively lighter, a mass timber structure reduces the vertical and seismic loads that are ultimately carried by the foundation. Less heavy buildings result in lighter foundations that require less concrete and reinforcing steel, and are more suitable for Richmond's typically softer soils. In order to support heavy buildings on soft soils, "raft" concrete foundations from 5 to 8 ft thick are currently used in Richmond. It is anticipated that potentially, mass timber construction may achieve potentially very significant cost savings through reduced foundations. Other advantages of lighter buildings include less intense requirements for soil densification, as well as avoiding prolonged concrete pours that at times have proven to cause noise issues with surrounding neighbors.

Appropriate and Likely Building Forms in the City

The most suitable applications optimizing the use of Encapsulated Mass Timber will be for taller multi-family, mixed-use or office buildings in appropriately designated areas of the City Centre with maximum permitted heights up to 35 m and potentially 10 storey (see *orange areas* identified in the Attachment 2). Within these areas, the proposed wood construction system can achieve the same maximum permitted height and density as concrete and steel buildings, and be economically competitive. Industry advises that below 8 storey the mass timber system is not economically feasible compared to other construction typologies such as "stick-built" wood frame currently used for 6-storey multi-family buildings. Building Code limitations require buildings taller than 12 storey to be constructed of non-combustible materials, typically concrete.

The City Centre Area Plan (CCAP) outlines the desired formal relationship between permitted density and building height in order to provide for an overall, varied skyline. Areas of highest density identified within the overall CCAP and for each of the specific Village Centres have the corresponding highest maximum permitted building heights, to establish core areas that are surrounded by areas of gradually lower densities and commensurate heights by design.

As the proposed Building Code amendment will limit mass timber construction to a maximum of 12 storey, staff are of the opinion that the potential height and density identified for the core Village areas in the CCAP should be preserved for built form that achieves the maximum height and density, while respecting other design guidelines including maximum floor plate size and minimum tower separation guidelines. While the technology supported by the proposed National Building Code amendment offers opportunity for innovative design and construction, a 12 storey building could only achieve the maximum permitted density if larger floor plates are utilized, which would

result in buildings which are more bulky and massive, contrary to the design guidelines and regulations set out for the City Centre. It is staff's recommendation that if Council wishes the City to participate as an 'early adopter' of this technology, the use of mass timber construction be limited to those areas in the City Centre where a maximum building height of 35 m is permitted.

Staff acknowledge that the National and Provincial Building Codes continue to evolve, and it is likely that as this new mass timber technology continues to mature and evolve, the Building Codes will allow construction of taller buildings. At that point in time, if 15 storey mass timber buildings can be constructed in compliance with the Building Codes, mass timber buildings could be constructed that would meet the anticipated height, density, floor plate and tower separation guidelines of the CCAP.

In staff's opinion, the 12 storey limitation on mass timber construction is an interim stage in the development of this construction technology that merits consideration in appropriate locations in the City Centre. Rather than an amendment to the Official Community Plan (OCP) and the CCAP to identify those locations where a 12 storey building can be considered, staff recommend that Council direct staff to consider mass timber construction only in those areas where 35 m buildings are permitted, to ensure that all other guidelines of the CCAP are met.

To assist staff and the development community with this direction, staff have prepared a draft information bulletin (Attachment 3) that will be posted on the City's website, and made available through Front of House to clarify where 12 storey Encapsulated Mass Timber construction will be permitted.

Constructability

Encapsulated Mass Timber construction is well suited for modularization and offsite manufacture of building components. Its floor systems, beams, columns, load bearing walls by definition are pre-manufactured wood building elements that are assembled into an integrated system with special connectors on site. This construction methodology offers offsite manufacturing of building elements to reduce the erection time and construction noise on site while improving the overall build quality. The practicability has been demonstrated in built examples locally and internationally with much of the design approach and engineering developed locally. Several Vancouver architectural and engineering firms are considered leaders in design of tall wood buildings having executed designs worldwide.



Positive impacts of offsite manufacturing include need for smaller on-site crews, and reduction of construction site noise and waste materials. Building elements built in a controlled factory environment has the potential for offering improved build quality as well as reduced production costs depending on shipping costs.



A building system using Encapsulated Mass Timber is flexible, working in conjunction with other materials and systems. Typically, the elevator core may be constructed of reinforced concrete while the building envelope may be of any suitable material or design. In the Brock Commons example, the building skin comprises a pre-manufactured assembly of metal, wood, glass and insulation installed on site.

This is an introduction of a modern building system using innovative technology. Industry will have to respond to demand by increasing material production. Currently North America's first manufacturer of Cross Laminated Timber (CLT) is Structurlam, a British Columbia company based in Penticton. It is one of two operational plants in the country. As the viability of the proposed construction system is demonstrated and gains popularity, the availability of the material will have to increase in order to address provincial demands and those North America wide. It is anticipated that there is already broad acceptance of this and similar building systems as a response to environmental concerns in North America and Europe. Challenges to provide adequate supply of CLT and potential cost increases as a result may pose limitations to industry acceptance and utilization until more manufacturing facilities become accessible.

The design professions and construction associations will also have to effectively educate their members on the technical aspects involved in order to ensure competency in design and execution. Widespread use of this system will depend on availability of the knowledge, and technical expertise in addition to accessible and available material supply.

Regulation

Similar to Richmond's experience as the early adopter of 6-storey wood frame construction that led to refined regulation and guidelines in later versions of the BC Building Code, staff anticipate participation in the present initiative to contribute significant refinement to codes, regulations and guidelines for the Encapsulated Mass Timber system. The Building Approvals Department's experience in such endeavors qualifies staff to serve in an expert capacity for regulation of the new system.

The greatest risk to wood construction and particularly for tall timber buildings is fire exposure during construction. Serious construction fires have occurred with 6-storey wood frame construction and these are motivations for strict fire safety procedures to be implemented with the proposed, taller timber system. Regulations such as those pioneered by the City of Richmond requiring the operation of fire suppression systems as each floor is constructed, the strict control of hot-works, functional operation of all fire walls during construction, and having no more than 4 storey of unprotected wood surfaces at any point during construction are already found in the provisional code items as proposed. The National Building Code provisions take a balanced approach between innovation and fire safety, incorporating levels of redundancy with passive and active fire suppression systems. The BC Professional Firefighters Association has endorsed this approach to the development of these codes. Richmond Fire and Rescue provides a comprehensive program of construction site safety, especially pertaining to a suite of special procedures and requirements for the construction of tall wood structures.

Financial Impact

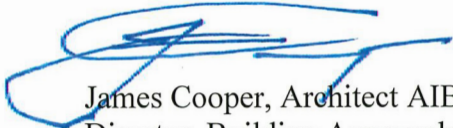
There is no financial impact.

Conclusion

The use of Encapsulated Mass Timber is an important new construction typology based on innovative building science and design that holds potential for significantly improved sustainability. Participation in the Province's initiative aligns with the City of Richmond's commitment to a sustainable community and its efforts to reduce carbon emissions, improve energy efficiency, and develop using renewable resources. Moreover, it is an extension of the City's leadership position in facilitating continuous improvement in the construction process.

Therefore staff recommend:

1. That the City's participation in the Provincial initiative to introduce code provisions for buildings up to 12 storey, constructed using the Encapsulated Mass Timber system in advance of their adoption into future versions of the BC Building Code be endorsed.
2. That staff be directed to consider mass timber construction for buildings only in those areas of the City Centre Area Plan where buildings up to a maximum of 35 m are permitted.



James Cooper, Architect AIBC
Director, Building Approvals
(604-247-4606)

JC:jc

Att. 1: Province's Expression of Interest Letter

Att. 2: Map of Permitted Building Heights by Area in Richmond City Centre

Att. 3: Proposed Bulletin 12 Storey Buildings Using Mass Timber Construction Guidelines



March 18, 2019

Dear Chief Administrative Officer:

Re: Expression of Interest – Early Adoption Initiative for Tall Wood Mass Timber Construction

The 2020 National Building Code is targetted to contain provisions for the construction of encapsulated mass timber wood buildings up to 12 storeys in height. As recently [announced](#), the Province will provide opportunities to build taller buildings with engineered wood products (encapsulated mass timber) in advance of provincial adoption of the 2020 National Building Code.

The Office of Housing and Construction Standards is inviting expressions of interest from local governments to participate in such an opportunity. This early adoption initiative will allow participating local governments to enable innovative tall wood buildings in their communities two to three years before adoption in the BC Building Code. At this point, the Office of Housing and Construction Standards is asking for expressions of interest only. Please see the attachment for information on the types of building occupancies allowed and requirements for participation. Further details on program requirements, links to technical information and dates of information sessions will be sent to those who respond.

If this initiative is of interest to your local government, please email building.safety@gov.bc.ca using "Tall Wood - Early Adoption" in the subject line **by Friday, April 5th, 2019** (extensions may be granted). **Please be assured that an Expression of Interest does not commit you to further participation in this process.**

Thank you in advance for your consideration and we look forward to hearing from you.

Sincerely,

Gord Enemark
Acting Assistant Deputy Minister
Attachment:



ATTACHMENT

Information for Interested Participants

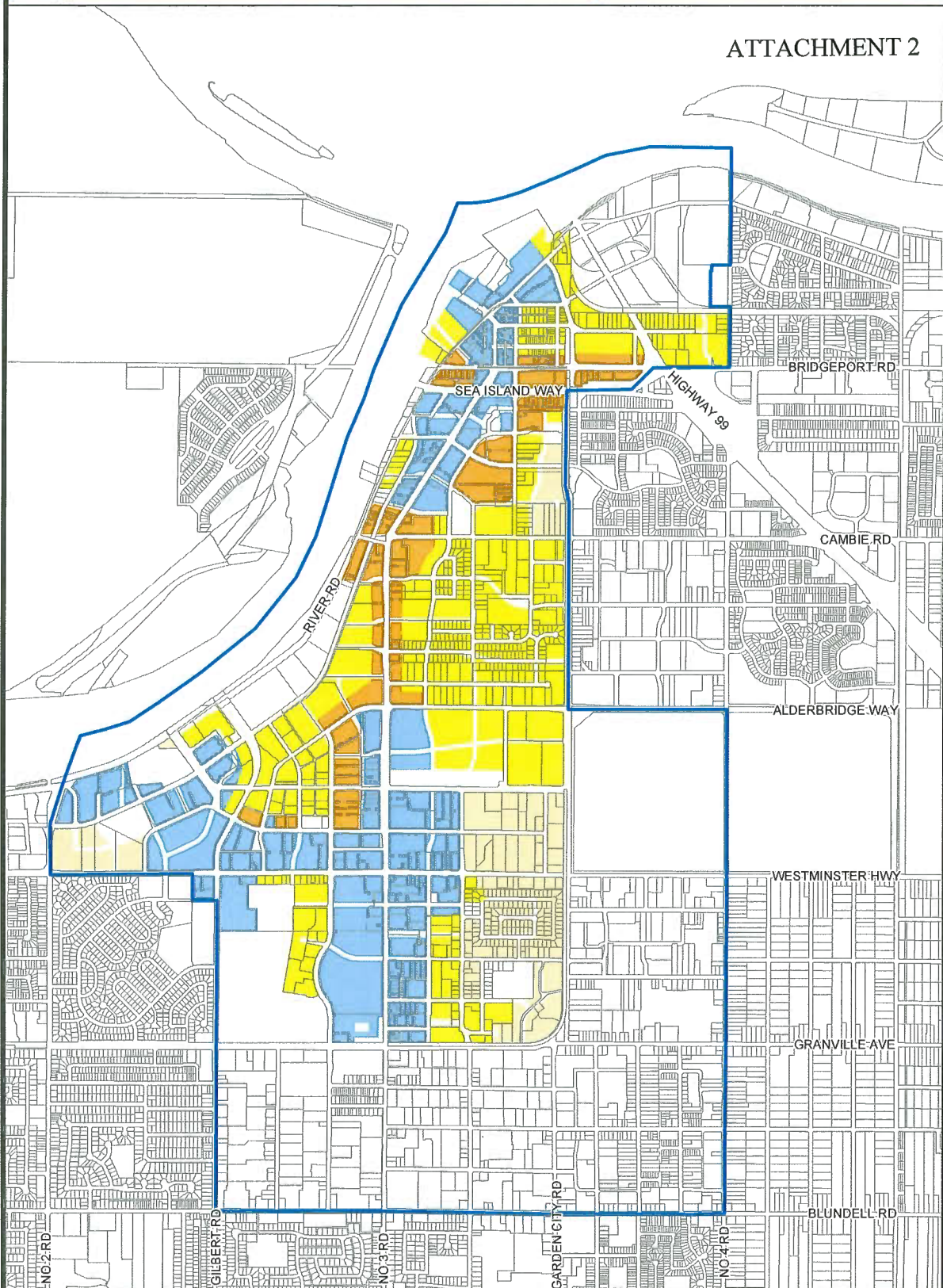
A local government is an ideal candidate for participation in the early adoption initiative if they have a Building Official with Level 3 Certification from the Building Officials Association of BC and land use bylaws that support buildings greater than six storeys in height.

While not required at this stage of the process, prior to a community's participation, a council resolution in favour will be required along with written confirmation that the planning, building/development and fire departments support participation.

The building occupancies that will be considered are Residential, and Business and Personal Services (as defined in the 2018 BC Building Code). Select mixed uses like education, restaurants and retail will be allowed on lower stories. More details can be found in the 2018 B.C. Building Code –

Division B: Acceptable Solutions Notes to Part 3 – Fire Protection, Occupant Safety and Accessibility (pages 2-5).





This initiative is subject to a ministerial regulation under the *Building Act*.



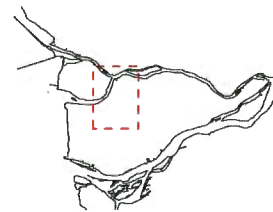
Legend

 City Centre Boundary

Permitted Building Heights by Area

-  15m
-  25m
-  35m
-  45m

Note:
The information shown on this map is compiled from various sources and the City makes no warranties, expressed or implied, as to the accuracy or completeness of the information.
Users are reminded that lot sizes and legal description must be confirmed at the Land Title office in New Westminster.
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**12 Storey Buildings Using Mass
Timber Construction Guidelines**

**No.: BUILDING-XX
Date: YYYY-MM-DD**

Purpose:

The purpose of this bulletin is to provide information on Richmond's adoption of Encapsulated Mass Timber construction as a permitted building system for buildings limited to 12 storey in height as applied to appropriately zoned areas.

Background:

After Council endorsement of the City of Richmond's participation in the Provincial Government's initiative to invite early adoption of the 2020 National Building Code provision, the City will accept building permit applications for construction of buildings up to 12 storey using the Encapsulated Mass Timber system.

Implementation:

The most suitable applications optimizing the use of Encapsulated Mass Timber will be for taller multi-family, mixed-use or office buildings in appropriately designated areas of the City Center with maximum permitted heights up to 35m and potentially 10 storey. *Please see orange areas identified in the Attached Map "Permitted Building Heights in City Centre".*

For more information please contact the Building Approvals Department at 604-276-4118 or email building@richmond.ca.