GHL CONSULTANTS LTD
Building Codes & Fire Science

409 GRANVILLE STREET, SUITE 950
VANCOUVER, BC V6C 1T2 CANADA

P 604 689 4449
F 604 689 4419
www.ghl.ca
Holder of AIBC Certificate of Practice

THE USE OF MASS TIMBER CONSTRUCTION IN CANADA

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by K.M. Gary Chen, MASc, P Eng and Andrew Harmsworth, M Eng, P Eng, CP, FEC

The construction of mass timber buildings is garnering significant interest throughout the Canadian building industry. While building with mass timber has existed for many years in many European countries, the move towards the use of mass timber for larger and taller buildings in Canada is based on the growing popularity of engineered wood products such as cross-laminated timber (CLT) and glue-laminated timber (glulam). Some of the benefits of using these relatively new construction materials include design aesthetics and positive environmental impacts. These materials also lend themselves well to prefabrication and may drastically reduce construction time and costs.

Current limitations on the use of mass timber in highrise buildings are primarily based on restrictions in Part 3 of the Building Code. The materials prescribed by the Building Code to achieve an acceptable level of safety in high-rise buildings are noncombustible structural materials such as concrete and steel. The notion is that these types of materials are able to provide the level of fire resistance required without contributing to the intensity of a fire due to their noncombustible nature.

Wood, based on its combustibility, is traditionally viewed as being easily ignitable and having the potential to lead to large fires. While this may be true of relatively small timber members, mass timber has been tested extensively and has been shown to provide a level of performance similar to, and in some cases better than, steel and/or concrete.

As with every building material, mass timber has inherent advantages and disadvantages, including its potential to contribute the fire severity. The disadvantages must be managed much in the same way as the disadvantages of steel and reinforced concrete. For example, steel, due to its high thermal conductivity and strength loss at high temperatures, often needs to be protected with other materials such as concrete, gypsum board, etc. A similar approach may be used to protect wood building elements in order to augment their fire resistance and/ or limit the probability that they will contribute to a fire.

UBC Brock Commons

The main fire protection and occupant safety objectives for every building are to provide an acceptable level of safety for building occupants and emergency responders, and to prevent structural collapse. With proper analysis and design, mass timber buildings are able to achieve a level of safety and fire performance equivalent to that provided by a steel or concrete building.

GHL's Involvement and Expertise

GHL has successfully addressed the use of mass timber construction in buildings required by the Building Code to be of noncombustible construction, using the alternative solution process based on the foregoing principles.

We are involved in several mass timber high-rise building projects, including **UBC Brook Commons**, an 18 storey mass timber highrise building currently under construction at the University of British Columbia in Vancouver. This project involved the use of CLT floor panels and glulam columns, with reinforced concrete construction for 1st storey and two concrete cores. The project was reviewed and approved by the Provincial government under a site-specific regulation pursuant to the Building Act as it is outside the scope of the current National and Provincial Building Codes. The project was extensively peer reviewed by a panel of expects, including fire safety engineers, scientists, authorities and firefighters. Fire protection features included fully encapsulated structural wood elements to limit the probability that they will contribute to a fire and a backup water supply to increase the reliability of the sprinkler system.

To view a time lapse, drone captured video of the building under construction provided by UBC, please click here.

GHL prepared a performance based analysis for the stair and elevator shafts for **The Origine**, a 13-storey mass timber high-rise building in Quebec. This building consists of 13 mass timber storeys on 1 storey of concrete with a mass timber core. GHL worked with the National Research Council of Canada (NRC) and other design consultants on the development of design solutions based on the objectives of the Building Code as well as other design objectives not specifically addressed by the Code but that were inherently necessary based on the uniqueness and novelty of mass timber in Canada.

We are also currently involved in the 19 storey **Terrace House** highrise building located in Vancouver which utilizes mass timber components.

GHL's expertise in working with mass timber structures is supplemented by our continued involvement with FPInnovations, the Canadian Wood Council, and the NRC. GHL also participated in the CSA O86 subcommittee for the design of timber structures for fire and was among the authors of the "Technical Guide for the Design and Construction of Tall Wood Buildings in Canada" published by FPInnovations.

We are a leading fire protection consulting firm in Canada with a team of engineers and building code professionals who possess extensive knowledge and experience in fire risk analysis and the development of innovative alternative solutions.

Our expertise provides us with the tools to address the use of mass timber in buildings for which the building code prescribes noncombustible construction, including highrise buildings.

The Origine, Quebec City

Terrace House, Vancouver

About the Authors

K.M. Gary Chen (MASc, P Eng) is a professional engineer registered in British Columbia and Alberta. Gary holds a Master's Degree in Mechanical Engineering from University of Waterloo, specializing in fire engineering, and a Bachelor's Degree in Chemical Engineering from UBC. His research focused on design of steel structure for fire loading, which is an area of active research interest, and finds applications in structural fire protection and design. In addition, he also has extensive knowledge in fire dynamics and computer-based fire models, including computational fluid dynamics (CFD) and zone models, which are the basis for performance-based fire engineering analysis.

Andrew Harmsworth (M Eng, P Eng, CP, FEC) has 30 years of engineering experience in Building Code and Fire Protection Alternative Solutions and Code compliance problem resolution. Andrew holds a Master's Degree in Fire Protection Engineering from UBC. He is a City of Vancouver Certified Professional who is an active member of the Association of Professional Engineers and Geoscientists of BC (APEGBC), as former Chair of the Building Codes Committee and represents APEG on the Building Code Modernization Strategy and Green Building Code task groups. He is also a member of the *CSA O86 Engineering Design in Wood* Task Group on Fire Resistance and a Board of Directors member for NEWBuildS, an NSERC funded network of fire related research projects at various universities across the country. Andrew is registered in BC, Alberta, Manitoba, NWT/Nunavut and Washington State as a Professional Engineer.