

ON5 MASS TIMBER BUILDING REGULATORY PERSPECTIVES



oN5 under construction March 2022. (Image: Scius)

Development in the City of Vancouver

Located in the City of Vancouver, the oN5 property was zoned for industrial use (I-1). The proposed major occupancy of Business and Personal Services (Class “D”) for the upper floors and “F2” Light Industrial for the ground floor were permissible outright uses. No rezoning was necessary. At 17.3 metres, the proposed height of oN5 was also within the permissible limit of 18.3 metres for I-1 Industrial zoned properties.

The City of Vancouver administers their own set of bylaws—Vancouver Zoning and Development and Building Bylaws—which are distinct from the BC Building Code.

The City of Vancouver has established a series of climate and sustainability related policies that informed the design of oN5. Most notably, the City has set a target of reducing embodied emissions by 40 percent by 2030.

oN5 is a four-storey office building located near the intersection of Ontario and E. 5th Avenue in Vancouver. Built on a narrow difficult-to-access mid-block site with only 7.54-metre wide street frontage, the commercial project overcomes significant constructability challenges by using a prefabricated all-timber structure. Cross-laminated timber (CLT) panels form the floors, walls and roof. The prefabricated loadbearing CLT walls are built to achieve Passive House envelope performance. The CLT floor panels use an innovative adhesive system to perform as a contiguous two-way slab and so forego the need for beams.

PROJECT TEAM

owner	exterior envelope
1155776 BC Ltd	Dubas Engineering Ltd.
architect	fire suppression
Hemsworth Architecture Inc.	TC Engineering Ltd.
structural engineer	code
Equilibrium Engineering Inc.	Evolution Building Science Ltd.
timber specialty engineer	geotechnical
Timber Engineering Inc.	GVH Consulting Ltd.
mechanical engineer	CLT fabricator
Rocky Point Engineering Ltd	Katerra
construction manager	seismic dampers
Naikoon Contracting Ltd	Tectonus
electrical engineer	structural adhesive
MCL Engineering Ltd.	Timbertec

BUILDING STATS

site area	fsr
280.375m ²	3
site dimensions	major occupancies
32.185m long x 7.540m wide	“D” Business and Personal Services; “F2” Industrial
gross floor area	applicable code
840m ²	Vancouver Building Bylaw Article 3.2.2.59 (Group D); 3.2.2.77 (Group F)
height	
17.3m	



ON5 MASS TIMBER BUILDING CODES AND REGULATORY STRATEGY

oN5 is permitted under the Vancouver Building Bylaw to be combustible construction because it is only four storeys—three storeys of mass timber over one storey of concrete. The project falls under Vancouver Building Bylaw Article 3.2.2.59 (Group D); 3.2.2.77 (Group F).

The building structure was organized around a ground floor concrete “box” for the industrial space which provided the necessary 1-hour slab fire separation with the office space above and a level platform off which to erect the mass timber panels for the three floors above.

The mid-block infill site was challenging because of the side walls that butt up against existing properties on both sides. Traditionally, zero-lot line walls are required under the spatial separation requirements of the code to be 1-hour rated non-combustible. Commonly, they are constructed out of concrete which can be time consuming, complicated, and take up a lot of floor area. This would have been problematic for oN5’s narrow mid-block site that is only 7-metre wide.

The use of prefabricated and pre-clad CLT panels was important for ease and speed of construction and an integral strategy for achieving structural integrity and fire rating. CLT was selected for the exterior side walls because of its ability to fulfill fire rating and shear and load bearing requirements at the same time.

Alternative solutions for CLT exterior walls

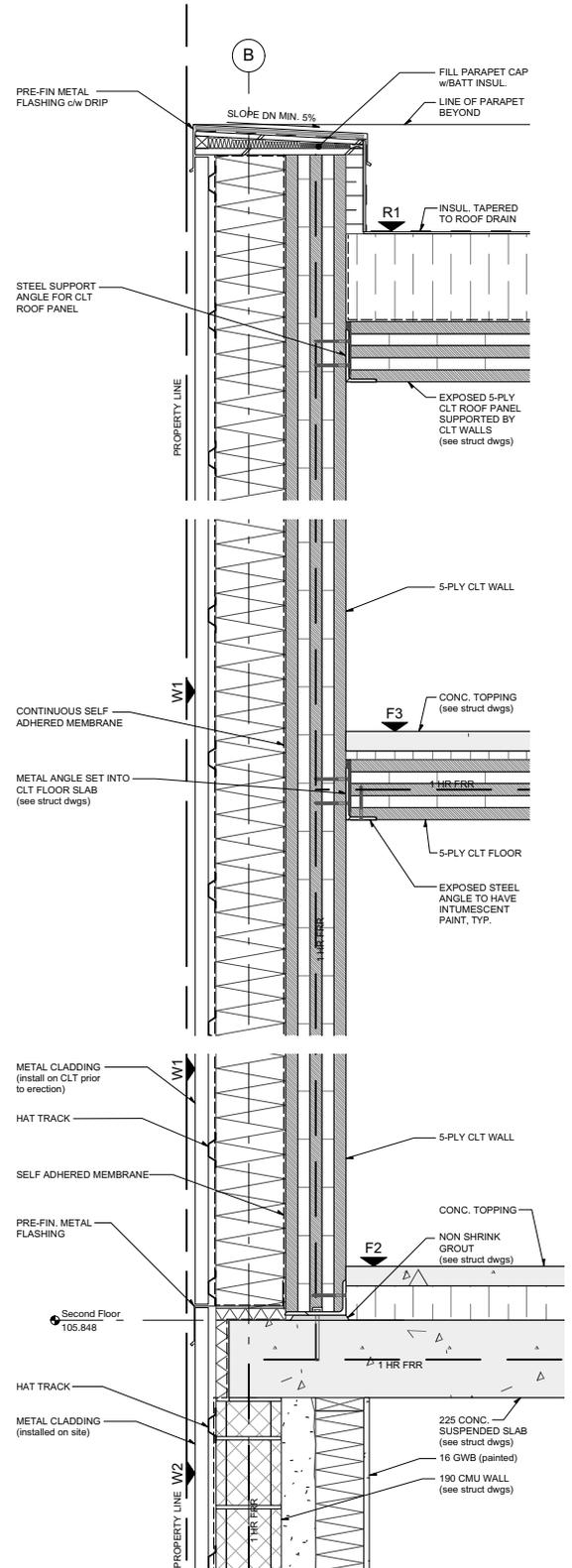
Using CLT in a fire rated 1-hour wall assembly required an alternative solution to be approved by the City of Vancouver, so involvement of a code consultant familiar with mass timber was important.

Evolution Building Science Ltd. prepared a comprehensive report and an alternative solution to the zero-lot line and address the fire rating requirements. The report was reinforced by extensive research, testing studies and assessments of combustibility parameters done by the National Research Council (NRC), along with the 2019 CLT Handbook which has a comprehensive chapter on the fire performance of CLT assemblies (Chapter 8).

A useful reference was a full-scale exterior wall test on a cross-laminated timber system conducted by NRC in 2014 in accordance with CAN/ULC S134-13 Standard Method of Fire Test of Exterior Wall Assemblies. Even though there are no windows in the exterior side walls of oN5, the S134 standard was familiar to City staff and provided an important level of comfort.

The code report and alternative solution was submitted in April 2021 along with the building permit application. Despite the COVID pandemic, a building permit was issued approximately six months later (late September 2021).

*Right: detailed section of the exterior side wall assembly showing the contiguous vertically oriented 5-ply CLT walls with exterior insulation and cladding already in place so it could be dropped directly into place and provide the necessary structural support and fire rating right away.
(Rendering: Hemsworth Architecture)*



ON5 MASS TIMBER BUILDING FIRE PROTECTION STRATEGIES

Fast response fire suppression system

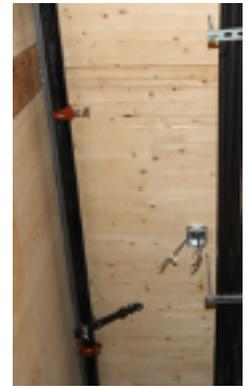
To provide more effective fire suppression design for the floor areas incorporating the CLT wall systems (Levels 2-4), fast-response horizontal sidewall sprinklers were installed along the east and west exterior wall faces of each office floor. The hydraulic design density for these floor areas was increased from beyond the standard NFPA 13 “Light Hazard” density of 0.1 USgpm/sf over 1,500 square feet to a higher density of 0.15 1USgpm/sf over 1,500 square feet. No NFPA 13 area reduction was deemed applicable.

Firestopping methods

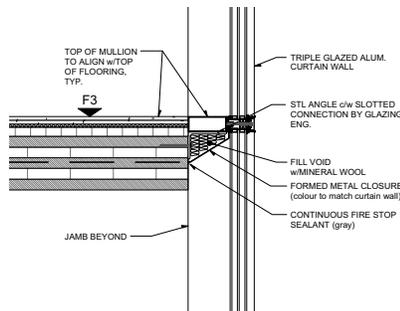
Firestopping in the form of packed mineral wool and/or firestop sealant was applied around penetrations (pipes, etc.) and where the CLT floor panels met the curtain wall frame. A fire caulk joint was applied wherever the CLT met the structural steel elements. Exposed structural steel (such as the moment frame) was coated with intumescent paint.

“Using mass timber for the side walls made sense, and that’s how I portrayed it to the city: that we’re trying to do a mass timber building with mass timber interior structure. So, having to do concrete block walls on the outside makes absolutely no sense in terms of prefabrication execution, constructability and everything else.”

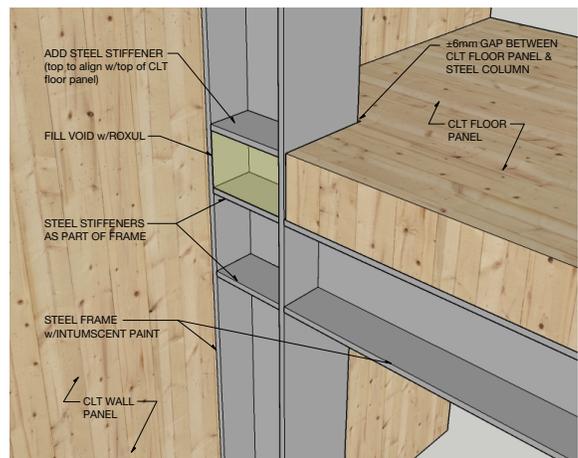
*– Geoff Triggs,
Evolution Building Science*



Sprinkler system rough-in. (Photos: MultiVista)



Firestopping where CLT meets curtain wall. (Rendering: Hemsworth Architecture)



Fire protection of the steel moment frame where it meets the CLT wall and floor. (Rendering: Hemsworth Architecture)



ON5 MASS TIMBER BUILDING DEVELOPMENT TIMELINE

The permitting process took 2.5 years to complete. The oN5 team noted that this time-frame is close to typical for most projects in BC. The use of CLT and the inclusion of innovative technologies were not responsible for delays. For oN5, the time waiting for the permits was well spent—bringing forward the pre-construction planning and performing virtual design and construction (VDC) planning rehearsals to tighten the schedule and budget, such that upon building permit approval, the building project could be rapidly executed.

Pre-2018

From the outset, oN5 was planned as a mass timber building that would incorporate the Tectonus seismic connections and TS3 adhesive system to deliver an affordable structural solution on a technically challenging site. Given the novelty of the technologies, early engagement with the City of Vancouver was essential to explain the systems and their applicability to mass timber construction in British Columbia. The owner engaged Evolution Building Science Ltd. to help navigate the permitting and regulatory process and also relied heavily on a network of experts, including other leading Canadian engineers and the project architect and builder.

2018: Site acquisition, development permit

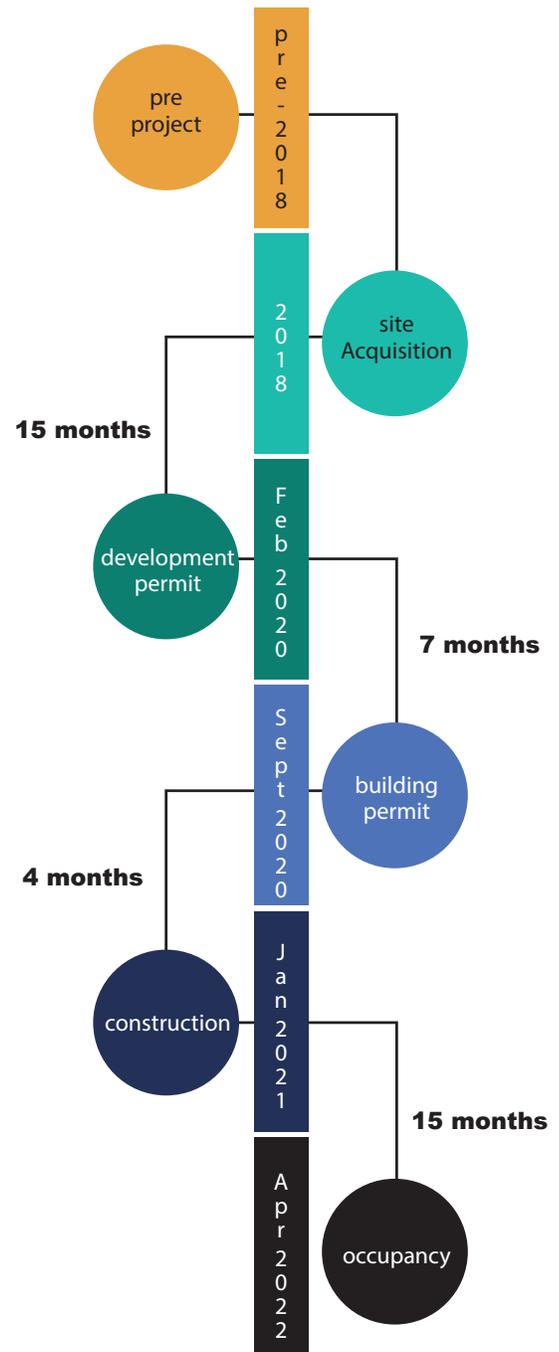
Upon acquisition of the property, Hemsworth Architecture was retained to prepare and submit the Development Application for oN5, including the introduction of the intent to use Tectonus and TS3. The City of Vancouver was excited and supportive of oN5's deployment of innovative technologies, but no unique relaxations, grants or processes were available.

2020: Development permit to building permit process

Even though the City imposed no special requirements for oN5, the development permit process took 1.5 years. While the project made its way through the development permit process, the oN5 team proceeded with schematic and design development in parallel. Naikoon Contracting joined the team as construction manager during this period to start developing the construction strategy. By the time the development permit was issued, the project team was already working on optimizing the construction sequencing and incorporating design assistance from key contractors and suppliers.

2020-2021: Building permit process

Once the development permit was issued, the project could submit for building permit. This process took a further six months. During the building permit application, the code consultant began the critical task of developing the alternative solutions to demonstrate how the CLT exterior walls comply with the Vancouver Building Bylaw fire rating and structural requirements. For the use of the Tectonus and TS3, the City of Vancouver relied on Equilibrium Consulting's Letters of Assurance to verify Vancouver Building Bylaw compliance.



This is the fifth in a series of bulletins regarding oN5. Other bulletins include: introduction; high performance low carbon construction; off-site construction experience; and on-site construction & delivery process. All bulletins can be found at www.naturallywood.com/project/on5-building.

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